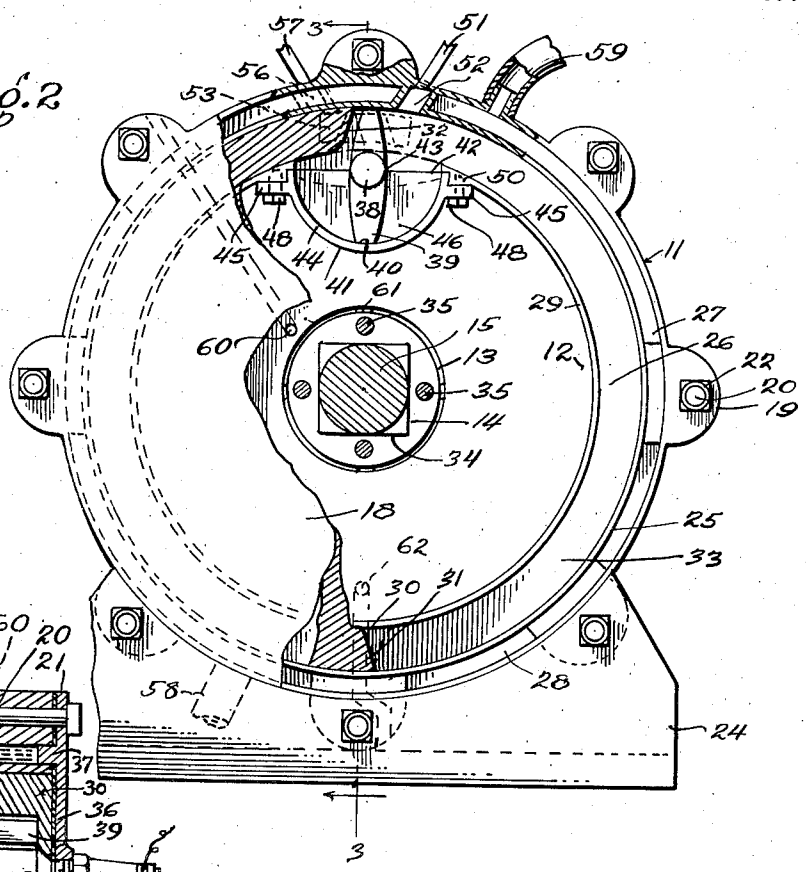
Jan. 7, 1941. W. E. STRITE 2,228,184

INTERNAL COMBUSTION ENGINE

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Fig. 2



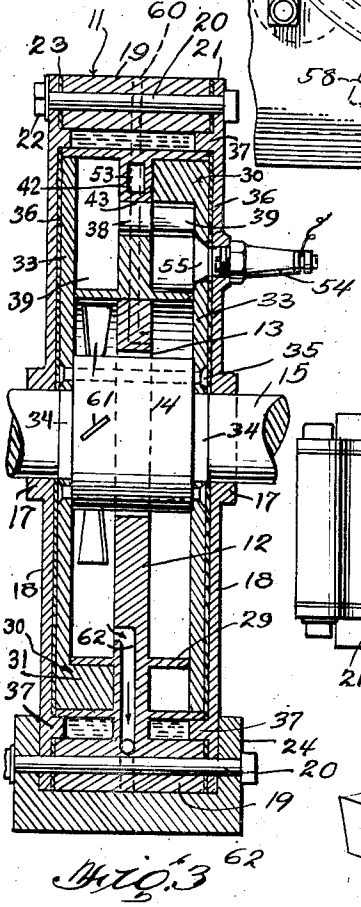


Fig. 3

Fig. 1

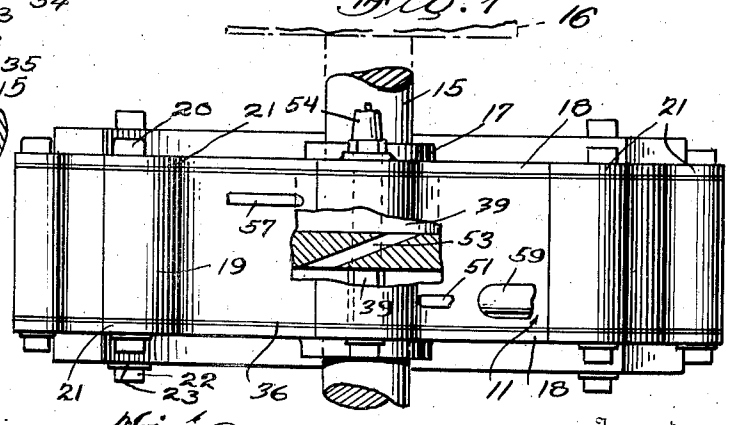
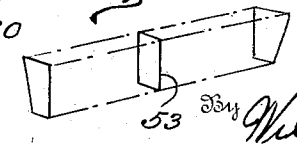


Fig. 8



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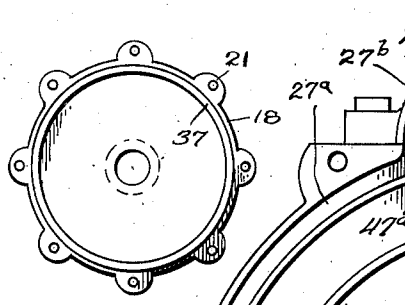


Fig. 5

Fig. 9

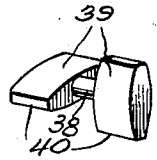


Fig. 6

Fig. 4

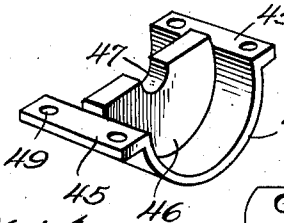


Fig. 7

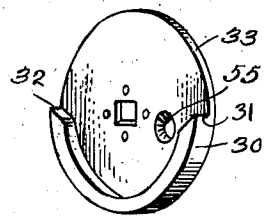


Fig. 10

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UNITED STATES PATENT OFFICE

2,228,184

INTERNAL COMBUSTION ENGINE

Worthey E. Strite, Washington, D. C.

Application August 31, 1938, Serial No. 227,829

7 Claims. (Cl. 123—13)

This invention relates to certain new and useful improvements in internal combustion engines of an improved type in which the four cyclic steps of fuel treatment obtains in a single rotation of the piston structure.

The primary object of the invention resides in the provision of an internal combustion engine of this type which is of extremely simple construction and operation as well as highly efficient and light in weight and which will give the maximum of power with the minimum of fuel.

Another object of the invention resides in the provision of an internal combustion engine of the character stated in which the engine is constructed in such a manner that each rotation of the piston structure and each complete revolution of the power shaft both coincide with each four cyclic steps of fuel treatment or each cycle of operation of the engine.

A further object of the invention resides in the provision of an internal combustion engine of the type stated which broadly follows the principles of operation of all previous types of cycle internal combustion engines as far as the cyclic steps of fuel treatment is concerned but which naturally necessitates the provision of a special new type of piston and piston chamber as well as many other new features of structure of various parts of the internal combustion engine, some quite extensive in character, in order to evolve this new type of engine.

A further object of the invention resides in the production of an internal combustion engine of the character hereinbefore set forth and in which an entirely new type of both construction and operation of valve (which sometimes serves as an abutment against which the gases reach) is employed for novel cooperation with the new type of piston and with the valve chamber communicating with the piston chamber and serving jointly therewith to receive the charge, at times, and in which to fire the charge, at times, and also to serve as a confining space during compression so that pressure may be built up on the spent gases so they will then be exhausted to the atmosphere.

A still further object of the invention resides in the provision of an internal combustion engine of the character stated which is of such improved and simplified construction that cams, springs and the like as employed in many previous engine structures are eliminated.

Other objects of the invention will appear in the following detailed description, taken in connection with the accompanying drawings forming a part of this specification and in which drawings:

Figure 1 is a plan view of the complete engine with parts broken away.

Figure 2 is a side elevation, with parts broken and parts in section, the side cover plate for this side of the engine being partially removed or omitted in this view.

Figure 3 is a vertical transverse section through the engine, taken substantially on the plane of line 3—3 of Figure 2.

Figure 4 is a reduced perspective view of one of the two rotating discs and the piston part carried thereby.

Figure 5 is a reduced perspective view of one of the side cover plates, showing the inner face thereof.

Figure 6 is a detailed perspective of the valve.

Figure 7 is a detailed perspective of the suspended half of the valve casing.

Figure 8 is a diagrammatic view to illustrate the walls of the charge passage through the solid central wall of the stator and between the piston chamber parts.

Figure 9 is an elevation of a modified form of the engine with the side cover plate removed and some parts omitted but showing the parts that are modified.

Figure 10 is a fragmentary elevation of the side cover plate employed in the modified form.

Referring more particularly to the drawings wherein like characters indicate like and corresponding parts throughout the several views and in which views the engine is shown as a complete simple unit, it is to be noted that the engine includes a one piece stator 11 in the form of a ring with an inner central solid wall 12 through which a central opening 13 is provided to freely accommodate the enlarged central portion 14 of the power shaft 15 carrying a conventional balance wheel 16 or the like and rotating in appropriate bearings 17 carried by outer side cover plates 18 employed for closing the sides of the stator. The ring-shaped stator 11 has a plurality of spaced perforated ears or lugs 19 on its outer face to receive bolts 20 for securing the cover plates 18 in position when the corresponding perforated radial lugs 21 of said cover plates 18 register with the ears or lugs 19, nuts 22 being secured on the bolts 20 after the cover plates 18 and washers 23 are in position. The stator 11 is firmly secured in position in an appropriate manner, as by mounting the same on a base 24 and extending the bolts 20 for several of the ears or lugs 19 through

upstanding or projecting portions of the base 24, as shown in Figures 1 and 2 as one method which may be employed when the stator 11 is mounted on edge with the power shaft 15 in a horizontal plane. Any other appropriate method of mounting or securing the stator 11 against movement, may be employed, if desired. Projecting from either face of the solid central wall 12 of the stator 11, close to the outer edge thereof is a circular flange 25 which serves a double purpose, that of the outer wall of a continuous circular piston chamber section 26 and the inner wall of a water chamber 27 completely surrounding the continuous circular piston chamber section 26 and the portion of the solid central wall 12 in the narrow space between the two walls 25 and the outer circular portion of the stator 11 is provided with openings 28 to permit a free flowing of water or any other cooling medium employed in the water chamber 27 from side to side of the engine. Projecting also from each side of the stationary wall 12 of the stator 11 is a second circular wall 29 which is concentric with the corresponding wall 25 but further from the latter than the wall 25 is from the outer wall of the stator 11, the wall 29 serving as the inner wall of a continuous circular piston chamber section 26.

It will be seen from the foregoing paragraph that the stator structure disclosed in this preferred form of the internal combustion engine presents in each side thereof a continuous distinctive and true piston chamber section 26, (previously mentioned) to accommodate special and distinctive true elongated piston sections 30 which are of arcuate form and describe substantially a semicircle from end to end or from working head to a tail of each piston section, one piston section 30 operating in each piston chamber section 26. The working head 31 of each piston section 30 is cut on a slightly diagonal line crosswise of the piston section 30 for purposes which will later be clearly apparent, while the other end or tail 32 of the piston section 30 is cut on a reverse diagonal line and beveled on a curve at its lower or inner corner for purposes which will also later appear as the description proceeds. Each piston section 30 is carried on the inner face of a rotating disc 33, at the outer edge thereof and when the rotating discs 33 are in position, the piston sections 30 carried thereby occupy at all times approximately one-half of the respective piston chamber sections 26 in which the respective piston sections 30 operate. The rotating discs 33 are mounted at their central portions on squared bosses 34 on the power shaft 15 at opposite ends of the enlarged central portion 14 of the latter and secured to said enlarged central portion 14 by headed securing members 35 or other appropriate means, so that the rotating discs 33 may be readily secured in position or removed as occasion may require. It is also to be noted that the rotating discs 33 extend over the respective walls 29 while the outer faces of the rotating discs 33 are substantially flush with the outer edges of the respective walls 25. When the parts of the internal combustion engine are assembled, a suitable packing sheet 36 or other appropriate means is provided between the rotating discs 33 and the respective outer side cover plates 18 for the two sides of the engine with the packing sheets 36 or other means being of sufficient diameter to extend over the edges of the wall-forming flange 25 to assure against leakage around the inner edge of the said wall-forming flange 25. Both of the outer side cover plates 18 carry circular flanges 37 on their inner faces which fit into the water chambers 27 to close the outer sides thereof, the circular flanges 37 corresponding in depth to approximately the thickness of the rotating discs 33 and the packing sheets 36. It is also obvious that means may be provided over the entire edge of the one piece stator 11 outer wall on each side of the engine between and connecting the packing 36 if not actually formed therewith, for the outer side cover plates 18 to fit against and thus assure against any fluid leakage around the edge of the engine.

This internal combustion engine requires a special novel valve structure for cooperation with the specific new type of piston sections 30, the valve structure including a central shank 38 on the opposite ends of which are carried special oval-shaped valve members 39 extending equal distances in each direction radially from the shank 38 with the opposite ends of each valve member 39 rounded, as shown at 40. The valve members 39 at the opposite ends of the shank 38 extend in planes at right angles to one another. At the position occupied by the valve, a section of the wall 29 on each side of the engine structure is cut away and the valve shank 38 is positioned just below or inwardly of the center of the arc described by the position which this portion of the wall 29 would have occupied and the valve members 29 thus permitted to operate at times, into and out of the respective piston chamber sections 26, during operation of the engine, as will be later fully described. In order to provide for mounting of the valve, a substantially semicircular opening 41 is provided in the solid central plate 12 of the stator 11, below or inwardly of the space provided by cutting away or eliminating a portion of the wall 29 as previously stated. This provides a straight wall 42 with a semicircular bearing opening 43 at the center thereof to serve as one-half of a bearing for the valve shank 38. A semicircular valve casing 44 is employed with oppositely outturned flanges 45 at the ends thereof and an upstanding longitudinal wall 46 extending between the flanges 45 and having a semicircular bearing opening 47 in its center which is opposed to the bearing opening 43 when the valve casing 44 is suspended in the opening 41 of the solid central wall 12 of the stator 11, so that the valve shank 38 is accommodated in the complementary bearing openings 43 and 47 as the upper edge of the valve casing central wall 46 fits against the wall 42. The valve casing 44 is firmly secured in position by appropriate securing members 48 passing upwardly through perforations 49 in the flanges 45 thereof and into bosses 50 at opposite ends of the wall 42 and slightly depending therefrom, for this purpose. The rounded ends 40 of the valve members 39 are curved or rounded to a radius corresponding to the valve casing 44 so as to ride close to the inner face thereof and thus act as a liquid seal between such ends 40 and the valve casing 44 while travelling in the latter during operation of the engine.

An appropriate fuel intake pipe 51 is connected with the intake port 52 which is preferably provided in the upper portion of the stator 11 near one side of the latter to provide for delivery of the fuel charges into one of the piston chamber sections 26 at a point just forwardly

of the valve member 39 working in such piston chamber section 26 when said valve member 39 is in upright position; the piston section 30 for this piston chamber section 26 necessarily having advanced sufficiently for the head end thereof to have moved away from the upstanding valve member 39 and uncovered the inlet port 52 in order to permit the fuel charge to enter the piston chamber section 26. A charge transfer passage 53 is extended on an angle through the upper portion of the solid central plate 12 of the stator 11 to provide communication between this first piston chamber section 26 and the corresponding or complementary piston chamber section 26 in the other side of the stator 11; the charge transfer passage 53 being so located that its intake port or entrance end opens into this first piston chamber section 26 at a point to the other side of the upstanding end of the valve member 39 and a short distance therefrom and the port is similar in shape to the piston tail 32 operating in that piston chamber section 26 and appropriately sized to provide a generous charge. Thus it will be seen that one side wall, that toward the upstanding valve member 39, is inclined and curved to correspond with the tail 32 of the piston section 30. The side walls of the charge transfer passage 53 are both substantially vertical at the center thereof and the opposite end or delivery end delivers the compressed charges passing therethrough into the complementary or second piston chamber section 26 at substantially the top or uppermost portion thereof, or substantially a position corresponding to the position of the intake port 52 for the first mentioned piston chamber section 26. At this delivery end of the charge transfer passage 53, the opposite or reverse side wall is inclined and slightly curved so as to correspond with the tail 32 of the second piston section 30 and also the intake port or entrance end of the charge transfer passage 53 in size and capacity except that the reverse side wall is affected, the lower edge of the charge transfer passage 53 being narrower than the upper edge at both ends of the charge transfer passage 53. As both piston sections 30 operate in the same direction, the first piston section 30 first passes over the straight side wall of the intake port or entrance end of the charge transfer passage 53 and then over the inclined and slightly curved wall, whereas the second piston section 30 first passes over the inclined and slightly curved side wall of the delivery end of the charge transfer passage 53 and finally over the straight side wall thereof during operation of the internal combustion engine. With this type of engine, the spark plug 54 is shown as being carried in the side cover plate 18 for the second side of the engine, at a point in advance of the valve shank 38 and near to the latter, although the position of the spark plug 54 may be altered as desired. If located in this position, however, at least a portion of the packing sheet 36 shown in the drawings must be cut away or eliminated and an opening 55 must be provided through the rotating disc 33 of crater form on the inner side of the rotating disc 33 and located inwardly of the piston section 30 carried by said rotating disc 33 and at a point near the piston head 31. The exhaust port 56 for the engine is extended through the edge of the stator 11 on the second side of the engine with an appropriate exhaust pipe 57 extended therefrom, diagonally to the charge intake port 52 and the fuel intake pipe 51.

A water inlet pipe 58 from a radiator or other source connects with the lower portion of the stator 11 to deliver cool water into the water chamber 27 while a water outlet or discharge pipe 59 extends from the upper portion of the stator 11, opposite the water inlet pipe 58 and diagonally thereto as well as close to the fuel intake pipe 51 thus, the cool water enters the water chamber 27 on the hotter side of the engine and leaves the water chamber 27 on the cooler side.

As further provision for bringing the engine to a uniform temperature and maintaining this temperature which provides for maximum operating efficiency, the engine is cooled at the center by air entering an air inlet port 60 in the upper portion of the stator 11 and extending part-way through the solid central plate 12 and then opening into the hotter side of the engine at a point inwardly of the piston chamber section 26 for this side of the engine and a centrifugal fan 61 is provided on the enlarged central portion 14 of the power shaft 15 in one side of the engine to agitate the cool air thus entering the engine and drive the air outwardly from the power shaft 15. The centrifugal fan 61 is located in the cooler side of the engine and therefore the cooling air after entering the hotter side of the engine will be drawn into the cooler side by way of the central opening 13 in the solid central wall 12 of the stator 11 and after circulating in both sides of the engine will finally pass out to the atmosphere by way of the air discharge outlet 62 through the lower portion of the solid central wall 12 from the cooler side of the engine and finally through the outer portion of the stator 11.

Any approved and well known system of oiling may be employed for this engine, such as the drip system used frequently on steam engines or any other appropriate system and therefore no specific oiling system has been illustrated. Also, while no packing rings or piston rings or the like have been shown and described, it is to be understood that any of these and other details of structure of such parts may be incorporated, as desired or found to be necessary.

In the modified form of the invention it is to be noted that a slightly modified form of valve is employed and mounted above the piston chamber sections 26*a*, the valve shank 38*a* carrying valve members 39*a* which are provided with longitudinal edges part of which are straight and the remainder rounded to a radius equal to the outer radius of the piston sections 30*a*, while the operating ends or faces of the valve members 39*a* each have a portion rounded to a radius equal to substantially two-thirds the thickness of the piston sections 30*a*, while the remainder thereof is rounded to a radius equal to the radius of the valve chamber 44*a* which, in this modified form substantially corresponds to the valve chamber 44 of the preferred form but is reversed and mounted on the top of the stator 11*a* by appropriate securing members 48*a* extending into bosses 50*a* on the upper portion of the stator 11*a*. In this modified form the valve casing 44*a* has a double wall to provide for a continuation 27*b* of the engine water chamber 27*a* at the top of the engine structure, on each side of the engine. This valve chamber 44*a* has a central wall 46*a* which rests on an upstanding portion 42*a* of the stator central wall 12*a* and comple-

mentary bearing openings 47*a* and 43*a* are provided at the central portions of the walls 46*a* and 12*a*, respectively, to accommodate the valve shank 38*a*. The valve in the modified form being positioned above the piston chamber sections 26*a* instead of below or inwardly thereof as in the preferred form thereby depends into and moves through the piston chamber sections 26*a*, during operation of the engine. In this second form, the piston sections 30*a* have the upper portions only 31*a* of their heads cut diagonally or beveled and likewise the upper portions only 32*a* of their opposite ends or tails are curved or rounded on a radius approximately one-half the thickness of the respective piston sections 30*a*, for proper cooperation with the modified form of valve, as will later clearly appear. A charge transfer passage 53*a* is employed in the modified form in substantially the same position as in the preferred form and substantially corresponds thereto except that it is of substantially rectangular form in cross-section throughout its length. Due to location of the valve above or outwardly of the main portion of the stator 11*a*, the side cover plates 18*a* are naturally provided with substantially semi-circular extensions 18*b* to fit against the sides of the valve casing 44*a* and the flanges 37*a* on the inner faces of the side cover plates also have arcuate or semi-circular extensions 37*b* to fit in the continuations 27*b* of the water chambers 27*a* when the side cover plates 18*a* are in position with all of the parts of the engine assembled. These side cover plates 18*a* also have on their inner faces in their extended portions 18*b* bearing blocks 18*c* which fit into the sides of the valve chambers 44*a* with the respective sides of the engine to serve to close said sides of the valve chamber 44*a* and bearing walls against which the valve operates, said bearing blocks 18*c* being of a thickness corresponding to the rotating discs 33*a* and having their walls 18*d* opposite the edges of the respective rotating discs 33*a* concaved to correspond to the edges or peripheries of the said rotating discs 33*a*. The side cover plates 18*a* are provided with a pair of openings 63 and 64 which also extend through the bearing blocks 18*c* near the corners thereof so that a fuel intake pipe may be connected with one of the openings 63 or 64 in the side cover plate on one side of the engine while the spark plug and an exhaust pipe are connected with the openings 63 or 64 on the side cover plate on the other side of the engine and the fourth or unused opening plugged or otherwise suitably closed. All other essential parts of the engine in the modified form correspond with the similar parts of the engine, as shown and described in the preferred form and therefore further detailed description of such parts at this time is believed to be unnecessary.

Having described in detail the construction of the engine, the method of operation will now be briefly stated: In Figure 2 the operative parts are shown in the position occupied just after fuel charge has been compressed in the first piston chamber section 26 and forced into the charge transfer passage 53 and the piston section 30 for drawing the charge into this first piston chamber section 26 and compressing the charge therein has advanced so that the tail 32 of this first piston section 30 has passed over the intake port of the said charge transfer passage 53 and is ready to advance further and actuate the valve member 39 operating in said first piston chamber section 26 and thereby turn the entire valve. During this advancement of the first piston section 30 the valve is rotated in an arc of substantially 90° and the second piston section 30 operating in the second piston chamber section 26 advances the same distance as the first piston section 30 and uncovers the discharge port end of the charge transfer passage 53 with the valve member 39 on that side of the engine now in an upright position to serve as an abutment. The engine is now ready for firing of the charge, with the crater-form opening 55 in the rotating disc 33 for that side of the engine registering with the spark plug 54. Upon firing of the charge between the upstanding valve member 39 and the head 31 of the piston section 30 on the second side of the engine, both sections 30 of the piston as well as the power shaft 15 will be effectively driven in a clock-wise direction. Considerable driving power will be obtained for this driving action due to the extensive and highly compressed charge confined in the restricted space between the head 31 of the piston section 30 and the upstanding valve member 39 opposite the same, part of such charge just previous to the firing thereof occupying the quarter of the valve chamber 44 over which the piston section head 31 has just partly passed. It is also apparent that, due to the bevel or incline of the piston section head 31, the force delivered thereto by the firing of the charge will be exceedingly effective for driving the piston in its circular movement; the upstanding portion of the valve member 39 opposite the piston section head 31 serving at this time, in a similar manner to the head of a piston chamber of the cylindrical type employed in the well known types of two-cycle or two-stroke cycle engines, four-cycle or four-stroke cycle engines and the like in which pistons reciprocate in the straight cylindrical type piston chambers. Under the force of this fired charge, the piston sections 30 and the power shaft 15 continue to rotate clock-wise until a complete stroke of the two-part piston is made around the two-part piston chamber and likewise a complete revolution of the power shaft 15 occurs, the dead or exhausted gases from this fired charge, escaping by way of the exhaust outlet 56 and the exhaust pipe 57 connected to the latter, only after the head 31 of the second piston section 30 has passed the engine exhaust port 56 on its way back to position for firing of the next charge. As this second piston section 30 returned to position for the next firing, as just stated, the first piston section 30 also returns to the position which it occupied at the time of the firing of the previous charge. It is further apparent that as the first piston section 30 and second piston section 30 are driven after the firing of each charge, the tail 32 of the second piston section advances toward the engine exhaust port 56 and clears through the same all previous expended or dead gases remaining in the second piston chamber section 26 from the previously fired charge. Then, as the piston sections 30 continue to rotate, the tail 32 of the second piston section 30 passes the exhaust port 56, then actuates the valve member 39 working in the second piston chamber section 26 and next passes over the discharge port end of the charge transfer passage 53 and next begins to drive the dead or expended gases of the next fired charge around and out of the second piston chamber section 26 as the entire second piston section 30 travels over the discharge port end of said charge transfer passage 53 before firing of an-

other charge in the said second piston chamber section 26. As the second piston section 30 is returning to position for firing of another charge, the valve is again given a quarter turn by engagement of the tail 32 of the first piston section 30 riding over the valve and thus placing the valve member 39 in upright position again in the second piston chamber section 26 and said valve member 39, whenever in this upright position in the said second piston chamber section 26, serves as an abutment or barrier against passage of the dead or expended gases being driven out of the second piston chamber section 26 by advancement of the tail 32 of the second piston section 30 toward the exhaust port 56 thus preventing such dead or expended gases from passing the upstanding valve member 39 over to the side of the same on which the next firing takes place. As the first and second piston sections 30 are exchanged from the position shown in Figure 2 to the position for firing of a charge, the first piston section 30 in its action of actuating the valve, moves in a clock-wise direction sufficiently for the tail end thereof to pass over and close or nearly close the fuel intake port 52, before firing of a previous charge in the second piston chamber section 26, thus preventing entry of any further charge or a new charge until the charge intake port is again uncovered. Now, as the piston sections 30 begin movement under force of the fired charge, the tail 32 of the first piston section 30 begins to drive the charge already admitted to the first piston chamber section 26 around the same in a clock-wise direction by the tail 32 and the head 31 of the said first piston section 30. When the piston sections 30 have made about one-half of their stroke around their respective piston chamber sections 26, under force of the exploded charge, the second piston section 30 will have actuated the valve, as above stated, and thus given the valve another quarter turn, thereby placing the valve member 39 on the second side of the engine in horizontal position while the second piston section 30 passes over the second valve member 39 and returning the valve member 39 of the first side of the engine to upright position. Just previous to this operation of the valve, the head 31 of the first piston member 30 will have passed the valve shank 38 and almost is through its movement over the fuel intake port 52 to again uncover the latter. Then, as the piston sections 30 continue their clock-wise movement for the second half of their stroke, the tail 32 of the first piston member 30 will continue to drive the charge clock-wise in the first piston chamber section 26 and compress the charge against the upstanding valve section 39 and into and through the charge transfer passage 53 until the tail end of the first piston section 30 rides over and closes the intake port of said charge transfer passage 53, to the position shown in Figure 2. During this second half of the stroke of the piston sections 30, the head 31 of the first piston section will be moving away from the fuel intake port 52 and thus creating a partial vacuum causing a suction to draw in an extensive new charge of fuel and this action will continue until the tail end of the first piston section 30 again actuates the valve and advances to its position to cover and thereby again close the fuel intake port 52 as the second piston section 30 advances to its position for firing of another charge. The valve section 39 working in the first piston chamber section 26, like the other valve member 39, serves as an abutment or barrier against passage of gases and therefore, when in upright position, prevents the gases from passing from one side of the upstanding valve member 39 to the opposite side thereof. Likewise, each valve member 39, when in horizontal position serves to effectively close the lower or depending portion or, in other words, the suspended lower portion of the valve casing 44, and thus closes this portion of the valve casing from the respective piston chamber section 26 while the piston section 30 passes over the horizontally positioned valve member 39. This is due to the specially shaped ends 40 of the valve members 39. The movements and operations of the piston sections 30 and the valve members 39 as above described, continue in the same order during the four cyclic steps of treatment of each successive fuel charge, during the operation of the engine. It is also clearly apparent that, during operation of the engine, the first piston section 30 serves both to compress and force into the fuel transfer passage 53 in advance of the piston section tail 32 one fuel charge while, at the same time, a new fuel charge is being drawn into the same piston chamber section 26 by said first piston section 30, as the head 31 thereof recedes or moves away from the fuel intake port 52, after uncovering the latter. Likewise, the second piston section 30, during each complete rotation or stroke thereof serves to force all dead or expended gases ahead of the tail 32 thereof and out of the second piston chamber section 26 by way of the exhaust port 56 while being driven under action of expansion of the succeeding charge against the head 31 of said second piston section 30 in this second piston chamber section 26. Therefore, both piston sections 30 are serving a double purpose, at the same time and continuously, during each rotation or stroke thereof. Furthermore, due to the construction of the engine and the operation of the piston members 30 and the valve members 39 and the special low casing of the valve and valve casing with respect to the fuel intake port 52, the fuel transfer passage 53 and the exhaust port 56 of the engine, the four cyclic steps of treatment of fuel are taking place with respect to four separate or successive charges of fuel, at the same time, during practically the entire stroke of the two-part piston or two piston sections 30 and, at practically every instant, during the operation of the engine, at least three of the cyclic steps of fuel treatment are taking place on successive fuel charges. This will be readily appreciated when it is realized that in starting the engine, the first charge is admitted through the fuel intake port 52 and then driven around the first piston chamber section 26 and compressed and forced into the charge transfer passage 53 by the tail 32 of the first piston section 30 operating in the first piston chamber section 26 while the second fuel charge is being drawn into this first piston chamber section 26 by the head 31 of the same piston section 30 and the said piston section 30 is then in the position shown in Figure 2. Before this first fuel charge can be fired, however, the first piston section 30 must be advanced still further, together with the second piston section 30, actuating the valve to give the latter a quarter turn as the tail 32 of the first piston section assumes position over the fuel intake port 52 and the head 31 of the second piston section 30 moves away from the delivery port end of the charge transfer passage 53 to uncover the latter with the second valve member 39, at this

time, occupying an upstanding position and ready to serve as an abutment. At this time the first charge may be fired and during the first part or approximately one-half of the full stroke of the second piston section **30** under influence of the fired charge, together with the first piston section **30**, said first piston section **30** is riding past the charge intake port **52** and compressing the said fuel charge in the first piston chamber section **26** ready to later drive the said second fuel charge into the charge transfer passage **53** when the entrance port end of the fuel transfer passage **53** is again uncovered, the valve again operated and the delivery port end of the fuel transfer passage **53** covered by the second piston section **30**, during the first part of the second half of the complete stroke of the said two part pistons or piston sections **30**. Each time the tail **32** of either piston section **30** approaches the cooperating valve member **39** with the latter in upstanding position, such tail **32** must actuate the valve a quarter turn to change such upstanding valve member **39** to a horizontal position as the piston section **30** passes over said valve member **39**. Thus, the valve is given two quarter turns during each complete stroke or rotation of the two piston sections **30**, the valve being thus actuated alternately by the first piston section **30** and the second piston section **30**, as the engine operates.

As each firing of the successive fuel charges takes place in one piston chamber section of the engine, that side would naturally have more heat generated therein during operation of the engine, than the other side of the engine structure. This condition is counteracted, however, by admitting the water or other cooling fluid to the water chamber **27** on the hotter side of the engine structure by location of the water in that pipe **58** to this side of the transverse center of the engine structure while the water outlet pipe **59** is located to the other side of the transverse center of the engine structure or opposite the piston chamber section **26** in which the fresh fuel charges are admitted and compressed, thus providing for circulation of the cooling fluid from the hotter portion of the engine structure to the cooler portion thereof before reaching the water outlet pipe **59**. For similar reasons the cooling air is admitted to the central portion of the engine structure, inwardly of the piston chamber section **26** in which the fuel charges are fired and near the valve structure and from this side of the engine structure, the cooling air is then drawn along the power shaft **15** into the other or opposite portion of the engine structure and agitated by the centrifugal fan **61** and forced outwardly by the latter, finally escaping through the air discharge passage **62** from this cooler portion of the engine structure. Thus, it will be apparent that, through the medium of the cooling fluid and the cooling air circulating through the entire engine structure in this manner, the temperature of the entire engine structure is equalized, as nearly as possible, for the maximum efficiency of operation of all of the operative parts of the engine.

The operation is substantially the same for the modified form shown in Figures 9 and 10, except that the valve, being located above or outwardly of the piston sections **30***a* and piston chamber sections **26***a*, rotates in the reverse direction to the direction of movement of the piston sections **30***a*, during operation of the engine. As this is the only essential difference in operation, further description of the modified form is believed to be unnecessary.

While I have disclosed what I consider to be the best embodiments of my invention, I desire it to be understood that changes in detail may be made without departing from the spirit of this invention and I therefore, desire further not to be limited beyond the requirements of the terms of my claims.

Having now fully described my invention, what I claim is:

1. An internal combustion engine including stator having separated piston chamber sections therein; piston sections operable in one direction in said piston chamber sections of the stator; a power shaft operable in said stator; a rotatable valve operable in said stator with valve members operating into said piston chamber sections and actuated by said piston sections; said stator having a central partition plate separating said piston chamber sections; said partition plate having a fuel charge passage therethrough forming communication between said piston chamber sections; one of said piston chamber sections having a fuel intake port; the other said piston chamber section having an exhaust port; a power shaft for said engine rotatable in said stator; said valve having valve members located at right angles to one another for operation in the respective piston chamber sections and adapted at times to serve as abutments; said stator having means providing for a circulation of a cooling medium outwardly of said piston chamber sections; said stator having means to provide for circulation of a cooling medium in the center of the stator, inwardly of the said piston chamber sections; means for agitating the cooling medium in the center of said stator; and connections between said power shaft and said piston sections.

2. The engine as in claim 1, with the said stator of cylindrical form and having a central wall separating said piston chamber sections and each of said piston sections provided on the periphery of a rotor disk mounted on said shaft within each of said piston chamber sections, said rotor disc acting to seal the outer side wall of its respective piston chamber section.

3. The engine as in claim 1, with the said stator of cylindrical form and having a central wall provided with said fuel transfer passage connecting said piston chamber sections, the said fuel intake port opening into one of the piston chamber sections and said exhaust port opening outwardly of the other of the piston chamber sections through the periphery of the stator and at opposite sides of said rotatable valve, said fuel transfer passage being angularly disposed relatively to the axis of said rotatable valve so that its ports are disposed at opposite sides of the said valve members.

4. An internal combustion engine including a stator having piston chamber sections formed therein; said piston chamber sections being connected by a fuel transfer passage in said stator; one of said piston chamber sections having a fuel intake port; the opposite piston chamber section having an exhaust port; a valve with valve members extended in opposite directions and at right angles to one another and adapted at times to serve as abutments; said valve members being operable in said piston chamber sections; piston sections operable in said piston chamber sections in one direction during operation of the engine; said piston sections engaging said valve members and turning the valve as each piston section

in turn passes the valve during its operation in its piston chamber section; a valve chamber for said valves intersecting each of said piston chamber sections; a power shaft for the engine rotatable in said stator; and connections between said power shaft and said piston sections.

5. An internal combustion engine including a stator having distinctive true piston chamber sections therein and a fuel transfer passage between said distinctive true piston chamber sections; distinctive piston sections operable in one direction in said distinctive true piston chamber sections; one of said distinctive true piston chamber sections having a fuel intake port while the other said distinctive true piston chamber section is provided with an exhaust port; a valve chamber intersecting said distinctive true piston chamber sections at the point at which is provided the fuel transfer passage and between the fuel intake port and the exhaust port; a valve rotatable in said valve casing at the intersection of the same with the said distinctive true piston chamber sections; said valve including valve members operable into said distinctive true piston chamber sections alternately and adapted at times to serve as abutments and also to be engaged and actuated by said piston sections during operation of the latter in said distinctive true piston chamber sections to operate the valve a quarter turn as each piston section passes the valve; a power shaft for said engine; and connections between said power shaft and said piston sections.

6. An internal combustion engine including distinctive true piston chamber sections of circular form having communication formed therebetween by a charge transfer passage; one of the said distinctive true piston chamber sections having a fuel intake port; the other of said distinctive true piston chamber sections having an exhaust port; arcuate piston sections operable in said piston chamber sections and each arcuate piston section having a diagonally beveled head while its tail is oppositely beveled and slightly curved; a valve chamber intersecting both of said distinctive true piston chamber sections opposite the charge transfer passage and the fuel intake and exhaust ports of said distinctive true piston chamber sections; a valve operable in said valve chamber and having valve members operable into said distinctive true piston chamber sections alternately and adapted at times to serve as abutments; said valve members being extended at right angles to one another and engaged and moved alternately by the said tails of the piston sections operating in the respective distinctive true piston chamber sections during operation of the internal combustion engine; a power shaft for said engine; and connections between said power shaft and said arcuate piston sections.

7. An internal combustion engine including a stator having a central solid transverse wall with a central shaft opening therein and a pair of spaced concentric flanges on either side face of said central solid transverse wall to serve as the walls of distinctive true piston chamber sections of circular form; said central solid transverse wall having openings therein outwardly of the outermost flanges and inwardly of the outer circular wall of said stator to provide a water chamber entirely across said stator around said distinctive true piston chamber sections; side cover plates for said stator having circular flanges on their inner faces to fit into and close the sides of said water chamber; said stator having a central cooling chamber; means to provide for circulation of a cooling medium within said central cooling chamber; a power shaft operable in said central opening of said central solid transverse wall of the stator and rotatably supported in said side cover plates; a valve casing supported in said central solid transverse wall; a valve operable in said valve casing and having valve members operable into said distinctive true piston chamber sections and adapted at times to serve as abutments; arcuate pistons operable in said distinctive true piston chamber sections and engaging and riding over said valve members to actuate the valve during operation of the said piston sections in said distinctive true piston chamber sections; and connections between said arcuate piston sections and said power shaft.

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