No. 791,126. PATENTED MAY 30, 1905.

DE LONSON E. BARNARD, DEC'D.

R. A. BARNARD, ADMINISTRATRIX.

EXPLOSIVE MOTOR.

APPLICATION FILED JAN. 6, 1902.

3 SHEETS—SHEET 1.

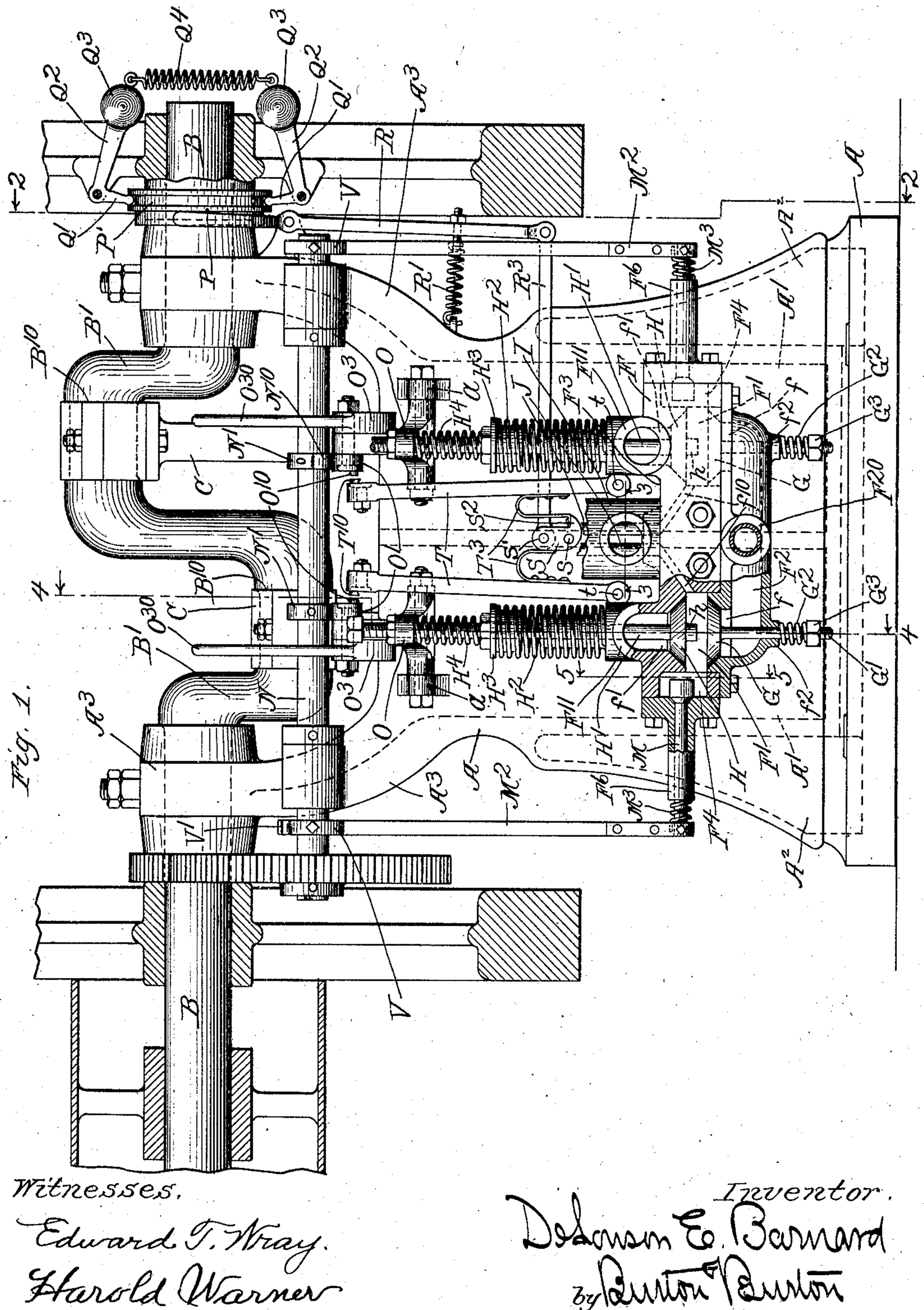


Fig. 1.

Witnesses.

Edward T. Wray.

Harold Warner

Inventor.

Delonson E. Barnard

by Burton & Burton

his Atty's.

No. 791,126. PATENTED MAY 30, 1905.

DE LONSON E. BARNARD, DEC'D.

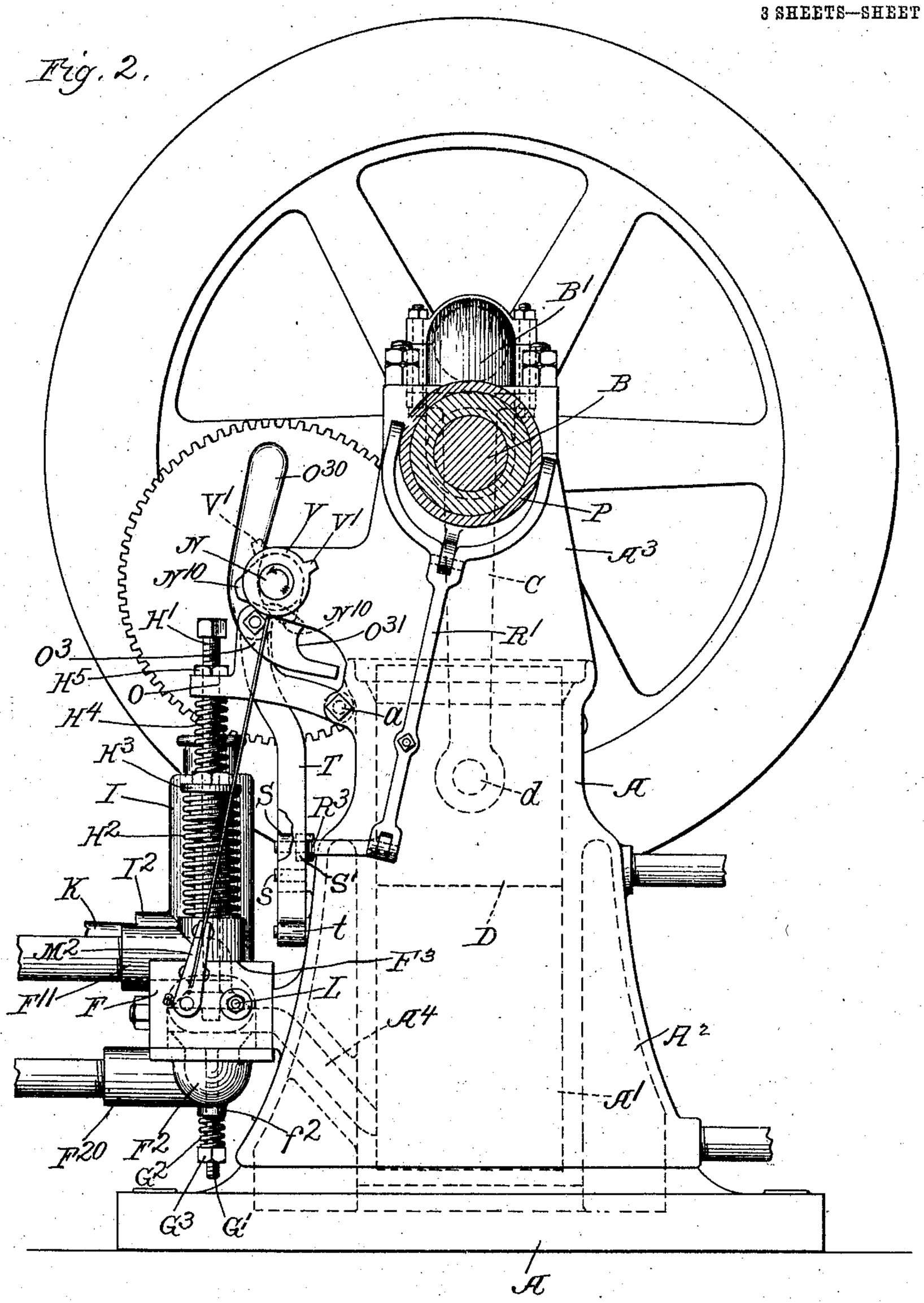
R. A. BARNARD, ADMINISTRATRIX.

EXPLOSIVE MOTOR.

APPLICATION FILED JAN. 6, 1902.

3 SHEETS—SHEET 2.

Fig. 2.



Witnesses.
Edward T. Wray.
Harold Warner.

Inventor.
DeLonson E. Barnard
by Burton Burton
his Atty's.

No. 791,126. PATENTED MAY 30, 1905.

DE LONSON E. BARNARD, DEC'D.

R. A. BARNARD, ADMINISTRATRIX.

EXPLOSIVE MOTOR.

APPLICATION FILED JAN. 6, 1902.

3 SHEETS—SHEET 3.

Fig. 4.

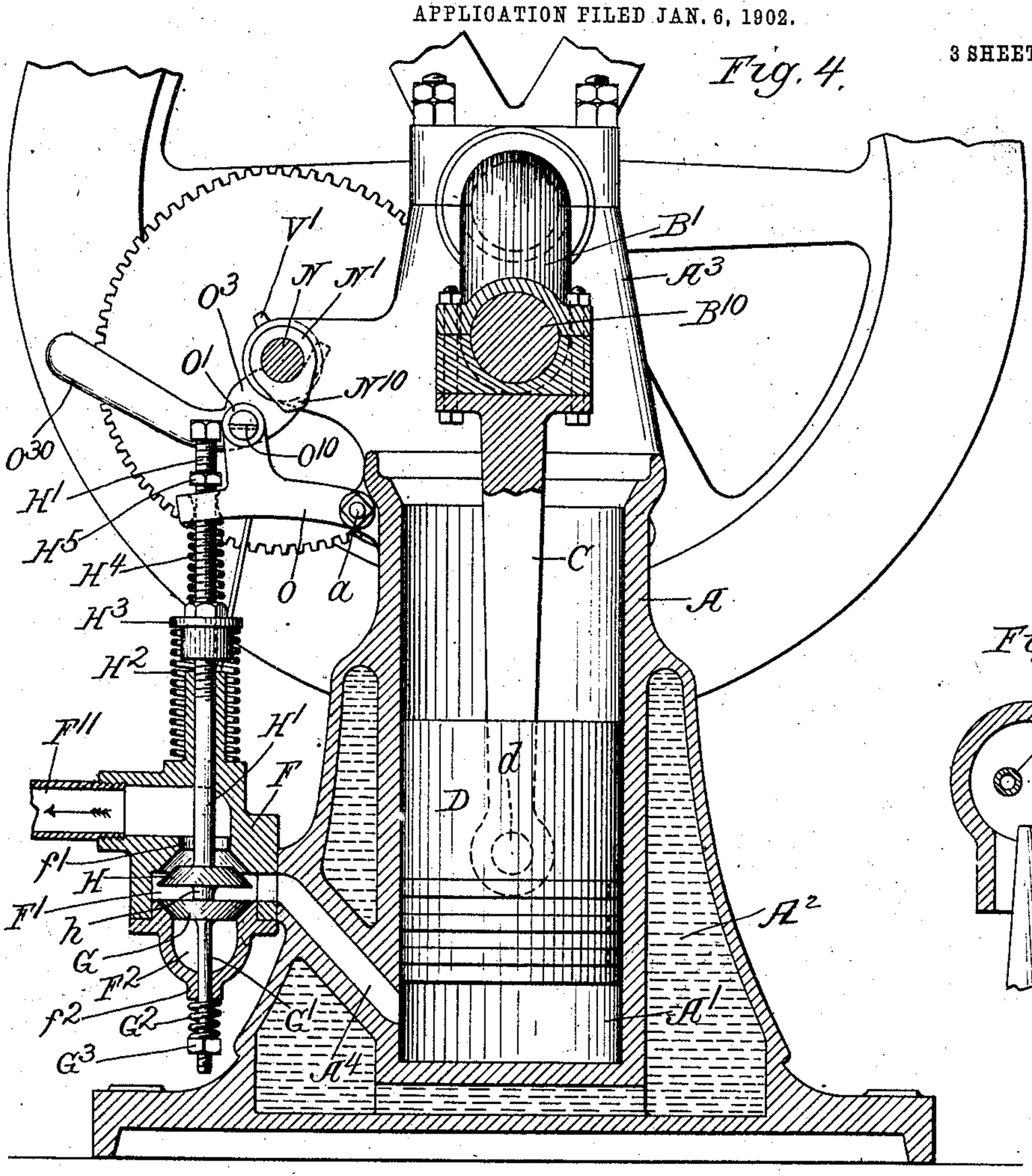


Fig. 3.

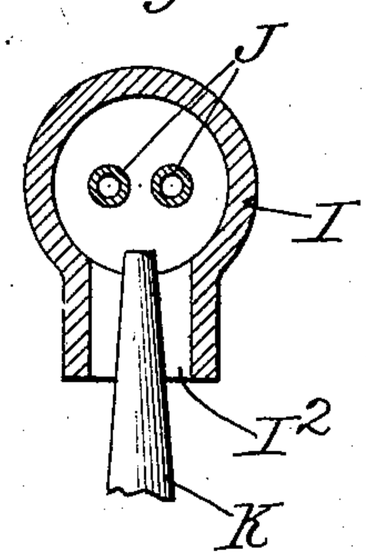


Fig. 5.

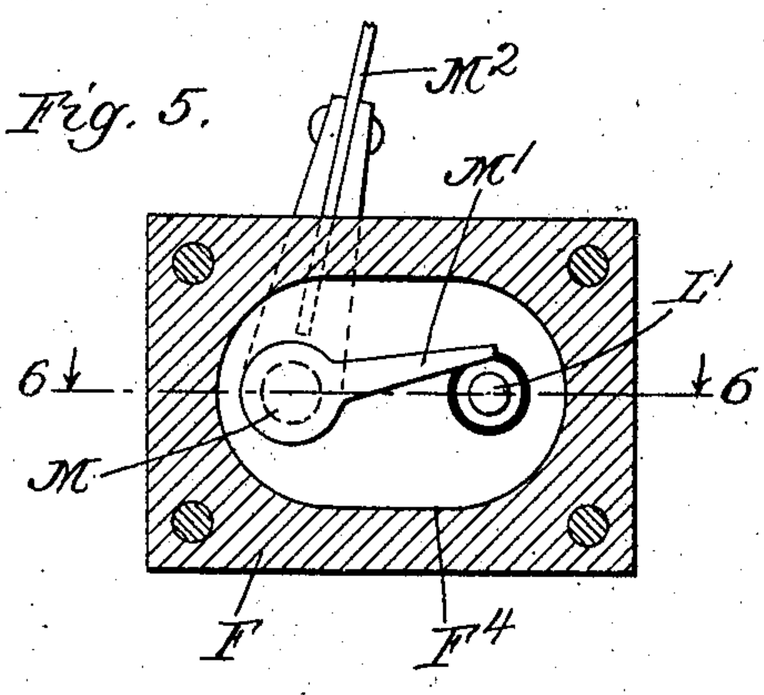
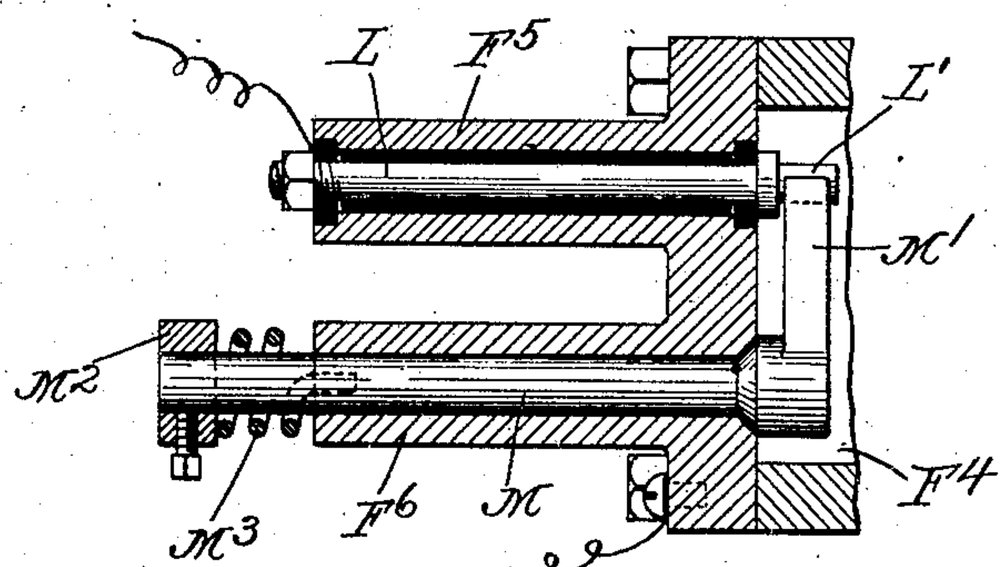


Fig. 6.



Witnesses.

Edward T. Wray.

Harold Warner

Inventor.

DeLonson E. Barnard

by Burton Burton

his Atty's

No. 791,126. Patented May 30, 1905.

UNITED STATES PATENT OFFICE.

DE LONSON E. BARNARD, OF CHICAGO, ILLINOIS; RUDY ALLISON BARNARD ADMINISTRATRIX OF SAID DE LONSON E. BARNARD, DECEASED.

EXPLOSIVE-MOTOR.

SPECIFICATION forming part of Letters Patent No. 791,126, dated May 30, 1905.

Application filed January 6, 1902. Serial No. 88,477.

To all whom it may concern:

Be it known that I, DE LONSON E. BARNARD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Explosive-Motors, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

This invention consists in improvements in explosive-motors in respect to governing devices and the means for intermitting the supply of explosive at will.

In the drawings, Figure 1 is a front elevation of my improved engine, partly sectional at the vertical plane of the axis of the main shaft, the fly-wheel being in section at that plane. Fig. 2 is a section at the line 2 2 on Fig. 1. Fig. 3 is a detail section at the line 3 3 on Fig. 1 through the chimney which incloses the incandescent igniting-tubes. Fig. 4 is a section at the line 4 4 on Fig. 1. Fig. 5 is a section at the line 5 5 on Fig. 1. Fig. 6 is a section at the line 6 6 on Fig. 5.

This engine comprises two cylinders erected vertically side by side and having their pistons connected to oppositely-disposed cranks upon a main shaft common to them both and journaled above the cylinders, the two cylinders being formed in one casting and being both encompassed by the same water-chamber formed in said casting, and said casting is also constructed to serve as the standard or frame for supporting the main crank-shaft and all working parts.

A is the main standard-casting, in which are formed the two cylinders A′ A′, which are upwardly open and which are encompassed by the water-chamber A^2 at the lower part and for a distance toward the upper end sufficient to include the parts especially exposed to the heat of the explosive fluid.

B is the main crank-shaft, having its journal-bearings in the arms A^3 A^3, extending upward from the main standard-casting A and having between said bearings two cranks B′ B′, to whose wrists B^{10} B^{10} are connected pitmen C C, respectively, which are jointed to the pistons D D, as seen at *d*, Fig. 2.

The inlet and exhaust passages and the valves controlling them are respectively formed and mounted in a fitting F, which is mounted on the forward side of the main standard-casting A, with its passages registering properly with ducts A^4 A^4, leading to the lower end of the cylinders, respectively, through the water-jacket, the casting being properly formed to provide for such passages without opening into the water-chamber. In the fitting F are formed the valve-chambers F′ F′, in which are the inlet-valves G G, seating downward over the inlet-ports *f f*, respectively, and the exhaust-valves H H, seating upward in the exhaust-ports *f′ f′*, the inlet-ports being connected by a passage F^2, formed in a boss extending along the under side of the fitting F and having a connection at F^{20} for the inlet-pipe leading from the mixer. (Not shown.) From the exhaust-ports *f′ f′* the exhaust-passages lead out through the exhaust-pipe connections F^{11} F^{11}.

From the valve-chambers F′ F′ ducts f^{10} lead convergingly toward the middle point of the fitting F and then upwardly, emerging side by side through the face F^3 at the top of the fitting F, and in the mouths of these ducts are inserted and secured the igniting-tubes J J, inclosed by a common chimney I, having at the lower end of the forward side a mouth I^2, into which the lighting-jet K protrudes and through which the lighting-flame is directed against the tubes J J for preliminary heating. At the opposite ends of the fitting F are electric igniting-pockets F^4 F^4, communicating with the valve-chambers F′ F′, respectively, and in these pockets are located the igniting contact-terminals of the electric-igniting devices. One of these terminals is an insulated pin L, which extends in through a boss F^5 and has within the pocket F^4 a reduced tip L′, into and out of contact with which the other terminal, consisting of the finger M′ on the rock-shaft M, is adapted to be carried by the rocking of said shaft. The shaft M extends out through a boss F^6, having at its inner end a tapering head adapted to seat valvewise in the countersunk inner end of the bore in said boss, through which the

shaft extends, and said shaft at the outer end is provided with a lever-arm M^2, which extends up to a point directly under the valve-operating shaft, hereinafter described, so as to be actuated by an element mounted on that shaft to cause it to rock the shaft M and carry the arm M′ into and out of contact with the pin L′ for the purpose of establishing and immediately afterward breaking the circuit causing the igniting-spark. Between the end of the boss F^6 and the arm M^2 there is interposed a coil-spring M^3, which is engaged at one end with the boss and at the other end with the arm, so as to constitute a connection between the arm and the boss by which the arm is fixed with its upper end in proper position to be encountered and actuated, as hereinafter described, the spring tending elastically to resist the rocking of the shaft away from that position and to restore it to the same. The spring also is adapted to be compressed axially to permit the shaft M to be forced in and to thrust it out again. The purpose of this construction is to afford means for cleaning the contacting surfaces by rubbing them together, which may be done at any time, whether the engine is in action or at rest, by taking hold of the arm M^2 and forcing it aside in direction to throw the finger M′ onto the pin L′ and while it is in this position pushing the shaft M inward against the resistance of the spring and allowing it to be forced outward, repeating the motion a few times to rub the finger on the pin sufficiently to cleanse the two surfaces.

I will now describe the valve action and governing devices associated with the same.

The main shaft is geared to the second shaft N in the customary manner, so as to give the latter shaft one revolution for each two revolutions of the main shaft. On said second shaft N, in proper relation to each cylinder, there is a cam N′, whose most eccentric portion N^{10} collides once in each revolution of the shaft with the abutment-roll O′ on the valve-operating lever O, said lever being pivoted to the main standard-casting at *a* and extending from its pivot so as to overhang the valve-chamber and be connected to the stem H′ of the exhaust-valve. On this valve-stem, about the lower portion, is coiled a spiral spring H^2, stopped at the lower end on the top of the fitting F and at the upper end on the adjustable stop collar or nut H^3, which is screwed onto the stem H′. On said stem, above said stop-nut, there is placed a second coiled spring H^4, stopped at the lower end on the adjustable stop H^3 and at the upper end against the under side of the valve-operating lever O, above which, on the stem, there is an adjustable stop-nut H^5. From the exhaust-valve H there is a projection *h* at the lower side, which is long enough to strike the upper side of the inlet-valve G when the exhaust-valve is opened, so that said inlet-valve affords a stop to the opening of the exhaust-valve and is itself held closed as long and as positively as the exhaust-valve is held open. The inlet-valve is opened by suction from the engine and is held closed yieldingly, subject to the action of the suction, by the spring G^2, coiled about the stem G′ of the inlet-valve, said stem protruding out through the boss f^2 on the lower side of the passage F^2 and being provided with a stop-nut G^3 at the outer end, between which and the boss f^2 the spring is stopped. The spring H^4 is stiffer than the spring H^2, and the result of this arrangement is that when the cam N′ forces down the lever O the spring H^2 yields first to permit the exhaust-valve to be opened until the projection *h* on said valve encounters the inlet-valve and is stopped thereby, holding the latter seated. Further movement of the lever O in the same direction under the action of the cam compresses the spring H^4, and said spring is first to react after the protuberance of the cam passes the abutment O′ before the spring H^2 can react to relieve the inlet-valve of the pressure by which the exhaust-valve holds it closed. The purpose of this action is to be found chiefly in the governing devices, as will appear from the following description. On the hub of one of the fly-wheels a grooved collar P is arranged to slide axially a short distance, its peripheral groove P′ being engaged with the short arms Q′ Q′ of the bell-crank levers, whose longer arms Q^2 carry the balls Q^3, which are connected by a spring Q^4, tending to draw them together, the bell-crank levers being fulcrumed at their angles on the fly-wheel, so that from the rotation of the wheel the balls receive centrifugal tendency, which is resisted by the spring, which tends to draw the balls together and toward the center. At the side of the standard there is pivoted a lever R, one end of which rests against the inner face of the peripheral grooved collar P, the other arm of the lever being connected by an extensible spring R′ to the standard, said spring operating normally to hold the upper end of the lever pressed against the collar and the collar forced to the limit of its range of movement outward on the hub of the fly-wheel—that is, in a direction tending to spread the balls and stretch the spring which connects them. The spring R′ thus operates to the same effect on the balls as the centrifugal tendency due to rotation of the fly-wheel and opposite to the tendency of the spring Q^4, the latter spring being strong enough normally to overcome the spring R′ and hold the balls together until the spring R′ is assisted by centrifugal tendency arising from the rotation of the wheel. From the lower end of the lever R a link R^3 extends to a cam S, fulcrumed on a stud *s*, projecting from the standard A and having at the upper end of the arm, remote from its pivot, a roll S′ and at the lower end, directly opposite its pivot, at the side toward

the lever R, a step S^2. T T are latches which are pivoted to the standard at *t t* and extend upward from their pivots, respectively, toward the shaft N, terminating under the shaft alongside the abutments O′ O′ on the levers O O, respectively, said abutments and the upper ends of said latches being provided, respectively, with hooks O^{10} and T^{10}, adapted to become engaged when the latter swing inward toward the abutments, and the levers are forced downward to a position carrying the abutments O′ out of range of action of the cams N′. The latches thus are adapted to lock the levers at a position at which they hold the inlet-valves closed and the exhaust-valves open and out of position at which the rotation of the shaft and the cam can affect them. In order that the latches may become thus engaged with the levers without requiring the levers to be forced farther than they are normally forced by the cam in its proper action and yet permit sufficient movement of the levers back toward the shaft to effect a secure engagement of the hooks O^{10} and T^{10}, it is evidently necessary that the levers should be forced by the cam a little farther than necessary merely to reduce the proper action of the valves, since otherwise the exhaust-valve would be lifted and would release the inlet-valve by the amount of movement necessary to permit the hooks to interlock. It is for this purpose that the springs H^2 and H^4 are arranged, as described, on the valve-stem, for it will be observed that by that arrangement the lever O may have a movement equal to the full amount of the compressibility of the spring H^4 in excess of the movement necessary to open the exhaust-valve and positively seat the inlet-valve, as described, without affecting the movement of said valves, which will be held securely in the position to which they are forced by the first part of the operating movement of the lever with a pressure which is measured by the tension given to the spring H^2 when it is compressed in the first part of the movement of the lever, while the lever is lifted by the reaction of the spring H^4 enough to disengage the hooks during all that portion of the rotation of the cam N′ during which the protuberance N^{10} is out of contact with the abutment-roll O′. This leaves the latch free to tilt out of engaging position whenever the governing device ceases to hold it in such position. The devices which hold the latches in said position comprise bow-springs T^3 T^3, attached to the latches, respectively. The roll S′ on the upper end of the cam S encounters one of these springs when the cam is rocked by the action of the governor at excess speed, while the end of the other is lodged upon and may be secured to the step S^2 at the opposite side and under said cam, so that the rocking of the cam about its fulcrum in the direction in which the spring R′ tends to rock it through the medium of the link R^3 tends to force both latches over toward the valve-operating levers, with which they are respectively designed to engage, and when thus forced by the action of the governing devices, as described, the hooks O^{10} and T^{10} on said parts, respectively, will become engaged at the lowest position of the valve-operating lever and will hold the lever at that position. When the reduction of the speed causes the cam S to be rocked back to position at which it no longer tends to hold the latches over toward the levers, respectively, the engagement of said hooks is relieved at the next revolution of the cam N′, forcing the levers O down to the extreme position and disengaging the hooks, leaving the latches free to swing outward from the levers and leave the levers free to follow the cam upward and restore the action of the valves.

In order to throw either cylinder out of action at will independently of the governing devices, I provide on the same stud on which the roll O′ is mounted a latch O^3, of which the handle O^{30} extends upward past the shaft N, the opposite end extending under the shaft and having its upper edge eccentric to the fulcrum of said latch and provided at the outer portion with a seat O^{31} for the shaft N. When the operator desires to put either cylinder out of action, the handle O^{30} of the lever O^3 may be seized and the lever rocked outward, the lever O being by the same movement naturally and easily pressed downward or the operator merely holding the lever O^3 until the action of the cam N′ forces the lever O downward and at the lowest point rocking the lever O^3 outward until the shaft lodges in the seat O^{31}, by which lodgment the latch is locked in the position into which it is thus thrown and the lever O is held positively down out of range of engagement with the hook T^{10}—that is, at a point at least as low as it could be forced by the cam N′. While in this condition no action of the governing mechanism will affect the cylinder which is thus thrown out of action, and the operator can at any time by releasing the latch O^3 restore the cylinder normally again to the control of the governor.

To operate the sparking or electric igniting device, the shaft N has outside it two bearings, respectively, the collars V V, which have projection V′, which in each revolution collides with the upper end of the lever-arm M^2 and rocks the finger M′ into contact with the tip L′ of the insulated terminal L, and thereby establishes the circuit which is immediately broken by the projection V′ running off from the end of the arm M^2, allowing the spring M^3 to retract the finger from the tip, causing the igniting-spark to pass between the two. The arm M^2 is a spring-arm, so that the projection V′ may be calculated to give the end of said arm a little more movement than the minimum which might be sufficient to force

the finger into touch with the insulated tip, such excess of movement rendering it certain that the contact will be made with pressure enough to insure the passing of the current and the elasticity of the arm preventing breaking or undue resistance to the rotation of the shaft N when the projection V strikes said arm.

I claim—

1. In an explosive-motor in combination with a rotating shaft; a valve-actuating lever; means rotated by the shaft for operating the lever; a spring which transmits the opening movement from the lever to the valve, and a latch mounted on the lever and adapted to be rocked against the shaft to hold the lever away from the latter for locking the valve out of action at will.

2. In an explosive-motor, in combination with the valve-operating lever, a rotating shaft; a cam for operating the lever and a spring which transmits the opening movement from said lever to the valve; a latch pivoted on the lever, having a handle extending in direction to be reciprocated longitudinally by the valve-actuating movement of the lever, said latch being adapted to be rocked against the shaft when the lever is at most remote position therefrom and hold the lever at such position.

3. In an explosive-motor, a governor comprising centrifugal balls, means for causing them to approach when free from centrifugal influence; means for locking the engine-valves out of action; a spring which tends to effect engagement of such locking device; connections from the centrifugal balls by which their approach operates in opposition to such spring, and their centrifugal operation releases the spring from such opposition, whereby the locking is effected under the action of the spring alone.

4. In an explosive-motor in combination with a lever for holding the inlet-valve closed; the latch, T, having a hook, T^{10}, and means on the lever for engagement with the hook when the lever is in position for holding the valve closed; a centrifugal governing device and connections by which it moves the latch into lever-engaging position when said governing devices are operated centrifugally by the speed of the motor, said connections comprising a spring which transmits said movement to the latches, whereby the same is transmitted yieldingly.

5. In an explosive-motor comprising a plurality of chambers in which an explosion is produced; the inlet-valves pertaining to said chambers, respectively, and the respective levers for holding said inlet-valves closed; latches, T, T, having, respectively, hooks for engaging the valve-operating levers, said levers being provided with means for such engagement and adapted to be engaged at valve-closing position; centrifugal governing devices and connections by which they move the latches into lever-engaging position upon centrifugal action of said governing devices; said connections comprising a lever fulcrumed on the frame and the means extending from the governing devices for rocking it about its fulcrum, and springs on the latches, respectively, against which said lever bears to transmit motion to the latches when the lever is rocked by said centrifugal action.

6. In an explosive-motor in combination with a lever for operating the exhaust-valve, the latch, T, having a hook, T^{10}, and means on the lever for engagement with the hook when the lever is in position for opening the exhaust-valve; a centrifugal governing device and connections by which it moves the latch into lever-engaging position when said governing devices have been operated centrifugally by the speed of the motor, said connections comprising a spring which transmits said movement to the latches whereby the same is transmitted yieldingly.

7. In an explosive-motor comprising a plurality of chambers in which an explosion is produced, the exhaust-valves pertaining to said chambers respectively and the respective levers for operating said exhaust-valves; latches, T, T, having respectively hooks for engaging the valve-operating levers, said levers being provided with means for such engagement and adapted to be engaged at valve-opening position; centrifugal governing devices and connections by which they move the latches into lever-engaging position upon the centrifugal action of said governing devices, said connections comprising a lever fulcrumed on the frame and means extending from the governing devices for rocking it about its fulcrum, and springs on the latches respectively against which the lever bears to transmit movement to the latches when the lever is rocked by said centrifugal action.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 27th day of December, A. D. 1901.

D. E. BARNARD.

In presence of—
CHAS. S. BURTON,
HAROLD WARNER.

Correction in Letters Patent No. 791,126.

It is hereby certified that Letters Patent No. 791,126, granted May 30, 1905, upon the application of De Lonson E. Barnard, of Chicago, Illinois, for an improvement in "Explosive Motors," was erroneously issued to Rudy Allison Barnard "as administratrix," whereas it should have been issued to said Rudy Allison Barnard "as *administrator*" of said De Lonson E. Barnard, deceased, and that the pronoun in the grant indicating sex should read *his* instead of "her;" and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of June, A. D., 1905.

[SEAL.]

F. I. ALLEN,

Commissioner of Patents.