M. MEHLE.

ROTARY ENGINE.

APPLICATION FILED SEPT. 2, 1914.

1,247,700.

Patented Nov. 27, 1917.

4 SHEETS—SHEET 1.

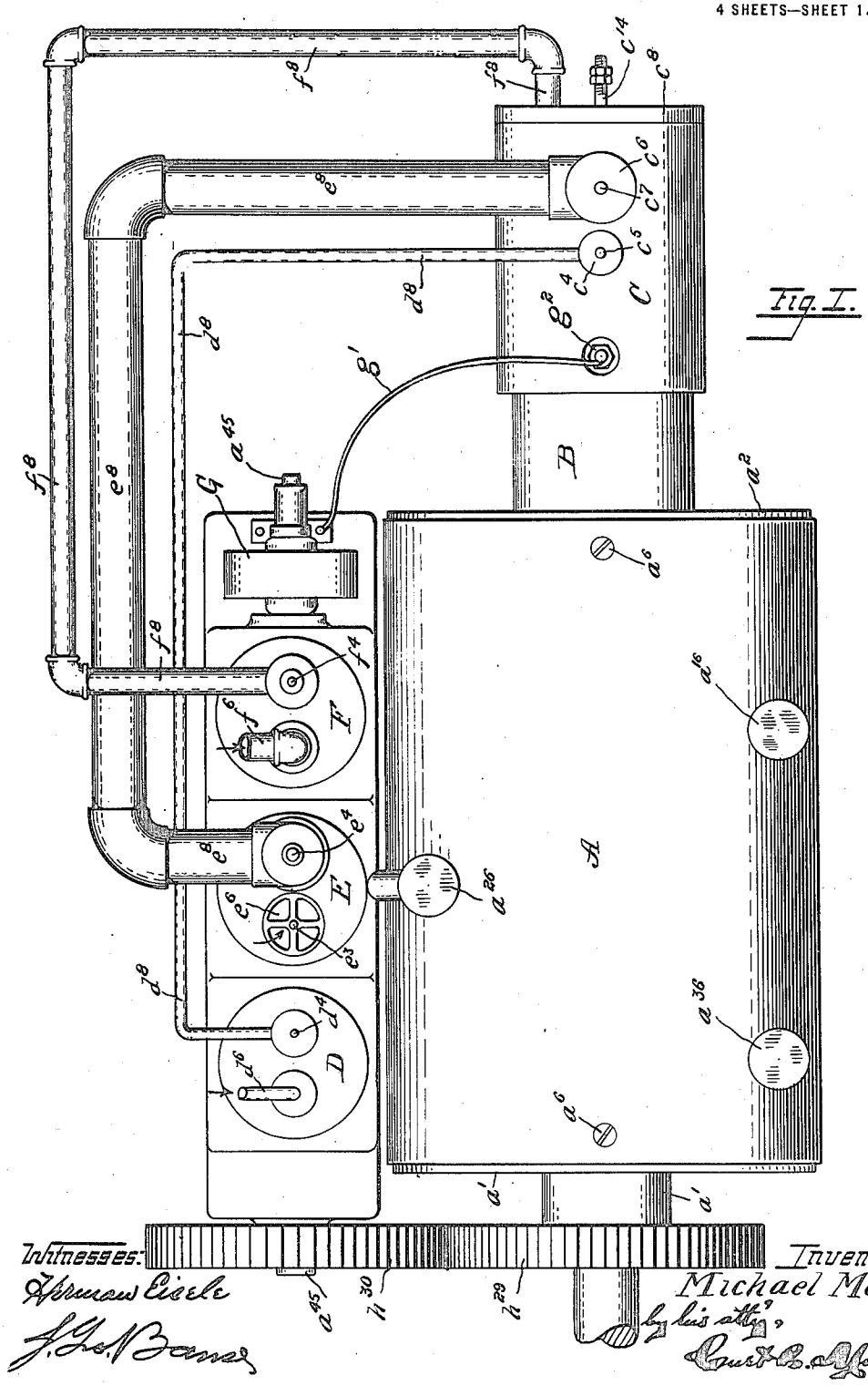


Fig. I.

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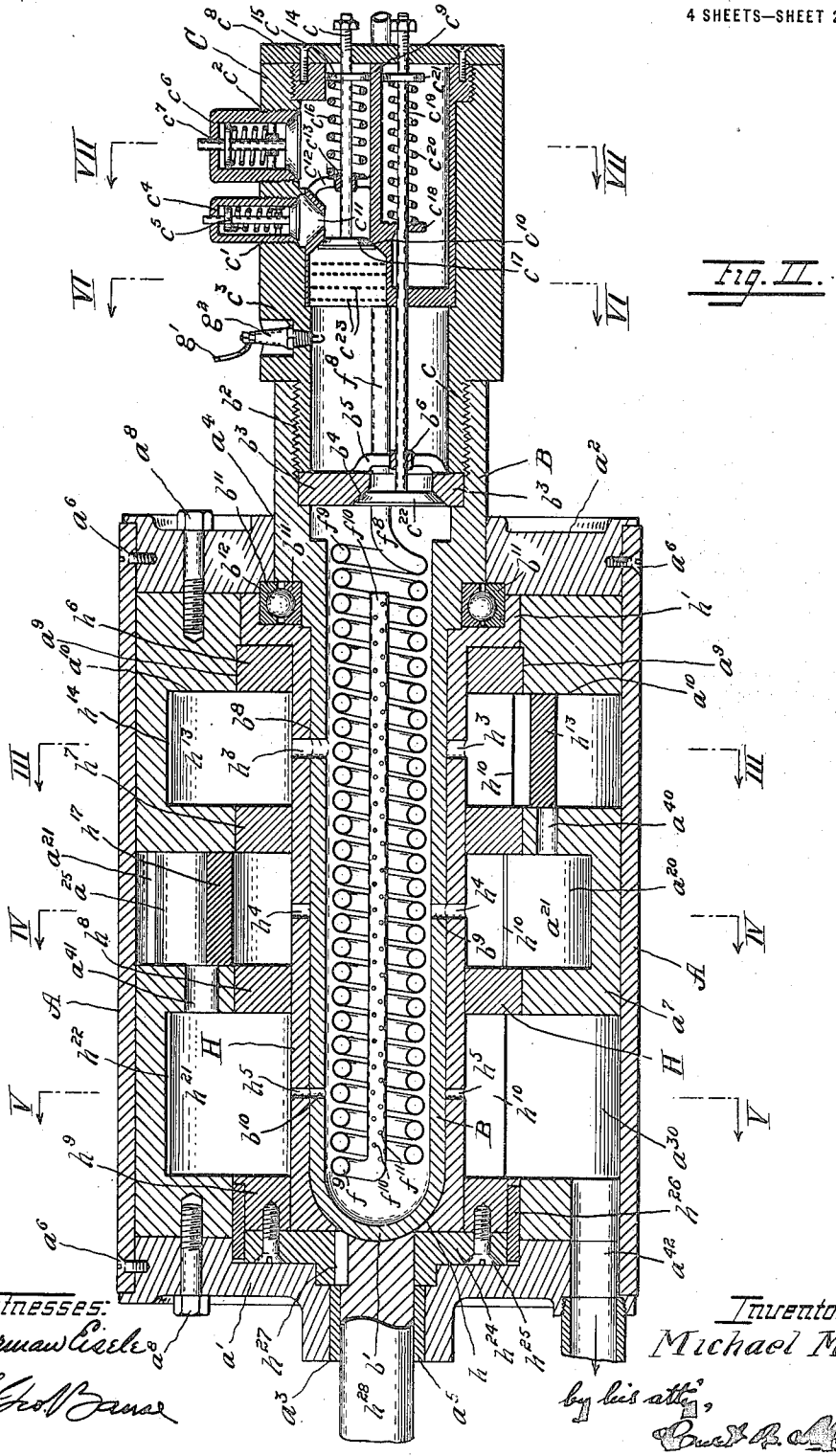


Fig. II.

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4 SHEETS—SHEET 3.

Fig. III.

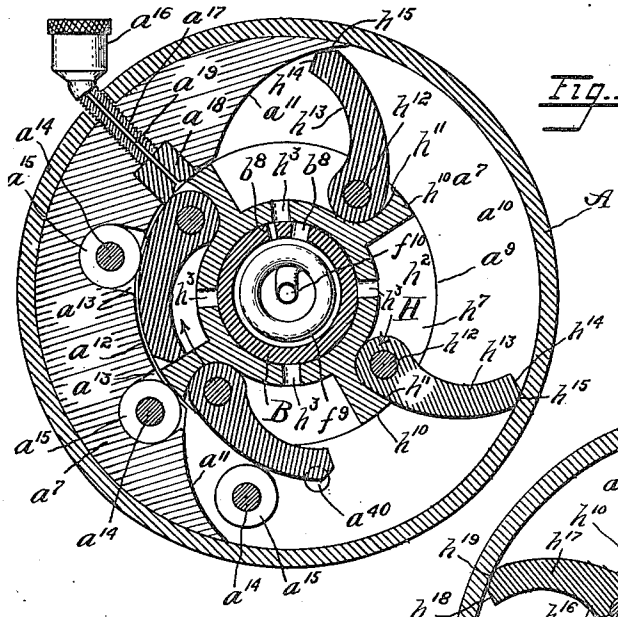


Fig. IV.

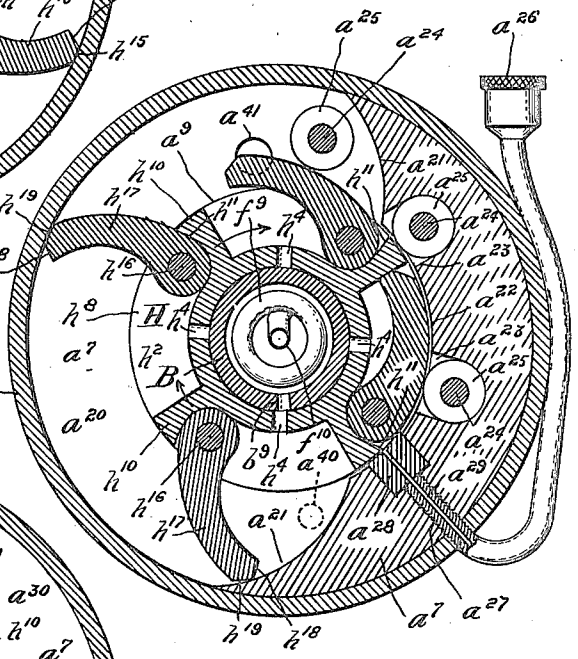
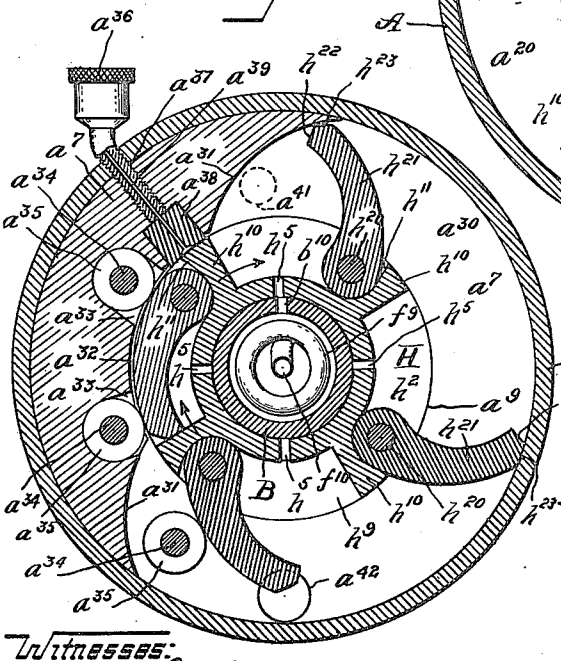


Fig. V.



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ROTARY ENGINE.

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1,247,700.

Patented Nov. 27, 1917.

4 SHEETS—SHEET 4.

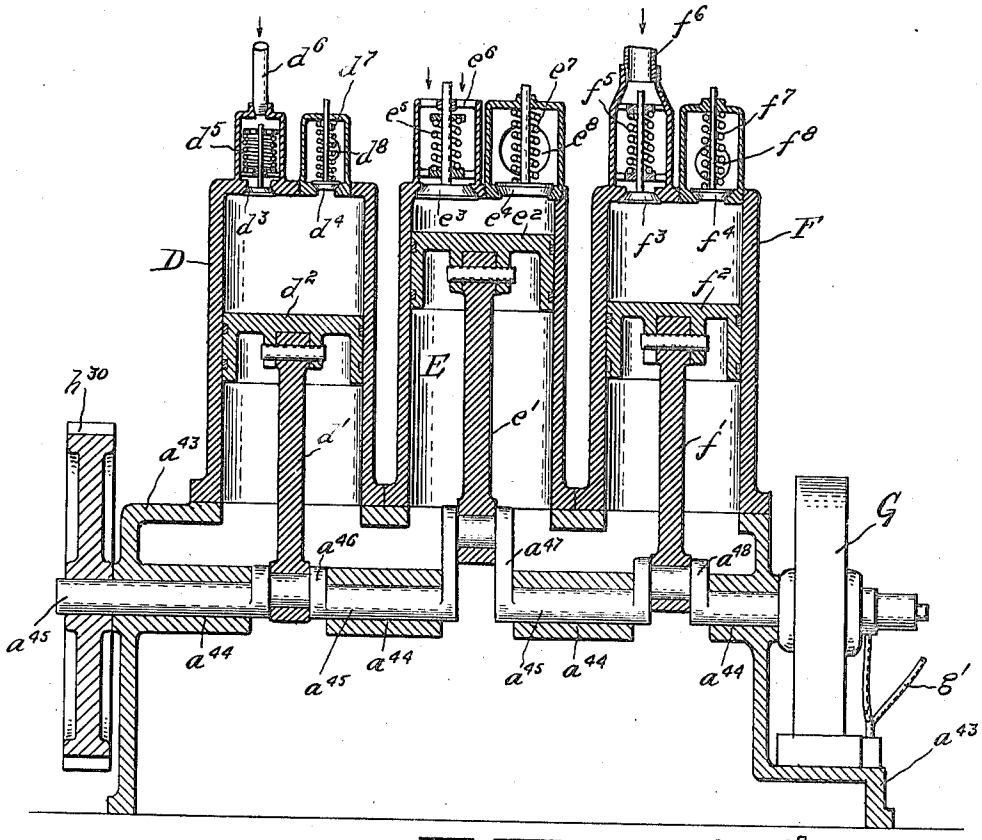


Fig. VIII.

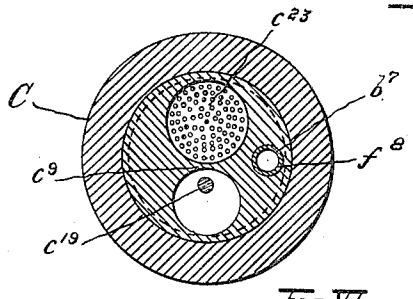


Fig. VI.

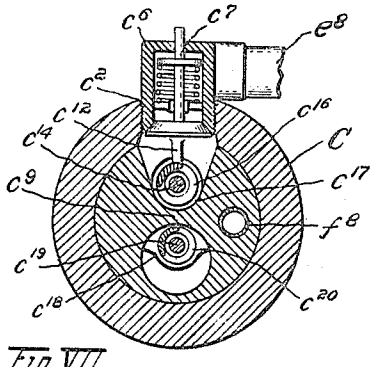


Fig. VII.

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Inventor:
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UNITED STATES PATENT OFFICE.

MICHAEL MEHLE, OF CLEVELAND, OHIO, ASSIGNOR OF NINE-FORTIETHS TO J. GEORGE BANSE AND NINE-FORTIETHS TO CHRISTIAN PETERSEN, BOTH OF CLEVELAND, OHIO.

ROTARY ENGINE.

1,247,700. Specification of Letters Patent. Patented Nov. 27, 1917.

Application filed September 2, 1914. Serial No. 859,776.

To all whom it may concern:

Be it known that I, MICHAEL MEHLE, a subject of the King of Hungary, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a new and useful Improvement in Rotary Engines, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

This invention relates to a prime mover of the rotary engine type and more particularly to such an engine capable of utilizing the energy of any elastic fluid as a sole motive power, or in combination with any other. The exemplification disclosed in the annexed drawings contemplates a simultaneous use of an explosive gas and steam.

The principal object of my construction is the provision of an engine suited to the development of high horse power in proportion to its size and weight. Other objects are to furnish a simple compact and durable mechanism, to approach a consummation in respect to economy and silence of operation, and to provide interior cooling means adapted to contribute work.

I believe it fitting to state that I am familiar with such inventions as are represented by U. S. Letters Patent numbered 653,788, 789,760 and 990,222 issued in 1900, 1905 and 1911 to J. F. Brady, H. Roeske and J. Brown respectively.

My inventive conception is associated with means which are hereinafter explained and variously combined in the claims. While the annexed drawing and particular description thereof, set forth in detail the preferred form embodying my invention, it should be understood that the means only exemplifies one of the many diversified mechanical forms with which the principle of my invention may be properly applied.

Figure I is a top plan of a turbine engine embodying my invention.

Fig. II is a vertical longitudinal section of the converting agents proper.

Fig. III is a section on line III III of Fig. II looking in the direction of the arrows.

Fig. IV is a section on line IV IV of Fig. II looking in the same direction.

Fig. V is a section on line V V of Fig. II likewise seen as directed by the arrows.

Fig. VI is a section on line VI VI of Fig. II looking in the same direction of flow of the expansive fluid.

Fig. VII is a sectional view on line VII—VII of Fig. II again looking to the left.

Fig. VIII is a vertical section of auxiliary pumping mechanism and an operatively connected magneto in elevation.

I will first describe the turbine embodying my invention, as merely exemplified by the four sheets of drawings, by identifying with distinct reference characters (capital letters) such parts as serve a primary function. A cylindrical casing A envelops a centrally positioned tubular valve member B, and fitted to the outer end of the latter is an induction chamber C which carries in operative relationship agents whereby the thermal energy of one working fluid may be converted into kinetic energy preparatory to discharge into the valve B, as disclosed in Fig. II, and in part in Figs. VI and VII. Suitably supported adjacent each other and laterally of the casing A, as clearly seen in Fig. I and separately in Fig. VIII, are three simultaneously operated pumps, D, E and F, which are adapted to supply in the most efficient proportion gas, air and water respectively. A magneto G adapted to energize the requisite igniter, is also seen in Figs. I and VIII to be operated simultaneously with the several pumps. The interior construction which Fig. II reveals, includes principally a rotor H which is interposed for revolution between the casing A and valve member B. Figs. III, IV and V are detail views of the rotor H in different positions.

Motive chamber.

The cylindrical casing A is closed at opposite ends by a pair of heads a' and a^2 having central openings a^3 and a^4 respectively. The opening a^3 is provided with a brass bushing a^5 whereby it may serve as a bearing. The casing is secured to the heads a' and a^2 by means of screws a^6. A hollow member a^7 of peculiar formation is supported adjacent the interior surface of the casing A, and the interior annular edges of the heads a' and a^2 by means of cap screws

a^8. The member a^7 is formed centrally with a bore a^9.

This bore at the end nearest the induction chamber C is formed with an arcuate partially annular recess a^{10} of given width, as seen in Fig. II. The recess a^{10}, best shown in Fig. III, extends outwardly as far as the interior surface of the casing A itself, or, in other words, the bore a^9 is enlarged through something like an arc of 180° to correspond in size with the bore of the casing A. The interior surface of the member a^7 which is opposite to the recess a^{10}, is formed outwardly beyond its bore with arcuate surfaces a^{11} of given curvature for reasons that will later become manifest. Intermediately of the surfaces a^{11} the bore a^9 is very slightly enlarged to form an arcuate recess a^{12}. The member a^7 is furthermore formed with a pair of additional recesses a^{13}, in extent the same as the width of the surfaces a^{11}, and each opening into the arcuate recesses a^{12} as clearly shown in Fig. III. A pair of pins a^{14} are pivotally mounted centrally across the recesses a^{13} and each carries a roller a^{15} adapted to very slightly intersect the arcuate recess a^{12} and thereby constitute a roller bearing for certain portions of the rotor H. A grease cup a^{16} is screw-threaded at a^{17} through the casing A and member a^7 and carries on its inner end in a suitable recess a member a^{18} provided with a wearing surface disposed inward with respect to the surface of the rollers a^{14}. Grease from the cup a^{16} is supplied to the wearing surface through a duct a^{19}. The purpose in providing such a wearing surface in conjunction with a supply of lubricant will be later explained.

The bore a^9 some distance beyond, with reference to the location of the induction chamber C, is formed with another arcuate partially annular recess a^{20} of about the same width as the recess a^{10}, though spaced therefrom so as to be in about the longitudinal center of the casing A, as again best seen in Fig. II. This recess a^{20}, constituting the second enlargement of the bore a^9 is, however, disposed diametrically opposite to the recess a^{10}, as best shown in Fig. IV. It extends outwardly as far as the interior surface of the casing A itself, or, in other words, the bore a^9 is enlarged through something like an arc of 180° to correspond in size with the bore of the casing A. The interior surface of the member a^7 which is opposite to the recess a^{20}, is formed outwardly beyond its bore with arcuate surfaces a^{21}, of given curvature for reasons that will later also become manifest. Intermediately of the surface a^{21} the bore a^9 is very slightly enlarged to form an arcuate recess a^{22}. The member a^7 is furthermore formed with a pair of additional recesses a^{23}, in extent the same as the width of the surfaces a^{21}, and each opening into arcuate recesses a^{22} as clearly shown in Fig. IV. A pair of pins a^{24} are pivotally mounted centrally across the recesses a^{23} and each carries a roller a^{25} adapted to very slightly intersect the arcuate recess a^{22} and thereby constitute a roller bearing for certain portions of the rotor H. A grease cup a^{26} is screw-threaded at a^{27} through the casing A and member a^7 and carries on its inner end in a suitable recess a member a^{28} provided with a wearing surface disposed inward with respect to the surface of the rollers a^{25}. Grease from the cup a^{26} is supplied to the wearing surface through a duct a^{29}. The object of inserting the member a^{28} having a wearing surface, will be stated farther on.

The bore a^9 a corresponding distance beyond the recess a^{20} is formed with still another arcuate partially annular recess a^{30} of somewhat greater width, as likewise most clearly represented in Fig. II. The recess a^{30}, in turn constituting the third enlargement of the bore a^9 is moreover disposed diametrically opposite from the recess a^{20} and, therefore, is located substantially as the recess a^{10} which is the initial enlargement of the bore a^9. The recess a^{30}, as best shown in Fig. V, extends outwardly as far as the interior surface of the casing A itself, or, in other words, the bore a^9 is enlarged through something like an arc of 180° to correspond in size with the bore of the casing A. The interior surface of the member a^7 which is opposite to the recess a^{30}, is formed outwardly beyond its bore with arcuate surfaces a^{31}, of given curvature for reasons that will later also become manifest. Intermediately of the surface a^{31} the bore a^9 is very slightly enlarged to form an arcuate surface a^{32}. The member a^7 is furthermore formed with a pair of additional recesses a^{33}, in extent the same as the width of the surfaces a^{31}, and each opening into arcuate recesses a^{32} as clearly shown in Fig. V. A pair of pins a^{34} are pivotally mounted centrally across the recesses a^{33} and each carries a roller a^{35} and thereby constitute a roller bearing for certain portions of the rotor H. A grease cup a^{36} is screw-threaded at a^{37} through the casing A and member a^7 and carries on its inner end in a suitable recess a member a^{38} provided with a wearing surface disposed inward with respect to the surface of the rollers a^{34}. Grease from the cup a^{36} is supplied to the wearing surface through a duct a^{39}. The reason for the presence of the member a^{38} with its wearing surface, will also appear later on.

The recesses a^{10}, a^{20}, and a^{30} are in fact expansion chambers for the motive fluid, and according to my invention, the recess a^{10} is merely an initial expansion chamber, whereas the recesses a^{20} and a^{30} are both initial and

progressive or secondary and tertiary expansion chambers respectively. This will be better understood when attention is directed first, to the passage a^{40} connecting the recess a^{10} with the recess a^{20}; and second, to the passage a^{41} connecting the recess a^{20} with the recess a^{30} on the opposite side of the motive compartment.

A single passage a^{42} leading from the recess a^{30} on the same side of the motive compartment as the passage a^{40}, exhausts through a registering opening in the head a'. In Fig. VIII the pump and magneto supporting structure a^{43} is shown in section to be provided with a plurality of spaced bearings having a common axis and each designated as a^{44}. A shaft a^{45} extends through the several bearings a^{44} and is provided intermediately thereof with cranks a^{46}, a^{47} and a^{48} of different throw according as it may be required to draw upon the supply of gas, air and water respectively.

Converting chambers.

A member B, which I term a tubular valve, projects snugly through the opening a^4 and has its interiorly positioned portion of reduced diameter and closed at the farther end b'. The outward extremity of the valve B is provided with interior screw-threads b^2, and inwardly adjacent the same with a partition b^3 having a valve seat b^4 on the inner side thereof. The partition b^3 furthermore has an opening b^7 indicated in Fig. VI for a purpose which will become apparent later. Mounted upon the outer side of the partition b^3 about the valve seat opening is a spider b^5 having a central opening b^6 intended to serve as a guide for the valve stem. The valve B is provided with ports b^8—b^8, b^9 and b^{10} disposed in the median planes of the recesses a^{10}, a^{20} and a^{30} respectively. Disposed between suitable annular seats formed in the inner corner of the head a^2 and opposed portion of the valve, are a pair of oppositely recessed rings b^{11} forming a race for the balls b^{12}.

The hollow chamber C has a constricted end C′ screw-threaded into the opening b^2. Above it is formed with three openings c', c^2 and c^3, the first two being occupied by inlet valves for gas and air respectively, while the opening c^3 is to be occupied by any suitable type of igniter. The inlet valve structure for the gas involves a chamber c^4 and a valve proper c^5 of the puppet type, which, since well known, may be properly designated by such a single reference character. The inlet valve for the air likewise involves a chamber c^6 and puppet-valve mechanism c^7. Removably seated in the rear end of the chamber C is a cap c^8. Inwardly this cap has a longitudinally extending partition member c^9 designed to form a valve seat c^{10} some distance from its inner end. The hollow casting c^8 is furthermore formed with a lateral opening c^{11} which is opposite the gas inlet and rearwardly of the valve c^{10}. A spider c^{12} is in turn carried rearwardly of the opening c^{11} and has a central opening c^{13} in line with the center of the valve seat c^{10}. A valve stem c^{14} extends through the end of the cap c^8 and carries a collar c^{15} adapted to inclose a spring c^{16} between itself and the spider c^{12}, whereby the valve head c^{17} on its inner end may be removed from its seat against the action of the spring c^{16}. The partition c^9 is provided just rearwardly of the valve seat c^{10} with a depending member c^{18} having an opening. A longer valve stem c^{19} also extends through the cap c^8 to inclose a spring c^{20} between the depending member c^{18} and a collar c^{21}. The inner end of the valve stem c^{19} passes through the opening b^6 and carries upon its extremity a valve head c^{22} adapted to fit the seat b^4, as clearly shown in Fig. II. Mounted in any suitable manner some distance forwardly of the valve head c^{17} are a plurality of mixing screens c^{23}.

The operation of the mechanism associated with the conversion chambers, is as follows: When gas and air are caused to be drawn through the puppet valves c^5 and c^7, they are thoroughly comingled by passage through the screens c^{23} and exploded by a spark from the igniter. The valve c^{22} is opened by the explosion whereby the gases are permitted to acquire velocity in the valve member B and find outlet through the ports b^8, b^9 and b^{10}.

Pumps.

The pump for the gas involves a cylinder D having interiorly a piston rod d', carrying a piston d^2, operatively connected with the crank a^{46}. Above, the cylinder has an inlet valve d^3 and an outlet valve d^4. Gas is drawn in against the action of the spring d^5 from a pipe d^6 leading to the source of supply; whereas the same is discharged against the action of the spring d^7 through the pipe d^8 which is directly connected with the chamber c^4 as shown in Fig. I.

The pump for the air involves a cylinder E having interiorly a piston rod e' carrying a piston e^2, operatively connected with the crank a^{47}. Above, the cylinder has an inlet valve e^3 and an outlet valve e^4. Air is drawn in against the action of the spring e^5 through an opening e^6; whereas the same is discharged against the action of the spring e^7 through the pipe e^8 which is directly connected with the chamber c^6 as shown in Fig. I.

The pump for the water involves a cylinder F having interiorly a piston rod f', carrying a piston f^2, operatively connected with the crank a^{48}. Above the cylinder has an inlet valve f^3 and an outlet valve f^4. Water

is drawn in against the action of the spring f^5 from a pipe f^6 leading to the source of supply; whereas the same is discharged against the action of the spring f^7 through the pipe f^8 which is directly connected through the cap c^8 and partition b^3 with a coil f^9 extending the entire length of the valve member B and then back through the center thereof as a straight length f^{10} having perforations f^{11}, as shown in Fig. II.

The magneto G is also operated directly by the shaft a^{45} and electrically connected by means of wiring g' with a spark plug g^2 seated in the opening c^3.

Rotor.

In connection with the description of the structure of the rotor H, attention is invited to Figs. II, III, IV and V. The rotor H snugly surrounds the valve B and is in turn snugly inclosed by the bore a^9 between which it is adapted to revolve. The end of the rotor H nearest the exhaust passage a^{42} is spherical surfaced at h to conform to the inner closed extremity b' of the valve B, as clearly shown in Fig. II. The opposite end of the rotor H is provided with an annular angular rimmed flange h' also best seen in Fig. II, which is adapted to envelop and roll upon the ball race b^{11}. Along its peripheral extent the rotor H is provided between each pair of planes that define the width or longitudinal extent of the recesses a^{10}, a^{20} and a^{30} respectively, and which planes are, therefore, transverse with re-respect to the imaginary axis; with four quadrantly spaced recesses h^2 which are in the nature of partial spherical sectors having convex bottoms as clearly shown in Figs. III, IV and V. Disposed in the median plane of the recess a^{10}, the rotor H is provided with four equally spaced ports h^3 communicating with the four proximate spaces h^2 respectively, and adapted to register successively with the differently sized ports b^8 b^8. Disposed in the median plane of the recess a^{20}, the rotor H is moreover provided with four somewhat smaller and equally spaced ports h^4 communicating with the four proximate spaces h^2 respectively, and adapted to register successively with the single port b^9. Disposed likewise in the median plane of the recess a^{30}, the rotor H is furthermore provided with four still smaller and equally spaced ports h^5 communicating with the four outlying spaces h^2 respectively, and adapted to register successively with the port b^{10}.

Forwardly, that is, on the side of the recess a^{10} nearest the chamber C the rotor H is shaped as a solid annular flange h^6 having a close mechanical fit with the bore a^9. A similar flange h^7 is interposed for movement between the recess a^{10} and the recess a^{20}, and as such separates the four spaces h^2 which are adapted to communicate with the recess a^{10}, from the four spaces h^2 which are adapted to communicate with the recess a^{20}. Likewise a third annular flange h^8 is intended for precise movement between the recesses a^{20} and a^{30} and it separates, in so far as concerns the bore a^9, the spaces h^2 which communicate with the recess a^{20} from those spaces h^2 which can communicate with the recess a^{30}. Finally, a rearwardly disposed annular flange h^9 slightly recessed on its outer rim, as well seen in Fig. II, closes the rear sides of the spaces h^2 which communicate with the recess a^{30}. Interposed between the four spaces h^2 which communicate with the recess a^{10}, between the four spaces h^2 communicating with the recess a^{20}, and also between the four spaces h^2 communicating with the recess a^{30}, and connecting as an integral structure the flanges h^6, h^7, h^8 and h^9, are twelve quadrantly spaced partitions h^{10}. The outer surfaces of the partitions h^{10} all offer a close mechanical fit with the wearing surface on the members a^{18}, a^{28} and a^{38} as the case may be. Those four partitions h^{10} which frictionally engage the member a^{18}, are concaved on their rear sides h^{11} with reference to the direction of movement indicated by the arrow in Fig. III. Mounted adjacent each of the concaved surfaces h^{11} is a pin h^{12} upon each of which a concavo-convex vane h^{13}, having its concaved surface inwardly disposed or rearwardly with reference to the direction of movement, is hinged. The free ends of the vanes h^{13} are fashioned with two angularly related surfaces h^{14} and h^{15}, the former of which is adapted to lie flush with the straight forward surface of the rearwardly adjacent partition h^{10} when the vane is shut; and the latter of which is adapted to present a close mechanical though not abutting fit with that portion of the interior surface of the casing A which envelops the recess a^{10}. Those four partitions h^{10} which frictionally engage the member a^{28} are concaved on their rear sides h^{11} with reference to the direction of movement indicated by the arrow in Fig. IV. Mounted adjacent each of the concave surfaces h^{11} is a pin h^{16} upon each of which a concavo-convex vane h^{17}, having its concave surface inwardly disposed or rearwardly with reference to the direction of movement, is hinged. The free ends of the vanes h^{17} are fashioned with two angularly related surfaces h^{18} and h^{19}, the former of which is adapted to lie flush with the straight forward surface of the rearwardly adjacent partition h^{10} when the vane is shut; and the latter of which is adapted to present a close mechanical though not abutting fit with that portion of the interior surface of the casing A which envelops the recess a^{20}. Those four partitions h^{10} which frictionally engage the member a^{38} are concaved on their rear sides

h^{11} with reference to the direction of movement indicated by the arrow in Fig. V. Mounted adjacent each of the concave surfaces h^{11} is a pin h^{20} upon each of which is hinged a concavo-convex vane h^{21}, having its concave surface inwardly or rearwardly with reference to the direction of movement. The free ends of the vanes h^{21} are fashioned with two angularly related surfaces h^{22} and h^{23}, the former of which is adapted to lie flush with the straight forward surface of the rearwardly adjacent partition h^{10} when the vane is shut; and the latter of which is adapted to present a close mechanical though not abutting fit with that portion of the interior surface of the casing A which envelops the recess a^{30}.

A collar h^{24} having its outer circumference flush with the recessed portion of the outer rim of the flange h^{9}, is secured to the latter by means of screws h^{25}. Such binding together is furthermore effected through the agency of a ring h^{26} which is shrunk upon both the flange h^{9} and collar h^{24}, as shown in Fig. II; and further by the fact that the collar h^{24}, is held in place endwise by the head a'. Keyed at h^{27} to the collar h^{24} is a shaft h^{28} having a precise bearing in the brass bushing a^{3}. In Fig. I a gear h^{29} is furthermore shown supported upon the shaft h^{28} and this gear meshes with a gear h^{30} on the shaft a^{45}. In this manner, as is apparent, any rotation on the part of the shaft h^{28} is directly transmitted to the shaft a^{45}, whereby the pumps D, E and F, as well as the magneto G, are made to functionate.

Operation.

In describing the operation of my inventive turbine, we will consider it permissible to have it assumed that the three pumps D, E, F, and the magneto G are arranged and adjusted to satisfactorily supply fuel, air, water and electric sparks. As earlier intimated, the different throws effected by the different cranks a^{46}, a^{47} and a^{48} may be varied at will until the best conjunctive working regulation shall have been attained. Looking, therefore, next to the chamber C wherein an explosive mixture of the fuel and air is to be carbureted and thereafter ignited such that the pressure generated by the gases of combustion will cause the resistance of the spring c^{20} to be overcome and permit such gases to charge through the valve c^{22} and by virtue of the velocity thereby acquired, rush lengthwise of the valve member B and find exit preparatory to expansion successively through the ports b^{8}, b^{9} and b^{10}; the transformation into rotatory motion of all such explosive energy in the form of expansive velocity will be substantially as follows:

The rapid egress of the gases will first be followed through the ports b^{8}, seen clearest in Fig. III. It will be noticed that one of these ports b^{8}, and particularly that one which is first caused, with consideration of the direction of movement of the rotor H indicated by the arrow in Fig. III, to be brought into registration with the moving port h^{3}, is smaller than the other and is intended to permit just sufficient expansive force to bring against the concave surface of the particular vane h^{13} to throw such vane outwardly against the concave shoulder h^{11} immediately after the tip of such vane has passed the corner formed by the intersection of the arcuate recess a^{12} and proximate arcuate surface a^{11}. This result is represented just the moment before its conclusion by the uppermost of the vanes h^{13} in Fig. III. About simultaneously thereafter kinetic energy is expended in sufficient quantity to contribute the first quota of work, this being accomplished by an expansive flow through the larger of the ports b^{8} and the port h^{3}, whereby the uppermost of the vanes h^{13}, as illustrated in Fig. III, is given an initial propulsion in the direction indicated by the arrow. The wearing surface on the member a^{18} is at that moment in firm engagement with that particular partition h^{10} which is immediately to follow. As will be understood by those sufficiently skilled in the art, the expansive velocity will therefore be compelled to follow the direction of independent movement initiated by the vane h^{13}.

In the meantime additional energy has been furnished toward the movement of the rotor in the prescribed direction, by the flow of the exploded charge through the ports b^{9} and h^{4} in the second stage illustrated in Fig. IV; and also by a corresponding reaction after passage through the ports b^{10} and h^{5} illustrated in Fig. V. The pairs of ports b^{9}—h^{4} and b^{10}—h^{5} are progressively smaller in order to minimize waste attendant upon a non-utilization of a step by step expansion, as will be presently explained. It is for a similar reason that the volume encompassed by the recess a^{30} which is nearest the exhaust passage a^{42}, exceeds the volume encompassed by the recesses a^{20} and a^{20}. In the meanwhile, moreover such portions of any given charge which has been carried between two adjacent vanes h^{13} and which still has an appreciable residual energy, is presently allowed to rush through the passage a^{40} to expend a certain added measure of work in the recess a^{20} and finally to expend still further from its residual energy after flowing through the passage a^{41} into the recess a^{30}. It will be perceived also that the residual energy belonging to gases that are carried around between any two of the vanes h^{17}, either after coming through the passage a^{40} from the first stage or directly through the ports b^{9} and

b^4, will be permitted to have further useful expansion through the passage a^{41}.

It will be noted furthermore that during the continued rotatory movement of the rotor H, the four vanes in each of the three stages are automatically closed and gradually, first partially by the rollers a^{15}, a^{25} and a^{35}, and thereafter completely by the pairs of anti-friction rollers a^{15}, a^{25} and a^{35} respectively, which are disposed in substantially the same arc as the wearing surfaces on the members a^{18}, a^{28} and a^{38}. This arrangement allows of facility and silence in operation. However, comparative noiselessness is furthermore conserved by having the vanes abut the shoulders h^{11} rather than the interior surface of the casing A. It will be understood that the movement of the rotor H is synchronized relative to the functionating of the pumps and magneto, and such that the rotor H in the first two stages illustrated in Figs. III and IV, is 60% open and 40% closed; while in the third stage illustrated in Fig. V, the rotor is 75% open and 25% closed.

Reference has hereafter only to be made to the manner in which steam can simultaneously perform work as an expansive fluid and at the same time make it possible to provide the factor of a highly useful cooling agency. Water on being pumped through the pipe f^6 becomes highly heated in the coil f^7, which is disposed in the direct path of the flow of the exploded gases, and emerges as high pressure steam through the perforations f^9, to follow thereafter in distinct portions the identical course and perform work of an identical character as that explained in connection with the conversion of the explosive mixture. It should be noted that the cooling agency of the coil f^7 is most effective at the hottest portion of the valve B and that therefore the cooling effect has the added value of approximating uniformity therealong.

I claim:—

1. A rotary engine comprising a casing, a rotor movable therein and provided with peripheral apertures of given size, a hollow cylindrical valve inclosing the axis of said rotor for closing the inner sides of said apertures and provided with closely adjacent ports of different size adapted successively to register with each of said apertures, a plurality of vanes adapted to close the other sides of each of said apertures and means for impinging a motive fluid lengthwise of said valve through said apertures and each of said ports and against said vanes during every revolution of the latter.

2. A rotary engine comprising a casing, a valve member projecting centrally into said casing and having one end closed, hollow rotors interposed between said casing and member and revoluble about the latter, said rotors having apertures affording communication to said valve member through the peripheries thereof respectively, the size of the apertures of one of said rotors being different from those of the other, a number of vanes movably mounted adjacent each set of said apertures respectively, an explosion chamber at the other end of said valve member and means for successively propelling a motive fluid from said chamber into said valve member and through different pairs of variously sized of said apertures.

3. A rotary engine comprising a cylindrical casing, a cylindrical valve member centrally disposed therein and provided with peripheral ports, an annular partition between said casing and valve member, rotors surrounding and revoluble upon said member on opposite sides of said partition, and grease ducts leading thereto, both wearing surfaces removably carried by said casing in the path of said rotors respectively, said rotors having a plurality of peripheral apertures adapted to register each with a given one of said valve ports, said partition having a passage, vanes pivotally connected outwardly adjacent said apertures, and means for directing a motive fluid successively into one end of said valve member through said valve ports, apertures and passage.

4. A rotary engine comprising a casing, a long cylindrical valve concentrically supported therein, a plurality of hollow rotors movable between said casing and valve and having passages in communication therewith and with each other, vanes pivoted about said rotors, means for impinging a motive fluid through said valve and against said vanes, and a water coil disposed lengthwise within said valve and in the path of discharge of said fluid toward all of said passages, said coil having perforations for the purpose specified.

5. A rotary engine comprising a casing, a hollow rotor movable therein and provided with vanes, an explosion chamber, mechanism whereby the thermal energy of the motive fluid is converted into kinetic energy within said chamber, a hollow valve member projecting through and communicating with said rotor and adapted to direct such energy in the form of velocity outwardly against said vanes, and means located in the path of movement of the gases of combustion from said chamber for generating an auxiliary motive fluid interiorly of said valve member and adapted to discharge the same directly into said rotor.

6. A rotary engine comprising a casing, a hollow valve member rotatably mounted therein and provided with an aperture, a rotor revoluble between said casing and member and formed with peripheral ports adapted to register with said aperture, means for supplying a motive fluid to said

valve member, and means including a water coil having a perforate portion and dependent upon the heat of said first mentioned means for simultaneously generating a distinct motive fluid within said hollow valve member whereby to expel the same directly through said ports co-mingled with said first mentioned motive fluid.

Signed by me, this 28th day of August, 1914.

MICHAEL MEHLE.

Attested by—
CHRISTIAN PETERSEN,
MARY COLEMAN,
WILLIAM C. BRACKEN.