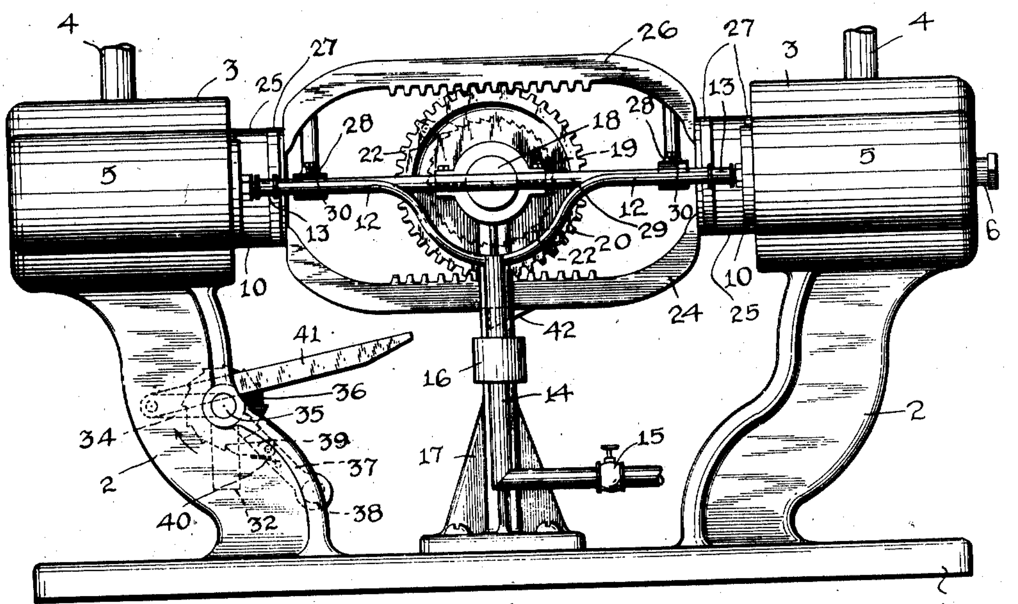
W. DINWIDDIE.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED OCT. 31, 1916.

1,365,666.

Patented Jan. 18, 1921.
2 SHEETS—SHEET 1.

Fig. 1



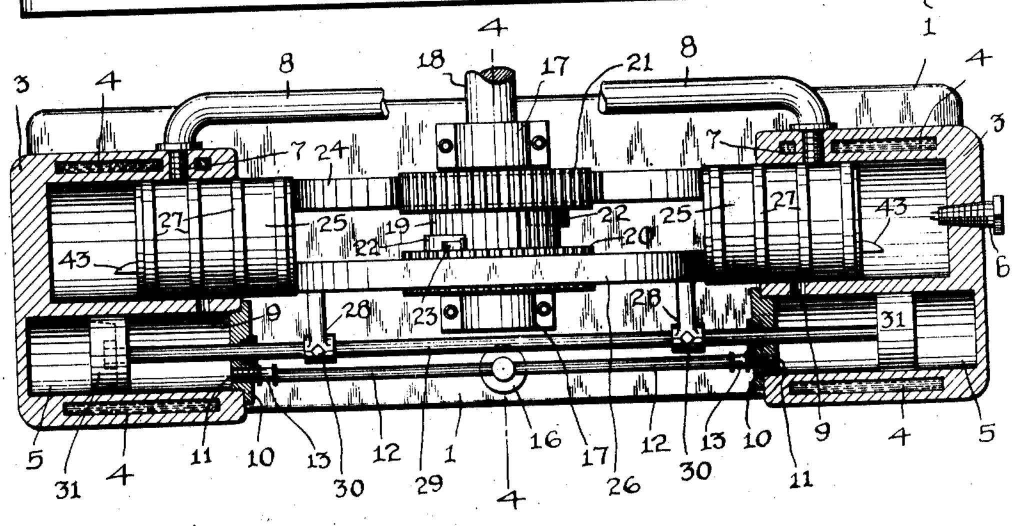


Fig. 2

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Fig. 3

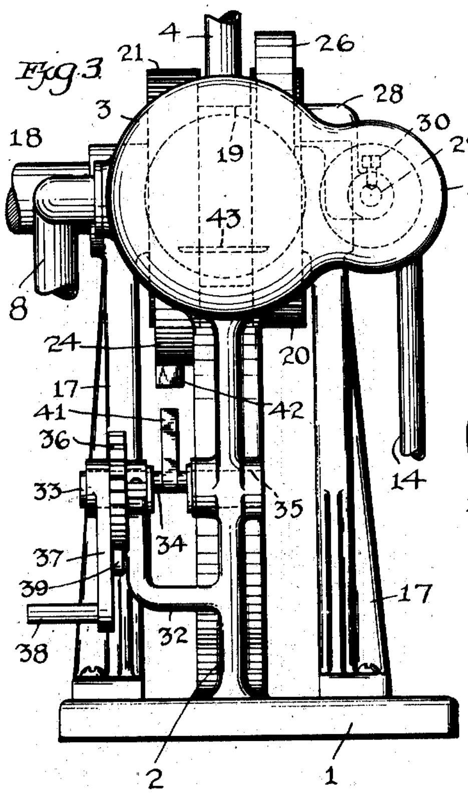


Fig. 4

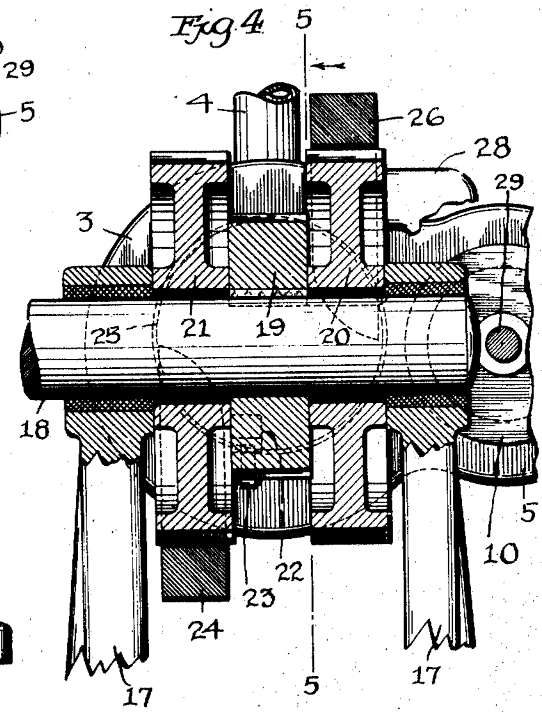
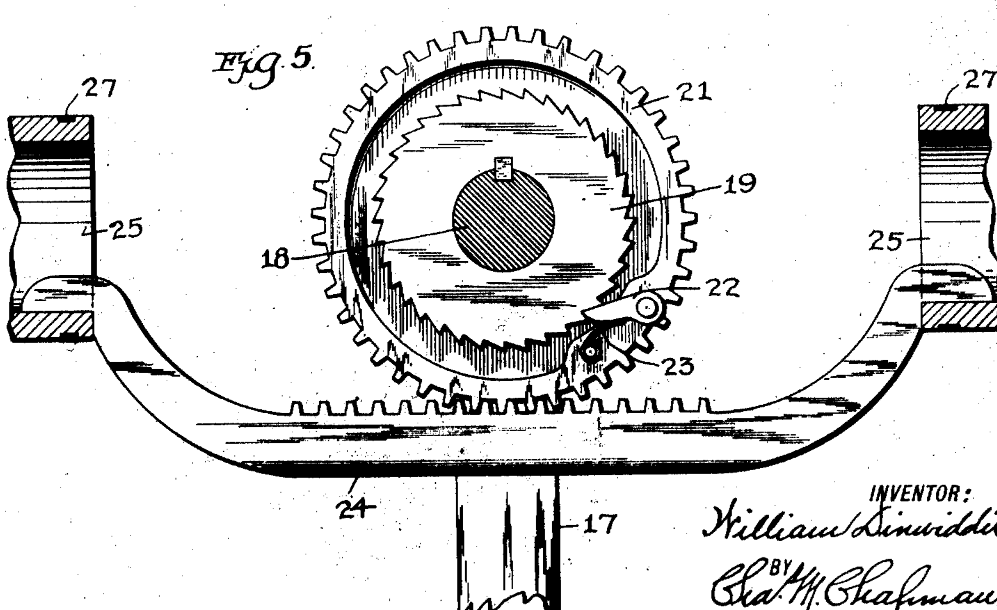


Fig. 5



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INTERNAL-COMBUSTION ENGINE.

1,365,666. Specification of Letters Patent. Patented Jan. 18, 1921.

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To all whom it may concern:

Be it known that I, WILLIAM DINWIDDIE, a citizen of the United States, residing in Metuchen, county of Middlesex, and State of New Jersey, have invented a new and useful Improvement in Internal-Combustion Engines, of which the following is a description.

This invention has reference to hydrocarbon or internal combustion engines, and particularly relates to two-cycle pre-ignition engines capable of using any kind of fluid fuel of the crudest nature and possessing a comparatively small number of heat units.

Among the objects of my invention may be noted the following: to provide a simple, inexpensive, effective, strong and durable engine, of the internal combustion type, capable of being run with crude petroleum or other cheap forms of liquid fuel and adapted, when once set in operation, to continue in operation by so-called pre-ignition, as long as the fuel lasts or the elements of the machine hold together and work properly; to provide an engine wherein the fuel is primarily compressed and then fed directly to the work cylinders, where combustion, by heat of compression, takes place and the power for work is produced; to provide a pre-ignition engine so constructed as to eliminate the usual air-pumps, air feeding mechanisms and similar gas compression devices, and to work solely on fuel fed directly to the work cylinders; to provide an internal combustion engine wherein power produced in the work cylinders is transmitted to the fuel compression cylinders to create the conditions necessary to enable the engine, when once started, to automatically produce combustion, by the heat of compression and continue in operation throughout the period of fuel-feed, or at the will of the operator; to provide a novel construction for a two-cycle pre-ignition engine capable of developing high power and of being adapted to various uses, such as stationary engines, and motor-propelled vehicles of all kinds; to provide a novel form of internal combustion engine wherein crank-shafts, dead-centers, fixed length of piston travel, and other objectionable features usually found in the modern engine, are eliminated; and to provide certain details of elemental construction adapted to carry out the workings of the engine in a simple, economical and effective manner, all as hereinafter described and set forth in the claims.

In order that my invention may be clearly understood, I have provided drawings wherein:

Figure 1 is a side elevation of an engine embodying my invention;

Fig. 2 is a sectional plan showing details of construction;

Fig. 3 is a left end elevation of Fig. 1;

Fig. 4 is a vertical section substantially on the line 4—4 of Fig. 2; and

Fig. 5 is a section substantially on the line 5—5 of Fig. 4.

It is to be understood, primarily, that my invention is adapted to any form of internal combustion engine or such engine adapted for any purpose, and that the embodiment of my invention shown in the drawings is only by way of example to illustrate the general principles and mode of operation and a simple mechanical means for producing the working structure.

Referring to the drawings, the numeral 1 indicates the base-plate or bed of the machine, 2 a pair of uprights made integral with, or bolted to, the bed, and each having its upper end formed into or provided with the work-cylinders 3, jacketed in any suitable manner as a part of a cooling system, as indicated at 4, and formed also with the fuel compression cylinders 5. One of the work-cylinders is provided with a usual spark-plug 6, connected with the ignition system in any usual way, and each work-cylinder is provided with the exhaust port 7, connected, as by pipes 8, with any usual exhaust system; and each work-cylinder, opposite the exhaust port, is provided with an inlet port 9, communicating with the fuel compression cylinders 5. The cylinders 5 are each provided with a removable head 10 having an inlet port 11, for fuel supply, connected with a supply pipe 12 having therein, in suitable position, and preferably adjacent the removable head 10, a check valve of any common form indicated conventionally at 13. The supply pipes 12 connect with the common supply pipe 14 having disposed conveniently therein a fuel stop-valve or cock 15, and which between the latter and the junction therewith of pipes 12, is provided with any suitable form of carbureter 16. Uprights 17, formed with or suitably connected to the base 1, have bearings in their upper ends in which the drive shaft 18 is journaled, the latter being disposed substantially mid-way between the inner ends of the work-cylinders and at a right-angle thereto, and being extended to any suitable point or position, where it is adapted to deliver its power. The shaft 18, between the two work-cylinders, has keyed thereto a ratchet-wheel 19 and, on opposite sides of the latter, has loosely running thereon gear wheels 20 and 21, each, as shown in Figs. 2 and 5, having pivoted thereto on its side adjacent the ratchet-wheel 19 a pawl 22, a spring 23 operating to maintain the pawl normally in engagement with the ratchet-wheel 19. The gear wheel 21 below the shaft 18 meshes with the rack-bar 24, the latter being in the form of a spread U and having its opposite ends connected, in any suitable manner, to the opposite pistons 25 which slide within the work-cylinders 3. The gear wheel 20, above the shaft 18, meshes with the rack-bar 26, identical in form with the rack-bar 24, and connected at its opposite ends in similar manner to the pistons 25. The pistons are provided with any suitable number of packing rings 27 disposed in the manner found most suitable for the purpose of preventing the escape of fluid from the compression cylinders 5 and the work cylinders 3. The upper rack-bar 26 is provided, at its opposite ends adjacent the pistons, with overhanging arms 28, the lower end of each of which latter is provided with a sleeve or bearing for the reception of the piston-rod 29, which latter is fixed to said arms in any suitable manner, as by a spot-screw 30. The piston-rod 29, at its opposite ends, passes through the head 10 and a bushing thereof in each of the compression cylinders 5, and, at its extreme ends, is provided with a piston 31. Thus, the piston-rod 29 is driven synchronously with the rack-bars 24 and 26 for the purposes hereinafter explained.

Viewing Figs. 1 and 3, it will be seen that the left one of the uprights 2 is provided with an offset and upwardly extending arm 32 forming a bearing for a stud-shaft 33, which is provided at its inner end with a head from which extends a crank 34, connected at its opposite end to the head of a similar stud-shaft 35, journaled in the adjacent upright 2. The shaft 33 next the bearing arm 32 has fixed thereto in any suitable manner the ratchet-wheel 36, and next to said ratchet-wheel has loose thereon the hub of a crank arm 37, the handle 38 of which is to be grasped by the operator. The crank arm 37 has pivoted thereon a pawl 39 held normally by the spring 40 in engagement with the ratchet-wheel 36. The crank 34 has journaled thereon a long pawl 41 adapted to coöperate with the tooth or lug 42 depending from the under side of the rack-bar 24.

From the above detail description, the following mode of operation will be readily understood:

The fuel is pumped, or fed by gravity, under control of the valve 15, through the pipe 14, to the carbureter 16, which, according to its usual mode of operation, mixes the same with atmospheric air in proper proportions, and the fuel thus provided is fed to the two-way pipes 12 into the compression cylinders 5. The check-valves 13 prevent the egress of the fuel from said cylinders 5. The water supply system will keep the cylinders 3 and 5 cool in usual manner. The engine is started by turning the crank-arm 37 and lifting the pawl-bar 41, as shown in Fig. 1, so that, as the crank 34 is moved upwardly and to the right, the end of the pawl-bar will engage the tooth 42. Continued rapid movement of the crank arm 37 will drive the rack-bars 24 and 26 to the right of Fig. 1, thus driving the right piston into the right cylinder and compressing the fuel within the work cylinder 3 and simultaneously driving the piston-rod 29 and the right piston into the right compression cylinder 5, thus freely admitting the fuel to said cylinder to the left of the piston 31. The sparking system having been set in operation and properly timed for ignition of the fuel at a certain degree of compression, the first explosion will take place in the right cylinder, as indicated in Figs. 1 and 2. In the meantime, the pawl-bar 41 will have been driven to its fullest extent to the right, Fig. 1, and the crank 34 carrying the same will have passed dead-center and will be on its descending movement, this always occurring considerably before the sparking period. Thus, the explosion in the right cylinder will, should it take place prematurely, drive the pawl-bar backwardly on the descending movement of the crank, thus causing the ratchet-wheel 36 to slip by the pawl 39 and avoid any backlash to the crank arm 37. The pawl-bar 41 will naturally, during this movement by its own weight, turn on the crank 34 and drop away from the tooth 42. The explosion in the right cylinder drives all the pistons to the left. The result of this action is that exhaust will take place in the right cylinder 3, and compression in the left cylinder 3, while compression of fuel in the right cylinder 5 will take place while intake of fuel occurs in the left cylinder 5. When the pistons have been driven to the left by the maximum power of the explosion in the right cylinder, exhaust will take place in the right cylinder followed by the inlet of fuel under high compression from right cylinder 5 to right cylinder 3, thus completing the cycle and scavenging the right cylinder 3. In the meantime, compression in the left cylinder 3 has reached the point of ignition and explosion, resulting in driving all the pistons to the right, thus compressing fuel in the left cylinder 5, during which exhaust takes place from the left cylinder 3, followed by inlet of highly compressed fuel and scavenging. To prevent too much loss of fuel from the work cylinders while the exhaust ports are open and scavenging is taking place, the deflecting-plates 43 are provided at the end of the pistons 25 within the cylinders 3, which operate to deflect the highly compressed fuel toward the outer end of the work cylinders, which, together with the explosion of the fuel within the work cylinders, will drive out all residue of products of combustion or waste. The foregoing operations continue until the supply of fuel is exhausted or is cut off. The operations just described obviously drive the rack-bars simultaneously and, during the left movement thereof, the top rack-bar 26 causes its gear wheel 20 to drive its pawl 22 so as to slip over the ratchet-wheel 19. During this operation, the lower rack-bar 24 positively drives the ratchet-wheel through the medium of its pawl 22, thus driving the shaft 18 and transmitting the power to the point of use. Reverse movement of the rack-bars causes the lower rack-bar to drive its gear wheel so that its pawl will slip over the ratchet-wheel, while the upper rack-bar will drive its gear wheel so that its pawl will positively drive the ratchet-wheel in the same direction as before, thus transmitting its power to the shaft 18 and to the point of consumption or use. It will thus be seen that the reciprocating motions of the engine are converted into intermittent rotary motion at the driving shaft 18, and that the engine is run purely on fluid fuel in the usual mode of internal combustion engines.

From the foregoing it will be understood that, in the operation of my invention, I have taken advantage of the well known physical law that compression of gases produces heat and that, in so doing, I have produced a practical, mechanical means to compress a mixture of a hydrocarbon and a gas to produce a temperature sufficiently high to ignite or explode the mixture without recourse to sparking means, flame production, heated wires, etc., excepting to produce first or initial explosion. It will also be understood, that after the first impulse in a work cylinder, produced in any well known manner, sufficient power is generated to compress the explosive mixture in opposed or otherwise suitably arranged cylinder and to ignite or fire the same by the heat of compression only, and that this operation continues indefinitely, regardless of the arrangement of the work cylinders; that is to say, an explosion in one work cylinder or set of cylinders is utilized to compress the mixture in another or set of cylinders and produce an explosion therein to be followed by the compression of the mixture in the first cylinder or set thereof and so on indefinitely. It will be further understood that my invention is not confined to a two-cylinder engine, nor to a two-cycle engine, since the cylinders may be multiplied to any practical number, and the engine can be designed as a four-cycle, or any other number of cycles desired, by the employment of well known mechanical arrangements.

The importance of my invention is emphasized by reference to the fact that all hydrocarbon or internal combustion engines, which embody mechanical arrangements including definite or fixed lengths of piston travel, crank shafts, and other structures, wherein dead-centers occur, are limited in their power production by the so-called pre-ignition factor, which demands that the compression of the hydrocarbon or gas mixture in the work cylinder shall not be so great as to cause the fluid to pre-ignite or explode before the piston has completed its travel or reached a point wherein, in the connected mechanism, dead-centers have been passed. If pre-ignition or premature explosions take place in engines of the designs which are now known, knocking, backfire and back-thrusts occur, which result in loss of effective power; but, in the operation of my engine, these defects are eliminated, since pre-ignition, if said expression can be used in connection with the explosion taking place in the work cylinder of my engine, results only in effective power, producing useful work; and no dead centers can occur, since the mechanism is of a type to eliminate the same and take advantage of minimum compression, as well as maximum compression, and any intermediate degree of compression, up to the theoretical or actual point of ignition. Hence, it will be readily seen that my invention permits the use of all kinds of hydrocarbons in the same engine, since it is able to take advantage, in the most effective manner, of the pre-ignition principle involved in the production of heat from gases by compression.

In the drawings, I have illustrated a specific form of clutch mechanism, a specific form of connection between opposing cylinders, and other details constituting a mechanical embodiment of my invention; but, it is to be understood that any form of clutch may be employed, as well as any other mechanical connection between pairs of cylinders, and that the latter may be differently arranged, all within the scope of my invention.

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

1. In an internal combustion engine, the combination of a work cylinder having an exhaust port, and also an inlet port; means for compressing the fuel within the work cylinder; means for feeding the fuel directly to the work cylinder under compression; a drive shaft; and a slip-clutch connection between the said shaft and the fuel compression and feeding means for actuating both said means.

2. In an internal combustion engine, the combination of a plurality of independent, widely spaced apart work cylinders, each having an exhaust port and an inlet port at substantially opposite points; pistons operating within the work cylinders to compress the fuel; means for feeding the fuel directly to the work cylinders under compression; common means for supplying the fuel to the fuel-feeding means; and means for actuating the pistons located in the space between the cylinders, including slip clutches.

3. In an internal combustion engine, the combination of a work cylinder; means for compressing fuel in said cylinder, the latter comprising a piston having a bar connected thereto, said bar having a lug; a pawl-bar for coöperation with said lug; and slip-clutch mechanism for actuating the pawl-bar into engagement with said lug.

4. In an internal combustion engine, the combination of a work cylinder; means for compressing fuel therein including a piston; a bar connected thereto having a lug; a pawl-bar for coöperation with said lug; a clutch mechanism; and a pivotal connection between the clutch mechanism and the pawl-bar.

5. In an internal combustion engine, the combination of a pair of oppositely arranged, spaced apart, alined work cylinders, each having an exhaust port and an inlet port near one end thereof; a compression cylinder combined with each of said work cylinders and extending in parallelism therewith and adjacent thereto, the said inlet port of each of the work cylinders entering the adjacent compression cylinder near one end thereof; means for feeding fuel simultaneously to both compression cylinders; pistons in the respective work cylinders and compression cylinders; means rigidly connecting the several pistons for conjoint operation; a rotary shaft and means for actuating the same from said rigid connection, including a slip clutch whereby each movement of reciprocation of the rigid connection will impart rotary motion to the said shaft.

6. In an internal combustion engine, the combination of a pair of oppositely arranged, spaced apart, alined work cylinders, each having an exhaust port and an inlet port near one end thereof; a compression cylinder combined with each of said work cylinders and extending in parallelism therewith and adjacent thereto, the said inlet port of each of the work cylinders entering the adjacent compression cylinder near one end thereof; means for feeding fuel simultaneously to both compression cylinders; pistons in the respective work cylinders and compression cylinders; means rigidly connecting the several pistons for conjoint operation; a rotary shaft and means for actuating the same, including a ratchet-wheel mounted on the shaft to rotate therewith; a pair of gear-wheels mounted on the shaft to rotate independently thereof; a pawl carried by each of said gear-wheels for engagement with said ratchet-wheel whereby to in turn impart movement thereto and to said shaft; and means carried by the said rigid connection to coöperate with the said gear-wheels and to impart thereto intermittent rotation during reciprocations of the pistons.

7. A hydrocarbon engine having, in combination, a supporting base; a pair of spaced apart uprights extending from said base, each of said uprights carrying a work cylinder and a compression cylinder, chambers of the two cylinders being substantially coextensive and arranged in parallelism; pistons working in the several cylinders; a rigid connection between the several pistons; an exhaust port near the end of each work cylinder; an inlet port near the end of each work cylinder and communicating with the adjacent compression cylinder, the rigid connection between the several pistons being arranged between the uprights; a carbureter common to the two compression cylinders arranged between the latter and having a connection thereto entering one end thereof adjacent the said inlet port; and means arranged between the two uprights adapted to be operated by the said rigid connection to transmit the reciprocating motions thereof and transform the latter into rotary motion.

8. A hydrocarbon engine having, in combination, a pair of oppositely disposed work cylinders; pistons working in said cylinders for compressing the fuel charge; a sparking device in one of said cylinders only;

fuel compression means for feeding fuel to the cylinders while being compressed; means for rigidly connecting the pistons for reciprocal action; and means for transforming the reciprocating action of the pistons into rotary motion, the interaction and relation of the elements being such that, after the initial impulse is given to the pistons by firing the charge in one cylinder by the sparking device, the operation of the engine is continued by firing the explosive mixture by heat of compression in both cylinders.

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