No. 765,777. PATENTED JULY 26, 1904.

J. F. HATHAWAY.

ROTARY EXPLOSIVE MOTOR.

APPLICATION FILED JUNE 10, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

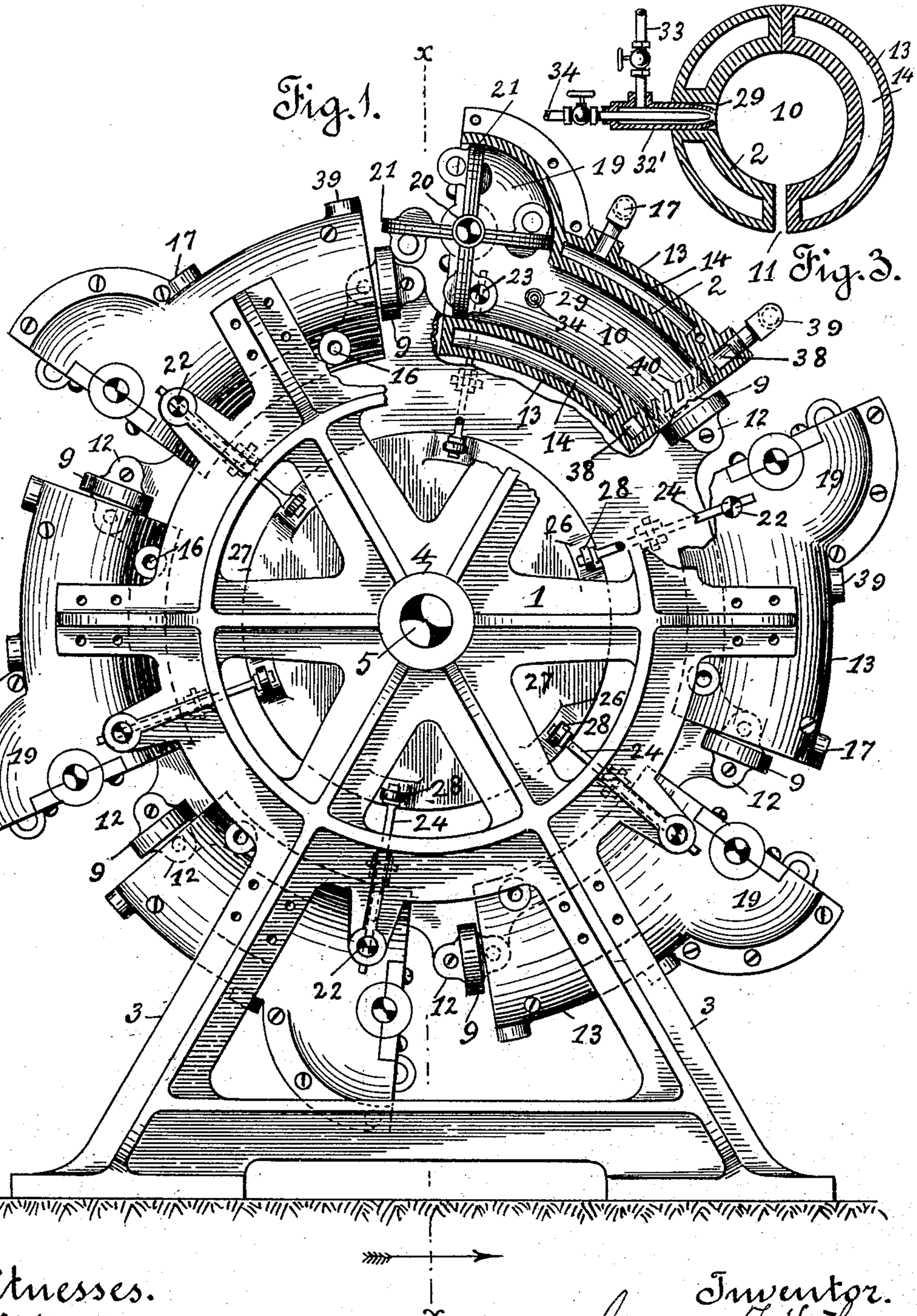

Fig. 3.

Witnesses.

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Walter D. Cane.

Inventor.

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by Macker

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 5.

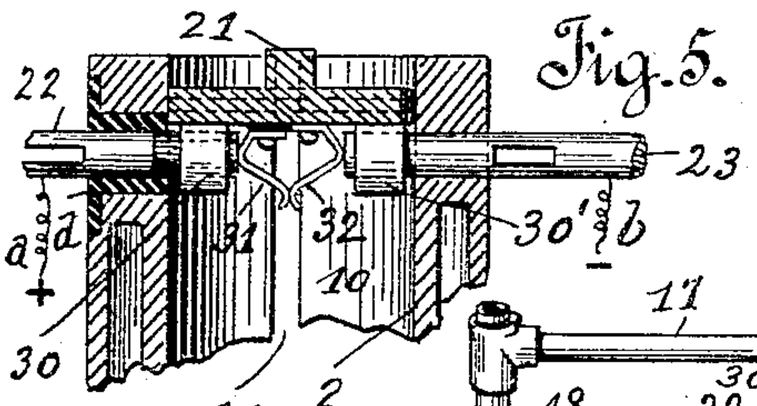

Fig. 2.

Fig. 4.

Witnesses.

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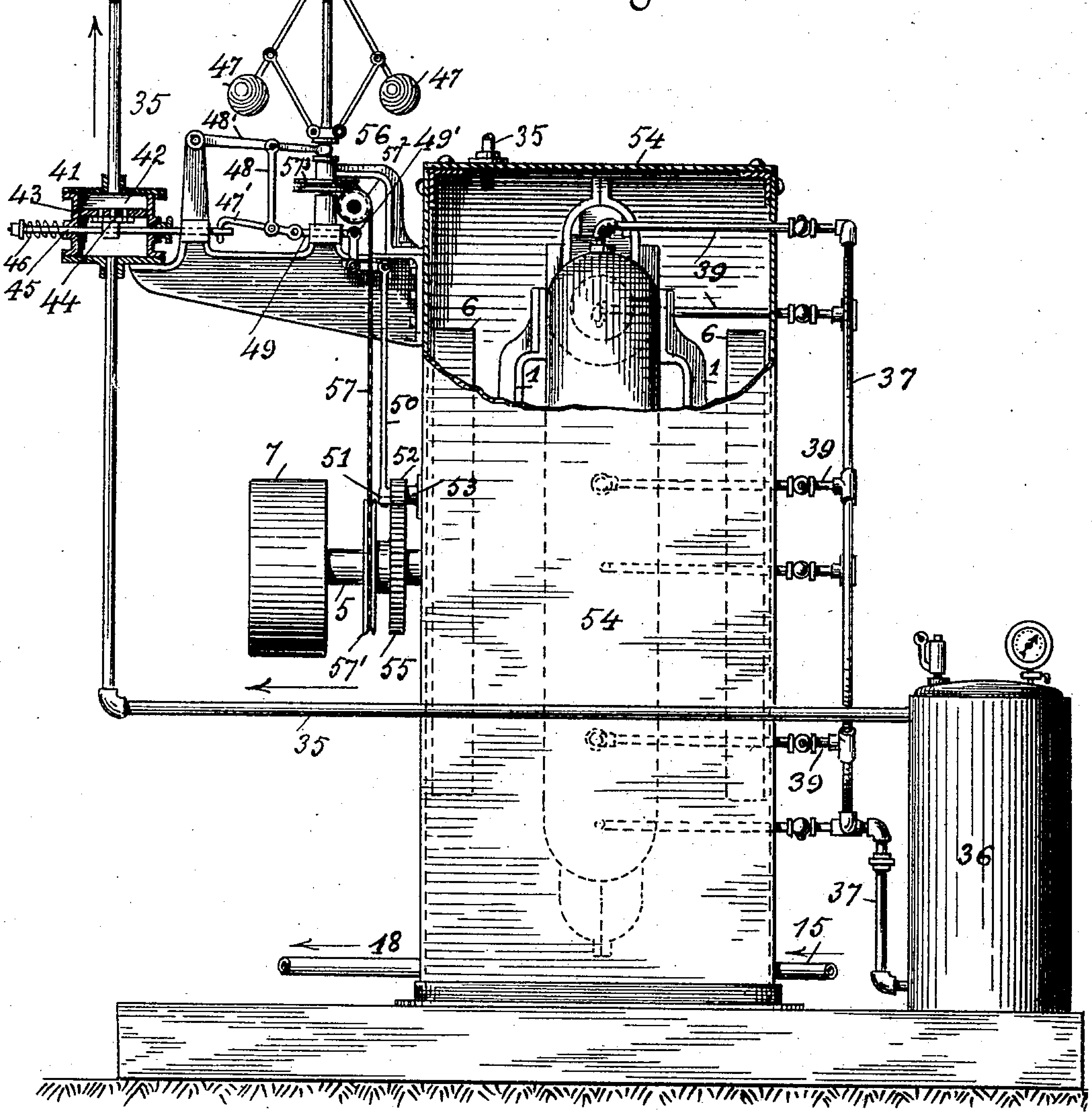
NO MODEL. 3 SHEETS—SHEET 3.

Fig. 6.



Witnesses.

H. E. Monteverde.

Walter F. Vane.

Inventor

James F. Hathaway

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No. 765,777. Patented July 26, 1904.

UNITED STATES PATENT OFFICE.

JAMES F. HATHAWAY, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO HATHAWAY ROTARY ENGINE CO., OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

ROTARY EXPLOSIVE-MOTOR.

SPECIFICATION forming part of Letters Patent No. 765,777, dated July 26, 1904.

Application filed June 10, 1903. Serial No. 160,833. (No model.)

To all whom it may concern:

Be it known that I, JAMES F. HATHAWAY, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Rotary Explosive-Motors; and I do hereby declare the following to be a full, clear, and exact description of the same.

The present invention relates to an explosive-motor adapted for the driving of vehicles or for use in the driving of machinery generally, the object of the invention being to form a compact, light, and inexpensive motor for the generation of power for use in operating automobiles or for machine purposes, the device comprising a series of independently-operative stationary explosive-cylinders, with a series of traveling pistons which successively work within the explosive-cylinders, with means operated during the travel of the piston through the explosive-chamber of the cylinders for the generation of a spark for the firing of the explosive mixture or hydrocarbon delivered into the explosive-chambers back of the traveling pistons, the invention further comprising details of construction hereinafter more fully pointed out in the specification.

To comprehend the invention reference should be had to the accompanying sheets of drawings, wherein—

Figure 1 is a side view in elevation, disclosing the motor removed from within its casing, the governor mechanism, feed-supply for the hydrocarbon or explosive mixture being removed and one of the explosive-cylinders being in section. Fig. 2 is a vertical sectional end view of the apparatus with its connections, the governor mechanism, the air-feed connections, and the outer casing being removed, said view being taken on line *x x*, Fig. 1 of the drawings. Fig. 3 is a cross-sectional view of one of the explosive-cylinders, said section being through the feed for the explosive mixture. Fig. 4 is a similar view of one of the cylinders, taken on a line of the lock mechanism for the gate or shutter for closing the end of the cylinder after the entrance of a piston therein. Fig. 5 is a detail horizontal sectional broken plan view of the mechanism set forth in Fig. 4, disclosing the position of one of the gate or shutter wings after the piston is within the cylinder; and Fig. 6 is an end view in elevation, the outer casing being partly broken away, disclosing the entire apparatus as erected for the driving of machinery generally.

The numeral 1 is used to indicate two fixed or stationary spaced disks, between which disks are held a series of separated independent cylinders 2. These cylinders may be said to constitute an outer rim for the spaced disks or plates 1, which disks or plates are held upward by the supports 3. Through bearings 4 of the disks or plates 1 works a power-shaft 5, which is provided with the fly-wheels 6, located beyond the disks or plates 1. The motion of the shaft 5 is transmitted by any suitable mechanism for power purposes, preferably through the medium of a belt (not shown) working over pulley-wheel 7, attached to one end of the said shaft.

To the shaft 5 is secured a circular spider 8, which is arranged to rotate between the disks or plates 1. To the periphery of said spider is attached a series of pistons 9, the diameter of which pistons is such as to fill snugly the chamber 10 of the cylinders 2 during the rotary travel of the spider 8. This spider is driven by the action of an explosive charge within the explosion-chamber 10, acting against the pistons 9, as hereinafter explained.

The outer edge of the spider 8 completely fills a longitudinal slot 11, cut through the bottom of each cylinder 2, the pistons being secured to the brackets 12, upwardly projecting from the periphery of the spider 8.

Each cylinder 2 is provided with a water-jacket 13, so as to form a water-circulating chamber 14. Water is delivered to the circulating-chambers 14 by the supply-pipe 15, which pipe connects with each chamber 14 by means of the branch pipes 16. The water es-

capes from within the chamber 14 of the cylinders 2 by means of the outlet-pipes 17, which pipes connect with a common outlet-pipe 18.

The forward end of each cylinder 2 is formed into an enlarged mouth 19, within which works a rotatable four-winged shutter or gate 20. The gate-wings 21 as thrown to cover or close the cylinder-mouth 19 are locked against movement by means of the laterally-movable lock-pins 22 23, which engage with the lower wing of the gate and hold the said shutter or gate 20 against rotation. These lock-pins, which, as hereinafter explained, also actuate the sparking means for the explosive charge of the cylinders, are moved inward and outward by means of the spring-pressed fulcrumed levers 24. The upper end of these levers engage with the outer portion of the lock-pins 22 23, which pins are normally held outward by means of the spring 25, exerting an inward pressure on the lower end of the said levers 24. These levers are moved to force the lock-pins inward by the cam-surfaces 26 of the disks 27, keyed to the shaft 5, bearing against the roll 28, secured to the lower end of each lever 24 during the rotation of said disks 27. The position of these cam-surfaces is such that the levers 24 are not operated to force inward the lock-pins 22 23 their full distance until the pistons 9 have moved a slight distance beyond the feed-inlet 29 for the hydrocarbon. However, the moment the pistons have entered within the explosion-chamber 10 of the cylinders 2 the lock-pins 22 23 will have moved such a distance as to lock the gate or shutter 20 against movement or rotation. The inner end of the lock-pins 22 23 as forced into the cylinders 2 move within the guides 30 30′, carried by the wings 21 of the said shutter or gate.

To the inner face of each wing 21, between the guides 30 30′, the spring-contacts 31 32 are attached, which contacts as they approach each other generate a jump-spark for the firing of the explosive charge within the chamber 10 between the rear wall of the piston 9 therein and the forward wall or face of the closing-wing of the shutter or gate 20.

The lock-pins 22 23 are connected by wires *a b* with a suitable battery or source of current. The lock-pin 22 moves within an insulated seat *d*, the outer end portion being insulated, so as not to make contact with its guide 30. As the lock-pins 22 23 approach the completion of their inward stroke they bear against the spring-contacts 31 32 and gradually close the switch or force the contacts together in order to generate a spark within the combustion-chamber 10 of the cylinders for the explosion of the explosive charge fed therein back of the moving piston.

The hydrocarbon or explosive charge is delivered into the cylinders through the feed-nozzle 32′, into which nozzle the explosive gas is delivered from the feed-pipe 33 and the air from pipes 34. The air-pipes connect with the air-supply pipe 35, which pipe leads from an air-supply reservoir 36. Into this reservoir at its lower end the heated exhaust from the several cylinders 2 is delivered by pipe 37, which pipe connects with the exhaust-chamber 38 of each cylinder by means of the branch pipes 39. By this means the air within the reservoir 36 is maintained somewhat heated and sufficient pressure obtained to force same, through its connection, into the feed-nozzle 32′ for each cylinder with the required force to eject the explosive mixture into the explosive-chamber of the cylinders.

As the pistons move from within the cylinders the spent gases resulting from an explosion enter the exhaust-chamber 38 of the cylinders 2 through the ports 40, forming communication between the explosive-chamber and the exhaust-chamber of the cylinders.

Within the air-supply pipe 33 is introduced a valve-coupling 41, within the chamber 42 of which is located a ported diaphragm 43. The flow of air through this chamber is regulated by the ported slide-plate 44, which is actuated by the reciprocating rod 45. This rod is normally held outward by the tension of the spring 46, said rod's movement being controlled by the fly-balls 47 of the governor 56 through the medium of pivoted levers 47′ 48 48′. As the fly-balls 47 are moved outward and inward by the increased or the decreased speed of the governor mechanism the position of the slide-plate 44, through the medium of the described connection, is moved to close and open the port-openings of the diaphragm 43 in order to proportion the feed of air in proportion to the running of the motor. By this means the supply of the explosive mixture into the explosive-chamber of the pistons is automatically controlled by the speed of the motor, inasmuch as the stroke or reciprocation of the slide-plate is regulated by the position at which the lever 47′ stands. This lever at its inner end is hinged or pivoted to a slide-rod 49, which is connected to one arm of the bell-crank lever 49′, the opposite arm of said bell-crank lever being pivoted to the upper end of the connecting-rod 50, which rod is attached at its lower end to a crank-pin 51, projecting from the pinion 52. This pinion is mounted upon a stud 53, attached to the casing 54 and is driven from an intermeshing gear 55, secured to the projecting portion of the shaft 5.

The governor 56 is driven by the endless connecting-cord 57, working over the pulley-wheels $57'$ 57^2 57^3.

Inasmuch as the operation of the parts for one cylinder during the explosion of a charge is identical with that which takes place in the other cylinders, it is not deemed necessary to follow the working of more than one of the cylinders, it being understood that what takes

place in one cylinder is being duplicated in the remaining cylinders.

Each cylinder 2 is in shape the segment of a circle which corresponds to the arc described by the pistons 9 during the course of their movement or circular travel.

The motor is started in the usual manner for imparting initial movement to explosive-engines—that is, by giving a few turns to the power-shaft. As the pistons 9 advance toward the enlarged mouth of the cylinders 2 they bear against the lowermost wing of the rotatable gate or shutter 20, moving the same inward in advance of the piston to rotate the said gate or shutter. The following wing will thus be turned downward back of the moving piston, so that by the time the piston 9 has advanced within the explosion-chamber 10 of the cylinder 2 beyond the feed-inlet 29 for the explosive compound or charge the rear wing of the rotatable gate or shutter will stand in a vertical position. The explosive compound or charge is delivered into the space thus formed between the rear face of the piston and front of the vertical wing. During this movement of the piston the disks 27 will have revolved such a distance as to cause the cam-surfaces 26 to bear outward against the lower end of the levers 24 to move the upper end thereof in a direction to force the lock-pins 22 23 inward into engagement with the guides 30 30′ of the vertical wing of the rotatable gate or shutter 20, thus locking the same against movement. As the said lock-pins 22 23 approach each other they bear against and gradually force toward each other the spring-contacts 31 32 to make a jump-spark, which spark explodes or fires the charge fed into the cylinder. The force of the explosion thus made drives the piston 9 from within its cylinder toward and into the cylinder immediately in advance thereof, where the same operation is repeated. During this travel of the piston the cam-surfaces 26 will move from engagement with the levers 24, when the pressure of the springs 25 will force the lower end thereof inward to move the upper end of the levers outward to withdraw the lock-pins 22 23 from locked engagement with the wing of the rotatable gate or shutter 20 to release the said shutter or gate in order that the same may be given a step rotation by contact therewith of the advancing piston.

It will be understood that the spent gases after an explosion escape into the exhaust-chamber of the cylinder, as hereinbefore described.

As the pistons are driven they impart rotation to the spider 8, which in turn drives the power-shaft 5.

As the described operation takes place in each cylinder during the movement of the pistons a continuous rotation is imparted or transmitted to the power-shaft 5, which power may be utilized for any desired purpose.

The essential feature of the present invention resides in the employment of a series of cylinders, with a series of driven pistons successively working within the cylinders, with means for feeding an explosive charge into each cylinder behind the piston moving therein, with automatically-operated mechanism for generating an explosive spark for firing the explosive charge back of the piston, together with operative means whereby the explosive force which drives the pistons is transmitted for power purposes.

Having thus described the invention, what is claimed as new, and desired to be protected by Letters Patent, is—

1. An explosive-motor comprising a series of cylinders, a series of pistons working successively through the cylinders, devices actuated by the movement of the pistons to close the end of the cylinders as the pistons enter therein, a power-shaft driven by the movement of the pistons, means for feeding an explosive mixture into the cylinders back of the moving pistons, and devices actuated during the travel of the piston for locking the cylinder-closing devices and firing the explosive charge fed into the cylinders.

2. An explosive-motor comprising a series of independent stationary cylinders, a power-shaft, a series of pistons connected thereto so as to travel successively within the cylinders, and means actuated during the movement of the pistons for exploding an explosive charge delivered into the cylinders back of the moving pistons.

3. In an explosive-motor of the described character, the combination with the cylinders thereof, of a plurality of pistons which work successively within the cylinders, of a rotatable gate or shutter located in each cylinder to close the mouth thereof as the pistons enter therein, means for feeding an explosive charge into the cylinders, and devices actuated during the travel of the pistons to lock the rotatable gate or shutter against movement, fire the explosive charge and release the locked gate or shutter after the explosion of a charge within the cylinders.

4. In an explosive-motor of the described character, the combination with fixed or stationary disks, of a series of independent cylinders held between the said disks, a power-shaft working in bearings of the disks, a series of independent pistons secured to the shaft through the medium of a spider-disk, said pistons working successively through the cylinders, and means whereby an explosive charge is fired back of the pistons as forced through the cylinders.

5. In an explosive-motor of the described character, the combination with a series of independent water-jacketed cylinders, a series

of pistons working successively through the cylinders, means for causing the pistons to travel in a circular path, an exhaust-chamber in each cylinder to receive the spent gases, a feed for delivering an explosive mixture into the cylinders back of the pistons moving therein, devices for automatically firing the explosive charge while the pistons are within the cylinders, an air-reservoir, connections between the exhaust-chambers and the reservoir for delivering the spent gases thereto, and connections between the said reservoir and the feed-nozzles for the cylinders for admitting air under pressure to enter the feed-nozzle to eject an explosive charge into the cylinders.

6. An explosive-motor comprising a series of circularly-arranged fixed cylinders, a series of connected driven pistons working successively through each of the said cylinders, means for automatically feeding an explosive charge into each cylinder back of the piston moving therein, and automatically-operated mechanism for generating a spark for firing the explosive charge.

In witness whereof I have hereunto set my hand.

JAMES F. HATHAWAY.

Witnesses:
A. J. HENRY,
M. A. HENRY.