

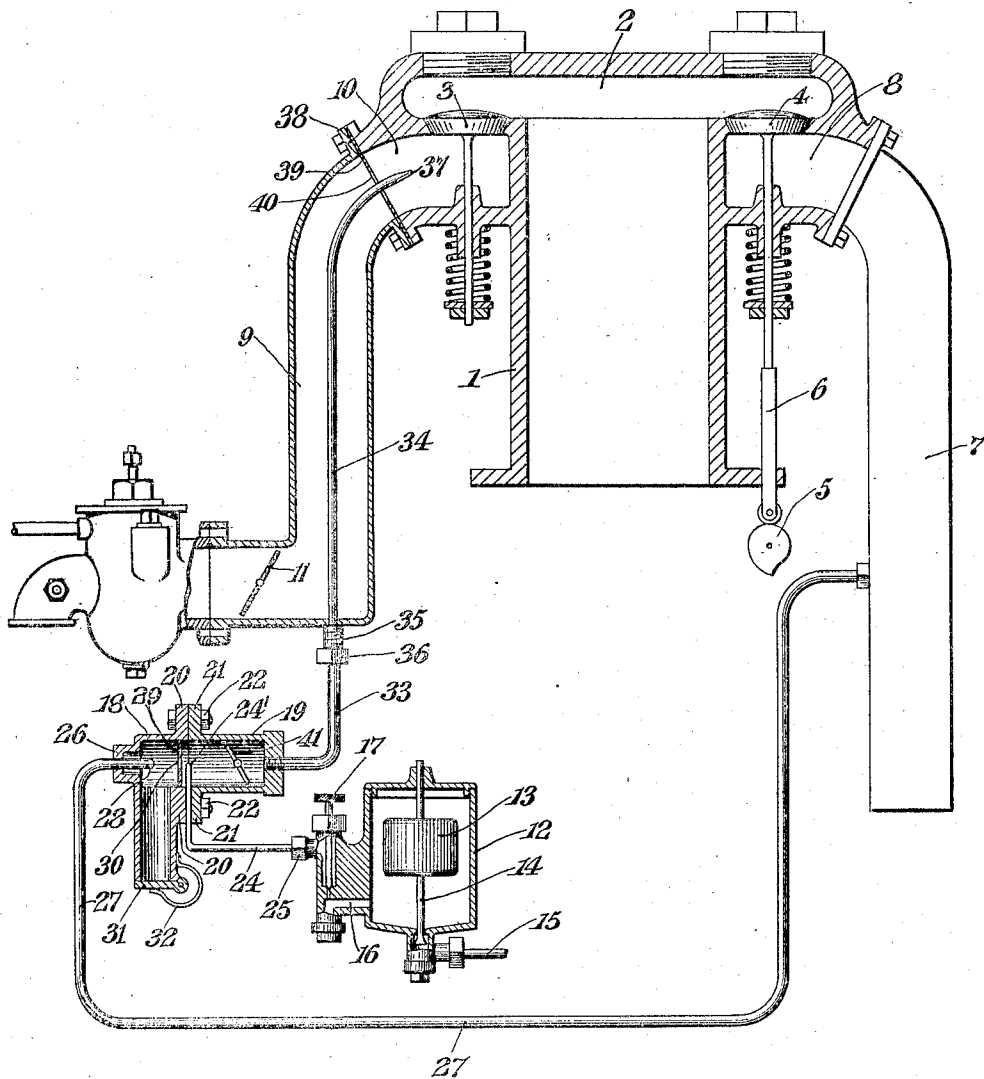
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FUEL SYSTEM FOR INTERNAL COMBUSTION ENGINES

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FUEL SYSTEM FOR INTERNAL-COMBUSTION ENGINES.

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My invention relates to a fuel system for internal combustion engines, and has, among other objects, that of finely atomizing the liquid fuel and by other means than that of the air current which supplies the air for the explosive mixture; and thereby overcoming the defect often occurring of a "wet" mixture due to insufficiently atomized particles of the liquid fuel carried along by the swiftly moving air current into the engine cylinder.

Another object of my invention is to substantially vaporize the liquid fuel, and preferably before the admixture thereto of the main body of air, to form an explosive mixture.

A further object is to employ the exhaust gases of the engine as the atomizing, and, by reason of their heat, as the vaporizing medium.

My invention consists in an apparatus for accomplishing these and other objects, which will be apparent from the following description and from the accompanying drawings of one illustrative embodiment of my apparatus,—in which—

The single figure is a longitudinal sectional view through the cylinder of an internal combustion engine, the valved inlet and outlet passages, and the inlet manifold thereto, and showing the exhaust conduit in elevation, and the devices of my fuel system, associated therewith, partly in vertical section and partly in elevation.

The internal combustion engine with which my fuel system is employed may be of any type in which an atomized or vaporized liquid fuel mixed with air forms the charge. In the illustrative embodiment I have shown a four-cycle engine having a cylinder 1, provided with a clearance space 2 to which the explosive charge is admitted upon the suction stroke by the spring-seated and suction-operated inlet valve 3, and from which the exhaust gases are ejected through the spring-seated exhaust valve 4, operated mechanically in its opening movement in the usual or any desired manner, a conventional showing of cam 5 and cam-rod 6 being here deemed sufficiently illustrative since my invention does not reside in these features.

An exhaust conduit 7 leads from the exhaust valve chamber 8, and an air inlet conduit 9 leads to the charge inlet valve chamber 10, which air inlet conduit is controlled by a throttle valve 11.

The mechanical devices of my improved fuel system include fuel feeding means and atomizing and vaporizing means for transforming the liquid fuel into a vapor before admixture therewith of air. Such means include the float chamber 12 with the float 13 therein upon the needle valve 14 controlling the entrance of the liquid fuel from the fuel inlet conduit 15, all designed to maintain a predetermined level of the liquid fuel in the float chamber. A fuel delivery conduit 16, shown in the illustrative embodiment as in the casting of the float chamber, is controlled at will by a needle valve 17.

The atomizing and vaporizing means include, in the illustrative embodiment, a right-angled chamber formed of two hollow castings 18 and 19 united by means of their flanges 20 and 21 and the bolts and nuts 22. In the lower meeting faces of the flanges 20 and 21, semi-circular grooves are formed to provide a vertically extending bore for the insertion of the upwardly extending arm of the liquid fuel pipe 24, the horizontal arm of this pipe being connected through the nipple 25 to the outlet from the conduit 16.

The upwardly extending arm of the liquid fuel pipe 24 terminates in a nozzle 24' substantially at the center of the atomizing and vaporizing chamber.

At one end of the horizontal portion of the atomizing and vaporizing chamber, the left-hand end as viewed in the drawings, a hollow boss 26 is formed having an aperture for the insertion of the pipe 27 leading from the exhaust conduit 7, the pipe 27 terminating in a nozzle 28 directly in line with but transversely disposed to the fuel nozzle 24'.

The pipe 27 is of small cross-sectional area and capacity as compared with the exhaust conduit 7, and is thus designed for the entraining from the exhaust conduit of a comparatively small quantity of the unspent exhaust gases in a stream moving at high velocity.

Between the exhaust delivery nozzle 28 and the fuel nozzle 24' is a gauging disk 29, its periphery tightly fitting the interior wall of the chamber 18, and having a central aperture 30, the center of which aperture is in line with the exhaust nozzle 28 and the fuel nozzle 24'. This aperture is designed in size to gauge the quantity of exhaust gases to be passed therethrough and across the fuel nozzle 24', and a plurality of disks having varying sizes of apertures may be provided

for separate insertion and use in the chamber 18 if variation in the quantity of exhaust gases for atomization and vaporization is demanded.

5 The vertically depending portion of the hollow casting 18 is provided with a flap valve 31 normally maintained in closed position by a curved spring 32 so that a sump is provided for the reception by gravity of the non-fluid particles in the exhaust stream emerging from the nozzle 28, the impingement of the exhaust stream emerging from the nozzle 28 against the gauging disk 29 facilitating the separation of these particles therefrom. The particles thus separated and delivered into the sump can be removed by a manual movement of the flap valve to open position, as will be apparent.

In the closed end of the atomizing and vaporizing chamber opposite to that in which the exhaust delivery pipe 27 is inserted, the right-hand end as viewed in the drawings, the horizontal arm of a right-angled pipe 33 is inserted, which pipe is connected to the pipe 34 in the air inlet pipe by the screw-threaded nipple 35 and nut 36, as shown.

The pipes 33 and 34 are of like cross-sectional area and preferably slightly larger than the liquid fuel pipe 24 or the exhaust delivery pipe 27, but of small capacity as compared with the air inlet conduit 9 and the atomizing and vaporizing chamber.

The pipe 34 preferably extends the entire length of the upwardly extending portion of the air inlet conduit and into the charge inlet chamber 10, there terminating in a nozzle 37.

Rearwardly of the nozzle 37, and for convenience with its peripheral portion held between the flanges 38 by which the air inlet conduit is secured to the inlet valve chamber, is a disk 39 having a central aperture 40 through which the pipe 34 extends; such disk functioning to reduce the area of the air passage.

A throttle valve 41 is provided in the atomizing and vaporizing chamber between the liquid fuel nozzle and the inlet to pipe 33, as shown.

It is to be understood that when an engine having multiple cylinders is used, the air inlet conduit 9 and the exhaust conduit 7 are in the form each of a manifold having branches to the respective cylinders and the single pipe 33 from the atomizing and vaporizing chamber is secured to separate pipes, functioning as does the pipe 34, and extending through the branches of the air inlet manifold to the respective cylinders.

For the starting and initial operation of the engine, a carburetor of the customary type, connected to the air inlet conduit 9, may be used if desired, and after the engine is in operation, the liquid fuel supply to that

carburetor shut off so that there is thereafter delivered from that carburetor only the air supply to the inlet conduit 9.

In the operation of the illustrative apparatus of my fuel system, a small stream of exhaust gases moving at high velocity is delivered from the exhaust conduit 7 through the pipe 27, and such stream of exhaust gases emerging from the nozzle 28 is gauged or reduced to a stream of predetermined quantity passing through the aperture 30 in the gauging disk 29. The stream of exhaust gases thus passing through the aperture 30 passes transversely over the liquid fuel nozzle 24 and entrains therefrom and atomizes the liquid fuel, the commingled exhaust gases and finely divided particles of liquid fuel then traversing the chamber 19 and the pipes 33 and 34, during which traverse the finely divided particles of liquid fuel become completely vaporized by the heat of the exhaust gases.

The proportions of the vaporized fuel and of the air to form the explosive mixture may be varied by means of the throttle valves 41 and 11 controlling, respectively, the quantities of fuel delivered through the pipes 33 and 34 and of the air delivered through the air inlet conduit 9.

The reducing disk 39 causes a concentration of the air stream adjacent the vapor nozzle 37 and hence a better commingling of these ingredients; and the location of the vapor outlet nozzle 37 on the engine side of the disk 39 and hence on the side of the greatest reduction in pressure assists in the more speedy delivery of the fuel through the comparatively small pipe 34.

In practice I have obtained satisfactory results in the atomization and vaporization of the fuel and in the ultimate explosive mixture produced, by gauging the stream of exhaust gases used in atomizing the liquid fuel to the smallest quantity sufficient to atomize and subsequently vaporize the fuel. This gauging I preferably accomplish by the gauging disk as shown, but my invention contemplates the accomplishment of this gauging by other means, including the selection of the pipe 27 itself of the predetermined cross-sectional area. As already stated, however, the size of the aperture may be varied somewhat, and it is to be understood that my invention is not limited to the precise gauging device or size of aperture stated.

I have also found that the provision of means for removing from the exhaust gases before commingling with the liquid fuel the non-fluid particles carried along with them, tends further to obviate the difficulties heretofore encountered, particularly the deposit of carbon within the engine cylinder.

Many modifications of my invention will be apparent to those skilled in this art with-

out departing therefrom or from the scope of the claims, my invention not being limited to the particular embodiment chosen to illustrate the same.

5 Having particularly described my invention, what I claim and desire to secure by Letters Patent is:

1. In a fuel system for internal combustion engines, in combination with the engine, a supply of liquid fuel and a fuel nozzle, means for entraining from the exhaust conduit of the engine a stream of exhaust gases, means for gauging said stream to a reduction sufficient to atomize said liquid fuel, and for directing said gauged stream into atomizing relation with the fuel nozzle, an enclosure open to the resulting mixture of exhaust gases and atomized liquid fuel and adapted to maintain without admixture of air the ingredients of said mixture in intimate contact to vaporize said atomized liquid fuel, a throttle in said enclosure, means for delivering said vaporized fuel from said enclosure and for adding air thereto to form an explosive mixture, and means for delivering said explosive mixture to the engine cylinder.

2. In a fuel system for internal combustion engines, in combination with an engine, a chamber communicating with the engine cylinder, a restricted liquid fuel nozzle extending into said chamber, a nozzle for the ejection of a fluid medium disposed in atomizing relation to said liquid fuel nozzle, a sump to catch non-fluid particles in said medium, and a conduit connecting said second mentioned nozzle with the exhaust conduit of the engine, and a throttle in said chamber.

3. In a fuel system for internal combustion engines, in combination with an engine having a charge inlet port and an exhaust port, an air supply conduit communicating with said charge inlet port, a reduction element in said air supply conduit adjacent said communication with said charge inlet port reducing the area of said communication, a second conduit communicating with said air supply conduit and with the exhaust conduit of said engine, and a liquid fuel nozzle extending into said second conduit intermediate said communications.

4. In a fuel system for internal combustion engines, in combination with an engine

having a charge inlet port and an exhaust port, an air supply conduit communicating with said charge inlet port, a reduction element in said air supply conduit adjacent said communication with said charge inlet port reducing the area of said communication, a second conduit communicating with said air supply conduit on the engine side of said reduction element and with the exhaust conduit of said engine, and a liquid fuel nozzle extending into said second conduit intermediate said communications.

5. In a fuel system for internal combustion engines, in combination with an engine, a chamber communicating with the engine cylinder, a liquid fuel nozzle extending into said chamber, a nozzle for the ejection of a fluid medium disposed in atomizing relation to said liquid fuel nozzle, a conduit connecting said second mentioned nozzle with the exhaust conduit of the engine, and means interposed between said nozzles for gauging the stream of exhaust gases issuing from said second mentioned nozzle to a reduction.

6. In a fuel system for internal combustion engines, in combination with an engine, a supply of liquid fuel, means for entraining from the unspent exhaust gases emitted from the engine a stream of such gases, means for separating non-fluid particles from said stream, means for thereafter directing said stream into atomizing relation with the liquid fuel to atomize the same, and means for delivering said fuel after said atomization to the engine cylinder.

7. In a fuel system for internal combustion engines, in combination with an engine, a chamber communicating with the engine cylinder, a liquid fuel nozzle extending into said chamber, a nozzle for the ejection of a fluid medium disposed in atomizing relation to said liquid fuel nozzle, a conduit connecting said second mentioned nozzle with the exhaust conduit of the engine, an apertured wall disposed between said nozzles with the aperture in alignment with said second mentioned nozzle, and a sump disposed at the side of said wall opposite said liquid fuel nozzle.

In testimony that I claim the foregoing, I have hereunto set my hand this 26 day of July, 1920.

CHRISTIAN F. WEEBER.