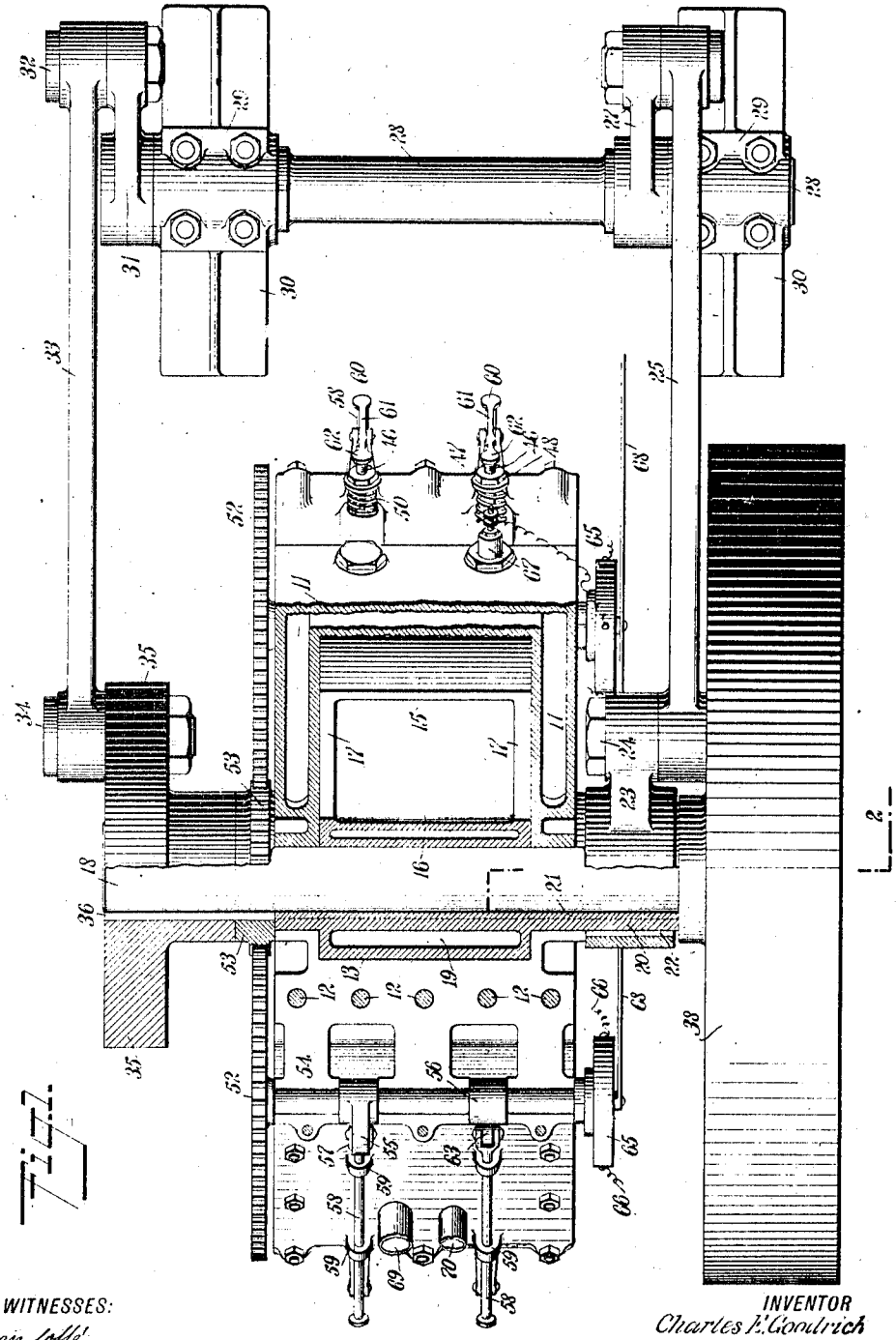
C. E. GOODRICH.

EXPLOSIVE ENGINE.

APPLICATION FILED MAR. 16, 1910.

988,704. Patented Apr. 4, 1911.

3 SHEETS—SHEET 1.



WITNESSES:

Ben Joffe

E. H. Murdock

INVENTOR

Charles E. Goodrich

BY Munn & Co.

ATTORNEYS

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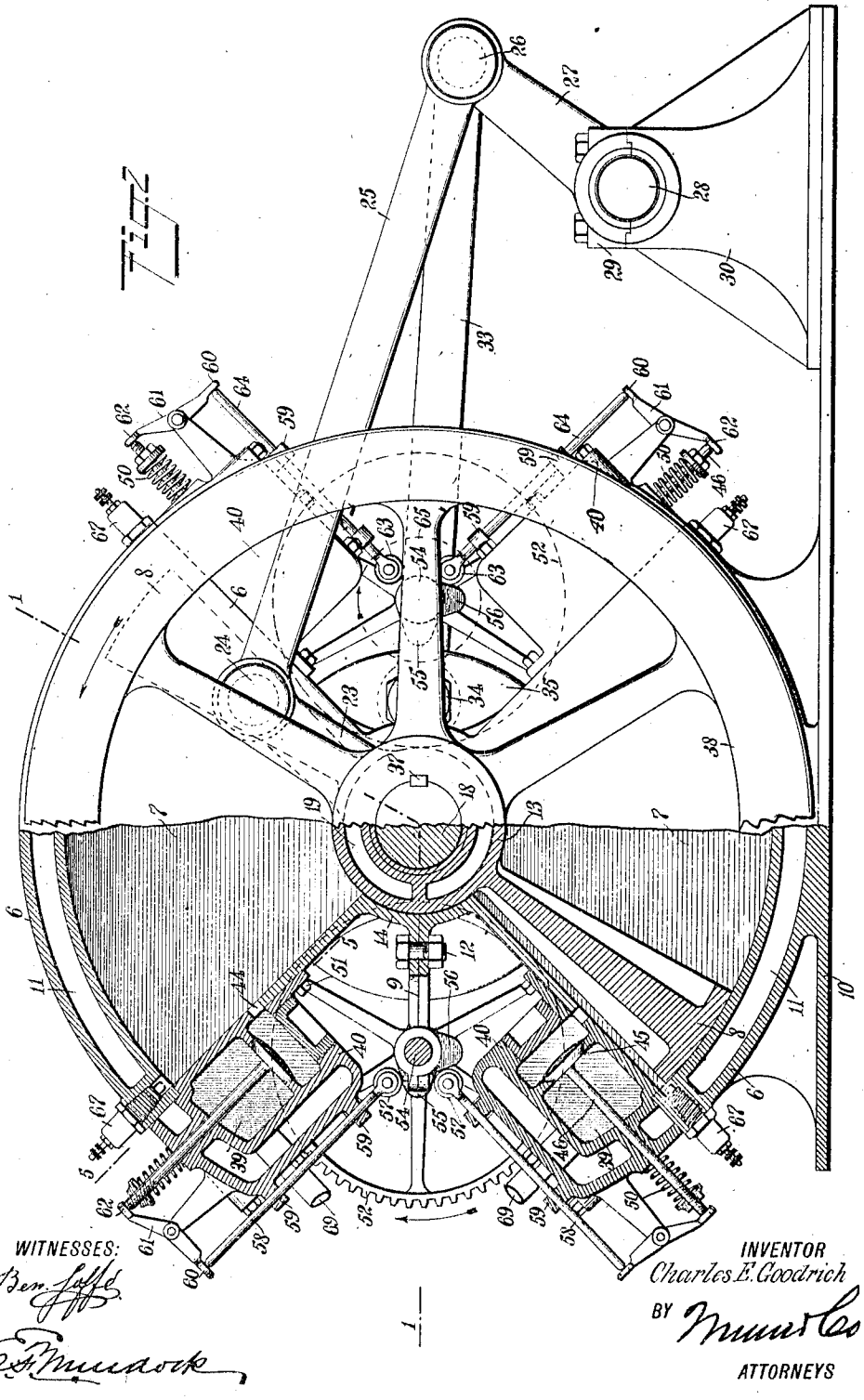
3 SHEETS—SHEET 2.

Fig. 1.



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3 SHEETS—SHEET 3.

Fig. 3.

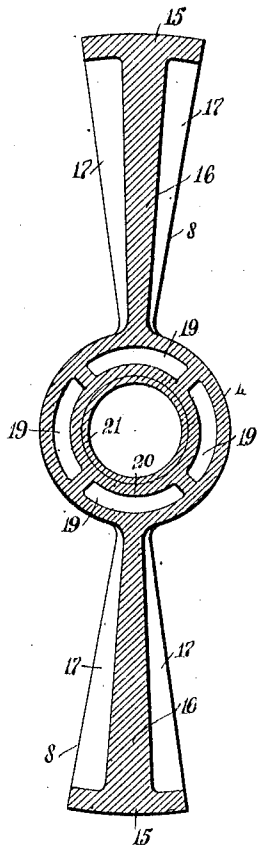


Fig. 4.

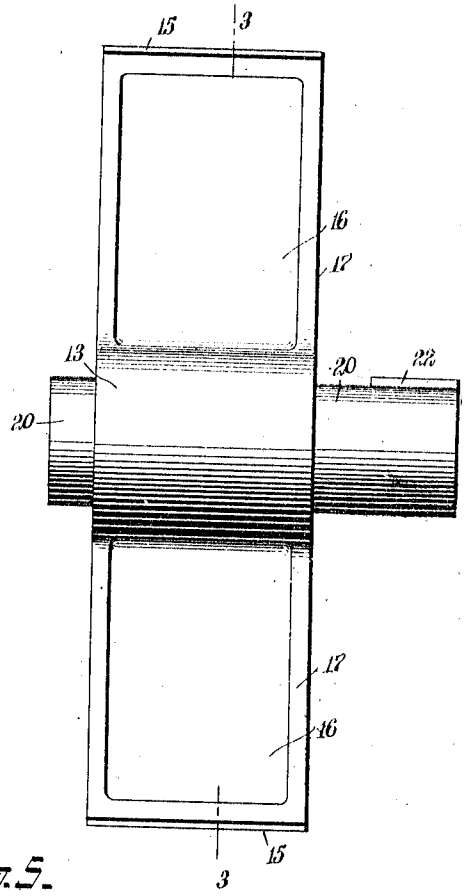
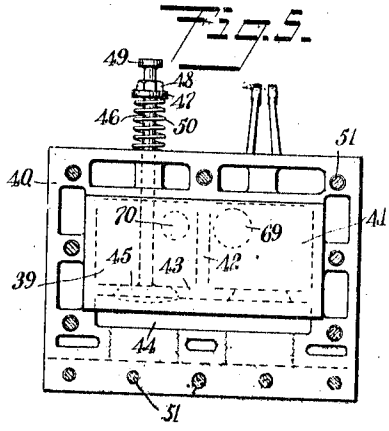


Fig. 5.



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ATTORNEYS

UNITED STATES PATENT OFFICE.

CHARLES EBENEEZER GOODRICH, OF DAGGETT, CALIFORNIA, ASSIGNOR OF ONE-HALF TO JOHN H. SLOAN, OF BARSTOW, CALIFORNIA.

EXPLOSIVE-ENGINE.

988,704. Specification of Letters Patent. Patented Apr. 4, 1911.

Application filed March 16, 1910. Serial No. 549,590.

To all whom it may concern:

Be it known that I, CHARLES E. GOODRICH, a citizen of the United States, and a resident of Daggett, in the county of San Bernardino and State of California, have invented a new and Improved Explosive-Engine, of which the following is a full, clear, and exact description.

Among the principal objects which the present invention has in view are: To provide a double oscillating piston arranged to produce a continuous reciprocating of a pitman and a rocking shaft connected therewith; to provide a plurality of explosion chambers each operable from both ends thereof; to provide a multiple reciprocating motor of the explosive type radially disposed about a rotary driving shaft having a fly wheel and designed to conform to the size of said fly wheel; to provide a plurality of hollow sector-shaped explosion chambers radially disposed about a driving shaft provided with a fly wheel, said sectors being separated to provide holding spaces for the valve mountings and operating mechanism therefor; and to provide a multiple unit explosion motor radially disposed about the driving shaft of the engine and having oscillated pistons rotatably mounted upon said driving shaft and a translating mechanism for converting the reciprocated motion of the pistons to a rotary motion of the shaft.

One embodiment of the present invention is disclosed in the structure illustrated in the accompanying drawings, in which like characters of reference denote corresponding parts in all the views, and in which—

Figure 1 is a plan view partly in section, of an engine constructed and arranged in accordance with the present invention, the section being taken on the line 1—1 in Fig. 2; Fig. 2 is a side elevation, partly in section, of the same, the section being taken on the line 2—2 in Fig. 1; Fig. 3 is a vertical section of the oscillating pistons employed in the present construction, the section being taken on the line 3—3 in Fig. 4; Fig. 4 is a detail view in side elevation, showing the oscillating piston and the hub thereof; and Fig. 5 is a sectional view taken on the line 5—5 in Fig. 2, showing the face plate and port passages of the valve chests.

In the construction of every engine certain features are necessary to the efficiency and operation of the same. One of these features may be stated as being the fly wheel with which the engine is provided. To confine the cubic space occupied by the engine, the shape and size of the fly wheel should be taken into account.

In the present invention I have constructed and disposed the engine parts as nearly as possible within the area of the fly wheel of the engine. In doing this I have attained the most compact form for the engine without limiting the piston area. To do this I have formed oppositely extended sectors 6, 6. The sectors 6, 6 are provided with hollow chambers 7, 7 opening toward the center to surround the hub of oscillating piston heads 8, 8. The sectors 6, 6 are constructed in two sections, the upper and lower, being parted on a horizontal central line 9, the lower section forming and being cast with the bed 10. Disposed about the periphery and side walls of the sectors 6, 6 to surround the chambers 7, 7 are water circulating spaces 11, 11. The upper and lower sectors are bolted together by bolts 12, 12 in the usual manner. The chambers 7, 7 are radiated from the center of the hub 13 of the piston heads, 8, 8, the said hub being held in separated and bearing relation by curved walls 14, 14 of the meeting portions of the said sectors. The piston heads 8, 8 are formed as shown in Figs. 3 and 4 of the drawings, having heads 15, 15 formed to the circumferential shape of the chambers 7, 7. Between the heads 15, 15 and the hub 13 are extended solid walls 16, 16 constituting the pistons in the present invention. The walls 16, 16 are provided with lateral edge flanges 17, 17 radially disposed, as shown in Fig. 3 of the drawings, whereby the edges of the said flanges may rest against the ends of the chambers 7, 7 to form a pocket between the walls 16, the said flanges and the ends of the said chambers, as shown in Fig. 2 of the drawings.

As will be hereinafter set forth, the pistons 8, 8 are oscillated about the driving shaft of the engine, while the driving shaft is continuously rotated in a constant direction. The hub 13 of the pistons is enlarged to provide water circulating spaces 19, 19, suitably connected with the water circulat-

ing spaces 11, 11, protecting a hollow sleeve 20 and the bearing 21 therefor. The bearing 21 is fitted snugly over the shaft 18 to run truly thereon. At the outer extremity of the elongated end of the sleeve 20 the said sleeve is provided with a key 22 to hold in fixed relation a crank arm 23, as shown in Figs. 1 and 2 of the drawings. The crank arm 23 is pivotally secured by means of a pin 24 to a crank rod 25. The crank rod 25 is pivotally secured by means of a pin 26 to a crank arm 27, fixedly mounted upon a shaft 28. The shaft 28 is suitably mounted in bearing boxes 29, 29 formed at the head of standards 30, 30, which are properly secured in fixed relation upon the bed 10. The shaft 28 is provided at the extremity opposite that whereon is mounted the crank arm 27 with a crank arm 31. The crank arm 31 is connected by means of a pin 32, a pitman 33 and a pin 34 to a disk 35. The radial dispositions of the pins 32 and 34 are so proportioned that the arc of the movement of the pin 32 on the crank arm 31 equals in length the path of half of the outer circular path of the pin 34, or, stated in other words, the rock of the crank arm 31 in each direction produces a complete half revolution of the disk 35. The disk 35 is fixedly secured by means of a key 36 upon the shaft 18. By means of a key 37, a fly wheel 38 is fixedly attached to the said shaft 18 at the end thereof opposite that carrying the disk 35. It will now be seen that as the pistons 8, 8 are rocked about the shaft 18, the said shaft 18 and fly wheel 38 connected therewith, are driven in a continuous and constant rotary direction by reason of the translating mechanism consisting of the crank arm 23, crank rod 25, crank arm 27, shaft 28, crank arm 31, pitman 33 and disk 35 interposed between and connecting the said pistons and said shaft.

The pistons 8, 8 are oscillated by explosions of an explosive mixture admitted and confined under proper conditions within the chambers 7, 7 and upon opposite sides of the walls 16, 16 of the said pistons. The explosive mixture is the usual mixture of gas and air, and is admitted to intake chambers 39, 39 of each of the valve casings 40, 40. The casings 40, 40 are each provided with an intake chamber 39 and an exhaust chamber 41. The said chambers are divided by a wall 42, and are each connected through ports formed in a wall 43 with a passage 44 formed in open communication with the interior of the chambers 7. Each of the ports in the wall 43 is closed by a valve 45, having a valve stem 46 extended through the outer wall of the casing 40 and provided with a washer 47 adjustably mounted thereon by a set nut 48. The stems 46 are each provided with a head 49, whereby the various valves may be depressed to remove the said valves from the seat against the expansion of a spring 50 surrounding each of the said stems 46.

The casings 40, 40 are each similar, and are mounted upon the sectors 6, 6 by being bolted to the ends thereof by means of bolts 51, 51. By means of this arrangement the casings are disposed on opposite sides of the pistons 8, 8, thereby being adapted to cause an explosion on each side of the said pistons within the chambers 7, 7, and to scavenge on each side of the said pistons. Admission of the explosive mixture and the exhaust of the products of combustion are controlled by the valves 45, controlling the passage into and out of the chambers 39, 39 and 41, 41 respectively. It will be understood that the valves 45 will be constructed to dimensions suitable for the employment in their respective operations.

It will be noticed that the disposition of the casings 40, 40 is such that they are not extended beyond the circumferential line of the cylindrical shape of the sectors 6, 6. The operating mechanism for the valves is likewise disposed within the space between the sectors and within the projected circumferential line thereof. The engines of which the pistons 8 and chambers 7 constitute the principal elements are of the four cycle type, therefore gear wheels 52, 52 are suitably proportioned to a gear wheel 53 in such manner as to operate the valves constantly with the known action of engines of this type, and with regard to the alternate action and opposite disposition of the valves with relation to the chambers 7.

A shaft 54 is provided with cams 55 and 56. The cams 55, as shown in Fig. 1 of the drawings, are disposed in the path of rollers 57 mounted on the ends of lifting pins 58. The pins 58 are guidably mounted in brackets 59, 59, and the upper ends extend under the tail 60 of a rocking lever 61, the spatula end 62 whereof rests upon the head 49 of the valve stem 46. The connecting mechanism for operating the valves is duplicated for the cams 56, which as shown in Fig. 2 of the drawings, rotates in the path of wheels 63 mounted on the ends of pins 64 for controlling the operation of the intake valves for the chambers 7. The cams 55 and 56 are disposed in proper timed relation. The said cams are oppositely disposed on the shaft 54 mounted on opposite sides of the engine, whereby the valves are mutually synchronized with reference to each other and with reference to the double action of the pistons 8, 8 in the chambers 7.

Mounted upon the shafts 54 are suitable rotary electric igniters 65, 65. The stationary outer casing is provided with suitable terminals 66, 66 properly disposed with reference to the coil and spark plugs 67, 67. The casings are connected by a rod 68, by

moving which the sparkers may be advanced or receded with reference to the compression of the pistons 8, 8. The chambers 39, 39 are provided with inlet and exhaust pipes 69 and 70, as shown in Figs. 1 and 5.

Assuming that the pistons 8, 8 are disposed as shown in Fig. 2 of the drawings, and that the explosive mixture is compressed to the right of the upper extension of the piston 8 in the upper chamber 7, the operation is as follows: The spark being produced in the plug 67 at the right of the upper chamber 7, explosion occurs in the said chamber to the right of the said upper extension of the piston 8, driving the said upper extension of the piston to the left. By the same movement which previously disposed the upper extension of the piston 8 at the right of the upper chamber 7, the lower extension of the piston 8 has been moved to the left of the lower chamber 7. In the action of the lower extension of the piston 8 there has been drawn into the lower chamber 7 a fresh charge of the explosive mixture to the right of the lower extension of the piston 8. Simultaneously there has been voided from the lower chamber 7 the dead charge of a previous explosion. When now the explosion just above described occurs in the upper chamber 7, the dead charge of a previous explosion in the said upper chamber 7 is voided through the exhaust ports 45 to the left of the said upper chamber 7. Simultaneously with this movement the piston 8 in the lower chamber 7 is carried to the right, compressing the charge of fresh explosive mixture at the right of the said lower chamber 7. When the said lower extension of the piston 8 has been thus moved to the right, a fresh charge of explosive mixture has been drawn into the said lower chamber 7 to the left of the piston 8 therein. At this instant, the engine is in the position where a compressed charge of explosive mixture is held to the right of the lower extension of the piston 8 in the lower chamber 7; a loose fresh charge of explosive mixture is held to the left of the lower extension of the piston 8 in the same lower chamber 7; and in the upper chamber 7 to the right of the upper extension of the piston 8 is a dead or combusted charge of explosive mixture. The ports in the lower chamber 7 on both sides of the said lower chamber are closed. The intake port to the left of the upper extension of the piston 8 in the upper chamber 7 has just been, or is on the point of, opening. The exhaust port on the right of the upper chamber 7 has opened, or is on the point of opening. The second explosion of the series being described now occurs, caused by a spark in the plug 67 at the right of the lower chamber 7. This second explosion moves the lower extension of the piston 8 to the left of the lower chamber 7, compressing the explosive mixture therein and to the left of the said piston 8. In the upper chamber 7 the upper extension of the piston 8 is moved to the right, forcing through the intake valve to the left of the upper chamber 7 a fresh charge of explosive mixture. At this instant the engine is in position where, in the lower chamber, to the right of the piston 8, the said chamber is filled with a dead charge; to the left in the said chamber is a compressed charge ready for explosion; in the upper chamber, to the left of the piston 8, is a loose fresh charge of explosive mixture; while to the right the old charge has been completely voided. At this moment a spark is caused in the lower chamber 7 to the left of the piston 8, moving the same to the right of the chamber, the exhaust port to the right of the said chamber being open to permit the scavenging of the dead charge of combusted material. The upper extension of the piston 8 has been moved to the left, compressing in the left of the upper chamber 7 the explosive mixture, while to the right of the said upper chamber and extension of the piston 8 therein has been drawn a fresh charge of explosive mixture. At this moment, after the three explosions, the engine is in the condition where, in the lower chamber on the right of the piston 8, the dead charge has been voided; to the left of the piston 8, and filling the major portion of the said lower chamber 7, is the combusted or dead charge of the former explosion; in the upper chamber 7 is held under compression a fresh charge at the left of the said upper chamber 7; while at the right of the piston 8 in the said upper chamber 7 is drawn a loose fresh charge of explosive mixture. At this moment the fourth explosion is produced by causing a spark in the plug 67 to the left of the upper chamber 7. With this explosion the cycle is completed and the parts are returned to the position above set forth at the commencement of this description. It will be observed that the explosions have been successive, and progressively arranged, and in the direction opposite to that followed by the wheel 38 and shaft connected therewith. By means of this arrangement the cams 55 and 56 are rotatively actuated over an arc of 270°, the proper disposition for the cams for operating the intake and exhaust valves in engines of the four-cycle type. As a result of the action above described it will be noticed that at each quarter of the rotation of the shaft 18 a forward impulse is imparted by one of the four explosions transpiring in the two chambers 7.

It will be observed that within a confined space there has been produced an engine, the piston area whereof is exceedingly large and the power production exceedingly great.

It will also be observed that the power impulse imparted to the shaft is even and constant, thereby equalizing and nullifying the vibration due to the direct reciprocation of a double impulse engine.

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

An explosive engine, comprising a driving shaft provided with a crank arm; two hollow sector-shaped explosion chambers disposed radially about said driving shaft and extended in opposite directions therefrom having straight radially disposed ends; walls separated to form recesses for valves and mechanism for controlling said valves; two oppositely extended piston blades integrally connected to form a central hub bearing rotatively mounted on said shaft, said piston blades being operatively extended in said explosion chambers and said blades having extended bearing ends disposed in guided relation with the cylindrical walls of said chambers; a radially extended arm fixedly connected with said pistons beyond the confines of said chambers; a crank arm fixedly mounted on said driving shaft; a plurality of pivotally united pitmen connecting said crank arm and said radially extended arm; means for guiding the united ends of said pitmen in a straight path; a plurality of valve mechanisms disposed on each of the said end walls of said chambers and having passages through said walls to within said chambers; a plurality of cam shafts mounted in bearings supported on said radial walls, said shafts being extended in parallel relation to the driving shaft; a plurality of cams mounted on said shafts and arranged in quadrated relation, said cams adapted to operate the similar valves in the adjacent valve operating mechanism at intervals of a quarter turn of said shafts; an ignition system embodying four igniters, two of which are mounted in each of said explosion chambers and one of which is disposed adjacent to each of the radial sides in said chambers; and a timing mechanism for operating the said igniters in rotative succession and in a rotary direction the reverse of that imparted to the driving shaft.

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

CHARLES EBENEEZER GOODRICH.

Witnesses:
E. L. MUDGETT,
J. O. WIFITE.