July 29, 1924. 1,502,926

J. H. SUTER

METHOD OF AND MEANS FOR FUEL INJECTION FOR INTERNAL COMBUSTION MOTORS

Filed June 7, 1920

Fig. 1

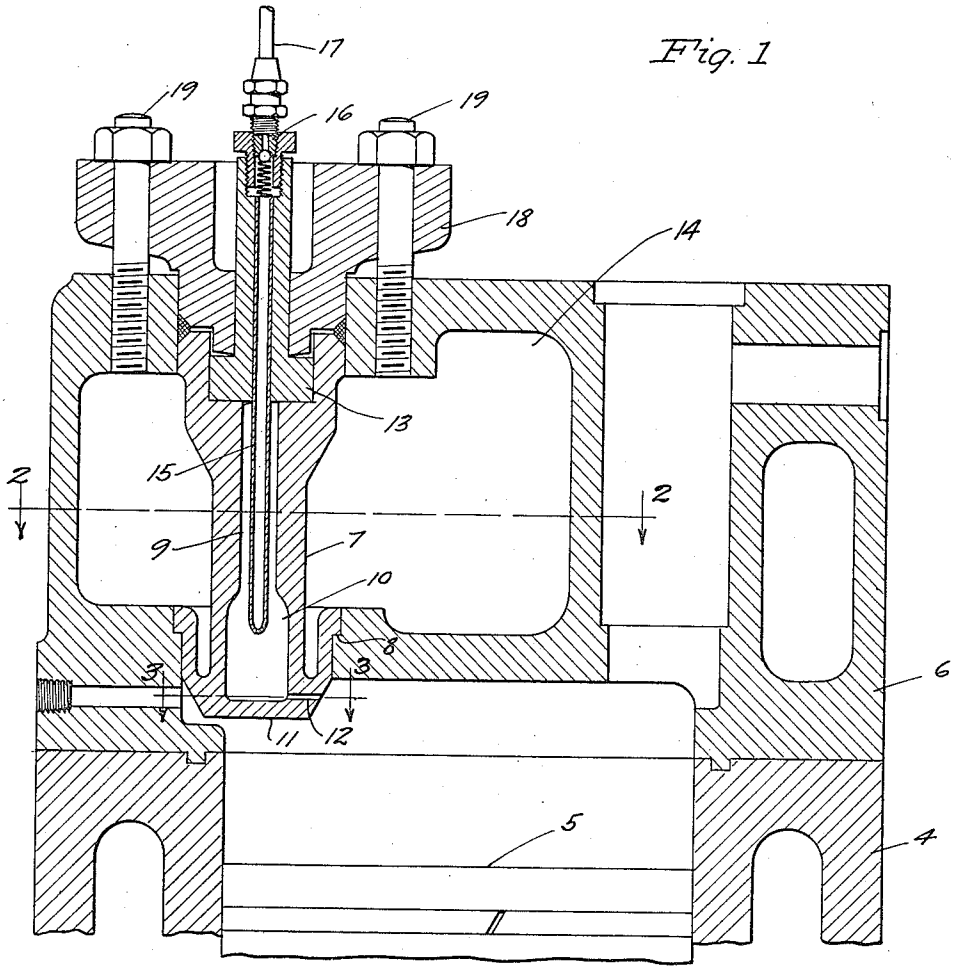


Fig. 2

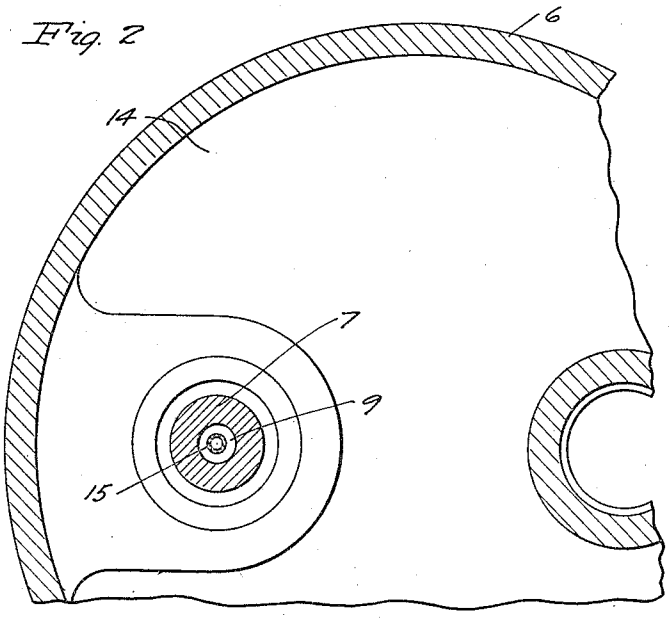
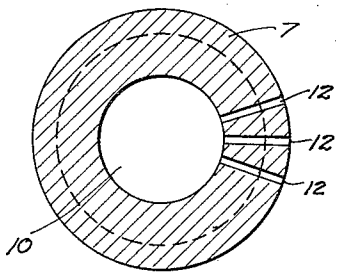


Fig. 3



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UNITED STATES PATENT OFFICE.

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METHOD OF AND MEANS FOR FUEL INJECTION FOR INTERNAL-COMBUSTION MOTORS.

Application filed June 7, 1920. Serial No. 387,096.

To all whom it may concern:

Be it known that I, JOHN H. SUTER, a citizen of the Republic of Switzerland, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in a Method of and Means for Fuel Injection for Internal-Combustion Motors, of which the following is a specification.

This invention relates to internal combustion engines of the Diesel type, in which hydrocarbon oil or other vaporizable fuel is introduced into the cylinder from an auxiliary chamber. This invention pertains particularly to the type of engine having an auxiliary chamber in communication with the cylinder, and in which a primary explosion of a portion of the fuel occurs by reason of the heat of the compressed air, the force resulting from this explosion ejecting the remainder of the charge into the cylinder.

Devices of this character have met with two primary difficulties. It has been the common practice to introduce the fuel charge substantially coincident with the instant of greatest compression of the air in the cylinder. This requires careful timing of this event. Another trouble encountered has been that of cracking of the hydrocarbon due to the heat retained by the walls of the chamber. A residue results from the cracking, which clogs the passages of the chamber and soon renders the device inoperative.

The objects of this invention are first, to provide a means and method of introducing the charge into the cylinder by means of a foul explosion in an auxiliary chamber, which will not produce carbonaceous deposits; second, to provide a method and means which will not require timing for the introduction of the charge into the chamber; third, to provide a means wherein the fuel is maintained adjacent the outlet of the auxiliary chamber and consequently reaches the interior of the cylinder at the desired time; fourth, to provide a construction such that the fuel is injected into the cylinder above the piston and not upon it or the cylinder walls; and fifth to provide a chamber so constructed as to have a fluid buffer back of the explosive zone, whereby a portion of the energy of explosion is accumulated and then gradually expended upon the remaining fuel in the chamber.

The above mentioned objects together with other objects and corresponding accomplishments are secured by means of the engine illustrated in the accompanying drawing, in which:

Fig. 1 is a vertical section through the head end of an internal combustion engine equipped with a fuel injection device for carrying out my invention; Fig. 2 is a fragmentary section as seen on the line 2—2 of Fig. 1; and Fig. 3 is an enlarged section as seen on the line 3—3 of Fig. 1.

Referring more particularly to the drawing, an engine cylinder is indicated by 4. Mounted therein for reciprocation is a piston 5. Secured to the cylinder by any of the well known mechanical expedients is a head 6 having mounted therein my improved fuel injection means.

Extending through the head adjacent the internal wall of the cylinder is an opening, in which is disposed a fuel injection nozzle 7 resting against a shoulder 8 in the head. The injection nozzle is provided with an elongated chamber 9 having an enlarged inner end 10 closed by a bottom wall 11. The injection nozzle projects into the clearance space above the piston, and communicates with the cylinder through ducts 12 on a level with the bottom and disposed to direct fuel transverse of the piston travel and into the clearance space. The injection nozzle is counter-bored at the top to receive a plug 13. Completely surrounding the fuel injection nozzle is a water chamber 14 forming a part of the water jacket of the engine.

The plug 13 has its upper end reduced in diameter, and extending therethrough is a fuel nozzle tube 15. The top of the plug is counterbored above the upper end of the nozzle and disposed in the counterbore is a valve cage 16 carrying a check valve. Connected to the valve cage is a pipe 17, which is preferably connected to a source of fuel supply under pressure.

A follower 18 holds nozzle 7 in position, and also acts as a glad to provide a leak type joint. There is also an extension on the follower disposed in the counterbore of the injection nozzle and holding plug 13

in position. The follower may be secured to the head by bolts 19 or any other convenient means.

Upon compression of the air in the cylinder, a portion of the latter rushes into the auxiliary chamber through ducts 12. Due to the volume of the enlarged inner end of the chamber, the velocity of the entering air is reduced, and is unable to raise any substantial part of the fuel which is injected into the auxiliary chamber at some time during the compression stroke. The fuel is delivered by the nozzle tube 15 to the bottom 11 of the chamber, and therefore remains in the immediate vicinity of the ducts 12. A portion of the fuel is vaporized and forms an explosion zone in the enlarged portion of the chamber. The upper end of the chamber is filled with inert gases and an accumulator zone is thereby provided to store a portion of the energy of the explosion which later occurs. The heat of compression ignites the combustible mixture in the enlarged portion of the chamber, an explosion occurs, ejecting part of the fuel on the bottom 11 and storing energy by compression of the inert gases in the accumulator zone. This energy is gradually restored and the remaining fuel ejected into the cylinder.

The intensity of the main cylinder explosion can be varied by changing the bottom area of the lower enlarged chamber. With a small bottom area, it is evident that after the primary explosion, the outrushing gases will pick up the fuel readily with the effect that quite a sharp explosion, and a spontaneous rise in pressure ensues in the main cylinder. On the contrary, with a large bottom area of the enlarged chamber, after the primary explosion, a longer time is required for the outrushing gases to gather the fuel which is spread over a larger area, with the effect that the fuel injection period to the main cylinder is extended over a longer period. This results in an easier pressure rise in the main cylinder. The whole chamber is water-cooled and to eliminate complication of cooling of the lower extreme of the chamber, that is of the flat bottom, the wall thickness may be increased for the easier heat exchange from the lower extreme to the cooling water.

What I claim is:

1. In an internal combustion engine, the combination of the cylinder thereof with a fuel injection means comprising a chamber having an elongated outer end and a bulbous inner end communicating with said cylinder, means to cool substantially all of the walls of said chamber, and means to introduce a charge of fuel into the enlarged end of said chamber.

2. In an internal combustion engine, the combination of the cylinder thereof with a fuel injection means comprising a chamber having an elongated outer end and a bulbous inner end provided with outlets disposed so as to direct fuel into the cylinder transverse to and above the path of travel of the piston, means to cool substantially all of the walls of said chamber, and means to introduce a charge of fuel into the enlarged end of said chamber.

3. In an internal combustion engine, the combination of the cylinder thereof with a fuel injection means comprising a chamber having an elongated outer end and a bulbous inner end provided with a bottom of substantial area for the reception of fuel, means to cool substantially all of the walls of said chamber, and means to introduce a charge of fuel upon the bottom of said chamber.

4. In an internal combustion engine, the combination of the cylinder thereof with a fuel injection means comprising a chamber having an elongated outer end and a bulbous inner end provided with outlets disposed so as to direct fuel into the cylinder transverse to and above the path of travel of the piston, said enlarged inner end being provided with a bottom of substantial area for the reception of fuel, means to cool substantially all of the walls of said chamber, and means to introduce a charge of fuel upon the bottom of said chamber.

In witness that I claim the foregoing I have hereunto subscribed my name this 1st day of June, 1920.

JOHN H. SUTER.