F. GRUZECKI.

GAS ENGINE.

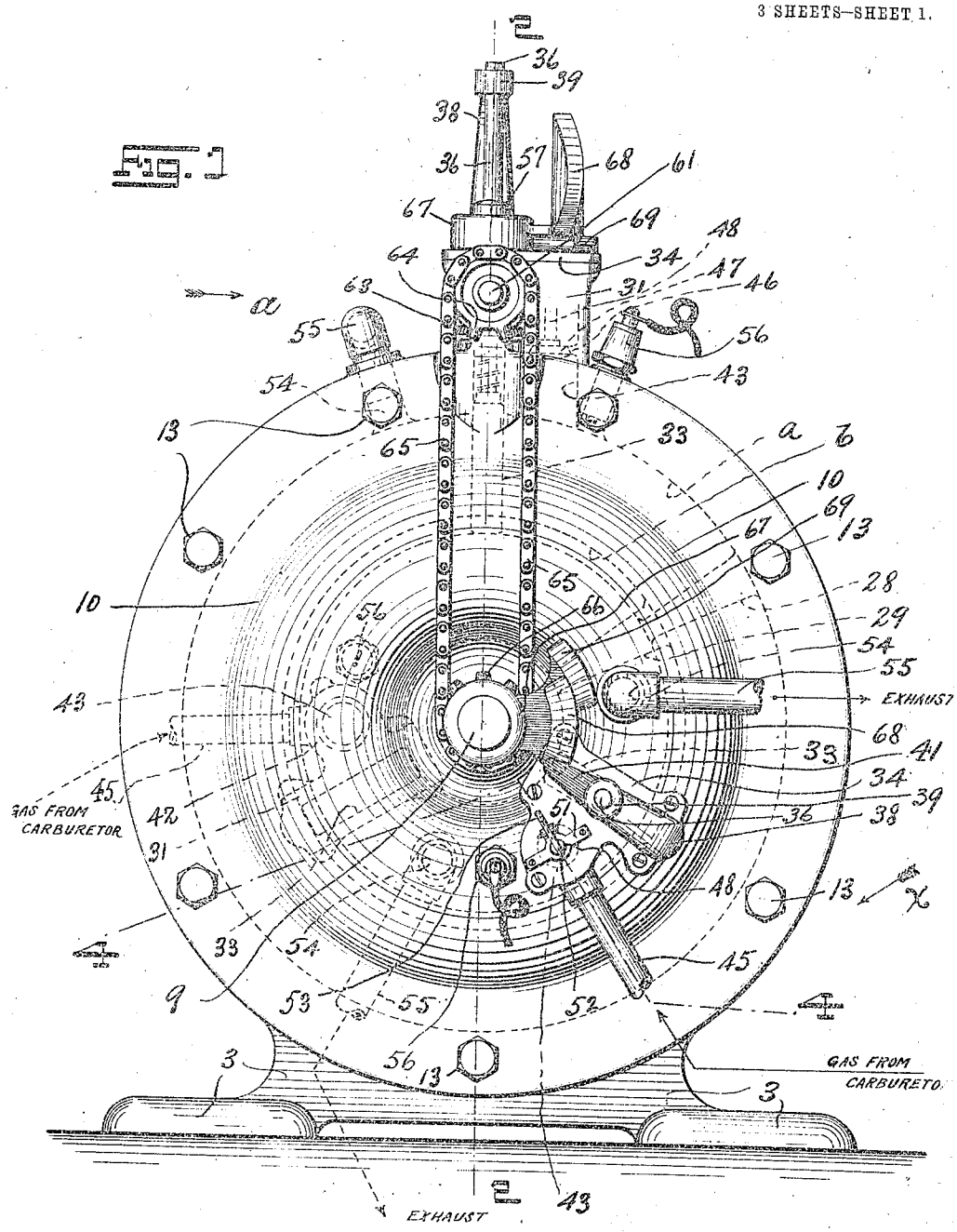
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1,132,928.

Patented Mar. 23, 1915.

3 SHEETS—SHEET 1.

Fig. 1



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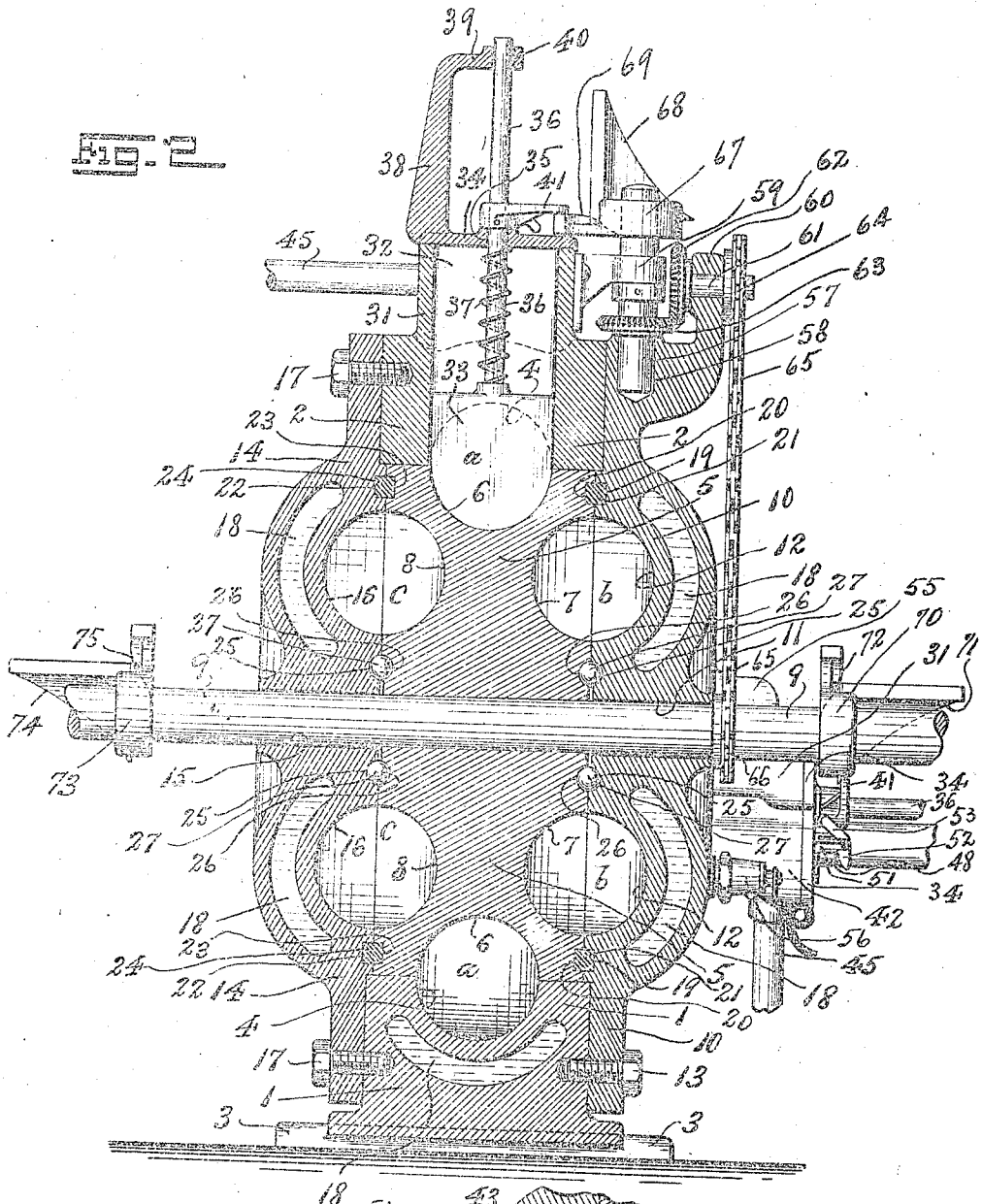
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3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

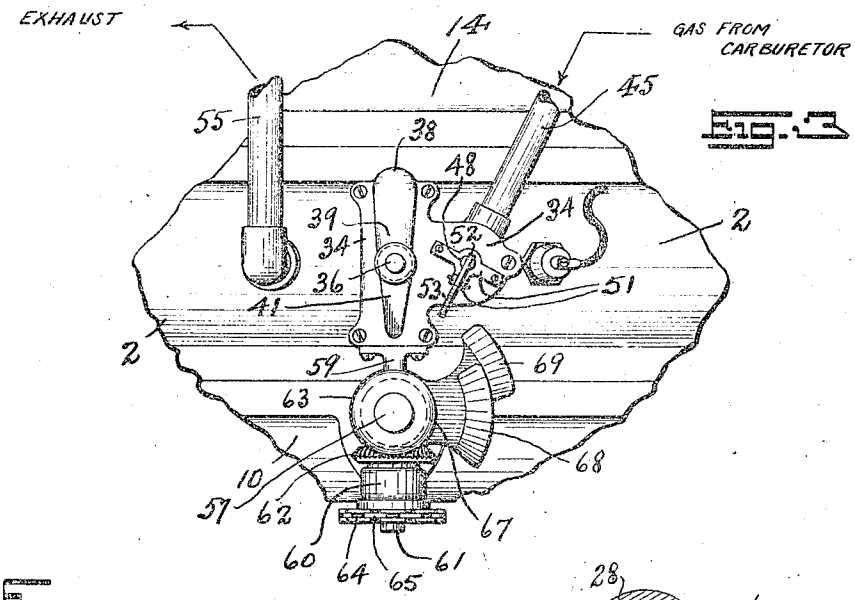


Fig. 3

Fig. 5

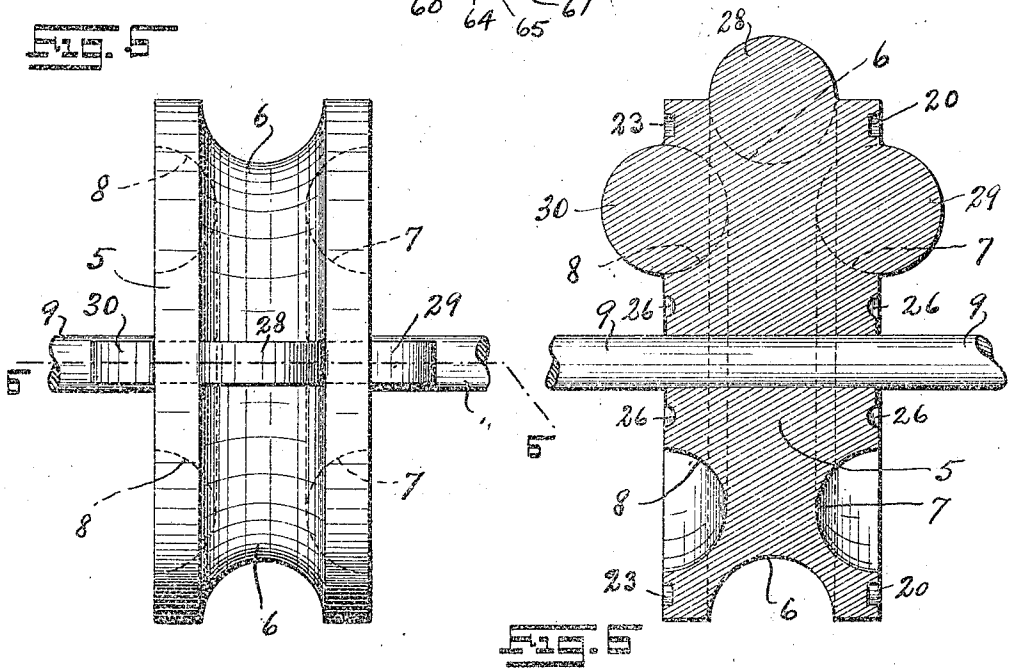


Fig. 5

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UNITED STATES PATENT OFFICE.

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GAS-ENGINE.

1,132,928. Specification of Letters Patent. Patented Mar. 23, 1915.

Application filed August 24, 1914. Serial No. 858,178.

To all whom it may concern:

Be it known that I, FRANK GRUZECKI, a subject of the Czar of Russia, residing at Passaic, in the county of Passaic and State of New Jersey, have invented certain new and useful Improvements in Gas-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to characters of reference marked thereon, which form a part of this specification.

The present invention relates, generally, to improvements in explosive or internal combustion engines; and the invention has reference, more particularly, to a novel construction of rotary explosive or internal combustion engine.

The said invention has for its principal object to provide a simple, efficient and economical rotary explosive or internal combustion engine, in which a casing and a rotor-element are combined and constructed in such a novel manner as to provide a plurality of combustion or firing-chambers; and furthermore each chamber is provided with a gas admission valve and port, an exhaust port, and a gate member, together with means for properly operating the same to produce explosive impulses successively in each of said chambers whereby the rotor-element is rotated.

A further object of the said invention is to provide a novel construction of gate-member which is adapted to enter each annular firing-chamber of the engine and thus provide a head or base against which the explosion of the gas reacts to drive forward the piston-vanes connected with the rotor-element; and, at the same time, a novel mechanism is provided for raising said gate-members out of said chambers so that the said piston-vanes of said rotor-element may pass the same at the end of each rotation of said rotor-element.

A further object of the present invention is to provide novel means for operating the gas admission valves and the gate-members of each firing-chamber in proper time relation relative to each other and to the rotation of the rotor-element, whereby the successive explosive impulses are obtained and timed in the respective firing-chambers.

Other objects of this invention, not at this time more particularly enumerated will be clearly understood from the following detailed description of the present invention.

With the various objects of the present invention in view, the invention consists primarily, in the novel rotary combustion engine hereinafter set forth; and, the invention consists, furthermore, in the novel arrangements and combinations of the various devices and parts, as well as in the details of the construction of the said parts, all of which will be more fully described in the following specification, and then finally embodied in the claims which are appended to and which form an essential part of this specification.

The invention is clearly illustrated in the accompanying drawings, in which:—

Figure 1 is a side elevation of the novel rotary internal combustion engine made according to and embodying the principles of my present invention. Fig. 2 is a vertical longitudinal section of the same taken on line 2—2 in said Fig. 1, looking in the direction of the arrow *a;* Fig. 3 is a detail plan view of a portion of the top of the engine; Fig. 4 is a detail transverse section taken on line 4—4 in said Fig. 1, looking in the direction of the arrow *x*, and illustrating more particularly the internal construction of the gas admission valve, such as is employed in connection with each firing chamber. Fig. 5 is a plan elevation of the rotor-element of the engine removed from the casing, and illustrating more particularly the position of the piston-vanes connected therewith; and Fig. 6 is a transverse section of said rotor-element taken on line 6—6 in said Fig. 5.

Similar characters of reference are employed in all of the hereinabove described views to indicate corresponding parts.

Referring now to the said drawings the reference character 1 indicates the lower half of the main body of the casing, and 2 indicates the upper half of said main body of the casing. Connected with said lower half 1 of the main body of said casing, and preferably formed integrally therewith, are the standard members or supporting base 3 of the engine casing. The said casing-members 1 and 2 when assembled together provide a central circular opening, the inner surface of which is provided with an annular groove or channel 4 of semi-circular cross section.

The reference character 5 indicates a rotor-element which is adapted to be rotatably mounted within said central circular opening formed by the members 1 and 2 of said casing, the said rotor-element being of substantially the same width as the width of said casing. The outer circumferential surface of said rotor-element is provided with an annular channel or groove 6 of semi-circular cross section, the same being adapted to register with said channel or groove 4 of the casing members 1 and 2, and to coöperate therewith in forming a circular combustion chamber *a*, extending entirely around the rotor-element. In like manner formed in one of the side surfaces of said rotor-element is an annular groove or channel 7 of semi-circular cross section, and formed on the opposite side surface of said rotor-element is a similar annular groove or channel 8. The said rotor-element 5 is fixed upon a main shaft 9.

The reference character 10 indicates one side face-plate provided with a centrally disposed bearing opening 11 through which extends one end of the shaft 9. The said face-plate 10 is adapted to be registered against one side of said casing-members 1 and 2 and secured thereto so as to extend over one side of said rotor-element 5. Formed in the inner surface of said face plate 10 is an annular groove or channel 12 of semi-circular cross section which registers with said groove or channel 7 of said rotor-element to form in conjunction therewith a circular firing-chamber *b*. Said face-plate 10 is secured to the casing-members 1 and 2 by means of bolts 13, or in any other suitable manner. In like manner the reference character 14 indicates an opposite side face-plate having a centrally disposed bearing opening 15, through which the opposite end of said shaft 9 extends and is journaled. This face plate 14 is also provided in its inner side surface with an annular channel or groove 16 of semi-circular cross section and which registers with said annular channel or groove 8 of said rotor-element 5 so as to form in conjunction therewith a firing-chamber *c*. Said face-plate 14 is secured to the casing-members 1 and 2 by means of bolts 17, or in any other suitable manner. The said casing members 1 and 2, and the said face-plates 10 and 14 may be each provided with internal spaces or openings 18 within their walls, adapted to provide a water jacket extending partially around each firing-chamber for the purpose of cooling the same. The said face-plate 10 is provided with an annular groove 19 adapted to register with a similar annular groove 20 formed in one side of said rotor-element 5 and located adjacent to its outer marginal edges, the said registered grooves 19 and 20 providing a space in which is arranged a packing-ring 21. And in like manner the face plate 14 is also provided with an annular groove 22 which registers with a similar annular groove 23 formed in the opposite side of said rotor-element 5 adjacent to its outer marginal edges, said registered grooves 22 and 23 providing a space in which is arranged a packing-ring 24. The face-plates 10 and 14 are further provided with ball seats 25 the same extending around and adjacent to said shaft 9, and provided in each side of said rotor-element, so as to register with said ball seats 25, are ball seats 26. Arranged in said ball seats are anti-friction balls 27. Connected with said rotor-element 5 so as to extend outwardly from each of its respective grooves or channels 6, 7 and 8 are piston-vanes 28, 29 and 30 respectively. These piston-vanes extend transversely across each groove or channel of said rotor-element, and project outwardly therefrom, the same being of circular form so as to project into and extend transversely across each groove or channel 4, 12 and 16 of the respective casing members and face-plates. Said piston vanes are alined one with the other transversely of the rotor element 5. Extending outwardly from the upper member 2 of said casing is a housing-member 31, the same providing an internal slideway or guide 32 in which is arranged a movable gate-member 33. The outer end of said housing 31 is provided with a cover-plate 34 having a centrally disposed opening 35 through which projects outwardly the stem 36 of said gate-member 33. Arranged between said cover-plate 34 and said gate-member 33, so as to extend around the stem 36, is a spring-member 37, the pressure of which normally tends to move said gate-member into the firing-chamber *a*, so that the same extends across said firing-chamber *a* and forms a partition or base within said firing-chamber. Extending upwardly from said cover-plate 34 is an arm 38 having at its upper end a lateral extension 39 provided with an opening 40, in which the upper free end of the said stem 36 is guided; also secured upon the exterior end of said stem 36 is an outwardly projecting lateral extension or lift-arm 41.

Formed in connection with said housing

31 is a valve casing 42, the same being provided with an internal passage forming a valve port 43 in communication with said firing-chamber *a*. Connected with said valve casing 42 is an opening 44 in which is connected the end of a gas delivery pipe 45, which leads from a suitable carbureter or gas producing mechanism. Formed in the interior of said gas port 43, and in connection with said valve casing 42, is a valve seat 46 upon which is normally seated a valve-member 47 which normally closes the said gas port 43. Connected with said valve-member 47 is an outwardly extending valve-stem 48 which projects outwardly through an opening 49 in said cover-member 34 which also extends over and closes the outer end of said valve casing 42. Said valve-member 47 is normally retained in closing position or seated upon its seat 46 by means of a valve-spring 50. Secured upon the outer surface of said cover-plate 34 is a fulcrum frame 51, to the standards of which is pivoted a lever 52 which engages the free end of said valve-stem 48, said lever having an outwardly extending operating arm 53 which, when properly engaged, oscillates said lever 52 to depress said valve stem, thus removing the valve 47 from its seat 46 and opening the valve-port 43 to the passage of gas therethrough into the firing-chamber *a*. Said gas admission valve and its gas-port is located on one side of the gate-member 33, and located on the other side of said gate-member 33 is an exhaust-port 54 in communication with said firing-chamber *a*, and communicating with said exhaust-port 54 is an exhaust conduit 55. Located beyond said gas admission valve is a spark-plug 56, which screws into the casing so that its terminals are located in communication with said firing-chamber *a*.

The reference character 57 indicates a vertical spindle, the lower end of which is journaled in a bearing opening 58 formed in said face-plate 10, and a portion of which is further supported and journaled in a bearing-bracket 59 projecting from said housing 31. Also connected with said face-plate 10 is a bearing member 60 in which is rotatably mounted a horizontal spindle 61. Secured upon the inner end of said horizontal spindle 61 is a bevel-gear 62 which meshes with and drives a bevel-gear 63 connected with said vertical spindle 57. Secured upon the outer end of said horizontal spindle 61 is a sprocket-wheel 64 over which runs a driving-chain 65 which is driven by a sprocket-wheel 66 secured upon said main shaft 9. Through the above described transmission mechanism the said vertical spindle 57 is driven or rotated at the same speed as said main shaft 9. Fixed upon the upper end of said vertical spindle 57 and driven thereby is a cam-member 67, the same having a gate-operating cam-portion 68 and a valve-operating cam-portion 69. As said cam-member 67 is rotated synchronously with and at the same speed as said shaft 9 and rotor-element 5, it is so positioned that, as the rotor-element 5 moves around under the impulse of the explosive force of ignited gas upon the piston-vane 28, and has about completed a revolution, the cam-portion 68 operates upon the lift-arm 41 to raise the same whereby an upward movement of said stem 36 draws upwardly into said slideway 32 of the housing 31 and out of said firing-chamber *a* said gate-member 33, so that said piston-vane 28 may pass said gate-member. As soon as said piston-vane 28 has passed beneath said gate-member 33, the cam-portion 68 has moved out of engagement with said lift-arm 41 and the spring 37 again returns said gate-member to normal position within and extending transversely across said firing-chamber *a*. As the piston-vane 28 continues its forward movement, the cam-portion 69 engages with and operates said lever-arm 53 to carry said lever 52 into depressing contact with said valve-stem 48, thus opening said valve 47 to allow a new charge of gas to enter said firing-chamber *a* between said gate-member 33 and said piston-vane 28. As soon as the piston-vane 28 passes said spark-plug 56, the ignition system is timed to cause an ignition spark at the terminals of said spark-plug which explodes the new charge of gas, the cam-portion 69 having in the meantime passed out of contact with said lever-arm 53 so that the valve-spring 50 has closed the valve 47. Under the impulse of the exploded gas charge, the expansion of which acts against the gate-member 33, an impact or propelling impulse is exerted upon said piston-vane 28 which drives around the rotor-element 5 to make another revolution which is transmitted to the main-shaft 9, in the meantime the movement of the said piston-vane 28 propels the exhaust or spent gases of the previous explosion through the chamber *a* and out of the exhaust port 54, the gate-member 33 preventing this exhaust from reaching or mixing with the fresh and subsequently exploded gas-charge. In this manner the cycles of operation are performed in the cylinder or firing-chamber *a*.

Connected with said face-plate 10 is a housing containing a gate-member, and gas admission valve-mechanism together with operating means therefor of the same construction as already above described, so that the same reference characters will identify the respective detail parts of the same. Said face-plate also is provided with an exhaust-port and spark-plug also identified by similar reference characters. These devices operate in connection with the firing-chamber *b* and the piston-vane 29 of the rotor-ele-

ment 5 in the same manner as do their counter-parts described in connection with the firing-chamber *a* and piston-vane 28. A cam-member 70 having a gate-operating cam-portion 71 and a valve operating cam-portion 72 is fixed upon and driven by said main shaft 9 to operate the said gate-member and gas-admission valve of said firing-chamber *b*. In like manner connected with said face-plate 14 is a housing containing a gate-member, and gas admission valve-mechanism together with operating means therefor of the same construction as already above described, so that the same reference characters will apply to identify the same. Said face-plate 14 is also provided with an exhaust-port and spark-plug also identified by similar reference characters. These devices operate in connection with the firing-chamber *c* and piston-vane 30 of the rotor-element 5 in the same manner as do their counter-parts described in connection with the firing-chamber *a* and piston-vane 28. A cam-member 73 having a gate-operating cam-portion 74 and a valve-operating cam-portion 75 is fixed upon the opposite end of said main shaft 9 to operate said gate-member and gas-admission valve of said firing-chamber *c*.

The respective gate-members, gas-admission valves, exhaust ports and spark-plugs are spaced one-hundred and twenty degrees (120°) apart, whereas the cam-members 67, 70 and 73, as well as the piston-vanes 28, 29 and 30 are respectively in alinement with each other, or so related as to travel together, consequently the cam-members respectively act upon their respective gate-members and valve-admission valves only when they pass them, hence the explosive impulse of the gas charges in the respective firing-chambers, act upon the respective piston-vanes 28, 29 and 30 successively. It therefore follows that there occurs a power impulse upon said rotor-element at every one-third revolution of the same, or three such impulses per revolution as the successive explosions in each firing chamber *a*, *b* and *c* occur. In view of such arrangement and operation a practically efficient engine is the result, which combines in a rotary engine all the advantages of the multiple cylinder type of reciprocating engine in producing a plurality of power impulses per each revolution of the main or driving-shaft. Of course, it must be understood that I do not limit myself to the use of three firing-chambers, since more or less than that number may be provided, with gas controlling mechanism spaced and operated to produce successive explosions therein, in fact by increasing the width of the rotor-element and casing the number of firing-chambers may be increased indefinitely as desired, and a plurality of such firing-chambers at the circumference of said rotor-element, may make it desirable to eliminate the side firing-chambers.

It will therefore be apparent that while the above description and the accompanying drawings show a preferred type illustrative of the principle of construction I desire to retain, I do not wish to limit myself entirely to such form and arrangement thus shown and described. I am also aware that some changes may be made in the general arrangements and combinations of the various devices and parts of the novel rotary internal combustion engine, as well as in the details of the construction of the said parts, without departing from the scope of the present invention as set forth in the foregoing specification, and as defined in the claims which are appended hereto. Hence, I do not limit my present invention to the exact arrangements and combinations of the various devices and parts as described in said specification, nor do I confine myself to the exact details of the construction of the said parts as illustrated in the accompanying drawings.

I claim:—

1. A rotary internal combustion engine comprising a casing having a central opening, a rotor-element mounted to rotate in said opening, a main shaft on which said rotor-element is mounted, side face-plates connected with said casing and adapted to inclose said rotor-element therein, bearing portions connected with said face-plates in which said main shaft is journaled to project exteriorly of said casing, the inner side of said casing having an annular channel, the outer circumference of said rotor-element having an annular channel registering with said channel of said casing and forming in conjunction therewith a circular firing chamber, each face-plate being also provided in its inner surface with an annular channel, each side face of said rotor-element having an annular channel which respectively register with said channels of said face-plates and form in conjunction therewith additional circular firing-chambers, each firing-chamber having a gas inlet port and an exhaust port, a gate-member adapted to enter and extend across each firing-chamber to partition its interior between its gas inlet port and its exhaust port, a gas admission-valve connected with each gas-inlet port, housings formed in connection with said casing and its face-plates in which said gate-members are slidably mounted, each gate-member having a stem projecting exteriorly from its housing, spring-means for retaining each gate-member in normal position, valve-housings formed in connection with said casing and its face-plates in which said gas-admission valves are mounted, each valve-housing having an internal

seat-portion upon which said valves are normally seated, spring-means for retaining said valves on their seats, a valve-stem connected with each valve and projecting exteriorly from said valve-housing, cam-levers mounted to engage the end of each valve-stem to depress the same and open said valves, piston-vanes affixed transversely to said rotor-element and adapted to respectively ride through said firing-chambers, means for momentarily withdrawing each gate-member out of its firing-chamber to permit the passing of said piston-vanes by the same.

2. A rotary internal combustion engine comprising a casing having a central opening, a rotor-element mounted to rotate in said opening, a main shaft on which said rotor-element is mounted, side face-plates connected with said casing and adapted to inclose said rotor-element therein, bearing portions connected with said face-plates in which said main shaft is journaled to project exteriorly of said casing, the inner side of said casing having an annular channel, the outer circumference of said rotor-element having an annular channel registering with said channel of said casing and forming in conjunction therewith a circular firing-chamber, each face-plate being also provided in its inner surface with an annular channel, each side face of said rotor-element having an annular channel which respectively register with said channels of said face-plates and form in conjunction therewith additional circular firing-chambers, each firing-chamber having a gas inlet port and an exhaust port, a gate-member adapted to enter and extend across each firing-chamber to partition its interior between its gas inlet port and its exhaust port, a gas admission-valve connected with each gas-inlet port, housings formed in connection with said casing and its face-plates in which said gate-members are slidably mounted, each gate-member having a stem projecting exteriorly from its housing, spring-means for retaining each gate-member in normal position, valve-housings formed in connection with said casing and its face-plates in which said gas-admission valves are mounted, each valve-housing having an internal seat-portion upon which said valves are normally seated, spring means for retaining said valves on their seats, a valve-stem connected with each valve and projecting exteriorly from said valve-housing, cam-levers mounted to engage the end of each valve-stem to depress the same and open said valves, piston-vanes affixed transversely to said rotor-element and adapted to respectively ride through said firing-chambers, means for momentarily withdrawing each gate-member out of its firing-chamber to permit the passing of said piston-vanes by the same, comprising a lift-arm connected with said stems of each gate-member, and a cam-member having a gate-operating cam-portion for engaging and lifting each lift-arm, stem and gate-member, said cam-members being driven from said main shaft and at main shaft speed.

3. A rotary internal combustion engine comprising a casing having a central opening, a rotor-element mounted to rotate in said opening, a main shaft on which said rotor-element is mounted, side face-plates connected with said casing and adapted to inclose said rotor-element therein, bearing portions connected with said face-plates in which said main shaft is journaled to project exteriorly of said casing, the inner side of said casing having an annular channel, the outer circumference of said rotor-element having an annular channel registering with said channel of said casing and forming in conjunction therewith a circular firing chamber, each face-plate being also provided in its inner surface with an annular channel, each side face of said rotor-element having an annular channel which respectively register with said channels of said face-plates and form in conjunction therewith additional circular firing-chambers, each firing-chamber having a gas inlet port and an exhaust port, a gate-member adapted to enter and extend across each firing-chamber to partition its interior between its gas inlet port and its exhaust port, a gas admission-valve connected with each gas-inlet port, housings formed in connection with said casing and its face-plates in which said gate-members are slidably mounted, each gate-member having a stem projecting exteriorly from its housing, spring-means for retaining each gate-member in normal position, valve-housings formed in connection with said casing and its face-plates in which said gas-admission valves are mounted, each valve-housing having an internal seat-portion upon which said valves are normally seated, spring-means for retaining said valves or their seats, a valve-stem connected with each valve and projecting exteriorly from said valve-housing, cam-levers mounted to engage the end of each valve-stem to depress the same and open said valves, piston-vanes affixed transversely to said rotor-element and adapted to respectively ride through said firing-chambers, means for momentarily withdrawing each gate-member out of its firing-chamber to permit the passing of said piston-vanes by the same, comprising a lift-arm connected with said stems of each gate-member, a cam-member having a gate operating cam-portion for engaging and lifting each lift-arm, stem and gate-member, and each cam-member having also a valve operating cam-portion adapted to engage

and depress each cam-lever to open each gas admission valve, said gate-operating cam-portion and said valve operating cam-portion of each cam-member being so related to each other that the former operates in advance of the latter, said cam-members being driven from said main shaft and at main shaft speed.

In testimony that I claim the invention set forth above I have hereunto set my hand this 20th day of August, 1914.

FRANK GRUZECKI.

Witnesses:
GEORGE D. RICHARDS,
EVA E. DESCH.