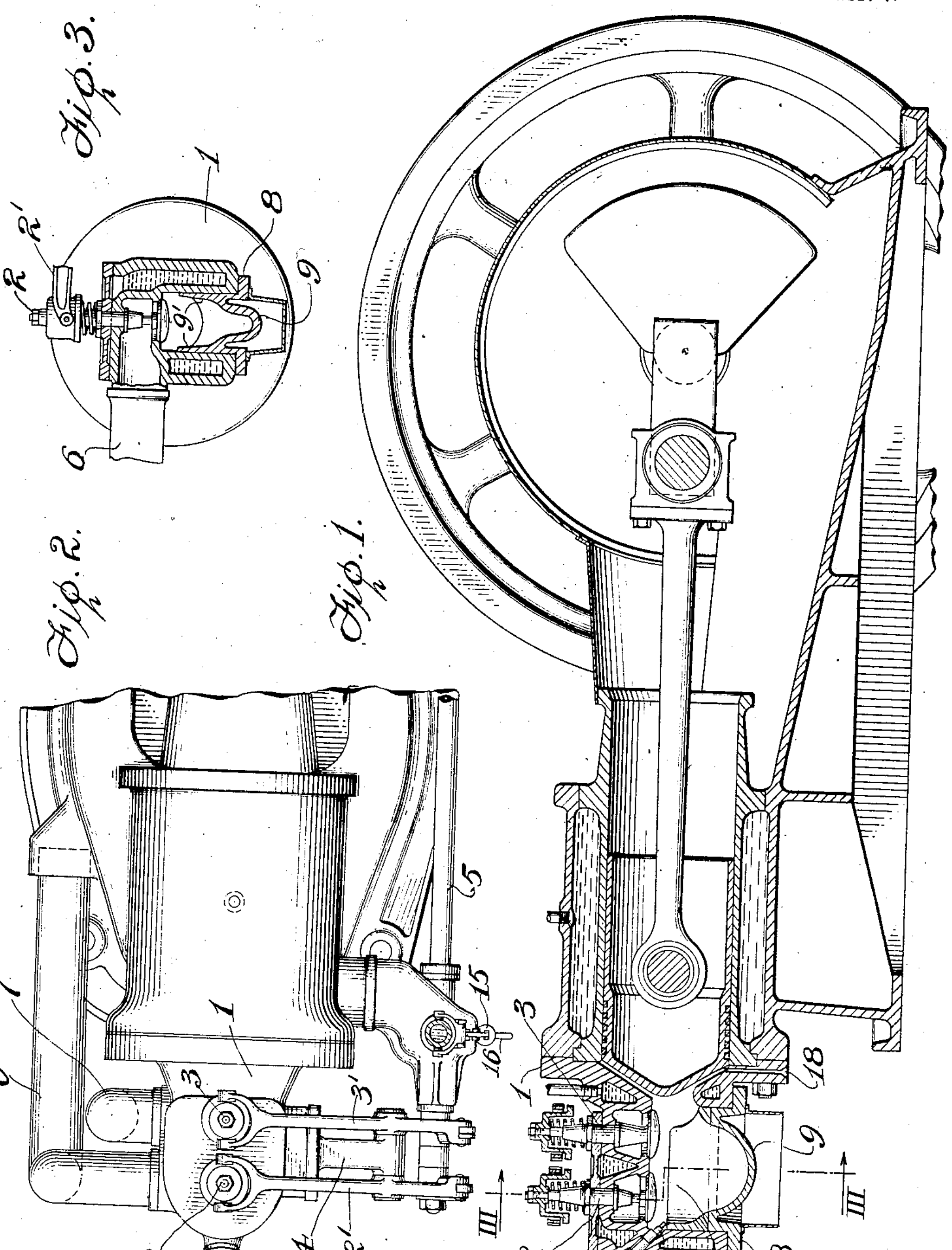
L. K. DOELLING.
OIL ENGINE.
APPLICATION FILED DEC. 10, 1915.

1,328,499.

Patented Jan. 20, 1920.

2 SHEETS—SHEET 1.



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2 SHEETS—SHEET 2.

Fig. 5.

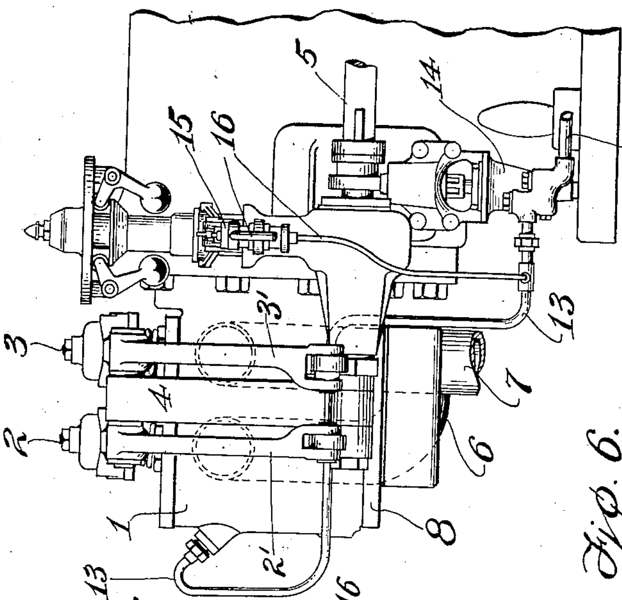


Fig. 6.

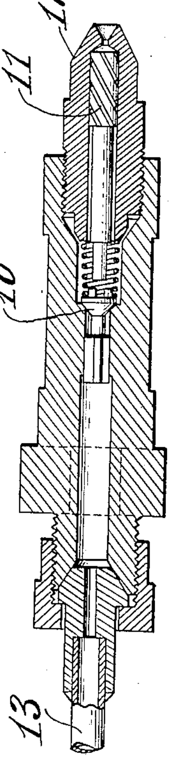
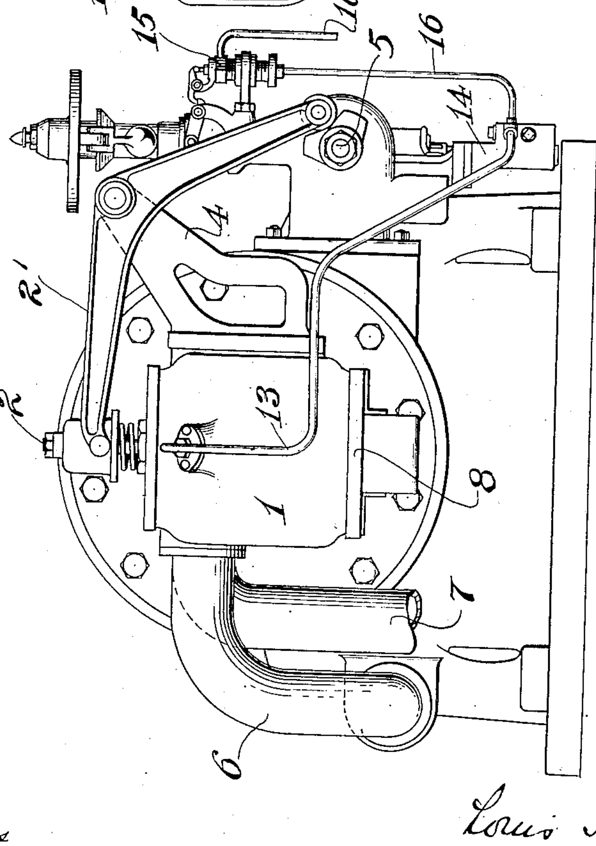


Fig. 4.



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UNITED STATES PATENT OFFICE.

LOUIS K. DOELLING, OF NEW ROCHELLE, NEW YORK, ASSIGNOR TO DE LA VERGNE MACHINE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

OIL-ENGINE.

1,328,499. Specification of Letters Patent. Patented Jan. 20, 1920.

Application filed December 10, 1915. Serial No. 66,064.

To all whom it may concern:

Be it known that I, Louis K. Doelling, a subject of the Emperor of Germany, and a resident of New Rochelle, Westchester county, New York, have invented the following-described Improvements in Oil-Engines.

The invention is an improvement in so called hot plate internal combustion engines of the special class wherein the compression of the air occurs about coincidently with the introduction of the fuel, and the latter is injected therein at about compression dead center, impinging more or less on the hot plate by which it is vaporized and ignited. The object of the improvement is to accommodate such engines, especially in the larger sizes, to efficient operation on heavy or tarry fuel oils injected by the impulse of the fuel pump and as a solid or mechanical spray; that is to say, without the use of high-pressure injection air to atomize and vaporize the fuel during delivery, thereby eliminating the expense and complication of high pressure air-compressing apparatus for that purpose. To this and other ends, the invention is concerned primarily with the form or shape of the combustion chamber and the coöperation therewith of the various other combustion-controlling factors, whereby such solid or mechanical oil spray is combined, ignited and burned with the combustion air at high thermal efficiency, and without objectionable deposit of carbon in the interior surfaces, and also without sacrificing established principles of proper engine design.

The specific form of the invention as at present preferred, is embodied in the horizontal type and such form is shown in the accompanying two sheets of drawings with sufficient detail to enable those skilled in the art to understand the mode of construction and the principles involved.

In these drawings,

Figure 1 is a longitudinal vertical central section through such an engine;

Fig. 2 is a top plan of the cylinder end thereof, the governor column being in section;

Fig. 3 a cross-section on line III—III of Fig. 1;

Fig. 4 an end elevation of Fig. 2;

Fig. 5 a side elevation; and

Fig. 6 a detail in larger scale, of the fuel injection valve.

The primary elements of the engine will be recognized from the drawings without description. The working face of the piston is obtusely coned and at the forward dead center approaches close to the correspondingly coned wall of the cylinder head structure 1, which latter is bolted to the end of the cylinder and contains within itself the combustion chamber proper and its several appurtenant parts. The cylinder proper communicates with the compression chamber in the cylinder head through a relatively narrow passage which is closed by the end of the piston when in its forward position, as illustrated in Fig. 1. The area of this restricted opening, it will be noted, is of considerably less than one third the cross area of the cylinder proper and is slightly eccentric thereto. The combustion chamber is a one-compartment chamber and is water-jacketed on all sides but one, which is constituted by the hot plate, and is only slightly longer in the direction of the spray than in width and of sufficient volume to give the chamber such capacity as will establish a compression pressure of about 150 pounds, more or less. The inlet valve 2 and exhaust valve 3 are placed side by side and arranged in a line parallel with the longer dimension of the chamber, and also, in the present case, parallel with the axis of the cylinder, and their disk-shaped heads virtually constitute the whole of one wall of the chamber, since the said chamber is no wider and very little longer, than actually necessary to accommodate the said valves and their necessary clearances. The said valves desirably form the upper wall or roof of the combustion chamber and are hence opened downwardly against their respective springs, by means of valve levers 2′ and 3′, respectively, the latter being fulcrumed on a bracket 4 on the cylinder head and operated by the cam shaft 5 in an obvious manner. The inlet valve 2 is disposed at the forward end of the chamber and receives atmospheric air through a pipe connection 6 with the hollow bed and crank case of the engine. The exhaust valve 3 is disposed at the other end of the combustion chamber, close to the cylinder opening, and connects to a lateral discharge pipe 7.

Directly opposite the two valves just described, the wall of the combustion chamber is formed by the hot plate 8, constituting in the present case the bottom or floor of the chamber and consisting of a bowl-shaped wall 9, which is bolted by its flange to the under side of the cylinder head and chamber and wholly unjacketed, save for a removable covering designed to assist in maintaining its temperature at a proper degree for the vaporization of the oil and the ignition of the combustion mixture. The water-cooled side and end walls of the combustion chamber are lined, except for a space or zone near the top, with a false wall 9′ of relatively thick cast-iron, and which may be formed in one piece or casting with the hot plate, so as to be insertible and removable therewith, but such lining is preferably formed as a separate part resting upon or secured to the unjacketed plate or closely proximate to it. The said lining in any case is designed to fit the water-jacketed wall of the cylinder head rather loosely, so as to provide only an imperfect thermal contact with it, which, in consequence, enables it to preserve a temperature substantially that of the hot plate itself. Yet the effects of the temperature of the said lining are in no wise injurious to the head as a whole, because of the efficient water-jacket with which it is provided. It may become considerably hotter without affecting the cylinder head walls, and if in time it becomes impaired as the result of such temperature, it can obviously be renewed at small expense. In this manner, substantially the whole or a large part of the combustion chamber proper may be formed of hot wall surface, on which carbon deposit will not form, or, if previously formed, will be immediately consumed.

The fuel injector delivers oil only (without air) into this combustion chamber, as already explained, and is mounted at the outermost end of the narrow chamber, substantially in central vertical alinement with the two valves and the cylinder opening and close to and forward of the air inlet valve 2. It is set in an inclined socket in the end wall of the water-jacketed head so as to point obliquely toward the trough-shaped hot bottom of the chamber, and also in a general way toward the cylinder opening. The detail of its construction is shown in Fig. 6, wherein it will be observed that the oil flowing past the spring-check 10, is driven through a number of helical grooves cut in the surface of a cylindrical pin 11 fitting the bore of the oil nozzle 12, and receives therefrom a violent whirling motion, in which state it emerges from the nozzle orifice and forms a scattering cone-shaped spray. The general principle of fuel injectors of this kind is familiar to the art and has been used extensively in smaller sizes of engines of this class, and no claim of novelty is made for such injectors, but it is desirable that the fuel injected into the combustion chamber above described shall be mechanically sub-divided as finely as possible as it issues from the nozzle, and for such purpose, the whirling type of oil nozzle constitutes an important combination element of the present invention. The term "mechanical oil spray" is used herein to refer to such fuel sprays or similar sprays in distinction from the high-pressure air-atomized, and air-injected oil-blast, which, with all its complication, the present invention eliminates. Fuel oil is supplied to the injector by a delivery pipe 13 from the fuel pump 14 operated direct from the cam shaft 5 (Fig. 5) and appropriately timed to deliver the oil charge slightly before or about compression dead center. The size of the charge so delivered is controlled automatically by the governor through the agency of a small by-pass valve 15, the function of which is to permit the escape back to the oil tank, of more or less of the oil delivered on each stroke of the pump, and as determined by the condition of the governor at the moment. The excess oil escapes from the pipe 14 through the by-pass pipe 16, in which the governor-controlled valve 15 is interposed, the remaining oil being forced through the pipe to the fuel injector.

The detail of the operating connections for this method of fuel regulation will be manifest in the drawings, and it will also be evident that any other form of automatic charge-regulating means will give equivalent results, although the apparatus shown has advantages and is preferred for the case in hand. The fuel pump is supplied from the tank by pipe 17.

When the engine as above described is to be started, the hot plate 9 is first heated sufficiently to ignite the oil. The piston is then brought to compression and the said first charge injected either by hand operation of the fuel pump, or otherwise, causing the engine to take up its cycle, or the said parts may be put in motion by means of starting air which may be introduced at 18 (Fig. 1). In the engine cycle the exhaust gases are expelled by the piston through the exhaust valve 3, opened for the purpose, and on the next following or suction stroke, air for combustion is drawn in through the inlet valve 2, opened inwardly for that purpose, and such air, by reason of the deflector effect of the head of the valve, but particularly by reason of the shape of the combustion chamber, in its relation to the said valve, as already described, enters the chamber initially in the form of a flat expanding disk, part flowing radially outward and directly toward and into the cylinder opening, and the rest being deflected by the front and side walls of the chamber and hence flowing downwardly over, and sweeping the hot lining of the combustion chamber and the concaved face of the vaporizer, thereby effectually scavenging the chamber of its residual combustion gases, and likewise supplying the air necessary for consuming incipient deposits of carbon thereon. The flow of air starts even in advance of the suction stroke of the piston, as the result of special relation of the valve cams of the levers 2′ and 3′. These are arranged to open the air valve just before the end of the exhaust-expelling stroke of the piston, so that the momentum of the outgoing exhaust gases causes an inward surge of fresh air into the chamber immediately followed by the suction stroke as above described. The last residue of consumed gases is thereby discharged from the chamber. On the ensuing compression stroke, the pure air therein is compressed, and at or about the height of the compression is wholly confined in the combustion chamber whereupon the fuel pump injects the measured fuel charge, and the latter, in a scattered condition, impinges upon the surface of the hot plate and its lining, becoming thereby quickly mixed with the compressed air and ignited. The shape and relative dimensions of the combustion chamber having the fuel injector disposed symmetrically with relation to the main axis thereof and in a position and at an inclination to reach directly all the air therein, brings about a condition in which practically the whole charge of compressed combustion air is penetrated by oil particles, thereby quickening the combination of the air with the fuel and resulting in an explosive rather than a slow-burning combustion. Actual use of engines possessing combustion chambers characteristically the same as that above described, demonstrates the efficacy of the location of the air inlet as described, for preventing the formation and accumulation of carbon deposits and the consequent interference with good thermal efficiency. The arrangement of all the valves as well as the fuel injector in the roof wall of the combustion chamber and of the hot plate as the lower wall, is important. The narrow opening leading horizontally from the chamber to the cylinder, is arranged near the roof or top wall of the former, and the hot plate is bowl shaped and relatively deep immediately in front of such opening.

While I have described my invention and the principle on which it operates so far as I understand the same, and the best mode known to me of applying that principle, it is to be understood that there is no intentional limitation herein to the specific form and detail of construction of the invention described except as expressly specified by the claims, and that various modifications of the said construction may be resorted to without departing from the invention or the benefits derivable therefrom.

I claim:

1. An oil engine having a combustion chamber supplied with oil and air only and provided with a spray injector delivering a mechanical oil spray thereto, inlet and exhaust valves disposed in the wall of said chamber in successive positions along the direction of the spray from said injector, a hot plate igniter forming the wall of the chamber opposite said valves and in position to intercept the said spray, in combination with a piston and cylinder communicating with the combustion chamber, and a valve-controlling system coördinated with the aforesaid parts whereby air is compressed in said chamber and the fuel is injected into same at or about compression dead center.

2. An oil engine having a combustion chamber supplied with oil and air only and provided with a spray injector delivering a mechanical oil spray thereto, inlet and exhaust valves disposed in substantial vertical positions in the upper wall of said chamber and in successive stations along the direction of the spray from the injector, a hot plate igniter constituting the lower wall of said chamber vertically beneath the said valves and in position to intercept the aforesaid mechanical spray, in combination with a piston and cylinder communicating with the combustion chamber and associated instrumentalities whereby air is compressed in said chamber and the fuel oil injected therein at about compression dead center.

3. An oil engine operating on oil and air only and comprising a combustion chamber provided with adjacent air inlet and exhaust valves in its upper wall and having its bottom wall unjacketed and forming a hot plate igniter vertically beneath said valves, in combination with a fuel injector adapted to spray oil only into said chamber and arranged in an end wall thereof to spray said oil toward the said hot plate and across the said valves, a piston and cylinder in communication with the chamber, and a valve control system coördinated with the aforesaid parts to compress air in the chamber and inject the oil spray therein before or about compression dead center.

4. An oil engine having a combustion chamber supplied with oil and air only and provided with a spray injector spraying oil without air, inlet and exhaust valves disposed in successive positions along the direction of the spray from said injector, and a hot plate igniter forming the wall of said

chamber opposite said valves and injector, in combination with a piston cylinder communicating with the said combustion chamber through a relatively narrow and horizontally-disposed opening, and valve gear whereby the said oil spray is injected into the chamber before or about compression dead center.

5. An oil engine consuming oil and air only and having a combustion chamber communicating with the engine cylinder through a relatively narrow horizontal opening and provided with a spray injector for solid-oil mounted in the wall of said chamber remote from said opening and with air inlet and exhaust valves disposed in said chamber in successive positions along the direction of the spray from said injector, the bottom wall of said chamber being unjacketed and constituting a hot plate igniter co-extensive with said chamber from the injector to the said opening, in combination with valve gearing, whereby the charge of compressed air drawn through the inlet valve is compressed and the fuel injected therein before or about compression dead center.

6. An oil engine consuming oil and air only and having a combustion chamber communicating with the engine cylinder through a relatively narrow and substantially horizontal opening, inlet and exhaust valves having their port axes arranged in a common plane, a mechanical oil-spray injector having the axis of its spray substantially coinciding with the same plane, and an elongated hot plate forming the wall of said chamber opposite to the said valves and injector and extending from the latter substantially to said relatively narrow opening.

7. An oil engine consuming oil and air only and comprising a combustion chamber having a spray nozzle at one end adapted to deliver a spray of oil only substantially lengthwise of the said chamber, all of one wall of said chamber from the injector to the opposite ends of the chamber being unjacketed and constituting a hot plate igniter, and air inlet and exhaust valves mounted in alinement with the spray and opposite to said unjacketed wall.

8. An oil engine consuming oil and air only and provided with a spray injector delivering solid-oil, air inlet and exhaust valves disposed side by side with the axes of their ports lying in a plane which substantially coincides with the axis of the injector spray, a combustion chamber having an unjacketed wall forming a hot surface igniter disposed oppositely to the said valves and having water-jacketed walls on three sides between said valves and the hot wall, the said chamber being symmetrically disposed with respect to said spray and valves in combination with a piston and cylinder communicating with said chamber and valve mechanism whereby the oil is injected into a body of compressed air in said chamber at or about compression dead center.

9. An oil engine comprising a combustion chamber provided with a spray injector delivering a spray of oil without air to said chamber, one of the walls of said chamber being unjacketed and constituting a hot plate igniter coextensive with the length of said chamber in the direction of the spray, and the remaining walls of said chamber being water-jacketed, in combination with a false wall in said chamber forming an interior continuation of the said hot plate within said water-jacketed wall.

10. An oil engine having a combustion chamber in communication with the engine cylinder through a relatively narrow opening, air inlet and exhaust valves arranged in alinement with the axis of said opening, an inclined spray injector opposite said opening and substantially coinciding with the plane of said valves, a hot plate igniter formed by an unjacketed wall of said chamber opposite said valves and the said spray injector, and a false wall for said chamber within the jacketed walls thereof constituting a continuation of the hot surface igniter.

11. An engine of the class described comprising a one-compartment combustion chamber including an uncooled wall and a mechanical oil spray injector directed toward said wall, mechanically operated air and exhaust valves opening directly into said chamber, and controlling means for said valves and injector adapted to operate the latter at compression dead center and to open the air valve prior to the closure of the exhaust valve.

12. In an oil engine, a combustion chamber having inlet and exhaust valves placed opposite an uncooled wall of said chamber, a spray nozzle injecting a mechanical oil spray into said chamber at about the end of the compression stroke and a restricted opening from said chamber to the cylinder having an area of less than one-third of the area of the cylinder, located opposite the spray nozzle and eccentrically to the axis of the combustion chamber, said chamber having its longest dimensions coincident with the axis of said restricted opening.

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

LOUIS K. DOELLING.

Witnesses:
LOUIS BARON,
H. R. HOWELL.