July 17, 1934. F. STEPHAN 1,966,911

FUEL ATOMIZING MEANS

Original Filed April 24, 1931 2 Sheets-Sheet 1

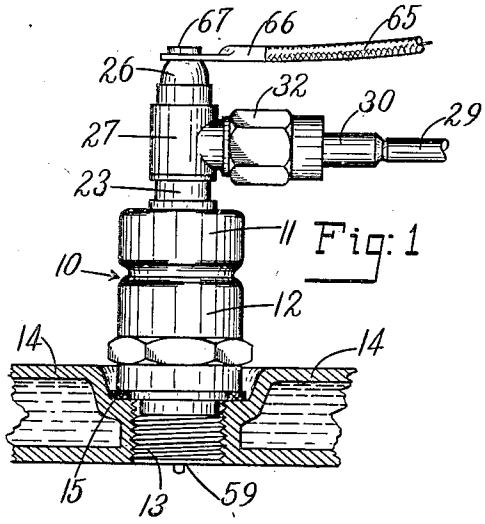
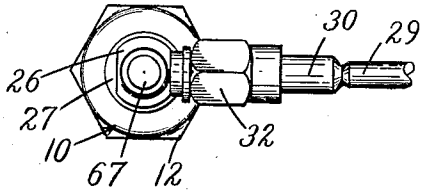


Fig. 1

Fig. 2



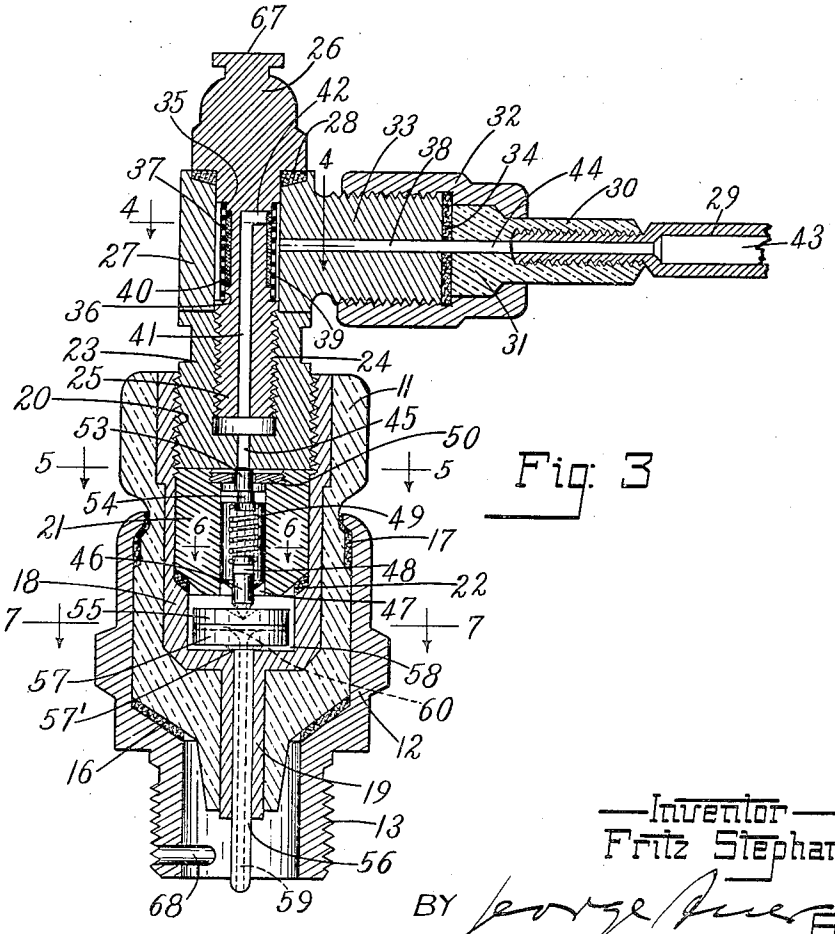


Fig. 3

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Fig: 4

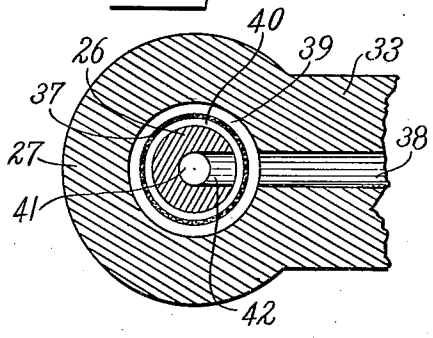


Fig: 5

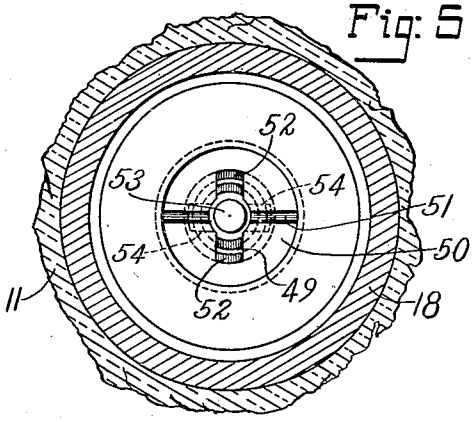


Fig: 7

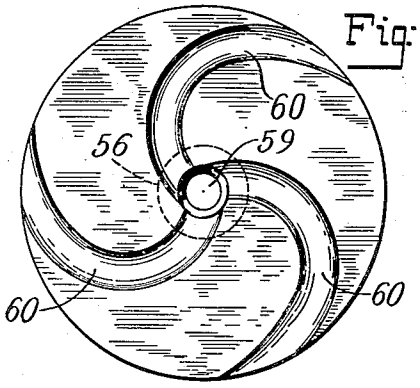
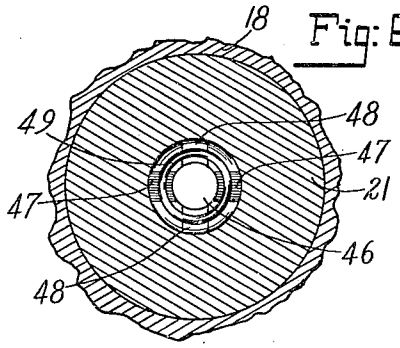


Fig: 6



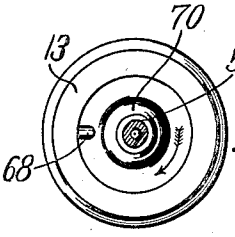


Fig: 9

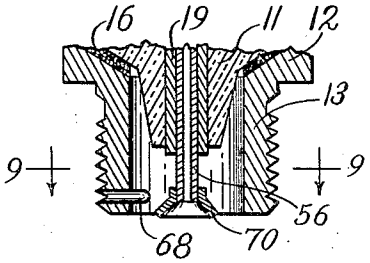


Fig: 8

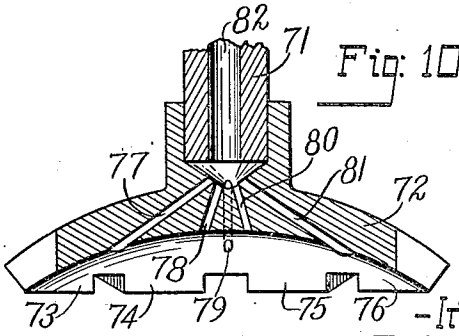


Fig: 10

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UNITED STATES PATENT OFFICE

1,966,911

FUEL ATOMIZING MEANS

Fritz Stephan, Chicago, Ill., assignor to Stephan Engineering Corporation, Chicago, Ill., a corporation of Delaware

Original application April 24, 1931, Serial No. 532,529. Divided and this application April 18, 1932, Serial No. 605,937

4 Claims. (Cl. 299—107.6)

My invention relates, broadly speaking, to a fuel atomizing system and more particularly to a device for atomizing fuel.

This is a division of my copending application Serial No. 532,529, filed April 24, 1931.

The device which I have disclosed and which I will presently describe in detail has been designed for vaporizing and atomizing liquid fuel, for example, fuel oil, for injecting the atomized fuel into a combustion chamber of an engine where the fuel is intermixed with air, and for igniting the mixture for the purpose of furnishing the motive power for the engine.

The following description refers chiefly to the atomizing functions and means of the invention. Certain other features, e. g., such as relate to the function of the device as an igniting means may be looked up in the above mentioned copending application. The device will be described with reference to the accompanying drawings, in which,

Figure 1 shows the device in elevation as attached to an engine cylinder;

Figure 2 is a top view of the device;

Figure 3 is an enlarged cross section of the device;

Figure 4 represents an enlarged cross section taken on line 4—4 in Figure 3;

Figure 5 illustrates an enlarged cross section taken along line 5—5 in Figure 3;

Figure 6 is an enlarged cross section taken on line 6—6 in Figure 3;

Figure 7 shows an enlarged top view of the lateral portion of the rotor as seen on line 7—7 in Figure 3;

Figure 8 shows a partial cross section of a modified device having a special discharge attachment on the hollow rotor shaft;

Figure 9 is a cross section taken on line 9—9 in Figure 8; and

Figure 10 represents a modified discharge attachment on the rotor shaft in enlarged cross sectional view.

Referring now to the drawings, Figures 1, 2 and 3, the device comprises the following parts:

An insulating body designated by the reference numeral 11 is partially disposed within a metal shell or mounting 12, and the latter is provided with a threaded portion 13 for attachment of the device to an engine cylinder, such as is shown in Figure 1 in fragmentary view designated by the reference numeral 14. A gasket 15 may be interposed between the mounting 12 and the engine cylinder in order to obtain a tight fit. Suitable gaskets or packings such as 16 and 17 provide a tight fit of the insulating body 11 within the mounting 12. The upper edge of the mounting 12 may be formed to grip the packing 17 as shown.

The tubular insert 18 provided in its lower portion with a projection 19 and in its upper portion with an internal thread 20 is cemented in the insulating body 11. The insert 18 holds the valve body 21 which fits against a packing or gasket 22 and is held in place by means of the top member 23—threaded into the insert 18 as shown particularly in Figure 3.

The top or closing member 23 is provided with an internal thread 24 for receiving the shaft 25 of the screw 26. This screw has an enlarged portion for clamping the fuel connection 27 on the shoulder of the member 23. The corresponding surfaces may be machined to provide a snug fit. A gasket or packing 28 is disposed in a recessed portion of the attachment 27 and the enlarged portion of the screw 26 presses against this gasket 28 for sealing the joint securely.

The fuel line 29 is provided at its end with a member 30 having an enlarged end 31. This member may be made of an insulating material such as a suitable phenol condensation product and the like. The enlarged portion 31 of the member 30 is disposed within a nut 32 which engages the threaded portion 33 of the attachment 27. A gasket 34 is interposed between the threaded portion 33 and the enlarged portion 31 of the insulating member 30 in order to furnish a tight joint for the fuel line 29.

The screw 26 is turned down in its central portion to provide shoulders 35 and 36. Attached around the resulting annular recess and resting on the shoulders 35 and 36 is a screen 37. This screen acts as a filter for the liquid fuel which is fed to the atomizer device through the fuel line 29. The arrangement is particularly shown in Figure 4 which is an enlarged cross section taken on line 4—4 in Figure 3, looking in the direction of the arrows.

The lateral duct 38 extending through the threaded portion 33 of the attachment 27 terminates substantially centrally of the recessed portion provided in the screw 26. The screen 37 is placed so that a chamber 39 results in front of the screen 37. The fuel oil fed through the duct 38 can flow freely and can enter through all the meshes of the screen 37. Due to the shoulders 35 and 36 on which the screen 37 rests, a second chamber 40 is provided behind the screen interiorly of the recessed portion. The fuel oil entering through the screen 37 can therefore spread

within the chamber 40 and can freely enter the transverse duct 42 which connects with the duct 41 extending longitudinally through the screw 26.

The arrangement of the screen 37 in the manner as I have described above particularly with reference to Figures 3 and 4, represents a very efficient way of conducting the fuel oil through the filter 37. The entire suface of the sceen is utilized since the screen is placed free of the ducts 38 and 42 so that the fuel oil can flow freely through all the meshes of the screen.

It may be mentioned at this point that the fuel oil fed through the fuel line 29 may be pre-filtered. The filter 37 is a fine filter and provided for excluding minute particles that may be contained in the oil.

The path of the fuel may be traced through the duct 43 in the fuel line 29, through the duct 44 in the insulating member 30, through a corresponding opening in the gasket 34, through the duct 38, screen 37, ducts 42 and 41. The fuel arrives finally at the duct 45 in the closing or top member 23. Before tracing the flow of the oil through the atomizer I will describe the arrangement of the check valve in the valve housing 21.

The valve housing 21 is provided at its bottom with a boring for receiving the pin 46. This pin 46 may have a circular flange or may be provided with two wings for inserting the pin through a slot 47 in the bottom part of the valve housing. The construction of the pin, when provided with the above mentioned wings, will be better understood with reference to Figure 6 which is a section taken approximately on the line 6—6 of Figure 3.

It will be seen from this Figure 6 that the bottom of the valve housing 21 is provided with a slot 47. The pin 46 has two wings 48, 48 which are placed in this view in right angle to the slot 47. The spring 49 engages the wings 48, 48 on the pin 46. This construction makes it possible to insert the pin into and to remove the same from the valve housing readily without any difficulty. The pin forms a unitary assembly with the valve housing 21 and its insertion into the valve housing and removal therefrom is made simple and efficient by the above described structure of the wings on the pin cooperating with the slot in the housing. It is understood, of course, that an ordinary circular flange may be provided on the pin 46 if it is desired. The provision of wings cuts down the lateral material and thereby reduces obstructions for the flow of the fuel through the valve body. However, as I have said above, the pin may also be provided with an ordinary flange.

The central boring of the valve body 21 is larger than the boring in the bottom part which is engaged by the pin 46. The upper portion of the valve housing is recessed and provided with an internal thread for receiving the closing plate member 50. This closing member may be provided with a screw driver slot 51, shown particularly in Figure 5 which is a section taken on the line 5—5 in Figure 3.

Referring now to Figure 5, it will be seen that this closing member 50 has a central boring, and a lateral slot 52 for inserting the valve member 53 in place. The valve member 53 may be provided with wings such as 54—54, for permitting its insertion through the slot 52 in the closing member 50. It permits ready insertion and removal of the valve plug and the free passage of oil. A round flange on the valve plug may be substituted, if desired.

The face of the valve plug 53 closes the duct 45 at the bottom of member 23 (Figure 3). I have shown a flat valve seat, but it is understood that the valve seat may be rounded. The spring 49 is disposed between the valve plug 53 and the pin 46 engaging the wings or flanges on these members, and forcing the valve plug upwardly to close the duct 45 while forcing the pin 46 downwardly against the cover plate 55 of the rotor. The valve is a unitary assembly having all parts enclosed within the valve housing 21. This arrangement reduces production cost and simplifies assembly. The contacting surfaces between the member 23 and the valve housing 21 may be machined to obtain a close fit between these parts. It will be seen that the valve mechanism is interposed between the fuel line 29 and the atomizing means yet to be described. Its function is to check the metered quantities of fuel delivered through the fuel line to the atomizing mechanism.

The atomizing mechanism is disposed in the lower portion of the device and comprises a rotor having two parts. The lower part is provided with a hollow discharge shaft 56 which extends through a boring in the projection 19 of the insert 18, and with a lateral portion 57 which is placed within the chamber 58 below the valve housing 21. The boring 59 in the rotor shaft 56 terminates in a discharge orifice. The face of the lateral portion 57 of the rotor is provided with curved grooves indicated in the drawings Figure 3, by dotted lines designated by reference numeral 60. A cover disc or plate 55 is placed on the lateral grooved portion 57 of the rotor. The surfaces are machined to secure a snug fit between these parts. The pin 46 engages an indentation in the rotor plate 55 as shown in Figure 3, centering the rotor and providing a bearing therefor. Due to the force of the spring 49 in the valve housing 21, the pin 46 will be pressed downwardly against the rotor plate 55 holding the rotor assembly in place. A shoulder 57' is provided on the rotor part 57 for attachment of the rotor at the bottom of the insert 18. This shoulder reduces the contacting surfaces and acts in the nature of a head bearing. The construction of the rotor grooves will be better understood by examining Figure 7 which shows the face of the rotor portion 57 when looking down on the rotor along the line 7—7 in Figure 3 in the direction of the arrows.

It will be seen from Figure 7 that the grooves 60 in the rotor face 57 curve toward the center and terminate at the shaft boring or discharge duct 59. The rotor shaft 56 is indicated in this figure by dotted lines. I have shown three grooves in the rotor face 57 but it will be understood that more or less such grooves may be provided as desired. The purpose of these turbine grooves 60 in the rotor face 57 is to conduct the liquid fuel in such a manner to the point of exit or discharge orifice that a complete atomization is accomplished. The fuel is forced through these grooves and will rotate the rotor. A high angular velocity in a plane transversal to the discharge duct and also transversal to the feed duct is thereby imparted to the fuel, creating a deliberate centrifugal force for accomplishing the breaking up of the fuel into a fuel dust or fine spray at the discharge port. The finely atomized fuel is ejected through the discharge orifice at the end of the rotor shaft.

The operation of the entire device is as follows:

The device is connected to an internal combustion engine in somewhat the same manner in which a conventional spark plug is attached. The liquid fuel, which may be of desired consistency and kind, is pumped into the device by means of a pump, in pulsations that will occur at the proper time of the cycle of the cylinder upon which the device is mounted.

A charge of fuel, i. e., a predetermined and measured quantity of fuel will thus enter through the pipe line 29. It will pass through the various ducts and through the filter 37 until it arrives at the duct 45 in the member 23. The charge of fuel is injected under pressure due to the operation of the pump and will therefore actuate the valve 53. The charge passes then through the valve housing easily and without any obstruction, and will enter the chamber 58 below the valve housing 21.

In continuous operation this chamber 58 as well as all ducts of the atomizer are flooded with fuel. A quantity of fuel injected in the manner described will therefore cause the operation of the valve, and fuel will enter the turbine grooves 60 in the rotor 57, and will rotate the rotor due to the action of the injected fuel which passes along the grooves 60. The fuel will be whirled about in the rotor, passing through the boring 59 in the shaft 56 of the rotor, and will leave the discharge orifice at the end of the duct 59 in the form of completely atomized fuel dust or spray. The atomized fuel will be mixed with the air in the compression chamber of the corresponding cylinder.

The ignition of the fuel mixture in the compression chamber may be accomplished by means of a spark. A separate spark plug may be used if it is desired. In the embodiment of the device which I have disclosed, I have combined the spark plug with the atomizer.

The cable 65 shown in Figure 1 may be provided with a terminal member 66 for attachment to the flanged head 67 of the screw 26. The current passes through the metallic part of the screw 26, member 23, valve body 21, insert 18, and the rotor shaft 56. The electrode or contact 68 is provided for completing the spark circuit. The spark occurs across the gap between the electrode 68 and the shaft 56 of the rotor. If desired, two or more such electrode contacts may be provided.

Dripping of the liquid fuel into the combustion chamber is prevented in the above described atomizer due to the action of the rotor. Upon the termination of a fuel charge or pulse, the turbine grooves in the rotor will throw off the fuel into the chamber 58 due to the centrifugal action of the rotor.

In Figure 8 I have shown a modification of the above embodiment. This figure shows the lower portion of the atomizer and I have applied the same reference numerals indicating identical parts shown in the drawings, Figure 3. Accordingly, numeral 12 designates the shell or mounting member; numeral 13 denotes the lower threaded portion of this mounting member for attaching the atomizer to the engine cylinder. The insulating body is designated by the numeral 11 and its lower conical neck projects downwardly as shown. The gasket or packing 16 is interposed between the mounting 12 and the insulating body 11. Numeral 19 designates the projection on the insert 18 which is cemented in the insulating body 11. The rotor shaft 56 extends through the boring in the projection 19 of the insert. Numeral 68 designates the electrode or spark plug contact.

Attached to the lower end of the shaft 56 of the rotor is a cup or slightly bell-shaped member 70. The attachment may be made by providing a thread on the end of the rotor shaft 56 and an internal thread in the member 70.

The cup-shaped member 70 will cause a finer distribution of the atomized fuel due to the centrifugal force resulting from its rotation, in addition to the other advantages which are described in the copending application.

In Figure 10 I have shown a modification of the attachment at the end of the rotor. The rotor shaft is designated in this figure by the numeral 71. A member 72 may be attached to the end of the rotor shaft by means of a suitable threaded connection between the two members. This attachment 72 is serrated at the periphery as is indicated by the reference numerals 73 to 76, inclusive. Ducts such as 77 to 81, inclusive pass through the member 72. The atomized fuel passing through the boring 82 in the rotor shaft will be forced through the ducts 77 to 81, inclusive, and this action will assist in the complete atomization and in the distribution of the fuel mist when it leaves the discharge duct of the rotor. The serrated periphery of the rotor will also operate to assist in the atomization of the fuel and in its distribution to the end of obtaining a proper fuel mixture in the combustion chamber due to the turbulence created by the serrated attachment.

Every detail part of the above described device has been designed with the view of providing accurate and dependable operation. The device is a unitary structure and is characterized by utmost simplicity of design, adapted for quantity production, and for quick assembly. The structure is sturdy, and does not require expert labor for attachment or expert maintenance of any nature.

It will be understood that modifications may be devised by following the teaching of my invention. Detail parts may be changed and the assembly may be altered in several ways. I therefore desire to have it understood that I do not intend to be limited in the application of the invention either to the precise structures which I have shown or to the use of my invention in connection with specific engines but only to the scope and the meaning of the following claims in which I have defined what I believe is new and distinguishing in the art.

I claim as my invention:

1. A fuel atomizing device for injecting fuel charges into the cylinder of an internal combustion engine to maintain continuous operation of said engine comprising, a housing for direct individual attachment to said cylinder, means for feeding liquid fuel charges into said housing, a check valve disposed in said housing in the path of said fuel charges, a rotor disposed in said housing posteriorly of said check valve and in the path of the fuel charges fed therethru, grooves in said rotor arranged to impart accelerated angular velocity to said fuel charges, means including a single spring for governing the operation of said check valve and for centering said rotor, and a tubular extension on said rotor projecting from said housing into said cylinder for ejecting said fuel charges into said cylinder.

2. A fuel atomizing device for injecting fuel charges into the cylinder of an internal combustion engine to maintain continuous operation of

said engine comprising, a housing for direct individual attachment to said cylinder, means for feeding liquid fuel charges into said housing, a check valve disposed in said housing in the path of said fuel charges, a rotor disposed in said housing posteriorly of said check valve and in the path of the fuel charges fed therethru, said rotor having a tubular shaft and a transversal plate, grooves in the face of said plate, a disc registering with the face of said plate for defining said grooves, said grooves being arranged to impart accelerated angular velocity to said fuel charges, means including a single spring for governing said check valve and for centering said disc on the face of said rotor plate, said tubular shaft extending thru said housing into said cylinder for ejecting said fuel charges thereinto.

3. A fuel atomizing device for direct individual attachment to the cylinder of an internal combustion engine comprising, a fuel line for receiving predetermined fuel charges under pressure and for feeding said charges thru said device to said cylinder to maintain the continuous operation of said engine, a filter in the path of said fuel charges, a check valve disposed in said device in the path of said fuel charges for controlling the passage of said fuel charges injected through said filter, a rotor in said device disposed posteriorly of said check valve in the path of the fuel charges fed therethru, grooves in said rotor arranged to impart accelerated angular velocity to said fuel charges, means including a single spring arranged to govern the operation of said check valve and to center said rotor, and a discharge shaft on said rotor projecting from said device into said cylinder for ejecting said fuel charges into said cylinder.

4. A fuel atomizing device for direct individual attachment to the cylinder of an internal combustion engine comprising, a fuel line for receiving predetermined fuel charges under pressure and for feeding said charges thru said device to said cylinder to maintain the continuous operation of said engine, a filter in the path of said fuel charges, a check valve disposed in said device in the path of said fuel charges for controlling the passage of said fuel charges injected thru said filter, a rotor in said device disposed posteriorly of said check valve in the path of the fuel charges fed therethru, grooves in said rotor arranged to impart accelerated angular velocity to said fuel charges, means including a single spring arranged to govern the operation of said check valve and to center said rotor, a tubular discharge shaft on said rotor and projecting from said device into said cylinder, and a discharge member on said shaft for ejecting said fuel charges into said cylinder.

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