J. M. FOY.

ROTARY ENGINE.

APPLICATION FILED MAR. 12, 1910.

996,477.

Patented June 27, 1911.

3 SHEETS—SHEET 1.

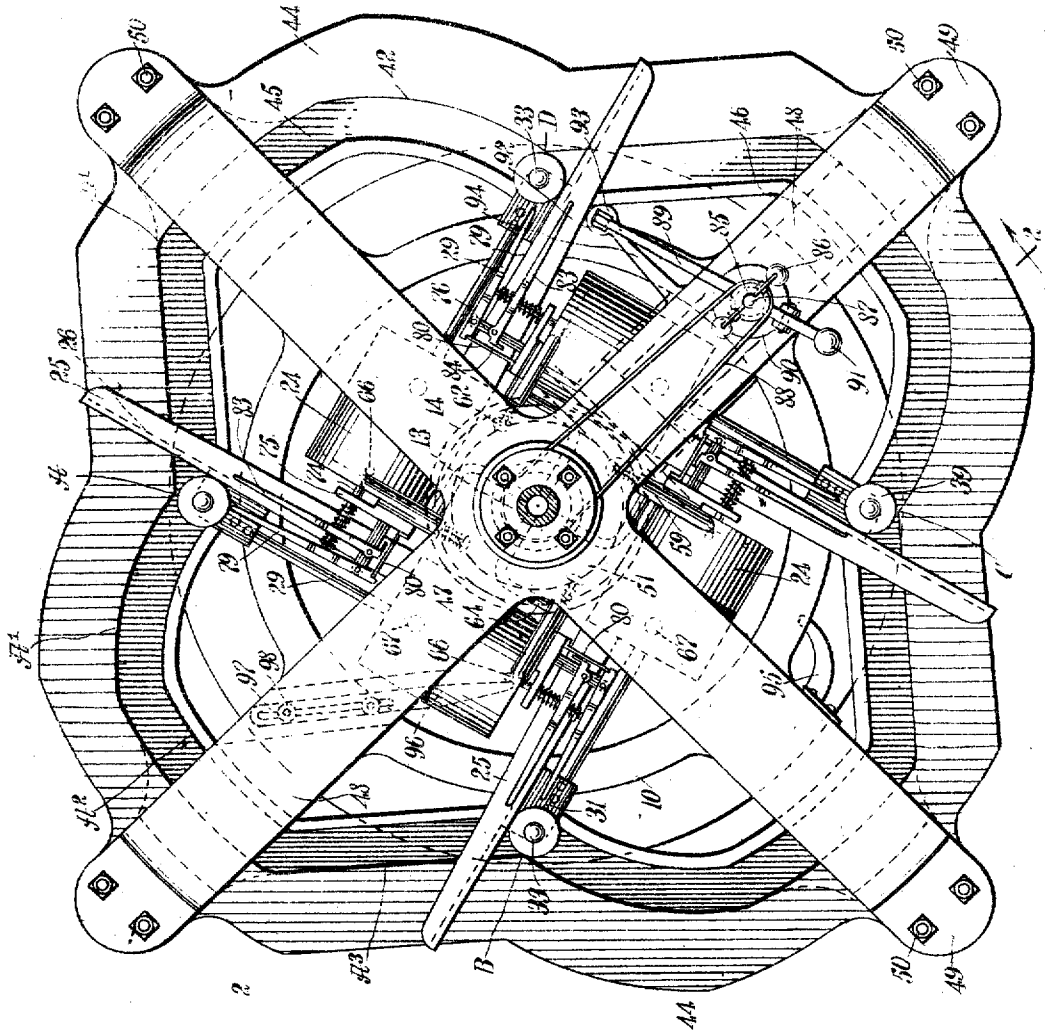

Fig. 1.

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3 SHEETS—SHEET 2.

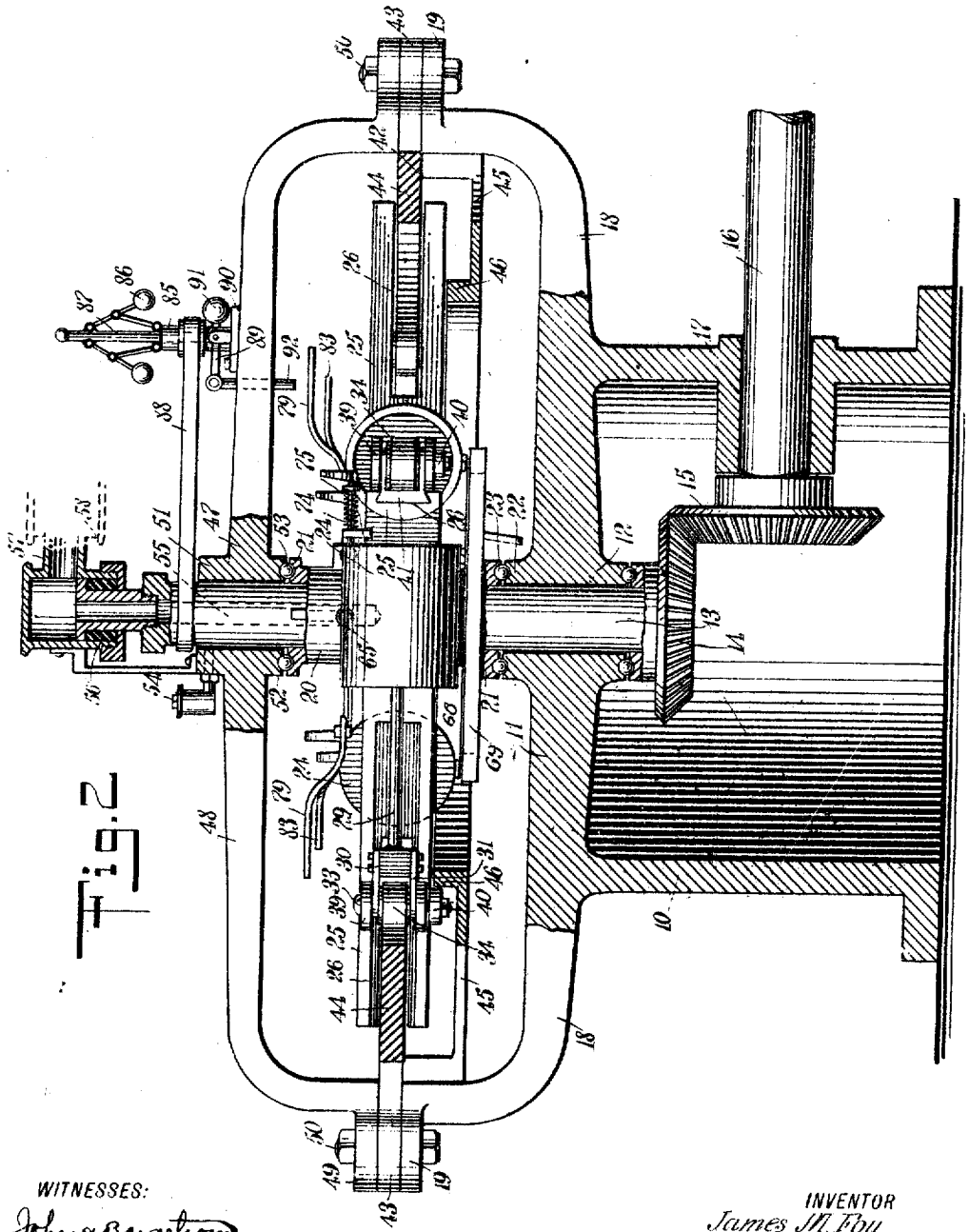

Fig. 2

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3 SHEETS—SHEET 3.

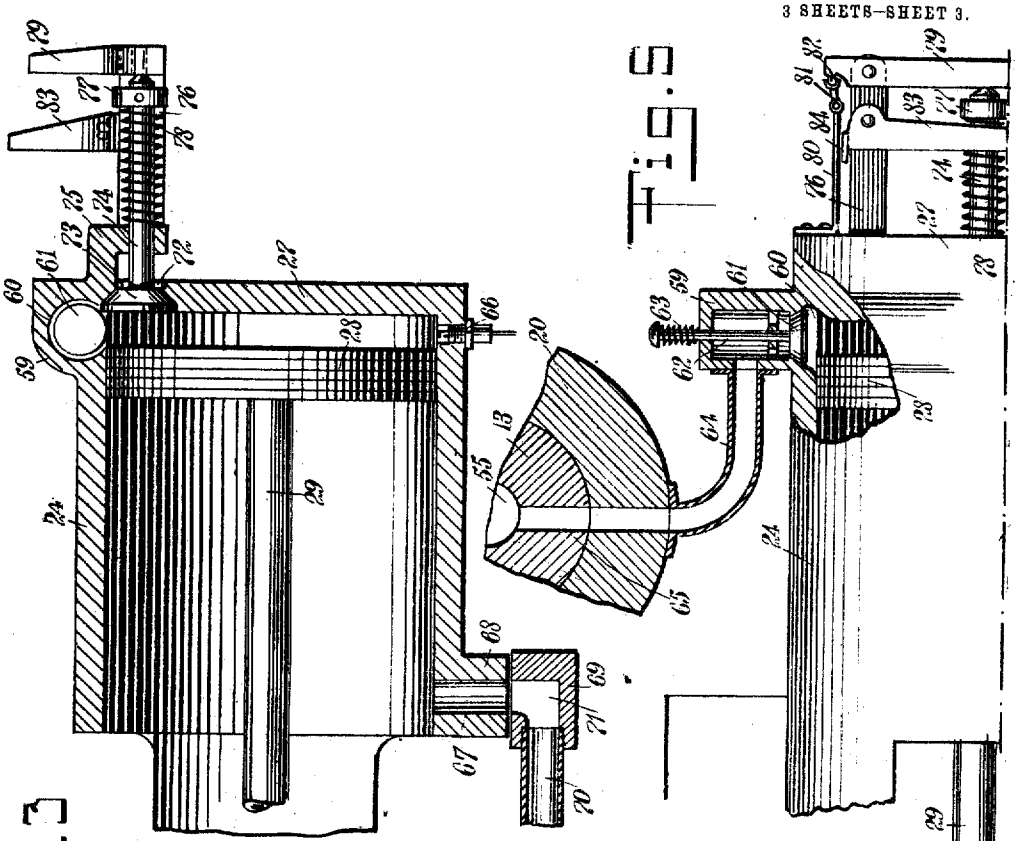

Fig. 5

Fig. 3

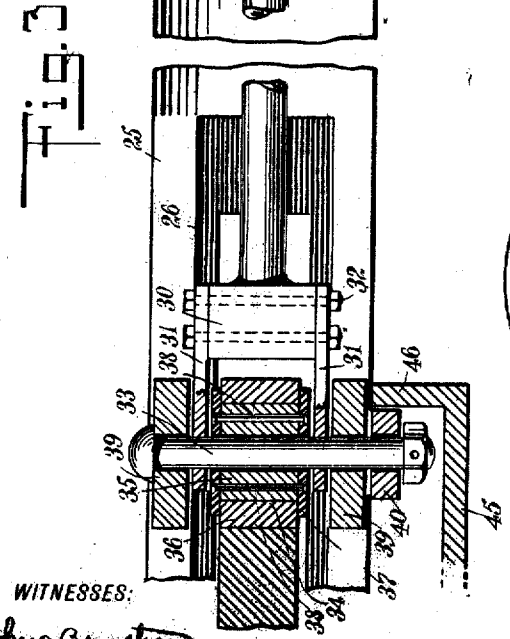

Fig. 6

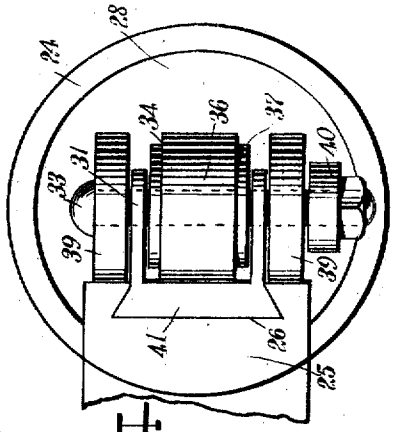

Fig. 4

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UNITED STATES PATENT OFFICE.

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ROTARY ENGINE.

996,477 Specification of Letters Patent. Patented June 27, 1911.

Application filed March 12, 1910. Serial No. 548,764.

To all whom it may concern:

Be it known that I, JAMES M. FOY, a citizen of the United States, and a resident of Palatka, in the county of Putnam and State of Florida, have invented a new and Improved Rotary Engine, of which the following is a full, clear, and exact description.

This invention relates to rotary engines, and has reference more particularly to a rotary, internal combustion engine of the revolving cylinder type, in which the governor controls the air inlet valve, to maintain the cylinders open if the speed of the engine exceeds a predetermined limit, so that no explosions can take place, and in which the piston rods are in guiding engagement with a suitable guide on the engine frame, whereby the piston heads are moved in the cylinders as these rotate.

The object of the invention is to provide a simple and efficient internal combustion, rotary engine which is compact in form, and can be exactly governed, in which the exploded charges are thoroughly scavenged from the cylinders, in which the exhaust gases are to a large extent carried off from the vicinity of the engine, and by means of which any desired number of explosive cylinders can be combined in one prime mover.

The invention consists in the construction and combination of parts to be more fully described hereinafter and particularly set forth in the claims.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views, and in which—

Figure 1 is a plan view of an embodiment of my invention; Fig. 2 is a vertical section of the engine, partly on the line 2—2 of Fig. 1; Fig. 3 is an enlarged, fragmentary, longitudinal section of one of the cylinders and the guide arm associated therewith; Fig. 4 is an end view of the piston rod, showing the means for engaging the fixed guide of the engine; and Fig. 5 is a plan view of part of one of the cylinders, showing a portion thereof in cross section, and illustrating the connection between the cylinders and the fuel-supply passage.

Before proceeding to a more detailed explanation of my invention, it should be clearly understood that the same is an internal combustion engine with which any suitable fuel can be used, for example, gasolene, alcohol, and other hydro-carbon explosive substances. While I have shown for example, an engine comprising four cylinders, each of which develops a single power stroke during one revolution, any other number of cylinders can be combined in a single engine, and the parts can be so arranged that one or more explosions per revolution are produced.

Certain of the details of construction form no part of the invention, and can be varied in accordance with special conditions and individual preference, without departing from the underlying spirit of the invention.

Referring more particularly to the drawings, I provide an engine frame having a base 10, of substantially cylindrical form and adapted to be mounted upon a suitable bed-plate or other support. The base has a top 11, in which is formed a substantially vertical bearing 12. A correspondingly vertical shaft 13 is journaled in the bearing, and at the lower end has a bevel gear 14, in mesh with a bevel gear 15 rigid with a shaft 16. The latter is the shaft from which the power of the engine is taken, and is journaled in a suitable bearing 17, formed at one side of the engine base. The base has laterally extending arms 18, the extremities of which are upwardly disposed and provided with outwardly-extending lugs 19, for a purpose to appear hereinafter. A sleeve 20, having at each end a bearing race 21, is keyed or otherwise rigidly secured upon the shaft 13, and rests at the upper end of the bearing 12, which forms a bearing race 22. Ball bearings 23 are positioned between the lower race 21 and the race 22, so that the sleeve is rotatably mounted, and can be operated with a minimum of friction.

I employ cylinders 24, having extensions 20^a rigidly secured to the sleeve 20, and spaced equi-distant. The cylinders are arranged at right angles to radii from the center of the shaft, and extend tangentially with respect to the shaft. Each has rigid therewith a guide arm 25, extending in the direction of the length of the cylinder, and provided with an undercut guide groove or slot 26. The cylinders have heads 27, and are open at the ends opposite to the heads, i. e., at the ends from which the guide arms extend. Within each cylinder is a piston head 28 having rigidly associated therewith a piston rod 29. The piston rods 29, at the outer ends have extensions 30, of the

opposite sides of which are secured bars 31, by means of bolts 32. Between the bars are pivotally mounted spindle bolts 33, carrying rollers 34 between the bars 31. The rollers may be of any suitable form, and consist, for example, of cores 35 having rims 36, and side pieces 37 secured thereto by means of rivets 38. At the outside of the bars 31, the spindle bolts carry outer guide rollers 39. Each spindle bolt further, has at the lower end a further guide roller 40. The arrangement of the rollers is shown most clearly in Figs. 3 and 4. It will be understood that the extensions 30, the side bars 31, and the rollers associated therewith, at the ends of the piston rods, constitute guide cross heads. The side pieces 37 of each cross head are connected by an integral member 41, the sides of which are beveled, and which constitutes a cross head slide, movably engaging in the undercut groove or recess 26 of the corresponding guide arm of the cylinder.

The arms 18 carry a guide 42 provided with lugs 43, corresponding to the lugs 19, and positioned thereon. The guide comprises an inwardly-extending flange 44 having associated therewith a downwardly offset flange 45, provided with an upwardly-disposed rim 46. The rim is located inwardly of the inner edge of the flange 44, as is shown most clearly in Fig. 1. The guide comprises in the present form of the invention, four symmetrical sections, extending, as is shown in Fig. 1, from A to B, from B to C, from C to D, and from D to A. Each section consists of three parts, for example A', A^2, and A^3. The first is outwardly curved with respect to the central shaft, the second is concentric with the shaft, and the third is inwardly disposed, and substantially straight, with respect to the shaft. The guide roller 34 of each cross head engages at the inner rim of the flange 44 of the guide. The roller 40 of each cross head engages at the inside of the outwardly disposed rim 46 of the flange 45. The rollers 39 are in rolling contact with the corresponding guide arm 25.

I employ a spider 47, having arms 48 preferably corresponding to the arms 18, and provided with downwardly disposed extremities, having lugs 49 seating upon the lugs 43. The lugs 19, 43 and 49 are secured together by means of suitable bolts 50. The spider has a central bearing 51, in which is journaled the upper portion of the shaft 13. The bearing 51, at the lower end forms a bearing race 52, between which and the upper race 21 of the sleeve 20, are located ball bearings 53. A lubricant cup 54 is mounted upon the bearing 51, and serves to supply lubricant to the shaft. The latter has a passage 55 therethrough, connected by means of a swivel stuffing-box 56, with a pipe 57 leading to a carbureter 58 or other suitable source of fuel supply. Each cylinder has associated therewith a fuel inlet valve casing 59, communicating with an inlet valve seat 60 adapted to be closed by an inwardly opening valve 61. The latter has a stem 62 movably arranged with respect to the valve casing, and controlled by a spring 63, so that the valve tends normally to seat, and thereby to close the inlet to the cylinder. Each valve casing 59 is connected by means of a tube 64, with a lateral passage 65 extending through the shaft 13 and the sleeve 20, and communicating with the passage 55 of the shaft, so that fuel can enter the cylinder from the carbureter. Each cylinder also has an ignition device 66, consisting of a spark plug or the like. Near the open ends, the cylinders have exhaust outlets 67, consisting of laterally disposed passages extending through an annular member 68 carried by the cylinders. An annular exhaust gas conductor 69 is located under the cylinders within the engine frame, and has exhaust openings and a pipe 70 by means of which the exhaust gas can be conducted to a point remote from the engine. The arrangement is such that during the exhaust stroke of each cylinder, the outlet thereof is in juxtaposition with an opening of the exhaust conductor 69, and is arranged to discharge into the passage 71 extending through the exhaust conductor 69, and communicating with the pipe 70, the member 68 closing the openings of the conductor when the cylinder outlets register with the openings.

Each cylinder head 27 is provided with an air inlet 72 constituting a valve-seat adapted to be closed by a valve 73, opening inwardly. The valve has a stem 74 movably arranged in an opening of a guide arm 75 having a post or carrier extension 76. The valve stem 74 has a head 77 engaged by a spring 78 mounted upon the stem, and engaging the arm 75, so that the valve 73 tends normally to remain closed. A valve opening arm 79 is pivoted at the end of the carrier 76, and is adapted to engage the end of the valve stem, so that the arm 79 can be operated to open the valve against the tension of the spring 78. A spring detent 80 is mounted upon the cylinder head and has a jointed extremity 81 adapted to engage a projection 82 at the end of the arm 79, to hold the arm in position such that the valve is open. A detent-controlling arm 83 is pivoted upon the carrier 76, and has a finger 84 adapted to engage the detent to release the same when the arm 83 is operated.

I employ a governor 85, mounted upon one of the spider arms 48, of the usual gravitational type, having movable weights 86 adapted to raise and lower a governor rod 87, according to the speed with which the governor is rotated. It is connected

by means of a belt 88, or in any other suitable manner, with the shaft 13. A lever 89 is pivoted upon the governor base 90, and has at one end a counterweight 91. At the other end, the lever has pivotally associated therewith, a trip pin 92, which is movably arranged in a guide 93 carried at the end of an arm 94, extending rigidly from a spider arm 48. An adjacent spider arm 48 has a fixed trip 95, the purpose of which will appear hereinafter.

An igniting member 96 is mounted upon the engine frame and is adapted to engage the igniting device of the cylinders when the same reach predetermined points of their travel, to cause sparks to be produced in the cylinders, and thereby to explode their charges. The igniting device has a slotted part 97, secured by means of set screws 98 to the engine frame, so that it can be adjusted to regulate the spark.

It will be noted that the guide arms 25 are bifurcated, so that the guide flange 44 is movably received by the sides thereof. This construction is most clearly shown in Figs. 2 and 3.

The operation of the machine is as follows, referring particularly to the cylinder whose cross-head is at the point D of the guide, and assuming that this cylinder has been scavenged and is ready to draw in a charge. The rotation of the cylinder causes the piston to move toward the open end of the same, owing to the engagement of the cross-head of the piston rod, with the guide, so that a charge is drawn into the cylinder during the time that it is moving from the point D of the guide, to the point D'. The charge 6 is compressed while the cross-head of the piston rod is traveling from the point D' of the guide, along the inwardly disposed part thereof, to the point A, as this portion of the guide forces the piston head toward the head end of the cylinder. When the cross head reaches the point A of the guide, the charge within the cylinder is exploded by means of the contact device 96, which has come into engagement with the spark plug 66 to close the circuit thereof. The cylinder then develops a power-stroke between A and A^2 of the guide. The portion A' of the guide is so arranged that the piston rod is at substantially right angles with respect thereto, and in consequence, the force of the explosion tends to drive the cylinder about the shaft 13. At the end of the power stroke, the exhaust outlet of the cylinder comes into operative relation with the exhaust gas conductor and the major portion of the gases escape through this conductor. Between A^2 and B of the guide, the cylinder is exhausting, the fixed trip 95 having opened the air valve of the cylinder, by engaging the arm 79 containing the valve, after the exhaust stroke has ended. Between B and D of the guide, the piston is reciprocated in the cylinder, and as the air valve is open, the cylinder is thoroughly scavenged thereby. The air valve is closed by the trip pin 92, so that when the cross-head of the cylinder again reaches the point D of the guide, it is ready to draw in another charge, and repeat the cycle of operations described above. If however, the speed of the engine has exceeded a predetermined limit, the trip pin will be drawn forward out of the possibility of engagement with the detent-controlling valve, which remains open, and no explosion will take place in the cylinder until it has completed another revolution.

Having thus described my invention, I claim as new, and desire to secure by Letters Patent:

1. A rotary engine comprising a frame, a cylinder mounted to rotate upon said frame, a piston in said cylinder, said frame having means for reciprocating said piston, said cylinder having a controlling valve, a tripping device carried by said frame, for operating said valves, a governor mounted upon said frame, means whereby said cylinder actuates said governor, and a second tripping device carried by said frame, and independent of said first tripping device, said second tripping device serving to control said valve, said governor being operatively connected with said second tripping device and adapted to render the same operative and inoperative.

2. A rotary engine comprising a frame, a cylinder mounted to rotate thereupon, said frame having a fixed guide arranged about said cylinder, a piston within said cylinder and having a piston rod movably engaging said guide, said cylinder having a controlling valve, a fixed trip carried by said frame and serving to operate said valve, a movable trip carried by said frame and serving to control said valve, and a governor carried by said frame and operatively connected with said movable trip, said trips being independent of one another and being arranged in paths such that said valve will be operated thereby as said cylinder rotates.

3. A rotary engine comprising a frame, a cylinder mounted to rotate upon said frame, a fixed guide carried by said frame about said cylinder, a piston within said cylinder and having a piston rod in operative engagement with said guide, a fixed igniting device carried by said frame and arranged in the path of said cylinder, said cylinder having means whereby a charge within said cylinder can be exploded at a predetermined point of the revolution of said cylinder, by the engagement of said means with said fixed, igniting device, said cylinder having a controlling valve, a fixed trip carried by said frame, for operating said valve, a movable trip carried by said frame, for operating

said valve, and independent of said fixed trip, a governor carried by said frame, means whereby said cylinder serves to actuate said governor, said governor being operatively connected with said movable trip, and means for supplying said cylinder with an explosive charge.

4. A rotary engine comprising a frame, a shaft journaled in said frame, a cylinder rigidly secured to said shaft and mounted to rotate therewith, a fixed guide carried by said frame and extending around said cylinder and said shaft, a piston within said cylinder and having a piston rod, said piston rod having a cross-head movably engaging said guide, means for igniting a charge within said cylinder, said cylinder having a controlling valve, a fixed trip carried by said frame, for operating said valve, a movable trip carried by said frame, for operating said valve, said trips being in paths such that said valve will be operated thereby as said cylinder rotates, a governor carried by said frame and operatively connected with said movable trip to control the same, and means for supplying said cylinder with an explosive charge, said guide having a part extending outwardly from said shaft, a part concentric with the axis of said shaft, and a part extending toward said shaft.

5. A rotary engine comprising a frame, a cylinder mounted to rotate in said frame and having a guide arm rigid therewith, a guide carried by said frame and extending around said cylinder, a piston within said cylinder and having a piston rod movably engaging said guide and said guide arm, said cylinder having a controlling valve, a trip device carried by said frame and serving to operate said controlling valve, an independent trip device carried by said frame and adapted to be rendered operative and inoperative relative to said valve, and a governor carried by said frame, means whereby said cylinder serves to actuate said governor, said governor being operatively connected with said independent trip device, said last-mentioned trip device being normally inoperative.

6. A rotary engine comprising a frame, a cylinder mounted to rotate in said frame and having a rigid guide arm extending longitudinally from said cylinder, a fixed guide carried by said frame and extending around said cylinder, a piston within said cylinder and having a piston rod, said piston rod having a cross-head movably engaging said guide and said arm, said cylinder having a controlling valve, a fixed trip carried by said frame and serving to operate said valve, a movable trip carried by said frame, a governor carried by said frame, means whereby the rotation of said cylinder actuates said governor, and means whereby said governor actuates said movable trip.

7. A rotary engine comprising a frame, a plurality of cylinders rigidly connected and mounted to ride upon said frame, a fixed guide carried by said frame and encompassing said cylinders, said cylinders having therein pistons and piston rods, said piston rods movably engaging said guide, each of said cylinders having a controlling valve, a fixed trip carried by said frame, for operating said controlling valves successively, a movable trip carried by said frame and adapted, when operative, to control said valves, a governor carried by said frame, and means whereby the rotation of said cylinders actuates said governor, said governor having means for controlling said movable trip, said trips being independent of one another.

8. A rotary engine, comprising a cylinder mounted to rotate, a piston therein having a piston rod, a valve controlling said cylinder, a trip device for operating said valve, a fixed guide about said cylinder and comprising an inwardly disposed flange and an offset flange having a laterally disposed rim, and a cross head connected with said piston rod and having rollers engaging at the inner edge of said first flange and at the outer side of said rim of said second flange respectively.

9. A rotary engine, comprising a cylinder mounted to rotate, a piston therein having a piston rod, a valve controlling said cylinder, a trip device for operating said valve, a fixed guide about said cylinder and comprising an inwardly disposed flange and a downwardly offset flange having a laterally disposed rim, and a cross head connected with said piston rod and having rollers engaging at the inner edge of said first flange and at the outer side of said rim of said second flange respectively, said sleeve having a rigid arm having a guideway, said cross head having a part slidably engaging said guideway, and being provided with additional rollers engaging said arms.

10. A rotary engine, comprising a plurality of cylinders rigidly connected, and mounted to rotate, a fixed guide encompassing said cylinders, said cylinders having pistons therein, and piston rods rigid with said pistons, and cross heads secured to said piston rods, said guide consisting of two parts each engaged by said cross heads, and constraining the same to move in opposite directions.

11. A rotary engine, comprising a cylinder mounted to rotate, a fixed guide, a piston within said cylinder and having a movable cross head engaging said guide, said cylinder having an exhaust outlet, a fixed exhaust conductor adapted to coöperate with said exhaust outlet when said cylinder is in a predetermined position, and means for supplying said cylinder with an explosive charge.

12. A rotary engine comprising a frame, a cylinder mounted to rotate in said frame, a fixed guide carried by said frame about said cylinder, a piston within said cylinder and having a piston rod movably controlled by said guide, said cylinder having a controlling valve, a movable arm carried by said cylinder, for operating said valve, a spring tending to maintain said valve in a normal position, a detent carried by said cylinder and controlling said arm, a movable detent-controlling arm carried by said cylinder, and trips carried by said frames, for operating said arms.

13. A rotary engine comprising a frame, a cylinder mounted to rotate on said frame, a fixed guide carried by said frame about said cylinder, a piston within said cylinder and having a piston rod movably engaging said guide, said cylinder having an air inlet valve, a movable arm carried by said cylinder and serving to operate said valve, a spring tending to maintain said valve in a normal, closed position, a detent carried by said cylinder, for holding said arm in position such that said valve is open, a second arm carried by said cylinder and operative to disengage said detent from said first arm, a movable arm carried by said frame, for operating said first arm, a movable trip carried by said frame, for operating said other arm, a governor carried by said frame, and means whereby said cylinder serves to actuate said governor, said governor being operatively connected with said movable trip.

14. A rotary engine, comprising a plurality of cylinders mounted to rotate, a fixed guide, pistons within said cylinders and controlled by said guide, each of said cylinders having an inlet valve, a member connected with said cylinders and having openings therethrough constituting exhaust outlets for said cylinders, a fixed exhaust conductor positioned under said member and having openings adapted to register with said exhaust outlets when said respective cylinders are exhausted.

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

JAMES MORRIS FOY.

Witnesses:
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