Sept. 13, 1932. J. H. LENTELL, JR 1,876,980

FUEL INJECTION DEVICE

Filed Nov. 6, 1929

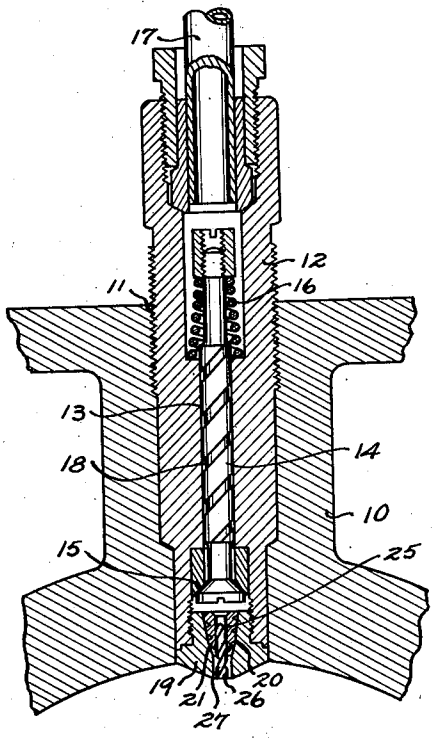


FIG. 1

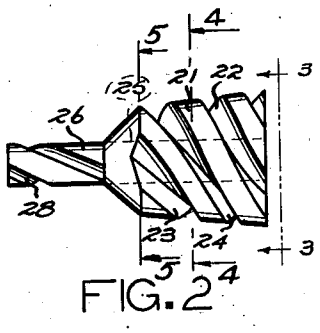


FIG. 2

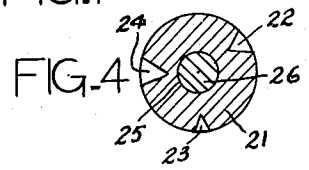


FIG. 4

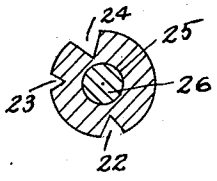


FIG. 5

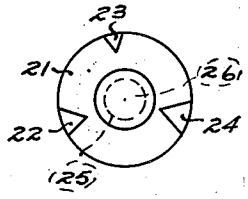


FIG. 3

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FUEL INJECTION DEVICE

Application filed November 6, 1929. Serial No. 405,118.

This invention relates to improvements in fuel injection devices for use with internal combustion engines, wherein liquid fuel is delivered directly into the cylinder during the compression stroke.

An object of the present invention is to provide an improved injection device embodying means for providing homogeneous spray distribution, and for delivering a whirling, finely divided column of fuel directly into the engine combustion chamber.

A further object is to provide simple and effective means for carrying the dispersion action of the injected fuel, beyond the exit section of the spray orifice, in order to obtain greater effectiveness of fuel dispersion as well as a greater degree of control of the issuing fuel stream, and to effect a substantial saving in the fuel rate of the engine.

Further objects and advantages will appear from the following detailed description of parts and the accompanying drawing, in which Fig. 1 is a sectional elevation of a preferred form of fuel injection device to which the present improvements are applied; Fig. 2 is an enlarged side elevation of a preferred form of fuel injection guide member, Fig. 3 is a top or plan view of the preferred guide member, as viewed from line 3—3 in Fig. 2, Fig. 4 is a section taken along line 4—4 of Fig. 2, and Fig. 5 is a section taken along the line 5—5 in Fig. 2.

It will, of course, be understood that the present detailed description of parts and the accompanying drawing relate to a single preferred executional embodiment of the invention, and that substantial changes may be made in the described arrangement and construction of parts without departing from the spirit and full intended scope of the disclosure as defined by the appended claims.

Referring by numerals to the drawing, 10 indicates a fragmentary portion of a cylinder head, in which is provided an opening 11 communicating with the interior of the engine cylinder. The body of an injector 12 of any suitable type, is threaded into the opening 11. This injector is formed with an axial bore 13, in which is disposed an injection valve 14 normally held in closed position upon a seat 15 by means of a spring 16. The fuel is supplied to the bore 13 through a connected supply pipe 17, which may be supplied by an injection pump, as is usual, and well known in the art. This fuel is forced through a tortuous passage 18 formed upon the stem portion of valve 14, and the arrangement is such that the oil pressure tends to open this valve. It will, of course, be understood that the above described injector may be replaced by any other suitable fuel injection mechanism, without affecting the operating conditions of the mechanism hereinafter described.

A tip portion or discharge jet 19 is removably attached to the injector body, and is provided, by preference, with a conical bore 20, which serves as a seat for a conical guide member 21. This guide member is provided with a plurality of spiral grooves, as indicated at 22, 23 and 24, (Figs. 2 and 3), which form guide passages for the supplied fuel. These helical passages may be formed of the same diameter and pitch, but in the preferred example each of the guide passages 22, 23 and 24, is formed of a different pitch, for a purpose hereinafter appearing. The diameter varies between the entrance and discharge portions of the passages, since they are formed in a tapered member. The differing pitch and angularity of the several guide passages best appears from the diagram of Fig. 4, and particularly from the slope lines extended from the center lines indicating the trend of the several fuel passages. Centrally of the member 21 is provided a bore 25, (best seen in Fig. 2) in which is rigidly secured a cylindrical member 26, which extends beyond the member 21, and into an orifice 27 formed in the nozzle member 19. The cylindrical member 26 extends axially through, and to the extremity of the orifice 27 for a purpose hereinafter appearing. The orifice 27 is formed substantially larger in diameter than the member 26, which is, for this reason, spaced from the inside wall of this conduit portion, in order to provide a passage for the issuing stream of fuel. The cylindrical member 26 is, by preference, provided with a plurality of spiral grooves 28, as best seen in Fig. 2, which are, by prefer-

ence, formed of a pitch and diameter, substantially differing from the grooves 22, 23 and 24, for a purpose hereinafter appearing. The purpose of the member 26 is primarily to extend or continue the dispersion action of the injected fuel, beyond the exit section of the orifice 27.

The herein described device is economical and efficient in operation. The fuel is injected through the value 14, having been given a whirling, spiraling action in passing through the tortuous conduits 18, whence it passes into the guide passages 22, 23 and 24 in the member 21. As the fuel column proceeds through these passages, there is produced a further whirling, spiraling action which tends to break up the liquid into a fine spray, mist or fog. The fuel issuing from the guide passages is directed into the orifice 27, in which the whirling action and dispersion is continued as the fuel is directed into the combustion chamber of the engine.

In the present device a plurality of fuel guides of different diameter and pitch are placed before the orifice. The differing helices prevent the different portions of the mass forming the fluid column, from rotating in exact concurrence, and thereby cause different parts of it to be dispersed at varying rates. In the present device, the plurality of helical fluid guides prevents the spray from assuming merely the form of a hollow cone, and permits of obtaining a more general spray distribution over a space of substantially cone shape.

In engines of the so called solid-injection type, the form and fineness of fuel spray are vitally important. In certain of the older prevailing types of injection devices, a spiral member is used immediately before the outlet orifice to the cylinder, in order to rotate the advancing column of fluid, and to cause dispersion of the fuel by centrifugal force as soon as it is no longer confined by the orifice. In the present preferred device, the plurality of helical guide passages directed into the relatively short annular passage 27, aids this action to obtain proper dispersion of the liquid fuel as it enters the engine combusion chamber. It has been found, in practice, that with the present arrangement, a more efficient centrifugal action is obtained, which brings about a more energetic dispersion in proportion to the pressure of the fluid supplied to the orifice. Further, it is possible to control with greater precision, the form and characteristics of the delivered fuel stream. The spiral guide passages are entirely protected by the walls of the member 21 from the products of combusion within the engine cylinder, for example, to prevent carbon formation. Any possibility of carbon formation in the helical guides or the orifice, is prevented by the high velocity of the fluid column in passing therethrough.

In the preferred device, herein described, the guide passages divide the fuel column into spiraling capillary streams of differential velocity, which create a centrifugal action beyond the orifice, which insures a complete vaporization of the fuel to be atomized and mixed with the compressed air in the combustion chamber, to obtain an effective and efficient burning.

I claim as my invention:

1. In a fuel injection device, a member for directing fuel discharge, and having a plurality of fuel guide passages therein, a pair of such passages being of different angularity and sectional area.

2. In a fuel injection device, a member for directing fuel discharged from the device, said member including a tapered portion, and a portion of substantially uniform diameter disposed nearest the discharge end of the member, there being a spiral guide passage formed on said tapered portion.

3. In a fuel injection device, means for directing fuel discharge, including a discharge conduit, and a member forming a helical fuel-directing passage, said member being disposed in, and having a portion spaced substantially from the wall of said conduit, said member extending substantially to the discharge end of said conduit.

4. In a fuel injection device, fuel-discharge directing means including a discharge conduit and a structure disposed coaxially within said conduit and forming a helical, fuel directing passage, a portion of said structure being contiguous to, and another portion thereof being spaced substantially from, the wall of said conduit, and extending substantially to the discharge end thereof.

5. A discharge jet for a fuel injector including a nozzle member having a bore therethrough, and a spirally grooved plug extending into said bore, certain of the grooves in said plug being of different pitch.

6. A discharge jet for a fuel injector including a threaded nozzle member having a bore therethrough, and a plug extending into said bore and having spiral passages formed therein, a pair of said passages being formed on different radii.

7. In combination, in a fuel injector body, a member detachably secured to said body, forming a discharge nozzle and having a passage therethrough, a helically grooved plug removably disposed in said member, the grooves of said plug being of various pitch and pitch diameters.

8. In a fuel injector, a tip member having an axial bore and a tapered seat, a plug engaging said seat and having a series of spiral grooves, means for supplying fuel to said grooves, and a member carried by said plug, concentric with said axial bore, for directing the fuel from said groove to the extremity of said tip member.

9. In combination with an injector, for solid injection engines, an injector body, a nozzle structure in threaded engagement with the injector body, and having an axial opening therethrough, forming a fuel discharge conduit, the outermost or intake portion of the conduit being tapered toward its discharge end, and the innermost or discharge portion being of uniform diameter, a plug disposed in said axial opening, said plug having a spirally grooved, tapered portion engaging the tapered portion of the axial opening whereby to position the plug, and a grooved extension on said plug, disposed within the discharge portion of the axial opening and in spaced relation to the wall thereof.

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