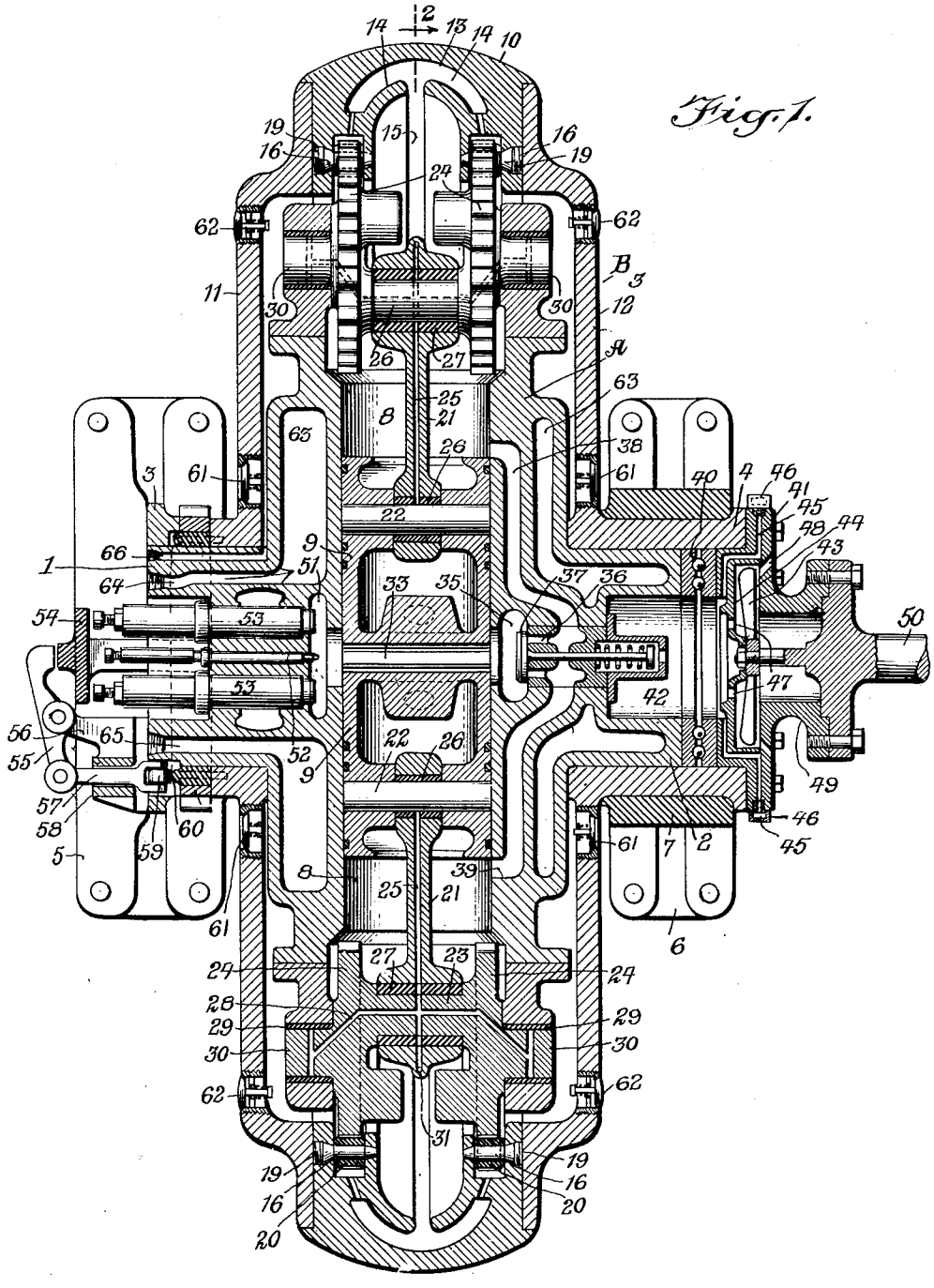
Nov. 29, 1932. F. M. DAINTON 1,889,641

INTERNAL COMBUSTION ENGINE

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Fig. 1.



WITNESSES

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INTERNAL COMBUSTION ENGINE

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Fig. 2.

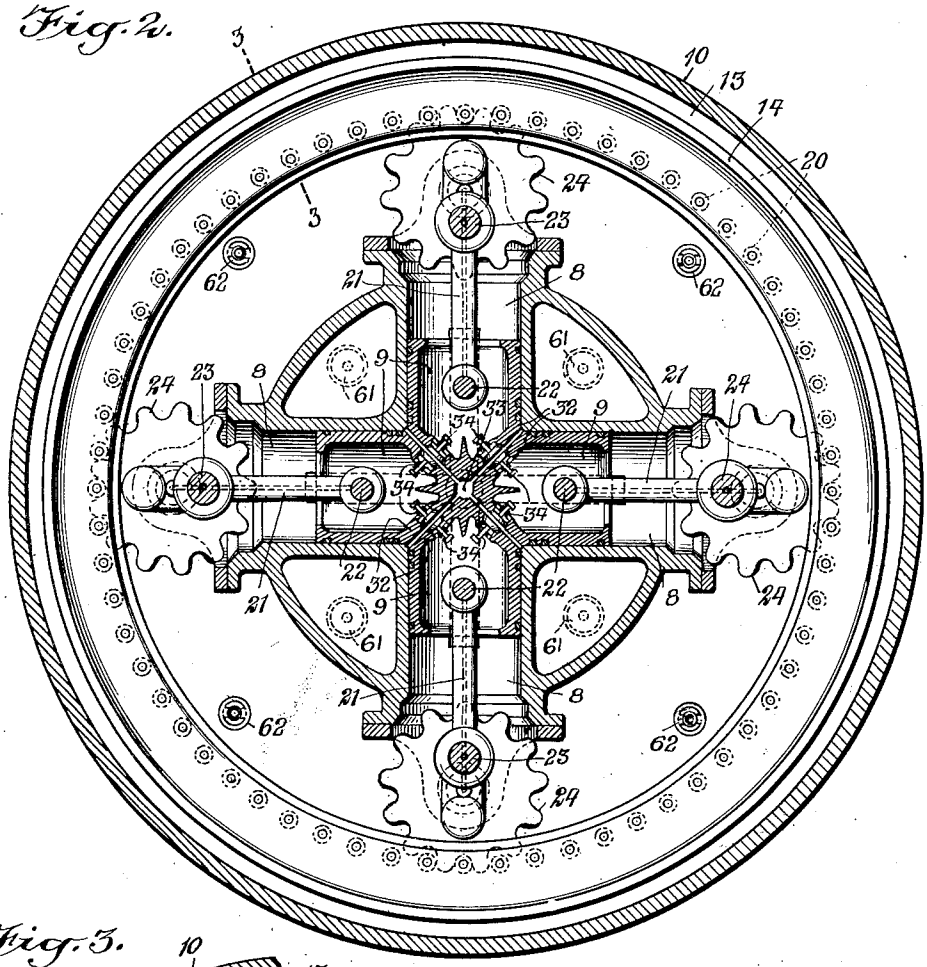


Fig. 3.

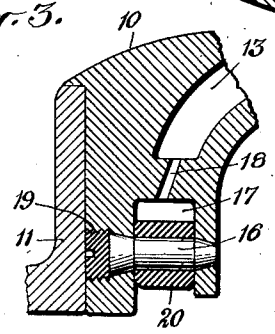
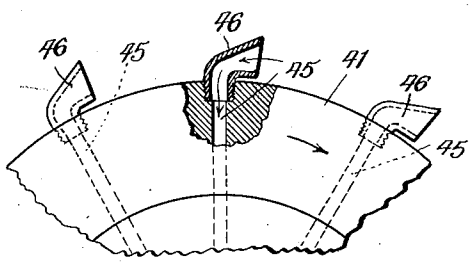


Fig. 4.



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INTERNAL COMBUSTION ENGINE

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Fig. 5.

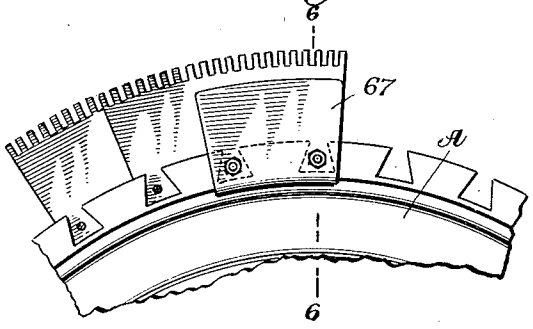


Fig. 6.

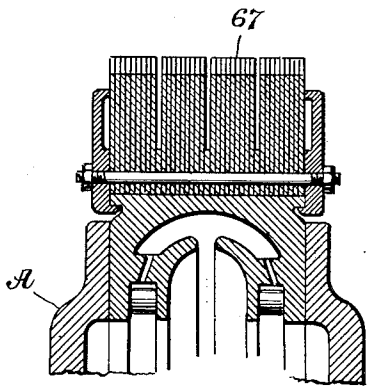


Fig. 7.

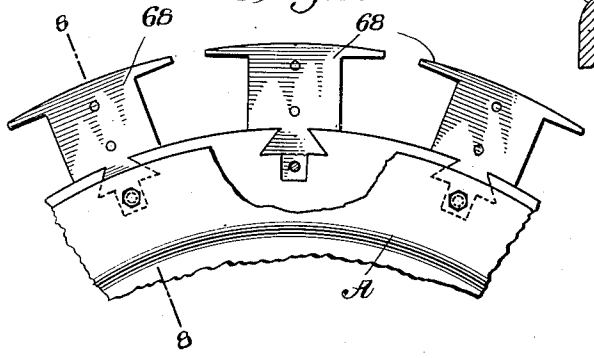
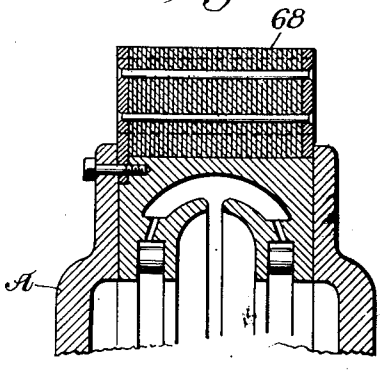


Fig. 8.



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UNITED STATES PATENT OFFICE

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INTERNAL COMBUSTION ENGINE

Application filed November 6, 1930. Serial No. 493,869.

This invention relates to internal combustion engines, and more particularly to Diesel engines of the four-cycle type.

An object of the invention is to provide an engine having a rotary casing to which motion is imparted by reciprocating pistons in a block stationary within the casing.

A further object is to provide an engine of this character, with improved air admission and controlling valves within the heads of the pistons which function to admit supercharges of air on the intake strokes of the piston, whereby the air confined by the pistons on their intake strokes is at a desired pressure before the compression strokes of the pistons begin.

A further object is to provide an improved arrangement of valves and ports for the initial admission of an air supply to the space between the pistons.

A further object is to provide an engine of this character with an improved arrangement of lubricating chamber in which the lubricant is held in proper relation to the chamber by the centrifugal action of the engine, and supplied to the various bearings through passages in the connecting rods.

A further object is to provide an improved self-contained air pump for maintaining a bearing cool within the engine.

With these and other objects in view, the invention consists in certain novel features of construction and combinations and arrangements of parts, all of which will be more fully hereinafter described and pointed out in the claims.

In the accompanying drawings—

Figure 1 is a view in longitudinal, vertical section of my improved engine, portions of the engine at the upper part of the figure being shown in elevation;

Figure 2 is a view in vertical section on the line 2—2 of Figure 1;

Figure 3 is an enlarged fragmentary section illustrating one of the pins of the casing and its mounting;

Figure 4 is a fragmentary view on a large scale, mainly in elevation and partly in section or broken away, illustrating the air intake nozzles of the air cooling mechanism, illustrated at the right of Figure 1;

Figure 5 is a fragmentary view in side elevation showing how my improved engine may be constructed to constitute an electric dynamo of the direct current type;

Figure 6 is a view in section on the line 6—6 of Figure 5;

Figure 7 is a fragmentary view in side elevation, partly broken away, showing how my improved engine may be equipped to form a dynamo of the alternating current type; and

Figure 8 is a view in section on the line 8—8 of Figure 7.

My improved engine comprises an engine block, indicated as a whole by the reference character A, which is of general circular form, and has cylindrical enlargements 1 and 2 at its respective ends constituting stubs on which cylindrical bearing sleeves 3 and 4, respectively, of my improved casing B are mounted to turn.

It is to be understood that the block A is stationary and may be rigidly supported by suitable frame-work 5 at the end of the enlargement, 1 and a frame-work 6 may be provided at the opposite side of the engine having a bearing sleeve 7 in which the bearing sleeve 4 turns.

The engine block A is formed with a series of (preferably four) radial bores constituting engine cylinders 8 in which working pistons 9 are mounted to reciprocate. As all of the cylinders and the working pistons and co-operating elements of all the cylinder units are precisely alike, the same reference characters will be employed to indicate like parts in each of the cylinder and piston assemblages.

The casing, indicated generally by reference character B, comprises a central or intermediate annular ring 10 to which side plates 11 and 12 are secured in any approved manner. The intermediate ring portion 10 of the casing B is formed with an annular internal lubricant chamber 13, which has converging flanges or walls 14 spaced apart to provide a slot 15 all around the casing in open communication with the interior thereof.

This ring portion 10 of the casing B is formed with two spaced circular series of

pins 16 constituting racks. I would call particular attention to the construction of mounting for these pins 16 which facilitates their removal and replacement in the event of injury, and insures a strong and durable structure. Attention is particularly directed to the detail view, Figure 3 of the drawings, illustrating one of these pins 16 and its mounting.

The pins 16 are preferably made from a high grade steel, heat treated, hardened and ground full surface. They have a two-step taper and extend across a groove 17 in the ring 10, said groove being connected by lubricant ducts 18 with the lubricant chamber 13. The two-step taper pin is inserted in place by a snug driving fit and same held in place by a screwed dowel or pipe plug 19. The outer plates of the casing, 11 or 12 as the case may be, bear against the outer ends of the pins and prevent any possibility of their displacement, but in the event a pin is broken the casing plate may be removed and a new pin inserted.

Connecting rods 21 connect pins 22 carried by the pistons 9 with crank pins 23 connecting pairs of toothed wheels 24. These toothed wheels mesh with the racks formed by the pins 16, but more specifically with the rollers 20 carried by said pins, and a reciprocating motion of the pistons imparts rotary motion to the toothed wheels 24, and the latter transmit rotary motion to the casing B.

The connecting rods 21 have longitudinal lubricant ducts 25 therein which communicate with bearing sleeves 26 and 27 on the pins 22 and 23, respectively. The crank pins 23 have longitudinally extending lubricant ducts 28 communicating with bearings 29 in the engine block A, in which axle stubs 30 on the toothed wheels 24 have rotary mountings. The extremity of the connecting rod 21 has an opening or entrance 31 for the lubricant which is caught up by the connecting rod in its motion so that lubricant is supplied to the several bearings by the action of the engine.

Of course, it will be understood that the turning movement of the engine maintains the lubricant normally in its chamber 13 by centrifugal force, and this lubricant is more or less under agitation so that the movement of the several parts insures a proper lubrication of the bearings.

It will be particularly noted by reference to Figure 2 of the drawings, that all of the engine cylinders 8 communicate at the center of the engine block, and that all of the pistons 9 have tapered inner ends or heads 32 with slightly curved extremities so that at the extremity of their inward strokes a relatively small space 33 is provided, and radial spaces are provided between the pistons so as to insure an efficient operation after ignition and during the working strokes of the pistons, and also owing to the high turbulent effect an unrestricted area of piston displacement is had.

The pistons 9 are provided in their working faces with check valves 34 for a purpose which will more fully hereinafter appear.

The engine block at its center and at one side thereof is formed with an air chamber 35 in open communication with all of the cylinders and with the space 33 above referred to. The outer wall of this chamber 35 has air inlet ports 36 which are normally closed by a check valve 37 opening inwardly. The ports 36 all communicate with radial passages 38, the ends of which constitute ports 9 communicating with the interior of the cylinders 8 and opened and closed by the working pistons 9, these ports being fully opened only when the pistons are at the extreme of their inward strokes, and at other times are closed by the pistons.

At this same side of the engine, where the valve 37 and passages 38 are located, a roller or other anti-friction thrust bearing 40 is provided between the enlargement 2 of the engine block A and a disk-like head 41 fixed to the bearing sleeve 4 of the engine casing B. A relatively large air chamber 42 is formed in the end of the enlargement 2, and a fan or blower 43 is located in a fan chamber 44 in the head 41.

A series of radial air inlet ports 45 are provided in the head 44 and communicate with the air chamber 42. Cup-like entrance nozzles 46 are provided at the ends of these ports 45 so that as the head revolves air will be drawn into the air chamber.

The fan or blower casing 44 has exhaust ports 47 and 48 in its walls through which air is drawn out of the chamber 42 by the action of the fan 43, and it will be understood that as the fan revolves a continuous flow of swirling air will be had within the chamber 42 to maintain the bearing cool.

The head 41 has an extension 49 thereon to which one end of a shaft 50 is fixed, and this shaft constitutes the driving shaft of the engine, although it is also possible to take off power from the periphery of the casing B.

The engine block A at the side thereof opposite to the valve 37 is formed with a chamber or space 51 in open communication with the interior of all of the cylinders and with the space 33 above referred to. An injection nozzle 52 is mounted in the enlargement 1 and communicates with the space or chamber 51, and a pair of exhaust valves 53 are also mounted in the enlargement 1 and communicate with said chamber or space 51. These exhaust valves are opened by the movement of an arm 54 controlled by a tappet lever 55, said lever pivoted between its ends by a bracket 56, and at its free end adapted to engage the arm 54. The outer end of the

lever 55 is pivotally connected to a link 57 mounted in a guide sleeve 58 in the engine support 5, and carries a roller 59 at its inner end in engagement with a cam ring 60 on the bearing sleeve 3 of casing B, so that as this cam ring is revolved it will time the opening of the exhaust valves 53.

The casing B is provided with air inlet check valves 61 and air escape governing valves 62. The valves 61 open inwardly and the valves 62 open outwardly, and said valves 62 are appreciably smaller and control smaller ports than do the valves 61, and are useful only in preventing over-pressure within the engine casing.

The engine block A may have any suitable arrangement of water jackets 63 in communication with inlet and outlet passages 64 and 65, respectively, and a normally closed inlet 66 may be provided in the enlargement 1 for the insertion of lubricant into the casing, or for the attachment of air pressure means to give the air within the casing a normal initial pressure, such as may be desired.

In Figures 5 and 6 of the drawings, I illustrate members 67, secured to the periphery of the engine casing A to form a dynamo of the direct current type, and in Figures 7 and 8 I illustrate the same general idea with members 68 secured to the periphery of the casing A to form a dynamo of the alternating current type. It will thus be noted that the casing may constitute in effect the rotor of a dynamo, but power may be taken directly from the drive shaft 50 and both sources of power may be utilized as may be desired.

The operation of the engine as above described is as follows: In Figures 1 and 2 of the drawings the pistons are shown in their extreme inward positions, which we will assume is the firing position. In describing the operation of the engine the strokes or cycles of the piston will be referred to as "inward" and "outward," as contradistinguished from the ordinary terminology of "upward" and "downward," because the several cylinders are radially positioned; while one is moving downwardly the opposite piston is moving upwardly, and the two horizontal pistons are moving in horizontal planes.

With the parts as indicated in the drawings, when the air is under maximum compression in the space 33 between the heads of the working pistons, the valve 37 is held closed by the pressure of air, but the ports 39 and passages 38 are in open communication with the interior of the casing as the pistons, when in their innermost positions, fully open the ports 39; hence, the pressure back of the valve 37 is equal to the pressure within the casing.

As the engine illustrated is of the Diesel type, an injector nozzle 52 is indicated, which may inject a solid stream of hydrocarbon, but, of course, the invention is not limited to the injection ignition means nor to the type of fluid injection employed.

When the injection takes place it is ignited by the compressed air and the pistons 9 are driven outwardly by the expansion of the burning gases. This, of course, constitutes the working stroke of the pistons and a turning motion is imparted to the toothed wheels 24 through the medium of connecting rods 21. The toothed wheels engage the racks comprising the circular series of pins 16 with rollers 20 thereon to reduce friction to a minimum, and the casing B is given a rotary movement.

On the second cycle or inward movement of the working pistons the burnt gases are forced outwardly through the exhaust valves 53 as these valves are opened, and held open during the complete second cycle or scavenging movement of the piston. On the third cycle, or intake stroke of the pistons, the pressure in the space between the pistons falls sufficiently to cause or permit the valve 37 to open and the compressed air in the passages 38 passes into the space 33 between the pistons, but as these passages are cut off by the pistons on their downward strokes additional air in the form of a super-charge is forced into the space 33 by the outward movement of each piston. As this outward movement of each piston compresses the air within the casing, such air rushes past the check valves 34 into the space between the pistons. Therefore, on the intake stroke of the pistons air is first admitted by the opening of the valve 37 and later by the opening of the valves 34 in the pistons, so that when the pistons reach the extremities of their suction or intake strokes a volume of air will be entrapped between the heads of the pistons of a pressure equal to the pressure of air within the casing.

On the fourth cycle, or compression stroke, of the pistons this air already under pressure, is compressed by the combined action of the pistons into a relatively small space so that air pressures proper for Diesel engines can be readily obtained. This is due not only to the combined action of the pistons but to the tapered formation of the heads of the pistons, so that the space between the heads is relatively small as compared to the volume of air which is entrapped and compressed therein. Pressures of seven hundred pounds or more can easily be accomplished, and this is amply sufficient for proper Diesel operation.

During the operation of the engine a swirling air-cooling operation is assured by reason of the fan 43, as above described, so that the thrust bearing 40 is maintained cool under all conditions, and in a very real sense this construction provides a self-contained air-cooling pump.

The rapid rotation of the casing B causes the lubricant in the chamber 13 to completely encircle the engine by reason of centrifugal force, and the movement of the connecting

rods 21 causes a certain pick-up of lubrication in the several ducts, as above explained, to carry lubricant to the bearings of the engine.

It will be particularly noted that by reason of the circular formation of the engine as a whole, the radial disposition and movements of the pistons in their cylinders, and the thrust imparted uniformly at different points or segments of the casing, insure a properly balanced engine and the arrangement of passages, chambers and weight is such that the engine has a symmetrical formation to maintain proper and efficient balance.

In an engine of this type no balance wheel is necessary as the casing itself constitutes the balance wheel with sufficient momentum to carry the pistons past dead center under all conditions. As above stated, the casing may constitute a prime mover and function as the rotor of a dynamo, or it may transmit motion mechanically to some other moving part, and, of course, the drive shaft 50 is primarily adapted for transmitting motion created by the engine.

In describing the operation of the engine, I have described the valve 37 as opening on the outward or intake strokes of the pistons, and it is obvious that this opening of the valve 37 will take place as soon as the pressure in the space between the pistons falls below that of the pressure of air back of the valve; hence, it is altogether possible that this valve may open before the exhaust valves 53 are completely closed, as the sudden inrush of air past this valve may function to complete the scavenging action. However, this timing of the opening of the valve may be varied to suit conditions, and this sudden inrush of air past the valve 37 may be utilized for scavenging purposes, if desired.

While I have illustrated what I believe to be the preferred embodiment of my invention, it is to be distinctly understood that various slight changes may be made with regard to the form and arrangement of parts without departing from my invention, and hence I do not limit myself to the precise details set forth but consider myself at liberty to make such changes and alterations as fairly fall within the spirit and scope of the claims.

What I claim is:

1. In an internal combustion engine, the combination with an engine block, an air-tight hollow casing mounted to turn thereon, and check valves controlling the passage of air into and from the casing, of radially positioned cylinders in the block communicating at their inner ends, reciprocating pistons in the cylinders, means operatively connecting the pistons to the casing which transform the reciprocating movements of the pistons into rotary movement of the casing, said block having air passages normally closed by the pistons and opened by the pistons when the latter are at the ends of their inward strokes, a check valve opening into the space between the pistons and admitting air from the passages to said space, and exhaust valves communicating with said space.

2. In an internal combustion engine, the combination with an engine block, an air-tight hollow casing mounted to turn thereon, and check valves controlling the passage of air into and from the casing, of radially positioned cylinders in the block communicating at their inner ends, reciprocating pistons in the cylinders, means operatively connecting the pistons to the casing which transform the reciprocating movements of the pistons into rotary movement of the casing, said block having air passages normally closed by the pistons and opened by the pistons when the latter are at the ends of their inward strokes, a check valve opening into the space between the pistons and admitting air from the passages to said space, exhaust valves communicating with said space, and check valves in the heads of the pistons opened by air pressure in the casing on the outward intake strokes of the pistons.

3. In an internal combustion engine, the combination with an engine block, an air-tight hollow casing mounted to turn thereon, and check valves controlling the passage of air into and from the casing, of radially positioned cylinders in the block communicating at their inner ends, reciprocating pistons in the cylinders, means operatively connecting the pistons to the casing which transform the reciprocating movements of the pistons into rotary movement of the casing, said block having air passages normally closed by the pistons and opened by the pistons when the latter are at the ends of their inward strokes, a check valve opening into the space between the pistons and admitting air from the passages to said space, exhaust valves communicating with said space, said pistons having tapering ends with concave recesses at their inner extremities forming an explosive chamber.

4. In an internal combustion engine, the combination with an engine block, an air-tight hollow casing mounted to turn thereon, and check valves controlling the passage of air into and from the casing, of radially positioned cylinders in the block communicating at their inner ends, reciprocating pistons in the cylinders, means operatively connecting the pistons to the casing which transform the reciprocating movements of the pistons into rotary movement of the casing, said block having air passages normally closed by the pistons and opened by the pistons when the latter are at the ends of their inward strokes, a check valve opening into the space between the pistons and admitting air from the passages to said space, exhaust valves communicating with said space, and

check valves in the heads of the pistons opened by air pressure in the casing on the outward intake strokes of the pistons, said pistons having tapering ends with concave recesses at their inner extremities forming an explosive chamber.

5. A four-cycle engine of the Diesel type, including a block, a rotary casing on the block constituting an air chamber, radial cylinders on the block communicating at their inner ends, pistons mounted for reciprocating movement in the cylinders and spaced from each other at their working faces, a toothed rack on the casing, gear wheels meshing with the rack, crank pins on the gear wheels, and connecting rods connecting the pistons and the crank pins whereby the reciprocating movement of the pistons is transformed into a rotary movement of the casing, chambers at opposite sides of the block in open communication with the space between the pistons, means for directing air into one of said chambers, and means for exhausting from the other of said chambers.

6. A four-cycle engine of the Diesel type, including a block, a rotary casing on the block constituting an air chamber, radial cylinders on the block communicating at their inner ends, pistons mounted for reciprocating movement in the cylinders and spaced from each other at their working faces, a toothed rack on the casing, gear wheels meshing with the rack, crank pins on the gear wheels, and connecting rods connecting the pistons and the crank pins whereby the reciprocating movement of the pistons is transformed into a rotary movement of the casing, chambers at opposite sides of the block in open communication with the space between the pistons, means for directing air into one of said chambers, means for exhausting from the other of said chambers, and means for directing a fuel charge into the space with which the exhaust valves communicate, and means operated by the turning movement of the casing for timing the opening of the exhaust valves.

7. An engine as set forth in claim 5, in which said block is provided with air passages connecting the cylinders with the space having the air inlet valve therein, said passages being open only when the pistons are in their extreme inward positions.

8. An engine as set forth in claim 5, in which the reciprocating movements of the pistons operate to compress the air in the casing which is admitted through valves in the pistons on the extreme of their outward intake strokes.

9. An engine of the character described including a stationary block having a series of radially extending communicating cylinders, reciprocating pistons in the cylinders, a casing having rotary mounting on the block and constituting an air chamber, check valves admitting air to the casing, other check valves governing the pressure within the casing, means operatively connecting the pistons and the casing for transmitting rotary movement of the casing, valved passages in opposite sides of the block, and valved ports in the pistons through which air is directed and controlled by the action of the pistons.

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