No. 835,337. PATENTED NOV. 6, 1906.

B. F. WALKER.

MULTIPLE CYLINDER ROTARY EXPLOSIVE ENGINE.

APPLICATION FILED DEC. 20, 1904.

5 SHEETS—SHEET 1.

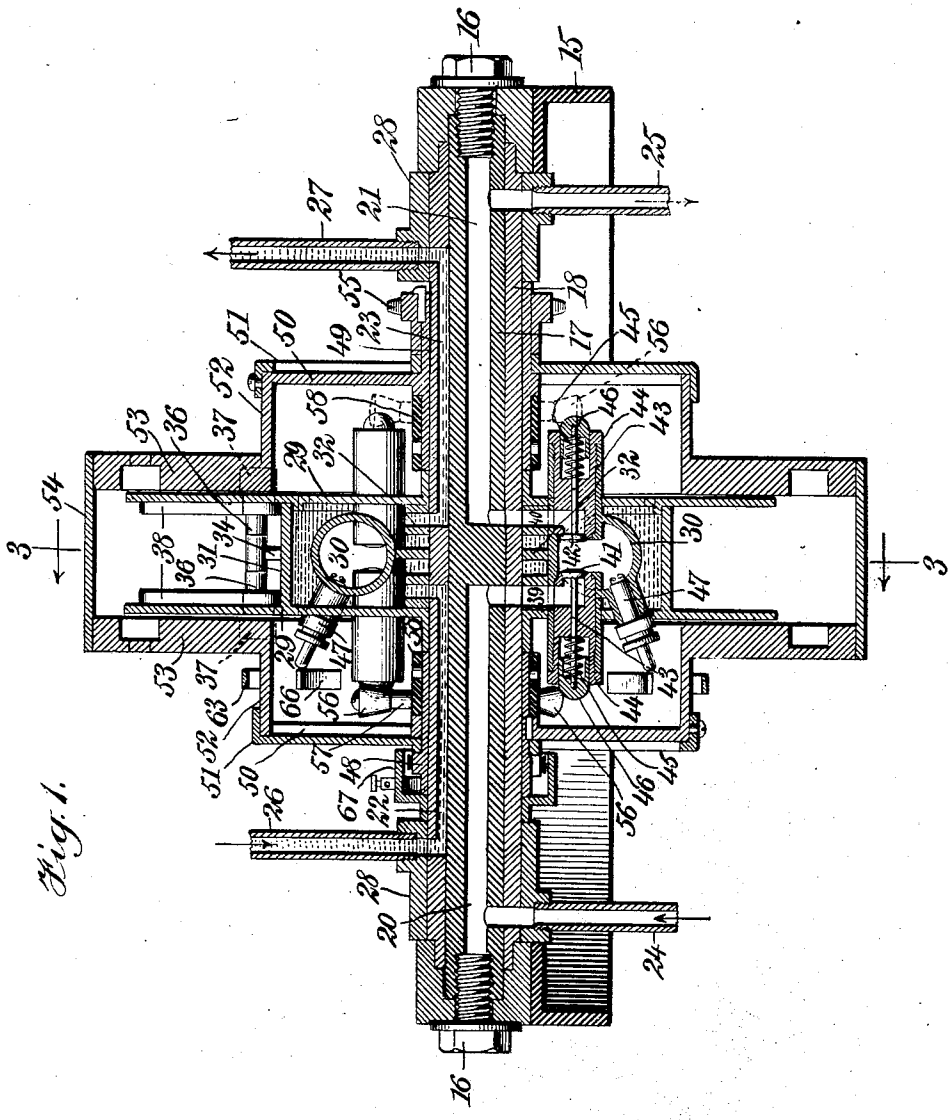


Fig. 1.

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5 SHEETS—SHEET 2.

Fig. 1.

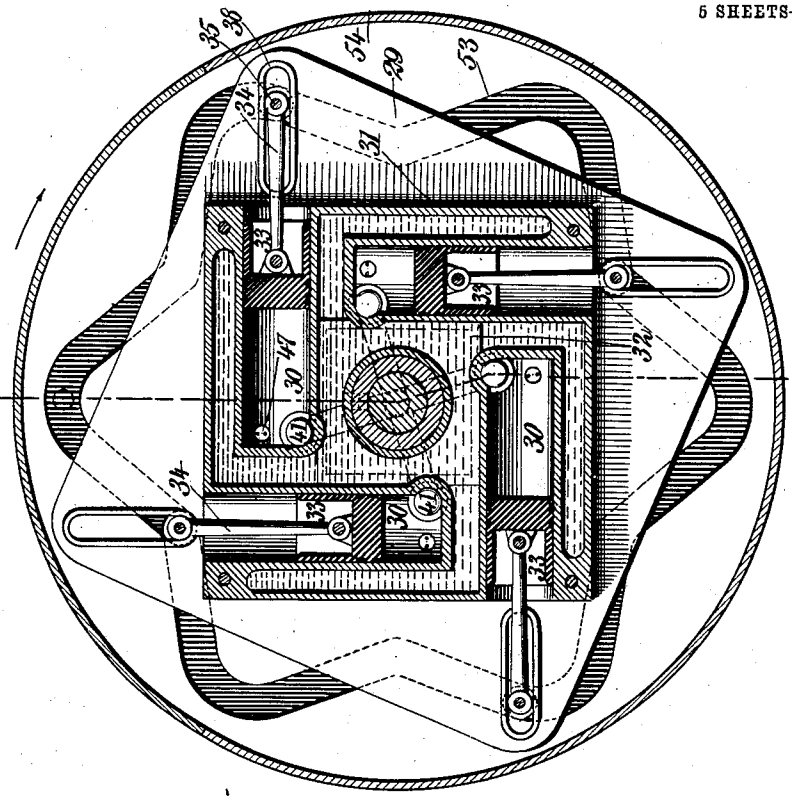
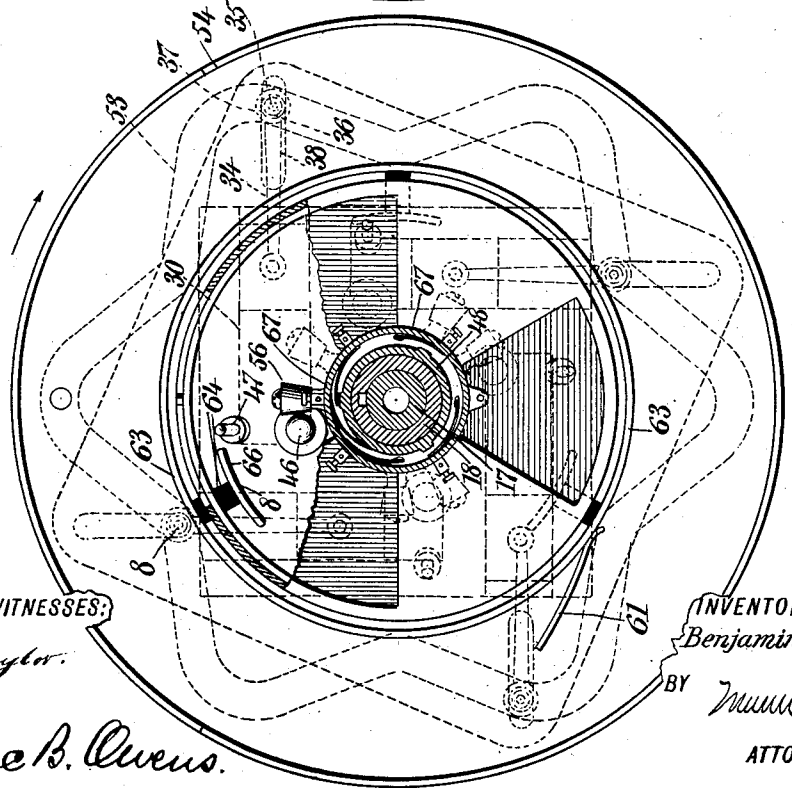


Fig. 2.



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5 SHEETS—SHEET 3.

Fig. 8.

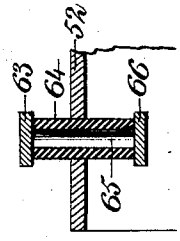


Fig. 5.

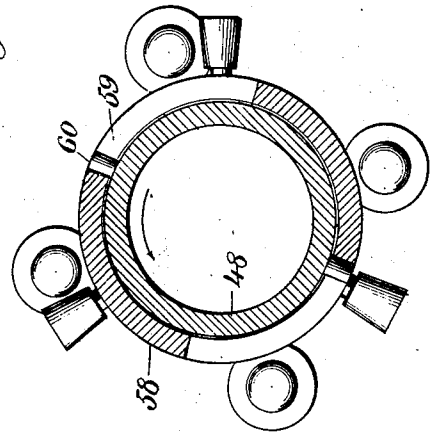
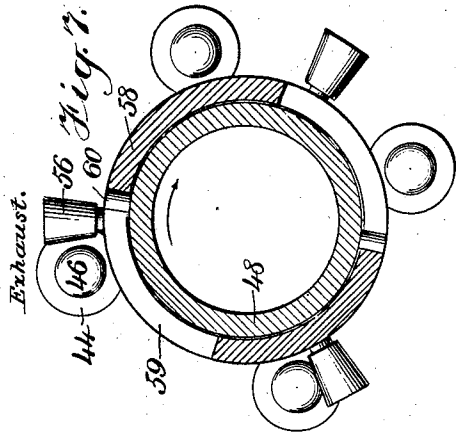


Fig. 7.



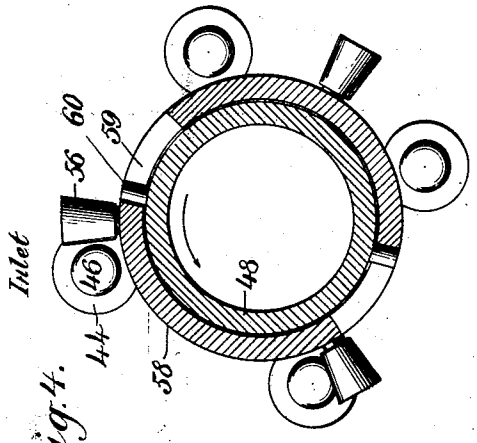


Fig. 4.

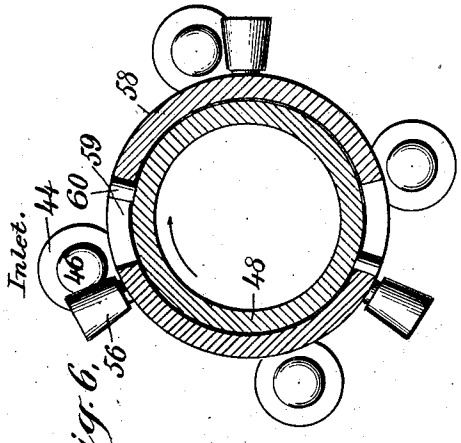


Fig. 6.

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5 SHEETS—SHEET 4.

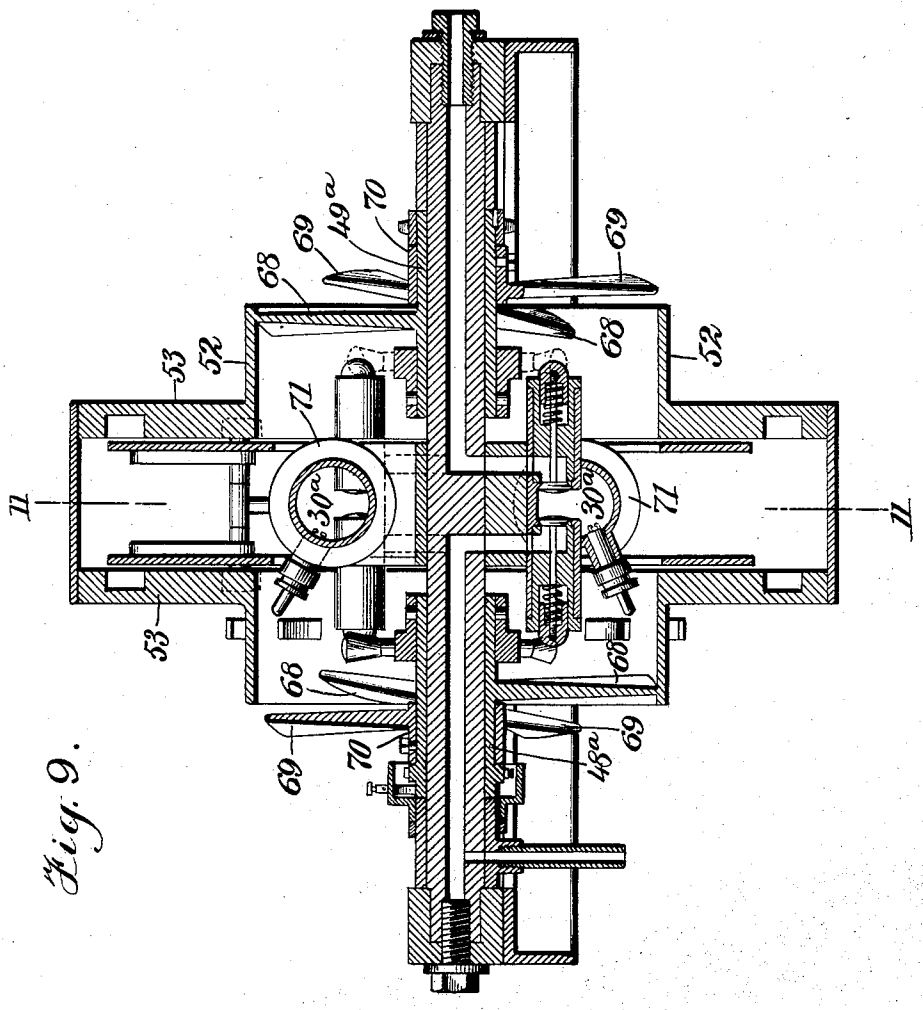


Fig. 9.

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5 SHEETS—SHEET 5.

Fig. II.

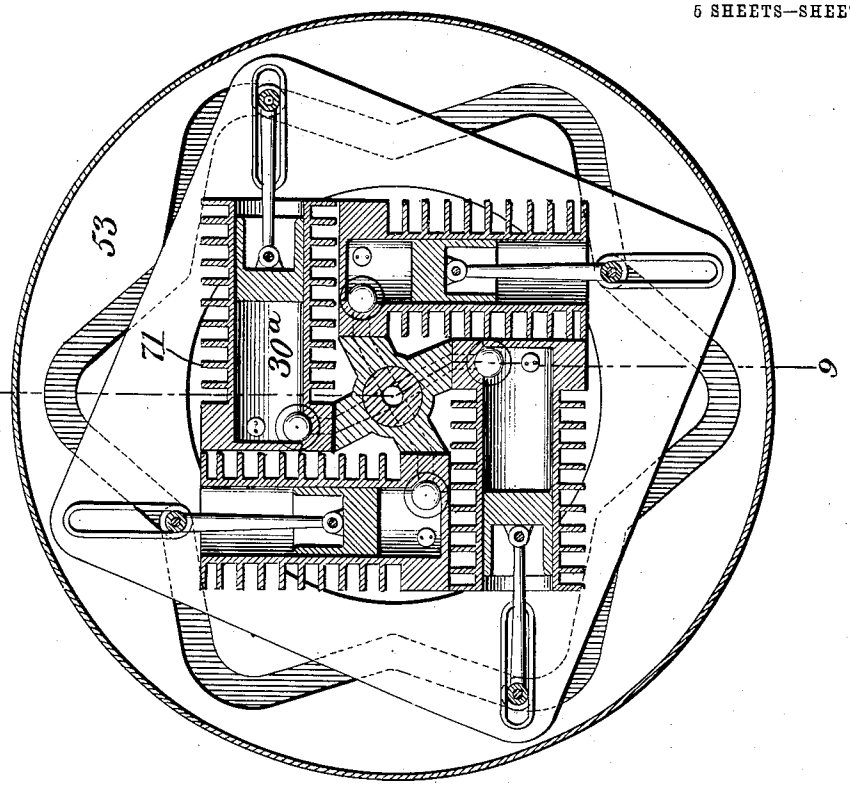
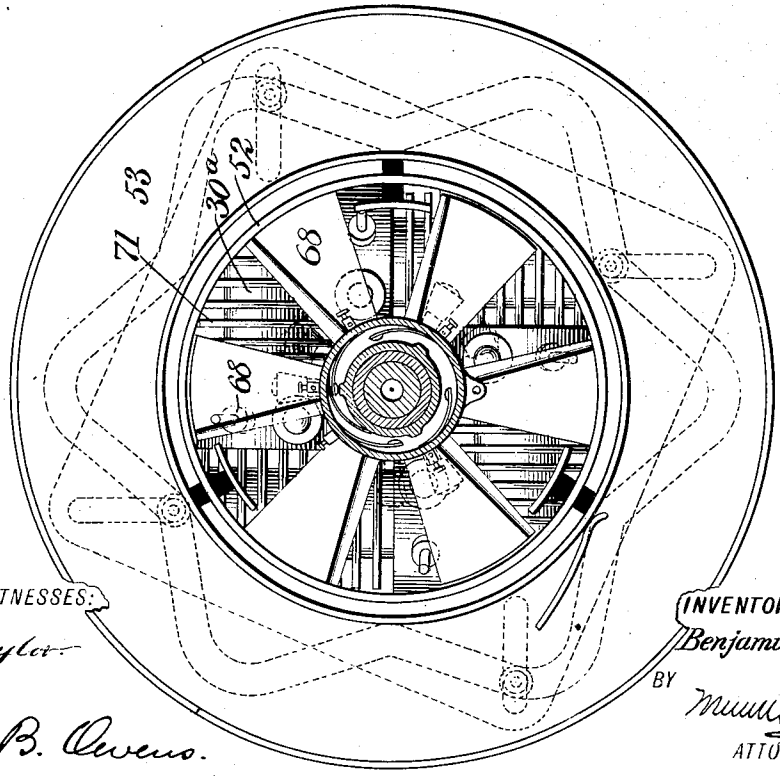


Fig. 10.



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UNITED STATES PATENT OFFICE.

BENJAMIN FRANKLIN WALKER, OF BRIDGEPORT, CONNECTICUT.

MULTIPLE-CYLINDER ROTARY EXPLOSIVE-ENGINE.

No. 835,337. Specification of Letters Patent. Patented Nov. 6, 1906.

Application filed December 20, 1904. Serial No. 237,612.

To all whom it may concern:

Be it known that I, BENJAMIN FRANKLIN WALKER, a citizen of the United States, and a resident of Bridgeport, in the county of Fairfield and State of Connecticut, have invented a new and Improved Multiple-Cylinder Rotary Explosive-Engine, of which the following is a full, clear, and exact description.

The invention relates particularly to a rotary internal-combustion engine in which a group of cylinders having reciprocating pistons are arranged to coact with a cammed part, one of which—the group of cylinders or the cammed part—is arranged to turn through the action or reaction of the pistons thereon.

The prime objects of my invention are to attain, first, several expansion-strokes from each cylinder at every revolution of the engine, thereby giving greatly-increased power with light weight and small area; second, direct thrust with no lateral strain on the piston and cylinder; third, dispensing with crank; fourth, a simple means for mechanically opening the inlet and exhaust valves; fifth, devices for automatically reversing the engine.

According to the specific example of my invention here shown the cylinders are stationary and the cam turns around them; but I desire it understood that this may be reversed, if desired.

The invention resides in certain novel features of construction and interarrangement of parts by means of which various improvements over existing structures are attained, and all of which will be fully set forth hereinafter and particularly pointed out in the claims.

Reference is had to the accompanying drawings, which illustrate as examples two forms of my invention, in which drawings like characters of reference indicate like parts in the several views, and in which—

Figure 1 is a longitudinal section of the engine, taken essentially on the line 1 1 of Fig. 3 and showing a form of the engine in which the cylinders are stationary and cooled by water circulated around the cylinders. Fig. 2 is a side elevation, parts being indicated by broken lines and other parts being shown in section. Fig. 3 is a cross-section of the engine, taken on the line 3 3 of Fig. 1. Figs. 4 and 5 are sectional views illustrating, respectively, the positions of the inlet and exhaust valve operating device with the engine running ahead. Figs. 6 and 7 are similar views illustrating the positions of said parts with the engine running reversely. Fig. 8 is a detail section showing the manner of mounting the conducting-ring for the igniter system. Fig. 9 is a longitudinal section on the line 9 9 of Fig. 11, showing a form of the engine in which the cylinders are air-cooled and also in which the cylinders are mounted stationary and the cammed member is arranged to rotate. Fig. 10 is a sectional side elevation of the same, and Fig. 11 is a cross-section of the same arrangement on the line 11 11 of Fig. 9.

Referring particularly to Figs. 1 to 8, 15 indicates the bed or frame of the engine, in which is securely mounted—for example, by bolts 16—a shaft, here illustrated as formed of two parts—to wit, an interior part 17 and a tubular outer part 18—held immovable with respect to each other by any suitable means. In the shaft-section 17 fuel feed and exhaust passages 20 and 21, respectively, are formed, and in the sleeve 18 water-circulating passages 22 and 23 are formed. Communicating with the inlet and exhaust passages 20 and 21 are pipes 24 and 25, respectively, and the water-circulating passages 22 and 23 communicate with pipes 26 and 27, as shown. The pipes 24 and 25, 26 and 27 communicate with their respective passages through the medium of boxes 28, encircling the end portion of the sleeve 18 and securely fastened thereto by any suitable means. Suitably fastened to the sleeve 18 of the stationary central shaft are the two side walls 29 of the box inclosing the motor-cylinders 30. Said side walls 29 are connected by end walls 31, located inward of the outer edges of the side walls, the side walls 29 and end walls 31 forming, in conjunction with the central shaft, an inclosure completely enveloping the motor-cylinders. This inclosure communicates with the passages 22 and 23, so that a cooling medium may be circulated through the inclosure around the cylinders to absorb the excess heat thereof. As shown best in Fig. 3, the cylinders 30 are disposed tangentially to the central or main shaft and open through the end walls 31. The cylinders are braced against said walls and also by means of webs 32 (see Figs. 1 and 3) connected with the cylinders and with the main shaft or by other suitable means. 33 indicates the pistons, which are reciprocal within the cylinders and have rods 34 con-

nected thereto. Said rods are joined at their outer ends with cross-pins 35, each of which carries two rollers 36 and two rollers 37. The rollers 36 run in guideways 38, formed in the extended or outer portion of the said walls 29 for the purpose of relieving the pistons and cylinders of lateral strain, and the rollers 37 project beyond said side walls to engage with the aforesaid cammed member, as will hereinafter fully appear.

Leading to each cylinder 30 is a radial passage 39 from the passage 20, and leading from each cylinder is a radial passage 40 to the exhaust-passage 21. In this manner the inlet and exhaust passages 20 and 21 are placed in communication with the cylinders, and these communications are controlled, respectively, by inlet-valves 41 and exhaust-valves 42. The stems 43 of these valves are mounted in stem-guides 44, extending transversely of the cylinders and longitudinally of the main shaft, the stems of the inlet-valves projecting toward one end of the said shaft and the stems of the exhaust-valve projecting toward the other. The valves 41 and 42 are yieldingly seated by the action of the spring 45, and the outer ends of the stems are provided with knobs 46, projecting beyond the stem-guides, as shown best in Fig. 1, so as to facilitate the operation of the valves by devices which will be hereinafter described. 47 indicates spark-plugs or other igniting devices, which may be of any desired construction. The spark-plugs, as here illustrated, extend through one of the side walls 29 and through the walls of the respective cylinders, so as to ignite the charges in the usual manner.

The rotating part of the form of motor illustrated in Figs. 1 to 8 comprises hubs 48 and 49, revolubly mounted on the main shaft. Extending outward from these hubs and fastened suitably thereto are webs 50, having orifices therein adapted to be closed by covers 51. These covers are mounted to turn with respect to the webs, so that by operating the covers the parts inclosed by the webs may be reached. The webs 50 have inwardly-extending annular portions 52 connected to or formed integral therewith, and these portions 52 carry outwardly-extending circular cams 53. It is pointed out that the parts 50 and 52 form an inclosure for the cylinders and their immediately-connected parts and that this inclosure mounts the cams 53. The cams 53 are duplicate of each other, and their form is illustrated in Figs. 2 and 3. Said cams are connected at their outer peripheries by a band 54. Power may be taken from the engine in any desired way—for instance, by a belt around the band 54. It will be observed that the parts 50, 51, 52, 53, and 54 form a rotating inclosure for the cylinders and the adjunctive parts of the engine, and by operating the inclosures 51 the interior of the inclosure may be reached at will. Power may be taken from this rotating structure at any desired point—for example, from the hub 49 through the medium of the sprocket-wheel 55, attached thereto. The cylinders and their connected parts being stationary and the cams being revolubly mounted, as explained, it is clear that upon a power movement of one of the pistons the action of the rollers 37 on the cams 53 will impart to the cams a turning movement, which will be taken up by the other parts forming the rotating element or rotor of the engine. It will also be clear that the movement of the cam having been once begun the cam will cause the pistons of the various cylinders to take the necessary negative movements involved in the cycle whether the engine be of the two or four cycle type. The circulating undulating cams serve, therefore, to receive the power impulses from the pistons and in turn to impart to the pistons the necessary negative stroke, such as the exhaust suction and compression movements, and repeating said functions in each cylinder several times at every revolution of the engine, thus giving greatly-increased power.

The valves 41 and 42 may be operated by any device connected to turn with the rotor. I prefer, however, to employ tappet-rollers 56, carried on radial studs 57, attached to collars 58, said collars being mounted loosely on the respective hubs 48 and 49. The collars are provided with slots 59, loosely receiving pins 60, projecting from said hubs. (See Figs. 4–7.) This allows the hubs a certain independent movement with respect to the collars; but upon the engagement of the pin 60 with the end walls of the slots 59 the collars are forced to take up the rotary movement of the hubs, and the tappet-rollers 56 are successively engaged with the valve-knobs 46, so as to operate the valves in time with the rotating movement of the engine. It is clear that by properly calculating the form and proportions of the various parts these valve operations may be timed to occur at the proper intervals and adapted either to two or four cycle principles of operation, as desired. The independent movement of the hubs with respect to the collars 58, owing to the slots 59, is provided to permit of reversing the engine without disturbing the proper relations between the tappet-rollers 56 and the valve-knobs 46. This action is shown in Figs. 4 to 7, in which Figs. 4 and 5 indicate the respective inlet and exhaust valve operating device in the position with respect to the hubs 48 which said parts assume when the engine is moving ahead. Upon the reversal of the engine the hubs 48 turn backward, taking with them the pins 60, the said pins moving through the slots 59 without imparting movement to the collars 58. When, how-

ever, the pins strike the opposite ends of the slots 59, the collars take up the movement of the hubs, (see Figs. 6 and 7,) and the operation again becomes normal.

The spark-plugs or other electrical igniting device 47 may be energized by any desired means. I prefer, however, to employ the jump-spark system, in which one terminal of the secondary current is suitably ground on the engine and the other terminal is led by a contact-finger 61 (see Fig. 2) to a conducting-ring 63, encircling one of the inwardly-extending portions 52 of the webs 50. As best shown in Fig. 8, this conducting-ring 63 is sustained by insulating-thimbles 64, and through these thimbles conductors 65 pass to contact-shoes 66, located within the said inwardly-extending portion 52 and in position successively to engage with the spark-plug, so as to transmit the current to or from the same, as the case may be. For advancing or retarding the spark and for otherwise regulating the ignition I preferably provide a commutator (indicated at 67) mounted loosely on the main shaft of the engine and adapted to be turned thereon, so as to bring about the spark regulation as desired. In this manner the charges may be ignited in the cylinder, and by advancing the ignition periods sufficiently the engine operating in one direction may be readily reversed, as may be understood.

In the organized operation of the engine, the fuel mixture being supplied to the pipe 24, upon starting the movement of the rotor the valves 41 and 42 and the piston 33 will be operated, so as to draw in and compress the charges in the various cylinders. In time with these operations the compressed charges will be ignited, and upon the power-stroke of the pistons the normal operation of the engine will begin. The rotor of the engine receives its impulses from the action of the rollers 57 on the undulating cams 53, and these cams in turn impart the necessary negative movement to the pistons. The valves are operated by the tappet-rollers 56, turned through their connection with the hubs 48 and 49, and the igniters are periodically actuated upon the contact of the rotating shoe 66 with the igniters, as explained. Simultaneously with the operation of the engine the cooling fluid is circulated through the pipes 26 and 27 and passages 22 and 23 and the various spaces of the jacket or inclosure around the cylinders, thus keeping the temperature at the proper degree.

Figs. 9, 10, and 11 illustrate a form of the invention in which the cylinders are stationary, the cammed member rotates, but in which the water circulation is replaced by means for air-cooling the cylinders. In attaining this end that portion of the walls 29 forming the inclosure around the cylinders, also the walls 50, are dispensed with, and the cammed members 53 are supported on the hubs 48^a and 49^a by means of radial arms 68. These arms are given the form of fan-blades, so that currents of air will be induced to flow past the cylinders through the space inclosed by the annular members 52, projecting from the inner walls of the cams 53. In addition to the fan-blades 68 blades 69 may be employed, these blades supplementing the blades 68 and being attached to the hubs 48^a and 49^a through the medium of hubs 70, as shown best in Fig. 9. The cylinders 30^a are provided with radiating projections 71 of the usual or any desired form and serving to radiate the excess heat from the cylinders. It follows from this air-cooling of the cylinders that the main shaft of the engine is provided only with ducts for the fuel-feed and exhaust, the water-circulating ducts being omitted. In all respects other than those mentioned this form of the engine shown in Figs. 9, 10, and 11 is constructed and operates essentially the same as the water-cooled form, as described.

While the arrangement of the fan-blades shown in Figs. 9, 10, and 11 is preferable, it should be borne in mind that this arrangement is not strictly essential and that any arrangement may be employed which will provide for the fan-blades rotating past the cylinders, so as to induce the cooling air-currents referred to.

Various changes in the form, proportions, and minor details of my invention may be resorted to at will without departing from the spirit and scope thereof. Hence I consider myself entitled to all such variations as may lie within the terms of my claims.

Having thus described the preferred form of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an engine, the combination of a cylinder, a cammed member, means for revolubly mounting one of said parts, a piston operating in the cylinder, a part engaged with the cammed member and connected to the piston, an electric igniter carried by the cylinder, and a contact-shoe connected with the cammed member whereby to periodically engage the igniter and contact-shoe by the relative movement of the cylinder to the cammed member.

2. In an engine, the combination of a frame or base, a stationary shaft held thereby, a box attached to the shaft, the shaft having ducts therein communicating with the box for the purpose specified, a cylinder inclosed by the box and supported by the shaft, the shaft having fuel feed and exhaust passages communicating with the cylinder, inlet and exhaust valves controlling said communication, a cammed member arranged to turn around the shaft, a piston operating in the cylinder, a part engaged with the cammed member and connected with the

piston, and a tappet located at each side of the cylinder and turning with said cammed member, the tappet being adapted respectively to operate the cylinder-valves, and being connected to turn with the cammed member.

3. In an engine, the combination of a frame or base, a stationary shaft supported thereby, a box attached to the shaft, the shaft having ducts therein communicating with the box and adapted to circulate a cooling medium through the same, a cylinder inclosed by the box and sustained by the shaft, a piston operating in the cylinder, a guide supported by and projecting from the box, a part playing in the guide and connected with the piston, and a cammed member mounted to turn around the shaft and engaged by said part connected with the piston.

4. In an engine, the combination of a frame, a stationary shaft sustained thereby, a cylinder carried by the said shaft, two circular undulating cams, hubs mounted to turn on the shaft, webs mounting said cams on said hubs, and inclosing the cylinder, a piston operating in the cylinder, a part having connection with the piston and engaging said cams, the said webs having openings therein, and closures removably covering the openings for the purpose specified.

5. In an engine, the combination of a base, a hollow shaft rigidly mounted therein, one end of the shaft being adapted to receive the motive fluid and the other end being adapted to exhaust the same, a working cylinder, means for attaching same to the shaft, a piston operating in the cylinder, an undulating circular cam, means for revolubly mounting the same on the shaft, a part having connection with the piston and acting on the cam to impart rotating movement to the cam, means establishing communication between the working piston and the ends of the shaft, a valve controlling each communication, two collars revolubly mounted with respect to the shaft, tappets on said collars adapted to operate the valves, and means connecting the collars with the cam to cause the collars to rotate therewith, said means permitting the collars a limited independent movement for the purpose specified.

6. In an engine, the combination of a base, a hollow shaft rigidly mounted therein, one end of the shaft being adapted to receive the motive fluid and the other end being adapted to exhaust the same, a working cylinder, means for attaching same to the shaft, a piston operating in the cylinder, an undulating circular cam, means for revolubly mounting the same on the shaft, a part having connection with the piston and acting on the cam to impart rotating movement to the cam, means establishing communication between the working cylinder and the ends of the shaft, a valve controlling each communication, two collars revolubly mounted with respect to the shaft, tappets on said collars adapted to operate the valves, means connecting the collars with the cam to cause the collars to rotate therewith, said means permitting the collars a limited independent movement for the purpose specified, a box inclosing the cylinder and sustained by the shaft, and means for circulating a cooling fluid through said box.

7. In an engine, the combination of a base, a hollow shaft rigidly mounted therein, one end of the shaft being adapted to receive the motive fluid and the other end being adapted to exhaust the same, a working cylinder, means for attaching same to the shaft, a piston operating in the cylinder an undulating circular cam, means for revolubly mounting the same on the shaft, a part having connection with the piston and acting on the cam to impart rotating movement to the cam, means establishing communication between the working piston and the ends of the shaft, a valve controlling each communication, two collars revolubly mounted with respect to the shaft, tappets on said collars adapted to operate the valves, means connecting the collars with the cam to cause the collars to rotate therewith, said means permitting the collars a limited independent movement, for the purpose specified, a box inclosing the cylinder and sustained by the shaft, and means for circulating a cooling fluid through said box, said means including passages formed in the said shaft.

8. In an engine, the combination of a bed, a shaft securely mounted therein, a cylinder attached to the shaft, a circular undulating cam, a part engaging said cam, a piston operating in the cylinder and having connection with said part, a rotating closure mounted on the shaft and inclosing the cylinder, said closure carrying said cam, and means for admitting and exhausting the motive fluid.

9. In an engine, the combination of a bed, a shaft fixedly carried thereby, said shaft having feed and exhaust passages respectively in its end portions, a cylinder, means for attaching the same to the shaft, means establishing a communication between the cylinder and said passages of the shaft, valves controlling said communications, an undulating circular cam, means for mounting the same to turn around the center of the shaft, a piston operating in the cylinder, a part having connection with the piston and engaging the cam, for the purpose specified, means for operating the valves, a box attached to the shaft and inclosing the cylinder, and means for circulating a cooling fluid through said box.

10. In an engine, the combination of a bed, a shaft fixedly carried therein, a cylinder attached to the shaft, the shaft having feed

and exhaust ports respectively in its end portions, means establishing communication between said ports and the cylinder, a piston operating in the cylinder, an undulating circular cam, a part having connection with the piston and engaging the cam, a rotating closure attached to the cam and mounted on the shaft, a box attached to the shaft and inclosing the cylinder, and means including ducts formed in the shaft for circulating a cooling fluid through said box.

11. In an engine, the combination of a base, a shaft revolubly mounted therein, said shaft having feed and exhaust passages respectively in its ends, a cylinder attached to the shaft, means establishing a communication between the cylinder and said passages of the shaft, a box attached to the shaft and inclosing a cylinder, means for circulating a cooling fluid through the box, said means including ducts formed in the shaft, slotted side walls projecting from the box, a piston operating in the cylinder, connecting-rods attached to the piston, a cross-pin attached to the connecting-rod and running in the slots of the side walls, two undulating circular cams mounted respectively adjacent to the side walls and having said cross-pin coacting therewith, and means for mounting the cams to turn around the shaft.

12. In an engine, the combination of a base, a shaft revolubly mounted therein, said shaft having feed and exhaust passages respectively in its ends, a cylinder attached to the shaft, means establishing a communication between the cylinder and said passages of the shaft, a box attached to the shaft and inclosing a cylinder, means for circulating a cooling fluid through the box, said means including ducts formed in the shaft, slotted side walls projecting from the box, a piston operating in the cylinder, connecting-rods attached to the piston, a cross-pin attached to the connecting-rod and running in the slots of the side walls, two undulating circular cams mounted respectively adjacent to the side walls and having said cross-pin coacting therewith, and means for mounting the cams to turn around the shaft, the last-named means comprising a rotating closure covering the cylinder and box and mounted revolubly on the shaft.

13. In an engine, the combination of a bed, a shaft fixedly carried thereon, a cylinder mounted on the shaft, side flanges supported from the shaft and having slots therein, a cross-pin running in said slots, a connecting-rod connected to the cross-pin, a piston operating in the cylinder and having a connecting-rod joined thereto, circular undulating cams located respectively at the outer sides of the side flanges and engaged by the ends of the cross-pin, and means for revolubly mounting said cams.

14. In an engine, the combination of a bed, a shaft fixedly carried thereon, a cylinder attached to the shaft, a revolubly-mounted cam, a piston operating in the cylinder, a part having connection with the piston and engaging the cam, means for admitting and exhausting the motive fluid to the cylinder, said means including a valve having its stem projected beyond the cylinder, a collar, a tappet attached to the collar and adapted to engage the stem of the valve to operate the same, and means for connecting the collar to turn with the cam.

15. In an engine, the combination of a bed, a shaft fixedly carried thereon, a cylinder attached to the shaft, a revolubly-mounted cam, a piston operating in the cylinder, a part having connection with the piston and engaging the cam, means for admitting and exhausting the motive fluid to the cylinder, said means including a valve having its stem projected beyond the cylinder, a collar, a tappet attached to the collar and adapted to engage the stem of the valve to operate the same, and means for connecting the collar to turn with the cam, said means permitting the collar a limited independent movement, for the purpose specified.

16. In an engine, the combination of a bed, a shaft fixedly carried thereon, a cylinder attached to the shaft, a revolubly-mounted cam, a piston operating in the cylinder, a part having connection with the piston and engaging the cam, means for admitting and exhausting the motive fluid to the cylinder, said means including a valve having its stem projected beyond the cylinder, a collar, a tappet attached to the collar and adapted to engage the stem of the valve to operate the same, and means for connecting the collar to turn with the cam, said means comprising a pin turning with the cam and piston loosely in a slot in the collar whereby to permit the collar a limited independent movement.

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

BENJAMIN FRANKLIN WALKER.

Witnesses:
SAMUEL C. SHAW,
FLORA E. DEW.