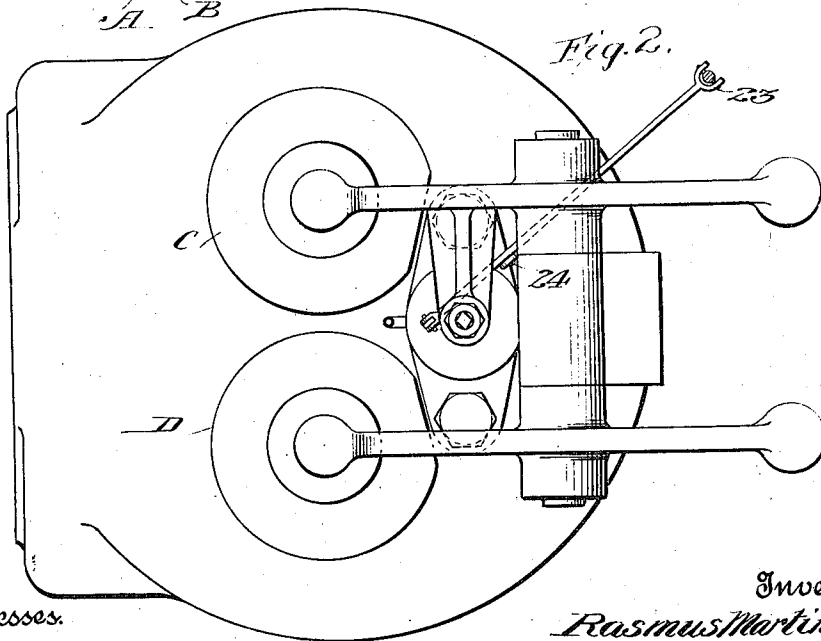
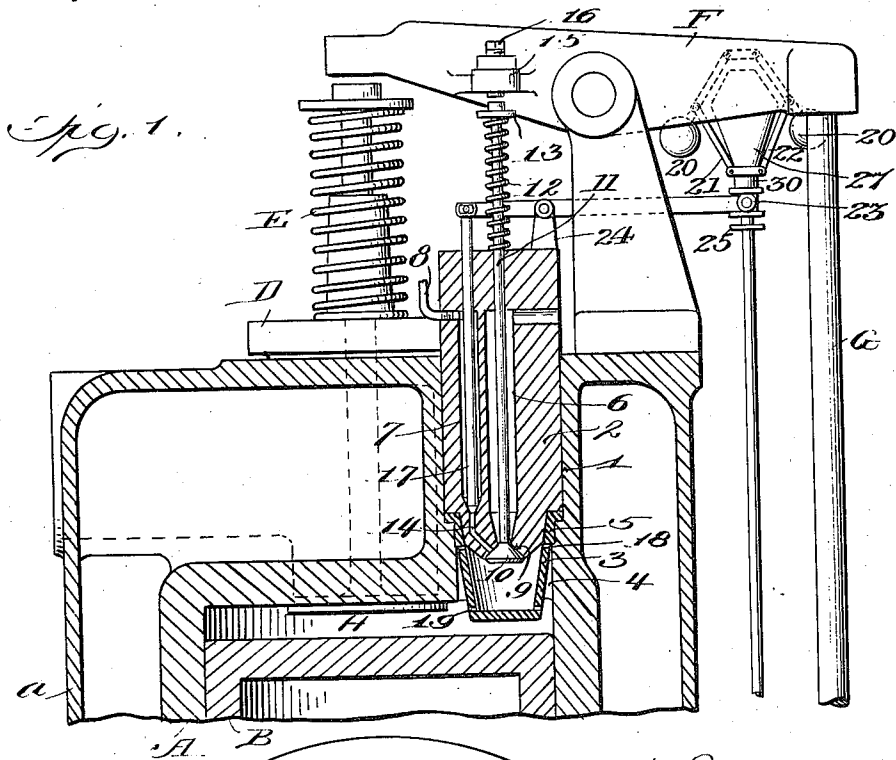


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OIL INJECTION DEVICE FOR OIL ENGINES.
APPLICATION FILED FEB. 2, 1912.

1,134,857.

Patented Apr. 6, 1915.



Witnesses.

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UNITED STATES PATENT OFFICE.

RASMUS MARTIN HVID, OF BATTLE CREEK, MICHIGAN, ASSIGNOR TO R. M. HVID COMPANY, OF BATTLE CREEK, MICHIGAN, A CORPORATION OF MICHIGAN.

OIL-INJECTION DEVICE FOR OIL-ENGINES.

1,134,857.

Specification of Letters Patent.

Patented Apr. 6, 1915.

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To all whom it may concern:

Be it known that I, RASMUS MARTIN HVID, a citizen of the United States, residing at Battle Creek, in the county of Calhoun and State of Michigan, have invented new and useful Improvements in Oil-Injection Devices for Oil-Engines, of which the following is a specification.

This invention relates to improvements in a means for delivering fuel oil to the combustion space of oil burning engines, and more particularly to the delivery and atomization of heavy oils which are not readily vaporized.

In engines of the Diesel type, which is recognized as being of high efficiency, and in connection with which the known methods of supplying oil are used, there must be employed an excessively high compression of the air charge in order to obtain the extremely high temperature required for the ignition of the fuel which is injected into the engine cylinder, and the injection of the fuel properly atomized is effected by means of air supplied under high pressure by an auxiliary compressing apparatus of a complicated and delicate nature.

The present invention avoids the complication of an auxiliary compressing apparatus, and the necessity for employing excessively high compression of the air charge in the engine cylinder, *inter alia*, because by eliminating the use of compressed air for atomization purposes, as in the ordinary Diesel engine, it eliminates the refrigerating effect which attends the passage of such compressed air into the combustion space; and it enables the effective utilization of fuel oils of extremely low grade.

The invention will be more readily understood if, as a preliminary, attention be called to the fact that in the composition of all oils commonly available as engine fuels, there occur some hydro-carbons of relatively high volatility, as compared with that of the main body of the fuel. Even the heaviest and least suitable oils for use in oil burning engines contain some percentage however small, of hydro-carbon constituents, the ignition point of which is materially lower than that of the fuel as a whole; and this characteristic, appertaining to the composition of all fuel oils, is utilized by the present invention.

The principal features of the invention

are the use of an oil containing and vaporizing receptacle as a means for supplying oil to the combustion space, and the development within said receptacle of an explosion of the vaporized constituents of the oil, preliminary to the combustion of the explosive mixture in the combustion space, which explosion, developing a high pressure internal to the receptacle, is effective to forcibly expel the unvaporized fuel content into the combustion space, an essential characteristic of the receptacle being that it is arranged and constructed to thoroughly atomize the oil as it issues therefrom, consequent to the said explosion within the receptacle.

A further feature of the invention is concerned with the development of the explosion aforesaid, and involves the subjection of the more volatile and ignitable constituents of the fuel charge to the action of that portion of the main air charge which occupies a defined zone of the heating chamber, wherein it obtains the highest temperature developed in the air charge and a temperature which is substantially in excess of the temperature of the main portion of the air charge in the combustion space. The heated air in said heating chamber ignites the vaporized constituents of the fuel charge, thereby producing an explosion in the vaporizing chamber or receptacle in which the fuel charge is confined, and, as above explained, this explosion is effective to expel the unvaporized fuel content into the combustion space of the engine, the receptacle thoroughly atomizing the oil as it issues therefrom under the force of the explosion.

A preferred embodiment of the invention is herein shown, and the mechanical agencies which this embodiment involves are a small air heating chamber in open communication with the combustion space of the engine, a fuel receptacle which serves also as a vaporization chamber, and has restricted communication with said air heating chamber and restricted communication, also, with the general combustion space of the engine, and air and fuel valves whereby the delivery of the auxiliary air and the fuel to the fuel receptacle is controlled. The air heating chamber is arranged with relation to the combustion space of the engine whereby an ample superficial surface is provided for absorbing during the combustion stroke, and for transmitting during the compression

sion stroke, an adequate amount of heat to obtain the desired increase of temperature in the heating chamber at the point where it communicates with the fuel receptacle.

5 The invention will be understood by reference to the accompanying drawings, in connection with the succeeding description.

10 In said drawings: Figure 1 is a sectional view showing the upper portion of an engine cylinder with a fuel supply device in which the features of invention are incorporated fitted thereto; and Fig. 2 is a plan view of the same.

15 Similar characters of reference designate corresponding parts throughout the several views.

The engine cylinder is indicated generally by the letter A and the piston by the letter B. The cylinder may be of any approved 20 construction, and, as shown, is provided with the usual cooling jacket *a*. The inlet valve is shown at C and the exhaust valve at D. The valves C and D are shown as fitted in the upper head of the cylinder, and may be 25 operated in any usual manner, for instance, being held in closed position by coil springs E and being opened by levers F which, in turn, are operated by the push rods G, the reciprocation of which is effected by the 30 two-to-one cam shaft (not shown).

In the embodiment shown, the upper head of the engine is formed at one side thereof with a bore 1, in which is fitted a plug 2. The lower portion of the bore may be fashioned to support the vaporizer cup 3, constituting an oil reservoir. As shown, the 35 cup 3 is of downwardly tapering outline, projecting somewhat into the compression and combustion space H, and the lower portion of the bore adjacent said cup has a cylindrical outline, so that a narrow annular chamber 4 is defined. As shown and preferred, the cup 3 is simply seated or fitted in the lower portion of the bore 1, but if desired, said cup can be made integral with 40 the head of the engine, as is obvious. The plug 2, which has at its lower portion an extended boss 5 that fits in the cup 3, is provided with a passage 6, opening to the atmosphere, and with a passage 7, by which 50 oil is fed, the passage 7 forming, in effect, a continuation of an oil supply pipe 8 which leads from any suitable source of supply, for instance, an elevated tank (not shown). The 55 passage 6 opens to a valve seat 9, formed in the under face of the boss 5 and is controlled by a valve 10, the stem 11 of which projects through said passage and beyond the upper end of the plug 2. The projecting portion of the valve stem 11 is surrounded by an expansive coil spring 12 which acts on the head 13 at the upper end of said stem and serves to hold the valve 10 in closed position. The valve 10 not only controls the 60 passage 6, but it also controls the passage 7,

the latter communicating with the valve seat 9 by a duct 14 of small diameter. The valve 10 is moved to open position by a depression of its valve stem 11, a tappet 15, provided on the lever F, which operates the inlet 70 valve C, being employed for this purpose. The tappet 15 carries at its end a screw 16, by means of which the relative timing of the operation of the valves C and 10 may be regulated within certain limits. The passage 75 7, at its junction with the duct 14, is controlled by a full inlet valve 17, the stem of which projects beyond the upper end of the plug 2 and is to be operatively connected in any suitable manner to the governor K. 80

The governor K may be of any suitable construction. As shown, it comprises the well known centrifugal fly-balls which are rotated at a suitable rate of speed by the 85 spindle 30, geared in any desired manner to either the cam shaft or the crank shaft of the engine. When the speed of the engine increases, the balls 20 swing outwardly, thereby, through the levers 21 and 22, lifting the governor weight 27, which surrounds 90 the spindle 30 and has its lower end associated in any suitable manner with the forked end of a lever 23. The lever 23 is pivoted on a bracket 24, which may be suitably located on the upper head of the engine, and 95 it is suitably pivoted to the projecting upper end of the fuel inlet valve 17. It will be noted that when the engine is still, or when its speed is not high enough to bring the governor into action, the lower end of the 100 governor will rest against the stop collar 25 on the spindle 30 and the valve 17 will have its highest position, thus admitting fuel oil through the duct 14 at a maximum rate. As 105 soon as the governor begins to move upwardly, due to an increase in the speed of the engine, the fuel inlet valve will be proportionately lowered, and the rate at which the fuel passes through the duct 14 will be 110 proportionately reduced.

The cup 3 is in restricted communication with the annular chamber 4 and also with the compression and combustion space H, small openings 18 and 19 being provided for 115 this purpose. The openings 18 are arranged at the extreme upper end of the chamber 4, and the openings 19 are arranged at the lower end of the cup 3.

In operation, it may be assumed that the 120 four stroke cycle is employed, and that the piston is at the top of the cylinder, having just completed the exhaust stroke, and that the exhaust valve is closed. As the piston moves outwardly, the valve C opens and pure air is drawn into the cylinder. At the 125 same time, or very shortly after the opening of the valve C, the valve 10 is opened through the instrumentalities described, and oil is delivered to the cup 3. Simultaneously with the delivery of the fuel oil to the 130

vaporizer, a small quantity of air, controlled to suit the requirements by means of the adjusting screw 16, will be drawn in through the passage 6, and this air, with the aid of the heat of the cup 3, will promote the vaporization of some of the more volatile constituents of the fuel charge. The carbureted air thus formed, during the suction stroke and during the compression stroke, will be effectively confined in the vaporizer cup, due to the restricted openings by which this space communicates with the general compression space.

As the clearance between the piston and the cylinder head is relatively small, and the ultimate compression space of the engine is correspondingly small, the temperature of the main body of the air charge becomes relatively high, but, on account of the relatively large wall surface from which heat will be derived, by the air confined in the annular chamber 4, the temperature of the air at the upper part of this annular chamber becomes materially higher than the temperature of the main body of the air charge. Thus, at a certain point near the end of the compression stroke, the temperature of the air confined in the chamber 4 becomes high enough to ignite the carbureted air in the receptacle 3. It follows that the times for ignition occur in regular and defined sequence during the operation of the engine, because the more volatile constituents in the receptacle 3 being relatively cold, by reason of the fact that heat has been made latent during the process of vaporization, they are not apt to ignite before the defined period of the stroke where the excessively heated air in the annular air chamber causes their ignition.

The preliminary explosion resulting from the ignition of the carbureted air confined in the receptacle 3 will effect a thorough atomizing, heating, and vaporization of the main fuel charge remaining in the receptacle 3 as said charge is forcibly ejected from the openings 19 to mix with the air contained in the combustion space. Immediately upon the preliminary explosion there will, therefore, follow a gradual slower combustion of the fuel until the last of it is consumed. The size and number of the openings 19 and their disposition with relation to the bottom of the receptacle 3 will, to some extent, depend on the nature of the fuel utilized, but in all cases said openings are selected to effect a thorough atomization of the fuel expelled therethrough by the explosion in the receptacle.

Owing to the thorough manner in which the fuel becomes atomized and heated as it is forcibly ejected from the vaporizer, the combustion temperature becomes high and the initial working pressure at par with that of engines working on the Diesel cycle;

and hence, a high efficiency is secured, notwithstanding the fact that the average compression temperature is materially lower than is usual in engines employing the cycle referred to.

It will be understood that no specific description herein contained is intended to put any limitation upon the appended claims, except as such is necessary to an exposition thereof.

Having fully described my invention, I claim:

1. The combination, with a cylinder and a piston of an oil burning engine, the cylinder having a combustion space, of an oil reservoir having an area exposed to the combustion space of said cylinder and having restricted communication with said combustion space, and a restricted chamber in open communication at one end thereof with the said combustion space and in restricted communication at its other end with the oil reservoir, a portion of the air admitted to the cylinder becoming heated during compression in the chamber to a degree greater than that of the air remaining in the cylinder and sufficiently to act, through the restricted communication between the chamber and the reservoir, upon the particles of oil in said reservoir which have become vaporized during compression and to thereby cause an explosion thereof.

2. The combination with a cylinder and a piston of an oil burning engine, of a vaporizing oil reservoir having an area subject to the heat developed in the combustion space and having a restricted communication with said space, a small chamber in open communication at one end thereof with the combustion space and at its other end in restricted communication with the reservoir, a fuel passage and an air passage through which oil and air may pass to the reservoir, and means acting intermittently in conformity with the suction strokes of the piston to control the admission of the fuel charge and the air charge to said reservoir.

3. The combination with a cylinder and a piston of an oil burning engine, a wall of the cylinder adjacent the compression and combustion space thereof being fashioned to provide a restricted chamber leading from and in open communication with said combustion space, of a vaporizing oil reservoir which is disposed concentrically within said chamber in spaced relation to the annular wall of the latter, the reservoir having an area subject to the heat in the combustion space and having a restricted communication with said space and having also a restricted communication with said chamber somewhat adjacent the closed end of the latter, whereby a portion of the air admitted to the cylinder becomes heated during compression in the chamber sufficiently to act

through the restricted communication between the chamber and the reservoir upon the particles of oil in said reservoir which have become vaporized during compression and to thereby cause an explosion thereof.

4. The combination with a cylinder and a piston of an oil burning engine, the cylinder having a combustion space, of an oil reservoir having an area exposed to the combustion space and having a fuel discharge opening communicating with said space and formed to completely atomize the fuel in connection with its discharge, and a restricted chamber in open communication with the combustion space and wherein a portion of the main air charge attains a degree of heat greater than that of the rest of the air charge in the cylinder, the restricted chamber being so related to the oil reservoir as to cause its highly heated air to set up an explosion within the reservoir of the particles of oil therein which have become vaporized during compression, the atomizing discharge of the fuel from the reservoir being consequent to said explosion.

5. In an internal combustion engine, a vaporizing fuel receptacle constructed and arranged to discharge its fuel content in a highly atomized condition into the combustion space of the engine, the engine having means for heating the receptacle to vaporize the more volatile constituents of the fuel content thereof, and means for conducting heated air from the combustion space into the receptacle to cause a preliminary explosion within the receptacle of the vaporized constituents of the fuel content thereof, the atomizing discharge of the fuel being consequent to such preliminary explosion.

6. In an oil burning engine, means for supplying fuel oil to the combustion space thereof, comprising a fuel containing, vaporizing, and atomizing receptacle having an inlet for the admission of heated air to cause an explosion within the receptacle and an outlet separated from said inlet and through which the fuel is discharged consequent to the explosion, the outlet being selected to produce a thorough atomization of the fuel continuous with the discharge thereof, the atomizing discharge of the fuel through said outlet being consequent to the explosion within the receptacle.

7. In an oil burning engine, means for supplying fuel oil to the combustion space thereof, comprising a fuel containing receptacle communicating with said combustion space, means communicating with said receptacle for conveying fuel therinto, means additional to the main air supply of the engine communicating with said receptacle for conveying air therinto, means associated with said receptacle for permitting the entrance therinto of heated air from said combustion space to cause an ex-

plosion in said receptacle preliminary to the combustion within said space, and a fuel atomizing outlet through which fuel is discharged into said combustion space from said receptacle, consequent to the explosion therein.

8. The combination with a cylinder and a piston of an oil burning engine, a wall of the cylinder adjacent the combustion space thereof being formed into a chamber in open communication with said space, of a vaporizing fuel receptacle constructed to discharge atomized fuel into said combustion space and arranged within said chamber in spaced relation to its surrounding wall and communicating with the space defined by said wall.

9. The combination with a cylinder and a piston of an oil burning engine, of a vaporizing fuel receptacle constructed to discharge fuel into the combustion space of said cylinder and to atomize the fuel continuously with its discharge, a wall of the cylinder adjacent the combustion space being formed to provide a chamber in open communication with said space and surrounding said receptacle, and wherein air from said space is superheated to cause a preliminary explosion within the receptacle, the atomizing discharge of the fuel being consequent to such preliminary explosion.

10. In a hydro-carbon engine, the combination of a cylinder and a piston, said cylinder being provided with a combustion space, a fuel receiving receptacle, means for supplying fuel to said receptacle, means for supplying air to said cylinder, means for supplying air to said receptacle independently of the air supplied to the cylinder, and means for causing an explosion of the content of the receptacle which is explosible therein, the receptacle having a restricted discharging communication with the cylinder selected to atomize the fuel continuously as it is discharged therethrough consequent to said explosion.

11. In a hydro-carbon engine, the combination of a cylinder and a piston, said cylinder being provided with a combustion space, a fuel receiving receptacle, means for supplying fuel to said receptacle, means for supplying air to said cylinder, means for supplying air to said receptacle independently of the air supplied to the cylinder, all of said means acting on the suction stroke of the piston, and means for causing an explosion of the content of the receptacle which is explosible therein, the receptacle having a restricted discharging communication with the cylinder selected to atomize the fuel continuously as it is discharged therethrough consequent to said explosion.

12. In a hydro-carbon engine, the combination of a cylinder and a piston, said cylinder being provided with a combustion

space, a fuel receiving receptacle having restricted communication with said combustion space at separated points in its length, means for supplying the fuel to be consumed to said fuel receiving receptacle, and means for supplying a limited volume of air to said fuel receiving receptacle, both said fuel and air being supplied on the intake stroke of the piston, the arrangement being such that a portion of the fuel charge is vaporized on its entrance to the fuel receiving receptacle, which vaporized portion is ignited by heated air from the combustion space entering one restricted opening in said fuel receiving receptacle, said ignition causing excessive pressure within said fuel receiving receptacle and the expulsion of the remainder of the charge through the other of said restricted openings, said last named restricted opening being selected to atomize the remainder of said fuel charge continuously with its expulsion from said receptacle.

13. In a hydro-carbon engine, the combination of a cylinder having a combustion space and a relatively small auxiliary heating space in open communication with said combustion space, a piston in said cylinder, a fuel receiving cup mounted within said auxiliary heating space, there being a limited area between the walls of said fuel receiving cup and the walls of said auxiliary heating space, said fuel receiving cup being provided with relatively minute apertures at separated points in its length, one aperture communicating with the limited area between the walls of said cup and said auxiliary heating space, and another of said apertures communicating with said combustion space, means for supplying fuel and a limited volume of air to said fuel receiving cup on the intake stroke of said piston, the fuel within said fuel receiving cup being partially ignited within the cup, the remainder of the fuel being expelled from the cup by the excess of pressure developed therein,

said fuel being atomized consequent to its passage through said minute aperture last named.

14. The combination with a cylinder and a piston of an oil burning engine, the cylinder having a combustion space, of an oil reservoir having an atomizing discharge communication with said space, and a restricted chamber in open communication with the combustion space and wherein a portion of the main air charge attains a degree of heat greater than that of the rest of the air charge in the cylinder, the restricted chamber being so related to the oil reservoir as to cause its highly heated air to set up an explosion within the reservoir of the particles of oil which have become vaporized therein, the atomizing discharge of the fuel from the reservoir being consequent to said explosion.

15. An oil burning engine having a cylinder, a piston, an oil cup for supplying fuel oil to said cylinder, means for supplying air to said cylinder to promote combustion therein, and means for supplying charges of oil and air to said cup at definite periods in the running of the engine whereby a percentage of the more volatile constituents of the oil combines with the air to form a combustible mixture within the cup, the heat developed on the compression stroke of the piston causing a preliminary explosion within the cup of the said combustible mixture, the cup having an opening through which oil is discharged into the cylinder consequent to said explosion and which is formed to thoroughly atomize the oil continuously with its discharge.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

RASMUS MARTIN HVID.

Witnesses:

ORTON G. CULVER,
ERNEST C. RICE.