E. S. & F. F. CAMERON.

ROTARY ENGINE.

APPLICATION FILED APR. 14, 1908.

915,828.

Patented Mar. 23, 1909.

3 SHEETS—SHEET 1.

FIG. 1.

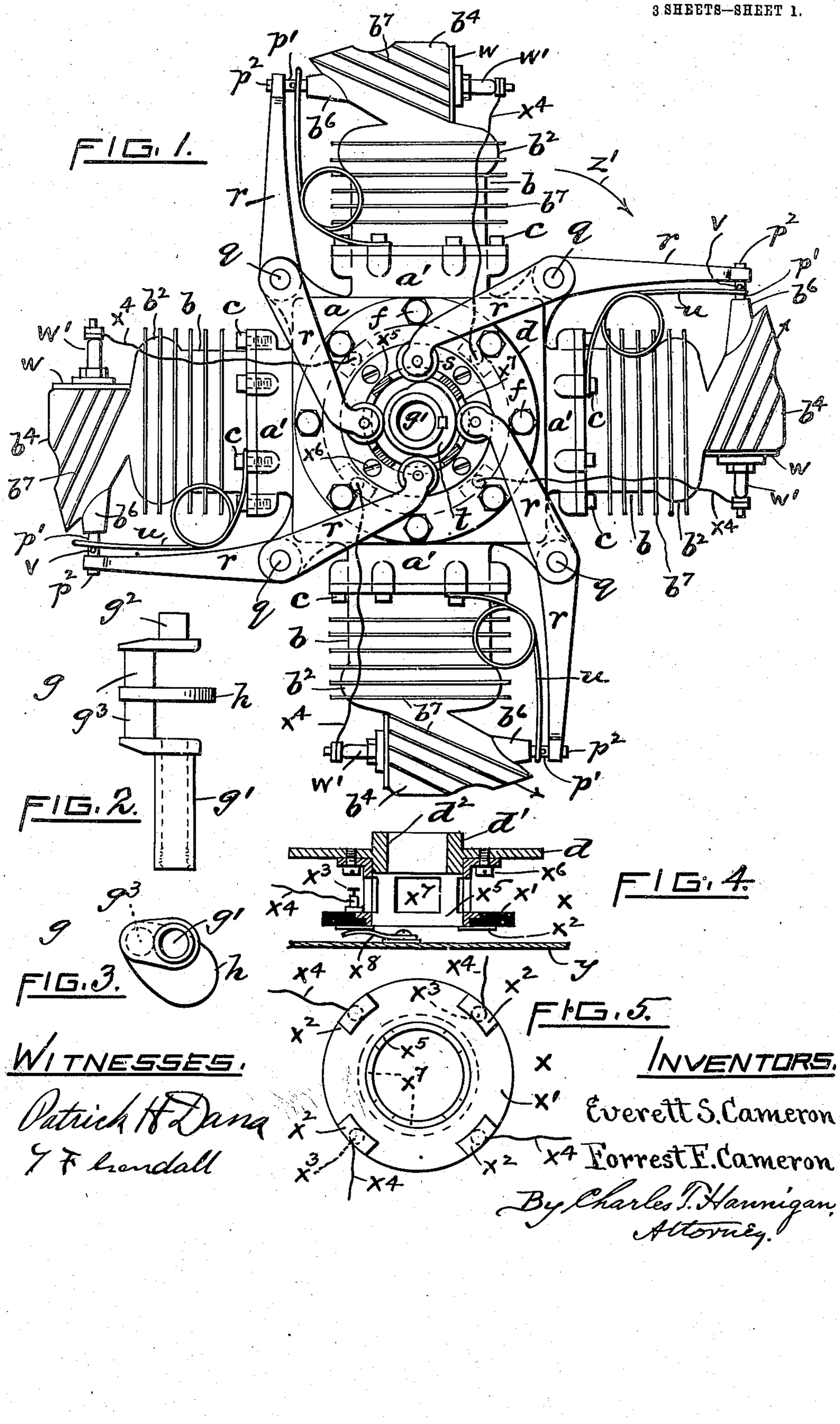

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

WITNESSES.

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3 SHEETS—SHEET 2.

FIG. 6.

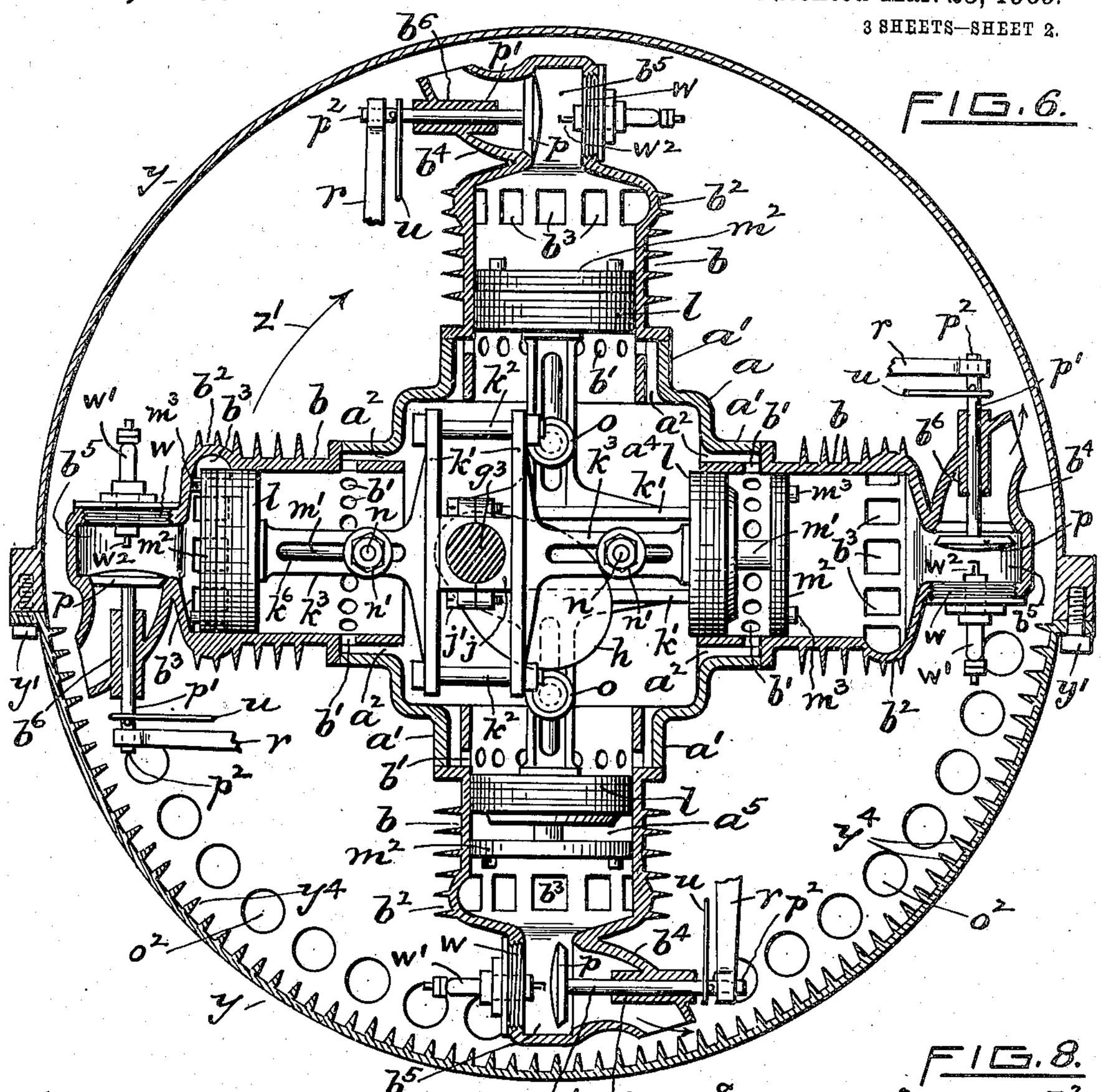


FIG. 7.

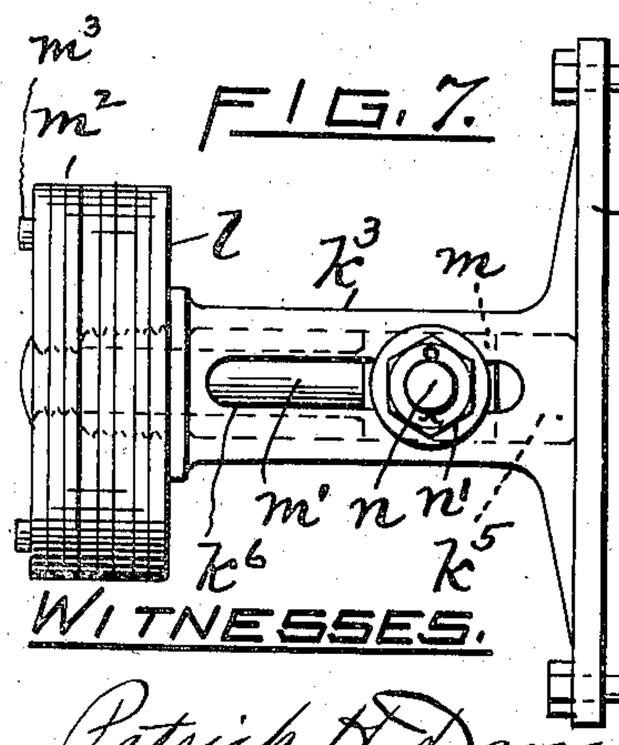
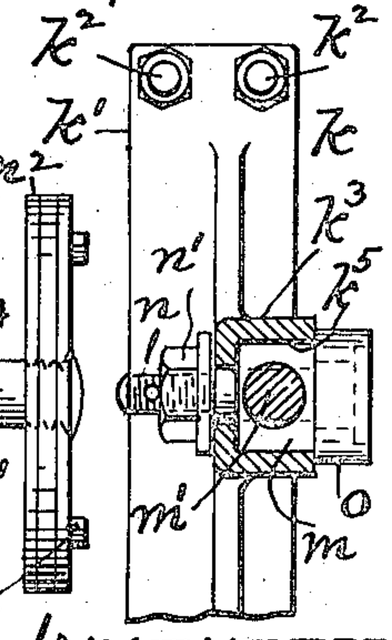


FIG. 8.



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3 SHEETS—SHEET 3.

FIG. 9.

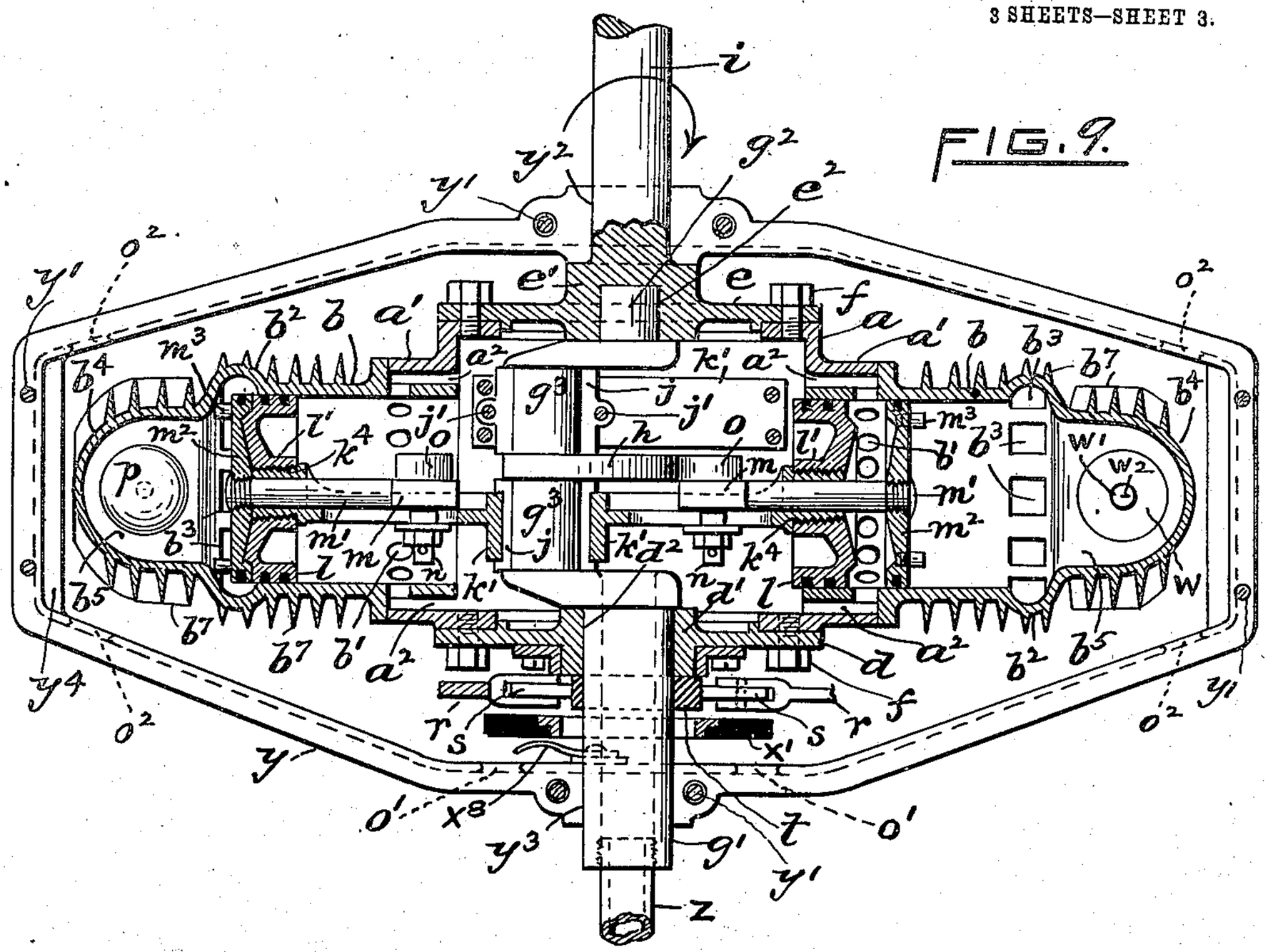
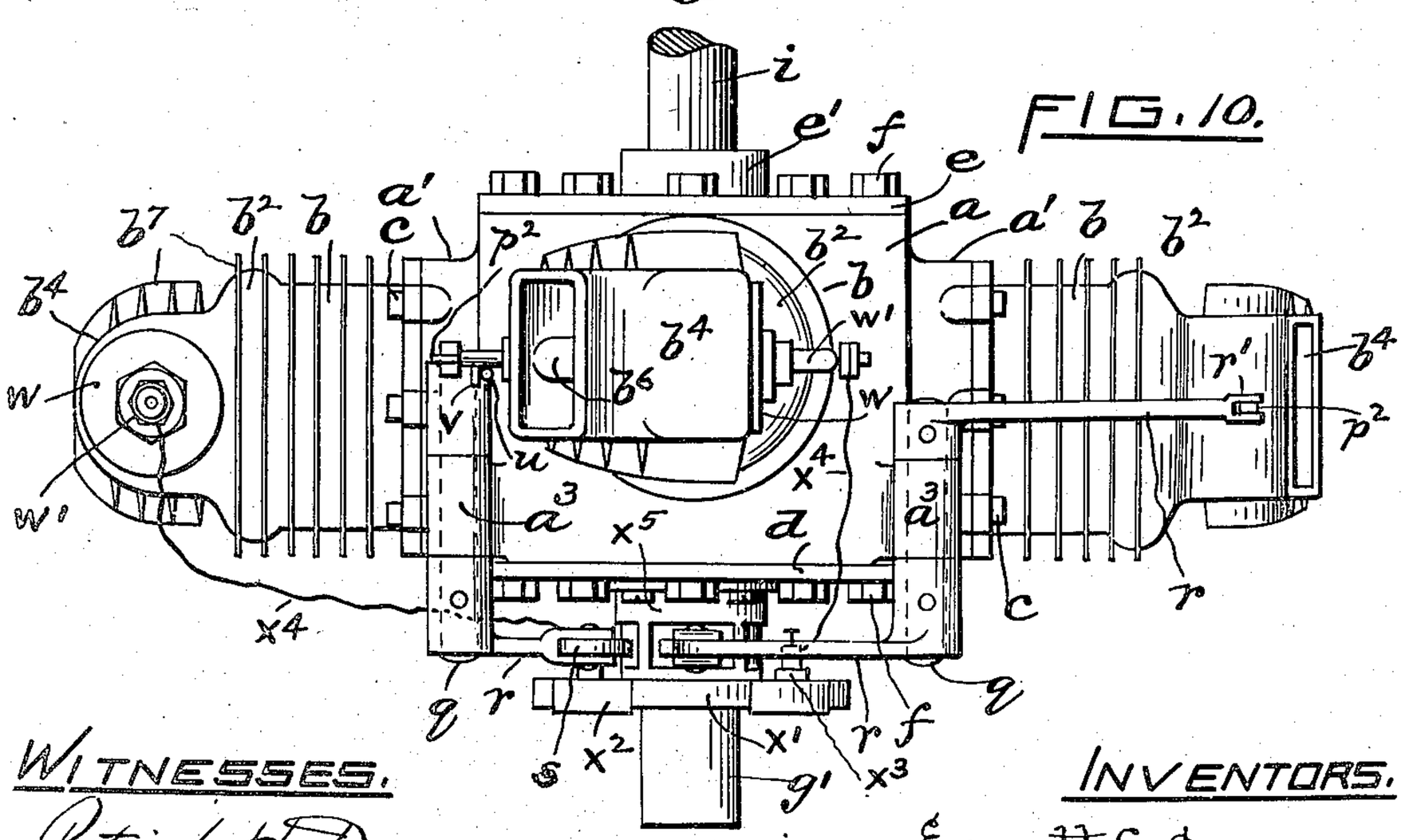


FIG. 10.



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UNITED STATES PATENT OFFICE.

EVERETT S. CAMERON AND FORREST F. CAMERON, OF BROCKTON, MASSACHUSETTS.

ROTARY ENGINE.

No. 915,828. Specification of Letters Patent. Patented March 28, 1909.

Application filed April 14, 1908. Serial No. 427,071.

To all whom it may concern:

Be it known that we, EVERETT S. CAMERON and FORREST F. CAMERON, citizens of the United States, residing at the city of Brockton, in the county of Plymouth, State of Massachusetts, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

Our invention relates to certain improvements in that class of rotary engines in which the motive power is obtained by the expansive action of ignited gases; and the object of our invention is to produce an improved structure by which the expansive force or impulse is given at each quarter revolution of the engine.

Further objects of the invention are to provide a one-throw engine-crank to act as an intake for the explosive mixture; means mounted on said crank whereby the burned gas is expelled during the time a new charge of explosive mixture is drawn in, and means whereby the exhaust gas may be used to increase the motive power of the engine.

The invention consists of the novel construction, arrangement, and combination of parts, as hereinafter described and specifically set forth in the claims.

In the accompanying drawings, Figure 1 represents a side elevation of our improved rotary engine with its casing removed. Fig. 2 is a top plan view of the engine-crank. Fig. 3 is an end view of the latter. Fig. 4 is a horizontal sectional view of an ordinary circuit breaker for receiving the electric current for the spark plug wire connections. Fig. 5 is a front elevation of the circuit breaker. Fig. 6 is a central sectional view of the engine, as mounted in its casing. Fig. 7 is a side elevation of one of the double piston structures for the engine-crank. Fig. 8 is a sectional view taken in line 8.—8. of Fig. 7. Fig. 9 is a plan view, partly in section and partly in elevation, of the engine and casing, and Fig. 10 is a plan view of the engine with its casing removed.

Like reference characters indicate like parts throughout the views of the drawings.

Our improved rotary engine has a centrally arranged crank case *a*, which is square-shaped in cross-section, and from each of four sides of this case projects an integral annular flange a^1, upon which is secured the open-end portion of a gas-cylinder *b*, by bolts *c*, *c*. The two opposite sides of the crank case *a* are closed by bonnets *d* and *e*, which are secured to said case by bolts *f*, *f*. These bonnets *d* and *e* have central integral hubs d^1 and e^1 arranged opposite each other and each hub provided with a journal bearing to receive the shaft portions of a stationary forked-crank. This crank member—designated by reference letter *g* in Figs. 2 and 3, has a long shaft portion g^1 of tubular form to fit the journal bearing d^2 of the bonnet-hub d^1, while the opposite shaft portion, of said member *g*, is made solid, as at g^2, to fit the journal bearing e^2 of the bonnet-hub e^1. The crank-pin g^3, of the member *g*, is adapted to impart a reciprocating movement to two double piston structures for the four gas-cylinders *b*, and centrally secured on said crank-pin g^3 is a cam *h* adapted to impart a movement, in one direction, to a valve-disk carried by each piston of each gas-cylinder. The engine or power-shaft *i* has one end made fast to the hub e^1 of the bonnet *e*, and said shaft *i* has its axial center in alinement with the axial centers of the shafts g^1 and g^2 of the crank member *g*.

Carried by the crank-pin g^3, at each side of the cam *h*, are two double piston structures each of which are made alike and as follows: A square-shaped block *j* is bored to fit loose upon the crank-pin g^3, and said block is divided in halves and secured together by screws j^1. This block *j* is free to slide between a yoke *k* (see Figs. 7 and 8) in the form of two guide-plates k^1, k^1 whose end portions are secured together by bolts k^2, k^2. Centrally of each guide-plate k^1 is an integral extension k^3 having a screw-threaded shank portion k^4 to engage thereby in the threaded hubs l^1, l^1 of cylinder-pistons *l*, *l*. As the engine revolves each pair of pistons *l*, *l* of a yoke structure, as described, is caused to move in their respective gas cylinders *b*, *b* at a right angle to the pair of pistons of the next adjacent yoke structure. A channel is formed in each yoke extension k^3 to act as a guideway, as k^5 in Fig. 8, to receive the flattened head *m* of a movable stem m^1 which passes through the shank portion k^4 of each yoke extension k^3, and on the outer end of each stem m^1 is secured a supplemental piston m^2, in the manner shown in Figs. 7 and 8. The slidable head *m* of each valve-stem m^1 is drilled therethrough to receive a bolt *n*, on which is loosely mounted a roll *o*, adapted to come in contact with the face of the crank-cam *h*. Each bolt *n* passes freely through

the slotted opening k^6 formed longitudinally in each yoke-extension k^1, and the projecting portion of said bolt is screw-threaded to receive a nut n^1 for securing the roll o in place, in the manner shown in Fig. 8.

Each gas cylinder b is provided with a row of admission ports b^1, b^1 arranged near the outer face of each annular flange a^1 of the crank case a, and the outer portion of each cylinder is surrounded by an enlarged integral head b^2 which is also provided with a row of transfer ports b^3, b^3. The head b^2 of each cylinder terminates with an integral exhaust nozzle b^4 which is provided with a narrow combustion chamber b^5 located centrally of each cylinder. An exhaust-valve p is movable transversely of each cylinder b, in the nozzle thereof, and each exhaust-valve is secured on a stem p^1 which passes through an integral hub b^6 of each nozzle b^4. A clearance a^2 is maintained between each annular flange a^1 of the crank case a and inner portion of each cylinder b, so as to provide an intake passage for the gas to the admission ports b^1.

Rods q, q are loosely mounted in integral hubs a^3, a^3 of the crank case a, and on the ends of each rod are secured a pair of rock-levers r, r, one free end of which is slotted, as at r^1, to fit upon the flattened end portion p^2 of each exhaust-valve-stem p^1, while the other free end of said levers is bifurcated to receive a roller s for contacting upon the face of a small cam t secured on the tubular portion of the stationary crank-shaft g.

A spring wire u is employed to close each exhaust-valve p after each explosion of gas, said wire having one end secured by a bolt c of each cylinder, from whence the wire bends in a loop form and has its opposite end resting beneath a pin v secured in each exhaust-valve-stem p^1, in the manner shown in Fig. 1.

Each nozzle b^4 is provided with a screw-threaded plug w to permit ready removal of an exhaust-valve when the seat of same requires to be reground. A firing spark plug w^1 is mounted in the plug w of each nozzle, and each spark plug has its ignition points w^2 within the combustion chamber b^5, as shown.

A circuit breaker x (see Figs. 4 and 5) is made fast to the bonnet d of the engine crank case a, and the construction of the circuit breaker is as follows: A disk x^1 of non-conductor material has four metallic sections x^2, x^2 inlaid therein, and each section is provided with a binding-post x^3 for securing each electric wire connection x^4 to a spark plug w^1. The disk x^1 is made fast on a metallic drum x^5 which surrounds the small fixed cam t that operates the exhaust-valves, and said drum is secured by screws x^6 to the bonnet d of the engine crank case a. Four openings x^7 are provided in the drum x^5 to permit movement of the respective rollers s, s upon the cam t. As the circuit breaker, as described, revolves with the engine, its contact sections x^2 come in contact with a fixed metallic blade x^8 secured in the side wall of the engine-casing, and this blade receives the electric current from the usual spark coil. (Not shown).

This improved engine is inclosed in a circular casing y, which is made in halves and secured together by bolts y^1, y^1, and said casing is provided with centrally arranged journal bearings, as at y^2, y^3 in Fig. 9, to respectively receive the engine-shaft i and tubular portion of engine-crank g. This engine casing y, which is designed to be held in a stationary condition, has its lower half provided with blades y^4 extending between its side walls, as shown in Figs. 6 and 9.

An intake-pipe z connects with the end of the tubular portion g^1 of the engine-crank, and said pipe leads from a carbureter (not shown) to supply the crank case a with the explosive mixture, which passes from said carbureter, through said pipe and through said crank.

The gas-cylinders b and their nozzles b^4 are each provided with the usual thin flanges b^7 to increase the heat radiating surface of said cylinders and said nozzles and effect a more rapid cooling of the same.

Having described the structural parts of our improvement, the operation of the engine is as follows: The engine-crank, which is designated as a whole by reference letter g in Figs. 2 and 3, is mounted in a fixed position in the bearing y^3 of the stationary engine-casing y. Referring to Fig. 6, the engine revolves in the direction indicated by the arrow z^1, and said figure illustrates the front double piston-structure in a horizontal position and as carried to its extreme left throw, by means of the crank g, while at the same time the rear double piston-structure is brought to a vertical position and held midway its stroke by said crank. As the engine revolves to carry the front double piston-structure to a horizontal position, as shown, the charge of explosive mixture will be compressed within the left hand combustion-chamber b^5, after which the fixed contact blade x^8 will come in contact with a metallic section x^2 of the circuit breaker, thus making an electric current and cause the charge of explosive mixture to explode at this point of the engine. Prior to explosion of charge the right hand piston l, of the front double piston-structure, will be at the end of its down stroke or next to the gas-chamber a^4 of the crank case a, and as the engine continues to revolve the right hand supplemental piston m^2 will be forced beyond the admission ports b^1, by reason of the roll o of said latter piston coming in contact with the face of the fixed cam h of the engine-crank. When the front double piston-

structure assumes the horizontal position shown in Fig. 6, the right hand exhaust-valve p begins to open, by means of the roller s coming in contact with the rise on the fixed cam t, as seen in Fig. 1, thus, as the right hand supplemental piston m^2 is forced beyond the admission ports b^1, by means of the roller o in contact with cam h, a charge is drawn between both pistons l and m^2, thereby causing the supplemental piston m^2 to expel all of the burned gas left by former explosion in the right hand cylinder b out through its nozzle b^4, when the main piston l will then follow up the said supplemental piston to compress the charge around the latter through the transfer ports b^3 into the combustion chamber b^5. Still referring to Fig. 6, the charge of explosive mixture being drawn in by the action of the supplemental piston m^2, between the latter and its adjacent piston l, as the engine continues to revolve we will assume the charge of gas is contained at a point a^5 at the lower portion of the rear vertical double piston structure. The exhaust-valve p at this lower portion of the engine is wide open to permit the full pressure of exhaust to strike upon the blades y^4 of the stationary casing, and by the time this rear piston structure begins to take a horizontal position, its lower supplemental piston m^2 will have moved midway over the transfer ports b^3, to the position shown at the left of Fig. 6, said supplemental valve being prevented from further movement by means of studs m^3 which are secured in its side and arranged to strike against the enlarged head b^2 of the cylinder b, thus a clearance is maintained for the explosive mixture carried by the adjacent piston l to pass through the transfer ports b^3 into the combustion-chamber b^5.

By means of the slidable supplemental pistons m^2, m^2, carried by each piston structure, the burned gas is entirely expelled before a new charge of explosive mixture is compressed in the combustion-chamber, thus preventing liability of explosion.

Each explosion is had at each up stroke or quarter revolution of the engine, and as there are always at least two nozzles exhausting direct upon the blades of the engine-casing, this exhaust pressure is utilized to give an extra impulse to the engine. As one double piston structure acts to compress a new charge of explosive mixture and at the same time expel the burned gas, the other double piston structure acts to carry a new charge of explosive mixture and at the same time cause the pressure of the exhaust to force directly upon the blades of the engine-casing, and so on, consecutively throughout the revolution of the piston structures. Thus it is seen that the pistons l and m^2 separate to draw in a charge between them, and each main piston l follows up each supplemental piston m^2 to compress the charge around the latter through the transfer ports b^3 into the combustion chamber b^5.

As the engine revolves cold air is drawn through inlet openings formed in the casing y and surrounding the tubular shaft g^1, as at points o^1, o^1 in Fig. 9, and this air acts as a cooling blast upon the exterior surfaces of the four cylinders b, and the exhaust gas from said cylinders mixes with this cold air and passes out through exhaust openings formed near the peripheral surface of the lower half of said casing y, as at points o^2, o^2 in Fig. 6.

Having thus described our invention, what we claim, is—

1. In a rotary engine, the combination with a supporting casing, of a fixed crank shaft mounted therein; a crank case rotatably mounted on said crank shaft, one end of said shaft being provided with an explosive mixture intake in open communication with the crank case; a power shaft carried by said crank case; four cylinders secured in oppositely disposed pairs on said crank case, each cylinder having a combustion chamber in its head and an integral exhaust nozzle leading therefrom, each cylinder being also provided with admission ports arranged near to and in open communication with the interior of the crank case and with transfer ports in its walls arranged near the combustion chamber; two double piston structures carried by the crank, each piston of a structure being movable in one of two oppositely disposed cylinders; a supplemental piston mounted on the end of each of said pistons; means to move forward each supplemental piston independently of its main piston at a certain part of the cycle to admit a charge through said admission ports to the space between said pistons, said pistons being adapted at another part of the cycle to force said charge around the supplemental piston through the transfer ports into the combustion chamber; a spark plug in each combustion chamber; means to cause a spark at each plug once in each revolution of the engine; an exhaust valve in each cylinder nozzle, and means to open and close each exhaust valve.

2. In a rotary engine, the combination with a supporting casing, of a fixed crank shaft mounted therein; a crank case rotatably mounted on said crank shaft, one end of said shaft being provided with an explosive mixture intake in open communication with the crank case; a power shaft carried by said crank case; four cylinders secured in oppositely disposed pairs on said crank case, each cylinder provided with admission ports arranged near to and in open communication with the chamber of the crank case, each cylinder having a combustion chamber in its head and an integral exhaust nozzle leading therefrom, and each cylinder provided

with transfer ports arranged near the combustion chamber; two double piston structures carried by the crank, and each piston being movable in one of two oppositely disposed cylinders; a supplemental piston mounted on each end of the piston structures; a cam fast on the crank and arranged to move forward each supplemental piston at a certain part of the cycle to admit a charge through the admission ports to the space between said pistons, and said pistons adapted at another part of the cycle to force said charge around the supplemental piston through the transfer ports into the combustion chamber; a spark plug in each combustion chamber; a circuit breaker having wire connection to each plug; an exhaust valve in each cylinder nozzle; a second cam fast on the crank shaft, and means actuated by the last mentioned cam to open and close each exhaust valve.

3. In a rotary engine, the combination with a supporting casing, of a fixed crank shaft mounted therein; a crank case rotatably mounted on said crank shaft, one end of said shaft being provided with an explosive mixture intake in open communication with the crank case; a power shaft carried by said crank case; four cylinders secured in oppositely disposed pairs on said crank case, each cylinder provided with admission ports in open communication with the interior of the crank case, each cylinder having a combustion chamber in its head and an exhaust nozzle leading therefrom, and each cylinder also provided with transfer ports near its combustion chamber; two double piston structures carried by the crank and the pistons of each structure being movable in two oppositely disposed cylinders; a supplemental piston mounted on the end of each piston of the structures; means to move forward each supplemental piston whereby a charge is drawn through the admission ports between said pistons, at a certain part of the cycle, while the opposite main piston follows up its supplemental piston to compress the charge around the latter through the transfer ports into the combustion chamber; a spark plug in each combustion chamber; means to cause a spark at each plug once in each revolution of the engine; an exhaust valve in each cylinder, and means to open and close each exhaust valve.

4. In a rotary engine, the combination with a stationary two-part circular casing having a series of integral blades arranged transversely therein, of a fixed crank shaft mounted in said casing; a crank case rotatably mounted on said crank shaft, one end of said shaft being provided with an explosive mixture intake in open communication with the crank case; a power shaft carried by said crank case; four cylinders secured in oppositely disposed pairs on said crank case and each cylinder having an exhaust nozzle in its head and arranged to discharge against the blades of said casing whereby the exhaust pressure is utilized to propel the engine, and each cylinder provided with admission ports, transfer ports and a combustion chamber; two double piston structures carried by said crank shaft and each piston being movable in one of two oppositely disposed cylinders; a supplemental piston mounted on the end of each piston; means to move forward each supplemental piston independently of its main piston at a certain part of the cycle to admit a charge through the admission ports to the space between said pistons, said pistons being adapted at another part of the cycle to force said charge around the supplemental piston through the transfer ports into the combustion chamber; means to cause a spark at each plug once in each revolution of the engine; an exhaust valve in each cylinder, and means to open and close each exhaust valve.

5. In combination, the two-part circular casing y having transverse interior blades y^4; the closed case a; the fixed crank shaft g supporting said case and provided with an explosive mixture intake in open communication with said case; the cam h fast on said shaft; the power shaft i carried by said case; the four cylinders b, b, b, b, each having a head b^2 and an exhaust nozzle b^4 leading therefrom, and each cylinder also provided with admission ports b^1 and transfer ports b^3; two double piston structures, each structure comprising a block j loose upon first mentioned shaft, the yoke k arranged to guide said block and said yoke having oppositely disposed extensions k^3, k^3 each provided with a channel, as k^5, and each extension having a shank portion beyond its channel, a main piston l fast upon each shank portion of the yoke-extensions, and the two main pistons of a structure adapted to move in oppositely disposed cylinders, a stem m^1 mounted in the shank portion of each yoke-extension and each stem having an integral head m slidable in the channel of the latter, a supplemental piston m^2 fast on each stem, and a roller o mounted on the head of each stem to contact with said cam in moving forward each supplemental piston; an exhaust valve p mounted in the combustion chamber of each cylinder; the cam t to actuate and force open each exhaust valve; a spark plug w^1 protruding into each combustion chamber, and a circuit breaker x having wire connection to each plug.

In testimony whereof we affix our signatures in presence of two witnesses.

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FORREST F. CAMERON.

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