C. T. WESTLAKE.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED AUG. 15, 1917.

1,291,316.

Patented Jan. 14, 1919.

2 SHEETS—SHEET 1.

Fig. 1

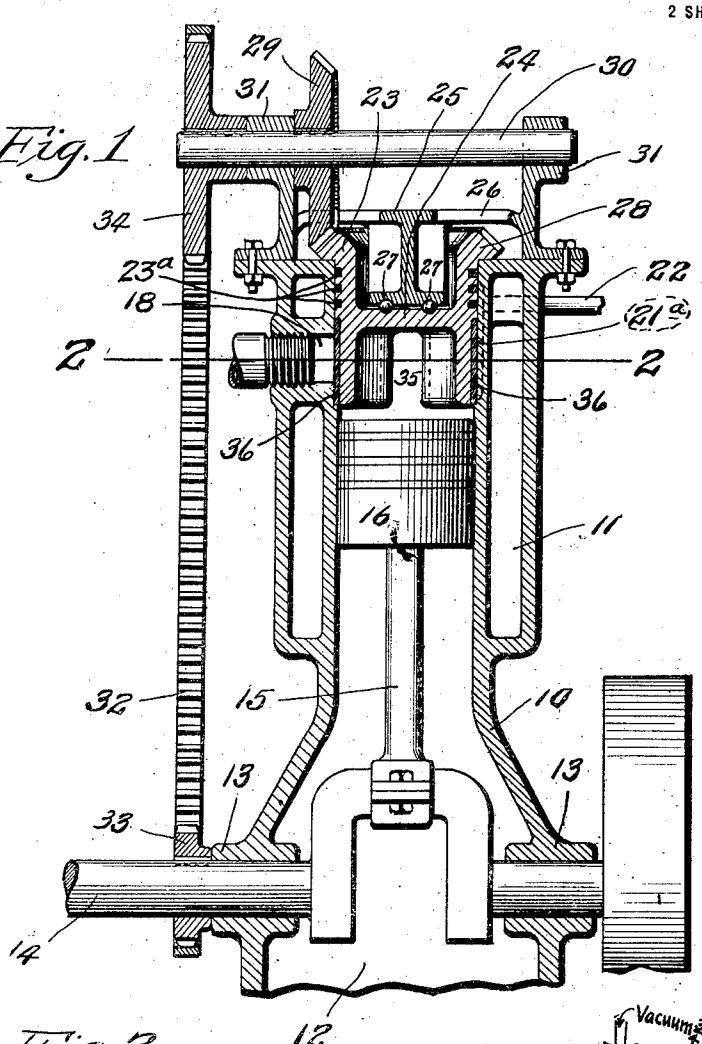


Fig. 2

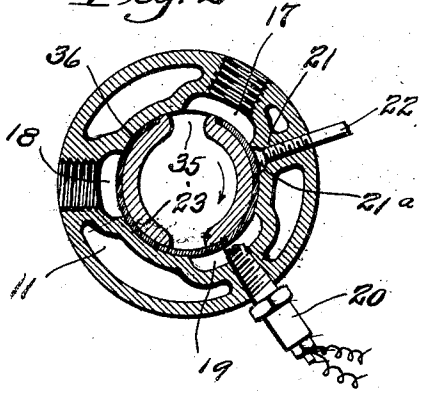
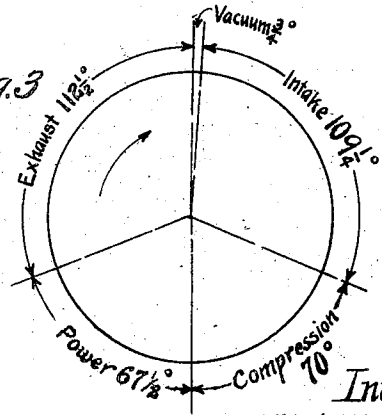


Fig. 3



Inventor

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By F. C. Ormsby Atty

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UNITED STATES PATENT OFFICE.

CHARLES T. WESTLAKE, OF ST. LOUIS, MISSOURI.

INTERNAL-COMBUSTION ENGINE.

1,291,316. Specification of Letters Patent. Patented Jan. 14, 1919.

Application filed August 15, 1917. Serial No. 186,373.

To all whom it may concern:

Be it known that I, CHARLES T. WESTLAKE, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Internal-Combustion Engines, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to internal combustion engines, particularly of the valveless type, that is, those engines which are devoid of the usual puppet valves which control the admission of the combustible vapor to the firing chamber and the subsequent exhaust of the products of combustion, my present invention being an improvement on the internal combustion engines disclosed in my copending patent applications filed July 30, 1915 and July 5, 1916, and bearing Serial Numbers 42,715 and 107,537, respectively.

The principal objects of my present invention are, to generally improve upon and simplify the existing types of internal combustion engines, particularly the forms of engines disclosed in the applications just mentioned; to eliminate the puppet valves usually associated with internal combustion engines; to materially reduce the number of working parts of an internal combustion engine and reduce to a minimum the friction developed during the operation of said parts; to provide an engine with a rotating member, a portion of which closes one end of the combustion chamber in the engine cylinder and serves as a head therefor, said rotating member also performing the functions of a valve to control the inlet of combustible vapor to the combustion chamber and the exhaust of burnt gases therefrom; to combine with the rotating member a sleeve which is normally in expansive contact with the inner surface of the wall surrounding the combustion chamber, thereby tending to minimize the leakage of combustible vapor while under compression and when firing; and further, to provide simple and effective means for delivering liquid lubricant onto the inner surface of the cylinder wall of the engine and the outer surface of the rotating member.

With the foregoing and other objects in view, my invention consists in certain novel features of construction and arrangement of parts, hereinafter more fully described and claimed, and illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section taken through the center of an internal combustion engine of my improved construction;

Fig. 2 is a horizontal section taken approximately on the line 2—2 of Fig. 1;

Fig. 3 is a graphic illustration of the degrees of movement of the rotating member which controls the inlet of combustible vapor to the firing chamber of the engine and the exhaust of burnt gases therefrom;

Fig. 4 is a diagrammatic sectional view and showing the position of the valve member during its period of vacuum producing movement;

Fig. 4ª is a diagrammatic view illustrating the positions of the piston and crank shaft while the valve member is in the position illustrated in Fig. 4;

Fig. 5 is a diagrammatic sectional view showing the valve member in position at the completion of the intake stroke of the piston;

Fig. 5ª is a diagrammatic view illustrating the positions of the piston and crank shaft at the completion of the intake stroke;

Fig. 6 is a diagrammatic sectional view showing the valve member in position at the time of firing;

Fig. 6ª is a diagrammatic view showing the positions of the piston and crank shaft at the time of firing, with dotted lines showing the movement of the crank shaft through the compression and power strokes;

Fig. 7 is a diagrammatic sectional view showing the position of the valve member at the completion of the power stroke and at the beginning of the exhaust stroke of the piston;

Fig. 7ª is a diagrammatic view illustrating the positions of the piston and crank shaft at the end of the power stroke, with dotted lines illustrating the movement of the crank shaft during the exhaust stroke.

Referring by numerals to the accompanying drawings which illustrate a practical embodiment of my invention, 10 designates the engine cylinder which is preferably cast in a single piece and the wall of said cylinder being provided with a chamber 11 through which circulates a cooling fluid.

Both ends of the cylinder 10 are open, and secured in any suitable manner to the lower end is a crank case 12, there being bearings 13 formed between said crank case and the cylinder for the usual crank shaft 14. Connected in the usual manner to the crank shaft 14 is one end of a piston rod 15, the other end being connected to a piston 16 of the usual type.

Formed through the upper portion of the wall of the cylinder 10 are inlet and exhaust ports 17 and 18 respectively, said ports being suitably spaced apart, it being understood that suitable tubular connections are made to these ports for the purpose of delivering combustible vapor to the inlet port and for conveying the products of combustion from the exhaust port.

Formed in the inner face of the wall of cylinder 10 at a point between the ports 17 and 18 is a pocket 19 and seated in the wall of the cylinder with its inner end located in said pocket is a spark plug 20.

Formed through the wall of the cylinder immediately to one side of the inlet port 17 is a comparatively small port or aperture 21 to which is connected a liquid lubricant supply pipe 22. The inner end of port 17 communicates with a vertically disposed groove 21^a, the same serving as a lubricant chamber. The internal diameter of the upper portion of the chamber within the engine cylinder is slightly larger than the internal diameter of the lower portion of said chamber or that portion in which the piston 16 operates. Mounted for rotary movement in this enlarged upper end of cylinder 10 is a substantially cylindrical valve member 23, the same being provided at a point intermediate its ends with an integrally formed web or plate 24, which latter performs the functions of a head for the combustion chamber within the cylinder. This member 23 is held in operative position in the upper end of the cylinder 10 by a bracket 25, which latter is formed integral with or fixed to a frame 26, the same being fixed in any suitable manner to the upper end of cylinder 10.

If desired, suitable anti-friction bearings 27 can be arranged between the bracket 25 and the top of the plate or web 24.

Formed integral with or fixed to the outer end of member 23, is an annular row of miter gear teeth 28 with which mesh the teeth of a miter or beveled gear 29, the latter being fixed to a shaft 30. This shaft is journaled in suitable bearings 31, the same being preferably formed integral with frame 26, and this shaft is driven directly from the crank shaft 14 in any suitable manner, preferably by means of a sprocket chain 32 and sprocket wheels 33 and 34. The wheels of this driving mechanism are of such sizes as that the shaft 30 makes one complete revolution to two of the crank shaft, and as the beveled or miter gears 28 and 29 are equal in size, it necessarily follows that the valve member 23 makes one complete revolution with each two revolutions of the crank shaft.

Formed in the wall of the member 23 below the web or plate 24 is a port 35, the same being adapted to register with the ports 17 and 18 and with the pocket 19. Surrounding the lower portion of member 23 and positioned in the enlarged upper portion of the chamber within cylinder 10 is a split sleeve 36 of comparatively thin resilient material, the ends of which terminate adjacent to the sides of port 35, said ends bearing against shoulders formed in member 23 so that as said member rotates, said sleeve will be rotated therewith. Normally, this sleeve is larger in diameter than the internal diameter of the enlarged upper portion of the combustion chamber within the engine cylinder so that when it is contracted, and placed in said combustion chamber with member 23, its tendency is to expand so that it is normally in expansive contact with a portion of the inner face of the wall surrounding the enlarged upper portion of the combustion chamber. The external diameter of the lower portion of valve member 24 is the same as the internal diameter of the lower portion of the chamber within the cylinder or that chamber in which the piston 16 operates and the split sleeve positioned on the lower portion of said valve member just fills the space between the lower portion of said valve member and the adjacent inner face of the wall around the enlarged upper portion of the chamber. This particular construction is effective in materially reducing the leakage of gas from the combustion chamber, particularly during compression of the gas, and likewise during the ignition thereof.

To effectively prevent the leakage of any gas upwardly between member 23 and the upper portion of the cylinder, a plurality of packing rings 23^2 are seated in suitable grooves formed in the periphery of said member 23 above the sleeve 36.

The width of the sleeve 36 is considerably greater than the width of the ports 17, 18 and 19; consequently, as member 23 and the sleeve rotate, the latter will in succession entirely cover said ports and completely isolate the same from the combustion chamber.

A portion of the wall of member 23 directly opposite the port 35 is removed in order to balance said member, but, as illustrated in Fig. 2, the space formed by the removal of this portion of the wall is closed by the central portion of sleeve 36.

While I have shown but a single cylinder, it will be understood that my invention contemplates a multi-cylinder engine, and

where such construction is carried out, it is desirable, though not essential, that the cylinders be cast *en bloc*.

During the operation of the engine, the piston 16 reciprocates in the usual manner within the combustion chamber in the cylinder and the rotary motion of crank shaft 14 is transmitted to shaft 30, and thence by means of beveled pinion 29 to valve member 23, the operating parts being of such sizes and so timed as that said valve member makes one complete revolution with every two complete revolutions of the crank shaft.

After an exhaust stroke and when the piston reaches its highest point of travel in the cylinder, port 35 is at a point between the exhaust and inlet ports 18 and 17, as illustrated in Fig. 4, and the valve member 23 rotates for approximately three-quarters of a degree between said exhaust and inlet ports, thereby producing a certain degree of vacuum in the chamber between the piston and the plate or disk 24. Immediately after this partial vacuum has been produced, valve member 23 moves so as to bring port 35 into register with inlet port 17, and as the piston moves downward, combustible vapor is drawn into the combustion chamber through port 18 and the supply pipe connected thereto. During this intake or suction stroke, the valve member 23 moves for a distance of approximately one hundred nine and one-quarter degrees during which time the crank shaft moves approximately two hundred eighteen and one-half degrees. (See Figs. 3 and 5[a]).

At the completion of the suction or intake stroke, the valve member 23 occupies the position as illustrated in Fig. 5, and the piston starts upward on its compression stroke during which movement the crank shaft moves approximately one hundred forty degrees, and valve member 23 moves approximately seventy degrees. (See Figs. 3 and 6[a]).

At the completion of the compression stroke, port 35 is in register with pocket 19, as illustrated in Fig. 6, and at the point of highest compression or an instant thereafter, the timing apparatus associated with the engine produces a spark at the inner end of plug 20, thereby firing the compressed charge with the result that the piston is forced downward on its power stroke during which time valve member 23 rotates approximately sixty-seven and one-half degrees, while crank shaft rotates approximately one hundred thirty-five degrees. (See Figs. 3 and 6[a]).

At the completion of the power stroke of the piston, valve member 23 occupies the position illustrated in Fig. 7, and as the movement of the operating parts continues, port 35 is brought into register with the exhaust port 18, thereby permitting the piston on its succeeding upward stroke to force the burnt gases out through said exhaust port and the pipe connected thereto, during which time valve members 23 moves approximately one hundred twelve and one-half degrees, while crank shaft moves approximately two hundred twenty-five degrees. (See Figs. 3 and 7[a]).

By virture of the fact that sleeve 36 is split and constructed in such a manner and of such material as to normally expand, it will be seen that said sleeve is at all times in expansive contact with that portion of the inner face of the wall of the combustion chamber in which the inlet and exhaust ports and the firing pocket are formed, and as a result, a comparatively tight joint is maintained between said sleeve and combustion chamber wall, consequently reducing to a minimum the leakage of gas during high compression and combustion.

One of the principal features of my invention is the means and arrangement for supplying liquid lubricant to the outer surface of valve member 23 and the inner surface of the wall cylinder with which said member contacts.

It will be noted that the liquid lubricant supply pipe enters the cylinder at a point immediately to one side of the inlet port 17, thus supplying lubricant to chamber 21[a], the latter being substantially as long as the valve member, and as the latter rotates in a direction from said inlet port toward the lubricant supply pipe, the liquid lubricant will be delivered directly onto the surface of valve member 23, after it has passed the inlet port, and said liquid lubricant will be carried around the inner surface of the cylinder for a considerable portion of a complete rotation of the valve member before the exhaust port is reached. As a result, the contacting faces of the valve member 23 and the wall surrounding the same are very effectively lubricated.

It will be noted that the rotary valve member 23 is formed in a single piece, and further that it is held to rotate in a fixed zone within the upper end of the cylinder by the bracket 25 and bearings 27, and by virture of this construction, friction and wear between the rotary valve member and the cylinder is reduced to a minimum, and further, the work incident to the insertion or removal of the valve member is greatly facilitated.

An internal combustion engine of my improved construction can be readily assembled or taken apart, is devoid of all puppet valves and the like which are ordinarily associated with internal combustion engines, is particularly efficient wherever a light, strong and powerful motor is desired, and by virtue of the fact that the en-

gine is constructed with comparatively few operating parts, friction and wear are reduced to a minimum.

It will be readily understood that minor changes in the size, form and construction of the various parts of my improved internal combustion engine can be made and substituted for those herein shown and described, without departing from the spirit of my invention, the scope of which is set forth in the appended claims.

I claim:

1. In an internal combustion engine, a cylinder open at both ends, the internal diameter of the upper portion of the chamber within said cylinder being larger than the lower portion of said chamber, a piston adapted to reciprocate in that portion of the chamber having the smaller internal diameter, and a valve member arranged for rotary movement in that portion of the cylinder chamber having the larger internal diameter, the said piston and valve member forming the closure means for the ends of the cylinder chamber.

2. In an internal combustion engine, the combination with a cylinder provided adjacent to one end with inlet and exhaust ports, of a valve member mounted for rotation in the end of the cylinder that is provided with said ports, an expansive sleeve carried by said valve member for controlling the opening and closing of said ports, said valve member being provided with a wall intermediate its ends, which wall forms a head for the combustion chamber within the engine cylinder, means adapted to directly engage the outer portion of said intermediate wall for retaining the valve member in operative position within the cylinder, and means adapted to engage the outer portion of said valve member for imparting rotary movement thereto.

3. In an internal combustion engine, the combination with a cylinder provided adjacent to one end with inlet and exhaust ports, of a valve member mounted for rotation in the end of the cylinder provided with said ports, an expansive sleeve carried by said valve member and adapted to control the opening and closing of said ports, said valve member being provided with a wall intermediate its ends which forms a head for the combustion chamber within the engine cylinder, and the outer end of said valve member being provided with an annular row of integrally formed gear teeth.

4. In an internal combustion engine, the combination with a cylinder provided adjacent to one end with inlet and exhaust ports, of a valve member mounted for rotation in the end of the cylinder provided with said ports, an expansive sleeve carried by said valve member and adapted to control the opening and closing of said ports, said valve member being provided with a wall intermediate its ends which forms a head for the combustion chamber within the engine cylinder, the outer end of said valve member being provided with an annular row of integrally formed gear teeth, and a series of packing rings carried by said valve member between the expansive sleeve and the row of gear teeth.

5. In an internal combustion engine, the combination with a cylinder provided at one end with inlet and exhaust ports, of a valve member mounted for rotation in the end of the cylinder having said ports, said valve member being provided intermediate its ends with a wall which forms a head for the combustion chamber within the engine cylinder, there being an opening formed in the wall of the valve member below said head, which opening is adapted to communicate with the inlet and exhaust ports, an expansive sleeve applied to said valve member and adapted to close the inlet and exhaust ports, the ends of which sleeve terminate adjacent to the sides of the opening in the valve member, and a piston mounted for operation in the other end of said cylinder.

6. In an internal combustion engine, the combination with a cylinder provided at one end with inlet and exhaust ports, of a valve member mounted for rotation in the end of the cylinder having said ports, said valve member being provided intermediate its ends with a wall which forms the head for the combustion chamber within the engine cylinder, there being an opening formed in the wall of the valve member below said head, which opening is adapted to communicate with the inlet and exhaust ports, an expansive sleeve applied to said valve member and adapted to close the inlet and exhaust ports, the ends of which sleeve terminate adjacent to the sides of the opening in the valve member, means bearing against the outer face of the head of the valve member for retaining the same in position within the cylinder, and a piston mounted for operation in the other end of said cylinder.

7. In an internal combustion engine, the combination with a cylinder provided at one end with inlet and exhaust ports, of a valve member mounted for rotation in the end of the cylinder having said ports, said valve member being provided intermediate its ends with a wall which forms the head for the combustion chamber within the engine cylinder, there being an opening formed in the wall of the valve member below said head, which opening is adapted to communicate with the inlet and exhaust ports, an expansive sleeve applied to said valve member and adapted to close the inlet and exhaust ports, the ends of which sleeve terminate adjacent to the sides of the opening in

the valve member, an annular row of gear teeth on the outer end of said valve member, and a piston mounted for operation in the other end of said cylinder.

8. In an internal combustion engine, the combination with a cylinder provided with inlet and exhaust ports, of a one-piece valve member mounted for rotation in the end of the cylinder provided with said ports, said valve member comprising a cylindrical body portion, a transverse wall which serves as a head for the combustion chamber within the engine cylinder, the outer end of the cylindrical body portion terminating in a series of gear teeth, an expansible sleeve carried by the inner end of the valve member for controlling the opening and closing of the inlet and exhaust ports, and a series of packing-rings carried by said valve member and arranged between said expansive sleeve and the gear teeth.

9. In an internal combustion engine, the combination with a cylinder provided with inlet and exhaust ports, of a one-piece valve member mounted for rotation in the end of the cylinder provided with said ports, said valve member comprising a cylindrical body portion, a transverse wall which serves as a head for the combustion chamber within the engine cylinder, the outer end of the cylindrical body portion terminating in a series of gear teeth, an expansible sleeve carried by the inner end of the valve member for controlling the opening and closing of the inlet and exhaust ports, a series of packing rings carried by said valve member and arranged between said expansive member and the gear teeth, and means for retaining said valve member in operative position in the end of the cylinder.

In testimony whereof I hereunto affix my signature this 10th day of August, 1917.

CHARLES T. WESTLAKE.