Jan. 10, 1956 F. G. PRESNELL 2,730,339

FUEL DISTRIBUTING SYSTEM

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Fig. 1

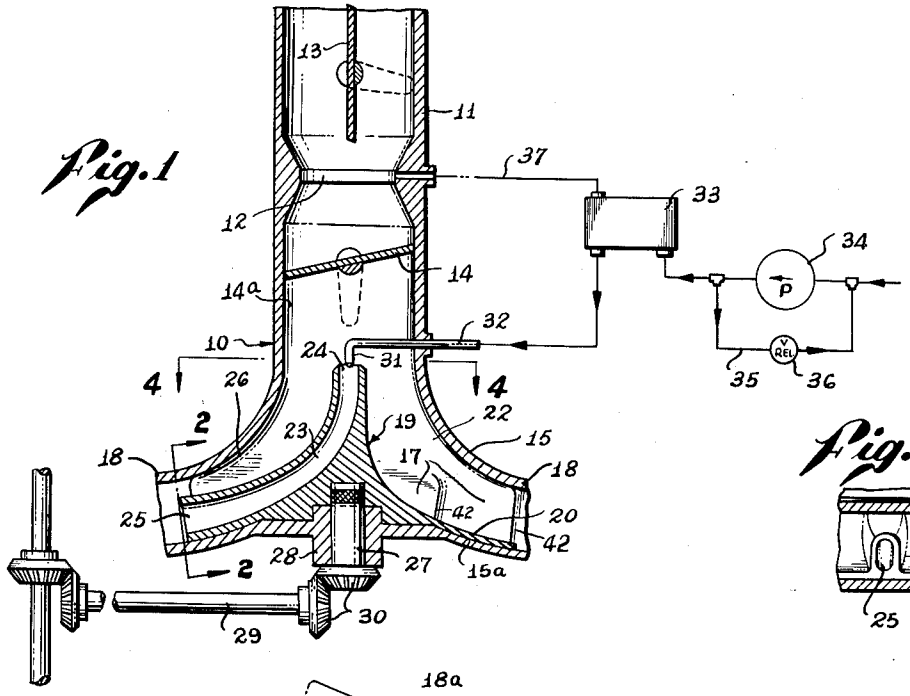
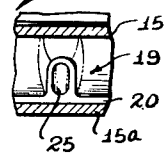


Fig. 2



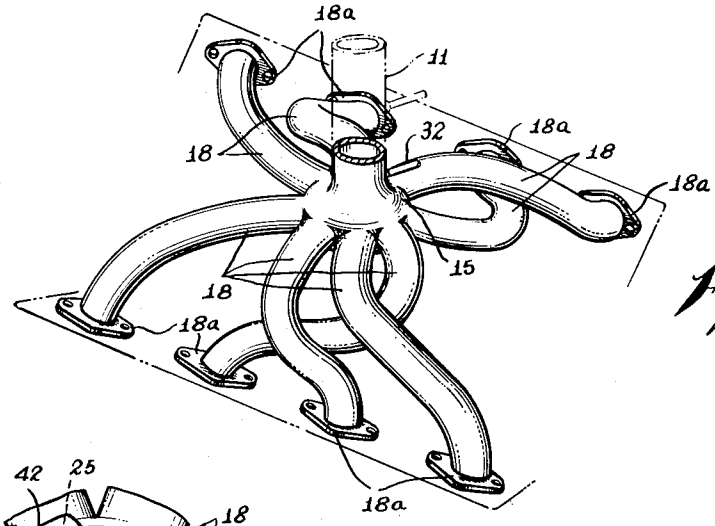


Fig. 3

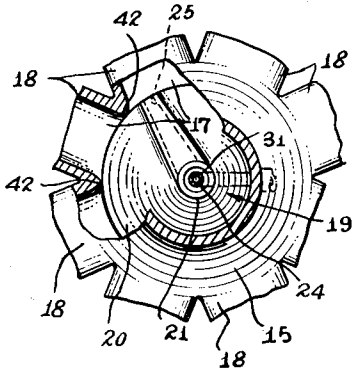


Fig. 4

INVENTOR.
FRANK G. PRESNELL
BY
Attorney

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FUEL DISTRIBUTING SYSTEM

Frank G. Presnell, Chillicothe, Ohio

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7 Claims. (Cl. 261—19)

This invention relates to fuel distributing systems and more particularly of an improved system for distributing an air-fuel mixture among the cylinders of a multi-cylinder internal combustion engine.

Fuel distribution in single carburetor multi-cylinder engines is notoriously imperfect, resulting in low fuel efficiency and power output. The fuel charge is sometimes pre-heated, since vaporized fuel distributes more uniformly than unvaporized fuel. Heating the charge, however, results in lowered volumetric and thermal efficiency and limits the compression ratio of the engine by increasing the tendency of the charge to detonate.

Another practice has been to make the engine inlet manifolds of small cross-sectional area resulting in higher gas velocities therethrough. These higher velocities permit more unvaporized fuel to be held in suspension, but the small passage areas of the manifolds lower volumetric efficiency and increase the engine pumping losses.

The use of dual or multiple carburetors with separate manifolds for each carburetor unit has resulted in improved distribution, but such units are generally more expensive and difficult to service than a single carburetor unit. Moreover, wear, dirt, uneven adjustment, or imperfections in manufacture can cause the units of a dual or multiple installation to deliver substantially different air-fuel mixtures.

It is an object of the present invention to provide a single fuel metering unit and distributing system for distributing an air-fuel mixture to the cylinders of a multi-cylinder engine, which overcomes the above-noted difficulties.

More particularly, it is an object of the invention to provide a unitary fuel metering system designed in a manner to obtain improved fuel distributing characteristics without requiring that the fuel charge be heated or the engine inlet manifolds be restricted in area.

These and other objects of the invention are attained by providing a distributing chamber at the end of an air induction pipe, the pipe and chamber being preferably surfaces of revolution about a common longitudinal axis. The chamber has a circular series of discharge ports located equidistantly from the axis of revolution of the chamber, and each of these ports is connected by a manifold branch to a respective engine cylinder, the lengths and passage areas of the various manifold branches being made preferably equal. Coaxially mounted within the chamber is a fuel distributor rotor, preferably in the form of a figure of revolution with respect to its axis, and having a large diameter base portion and a relatively smaller diameter neck portion.

The distributor rotor includes a fuel passage having at its upper end an intake orifice coaxial with the chamber axis, and terminating at its lower end, eccentrically of the chamber axis, in a discharge orifice directed away from the axis and toward the distributor chamber ports. The passage is thus designed so that its lower orifice is adapted to register successively with

a portion of each of the plurality of chamber ports upon rotation of the distributor rotor.

A fuel injection nozzle, fed under control of a suitable metering unit, is mounted in a stationary position in the chamber and is directed to feed fuel into the upper or intake orifice of the distributor rotor.

With this arrangement of a stationary fuel nozzle, a rotating distributor, and individual manifold branches, equal distribution of proper amounts of fuel to the cylinders of a multi-cylinder engine can be achieved.

A better understanding of the invention may be had by referring to the accompanying drawing, in which:

Figure 1 is a side view, partly in section, of a preferred form of the invention;

Figure 2 is a sectional view as seen along the line 2—2 of Figure 1;

Figure 3 illustrates in perspective the manifold connections from the fuel distributor to the various cylinders of an internal combustion engine; and

Figure 4 is a fragmentary, partially broken away, section taken on line 4—4 of Figure 1.

Referring to the drawings showing one typical illustrative embodiment of the invention, there is shown in Figure 1 a carburetor housing designated generally by the numeral 10. Housing 10 includes an air induction pipe 11, formed with a Venturi restriction 12. Preferably, and for the usual engine, this air induction pipe 10 is of the vertical or down draft type, though this arrangement should not be regarded as essential or limitative. Choke and throttle valves 13 and 14 are mounted in pipe 11 above and below Venturi 12, as shown. Below the throttle, pipe 11 widens out and merges into a lower distributor chamber 15 having a circular base 15*a*, the periphery of the chamber comprising a plurality of uniformly spaced ports 17 leading to a corresponding plurality of manifold branches 18. Preferably, and in the present illustrative embodiment, these ports 17 open outwardly from the chamber substantially radially with respect to the axis of the distributor, but it will be understood that this arrangement, while preferred, is not essential. It is merely required that there be provided a circular series of ports located equidistantly from the distributor axis. The air induction pipe, with its Venturi restriction, and the chamber 15, are concentric figures of revolution.

Mounted coaxially within chamber 15 is a fuel distributor rotor 19 having a circular base portion 20 of such diameter as to place its periphery adjacent the ports 17, the rotor tapering in an upward direction from this base portion to form a reduced coaxial neck portion 21. The rotor includes walls defining a curved fuel passage 23 extending downwardly into neck portion 21 and thence outwardly above base portion 20. This passage 23 has an upper upwardly opening fuel intake orifice 24, preferably circular in cross-section, and positioned coaxial with the rotor axis. The lower end of passage 23 terminates in a discharge orifice 25 in the base portion 20 located eccentrically of the rotor axis, and directed radially outward, the discharge orifice 25 being disposed closely adjacent the circle defined by the ports 17. The lower orifice 25 is preferably elongated in the direction parallel to the rotor axis. This orifice is so positioned that upon rotation of the rotor 19, the orifice will successively register with a portion of each of the ports 17 in the peripheral wall of chamber 15.

Rotor 19 is preferably, excepting for the elevated wall portions defining the lower portion of channel 23, a figure of revolution about its axis of rotation. Its shape is such as to provide a streamlined annular air passage 26 in chamber 15 open to pipe 11 and communicating with the ports 17. The flow of air from pipe 11 through this passage 26 and thence via the ports 17 into manifold

branches 18 is thus streamlined. The rotor can be conveniently rotated by shaft 27 connected thereto and journalled in the floor 15*a* of chamber 15 at 28 as shown. Shaft 27 is engine-driven by a shaft 29 through bevel gears at 30 and shaft 29 will be understood to be driven by the engine at the desired speed through any appropriate gear, as will be understood.

In the case of four-cycle engines, the rotor should be rotated at one-half the engine crank shaft speed.

Disposed above the rotor 19 at the lower portion of passage 14 is a fuel nozzle 31, which is directed to feed fuel into the upper orifice 24 of the rotor 19. The nozzle spout may be inserted a short distance in the passage 23 or adjusted to be just above the orifice, the diameter of the orifice being proferably substantially greater than the outside diameter of the nozzle.

Nozzle 31 is fed liquid fuel from a fuel line 32 connected to a fuel metering device 33, which may be of any well known or suitable type, one modern example of which is shown in United States Patent No. 2,372,306 to Adair. Metering device 33 is in turn supplied with fuel from a fuel pump 34. In the event the pump is of the positive displacement type, it may be provided with a by-pass line 35 having a relief valve 36, so as to by-pass fuel pumped in excess of that taken by the metering device. The amount of fuel fed into the line 32 by the metering device 33 is governed by the static pressure in the Venturi throat 12 in the air induction pipe 11, this pressure being communicated to the metering device through line 37 as shown.

Figure 4 shows the various inlet manifold branches for distributing fuel from the distributor chamber 15 to the various cylinders of an internal combustion engine.

Each port 17 in the peripheral wall of chamber 15 feeds into one end of an inlet manifold branch 18. Manifold branches 18 are preferably made of equal volume and flow resistance, and can often be made of equal length and equal cross-sectional area by introducing appropriate turns in both horizontal and vertical directions, as indicated. Equal volumes can also be obtained when equal lengths are not feasible by proper adjustment of cross-sectional area. However, while the equal volume feature has been described as preferred, and may provide some advantage, it is not considered essential, since equal distribution of fuel to the cylinders results primarily from the use of individual manifold branches, with provision for introducing equal charges into successive branches. For the purposes of illustration, a distributing system for a V-8 type engine has been shown.

Ports 17, all of which are of substantially the same size and shape, and are located at substantially the same radial distance from the axis of the rotor 19, are separated by substantially identical narrow lips or partitions 42 (see Figure 4), and are located in a zone which completely encloses an imaginary projection of passage 23 beyond orifice 25, to whose path of rotation the lips 42 are in close proximity. Lips 42 may be inclined from planes radial to the axis of rotor 19, and oppositely to the direction of rotation of the rotor, to minimize impingement of fuel on the walls of manifolds 18.

The ports 17 establish communication between chamber 15 and manifold branches 18, all of which preferably slope generally downward from chamber 15. It will of course be understood that each manifold branch 18 is connected to the inlet valve port of a single engine cylinder, and as already mentioned, these branches 18 diverge from chamber 15 in the order, in the direction of rotation of distributor rotor 19, of the firing of the engine cylinders to whose valve ports they connect. At their valve-port ends, manifold branches 18 are provided with positioning means, such as flanges 18*a*.

The operation of the fuel distributing system with reference to the above will now be described.

Liquid fuel from fuel pump 34 enters fuel metering device 33 where it is fed at a given rate through line 32

and continuously ejected from nozzle 31. The rate of feeding from device 33 is controlled by the static pressure in Venturi 12 through line 37 which in turn is determined by the air flow past the Venturi section. Thus, for an increased air flow, the static pressure at 12 will drop and device 33 is so controlled that this drop in pressure will increase the rate of fuel flow to nozzle 31. The proper mixture of the air entering passage 14*a* and fuel ejected from nozzle 31 is thus automatically maintained.

Rotor 19, as already mentioned, is rotated at half the engine speed. Fuel entering the passage 23 from nozzle 31 is carried down through passage 23 partly by the centrifugal force due to rotation of rotor 19, partly by its own momentum, and partly by flow of air from the induction pipe, and is issued from the lower passage orifice 25 to each of the ports 17 successively. Some air also enters the upper passage orifice 24 and is fed into the ports 17, but most of the air passes down through the annular recess 22 into the various ports 17. The surface of rotor 19 is made smooth and gradually sloped as shown to provide a streamlined conduit for the passage of air.

With the described arrangement, it will be appreciated at once that the proper mixture of fuel and air will be evenly distributed to the ports 17 and thus manifold branches 18. It is to be noted that this advantageous result obtains from the fact that only one fuel nozzle is employed, insuring a steady and uniform rate of flow for any given static pressure in Venturi 12, and only one distributing passage is used for feeding in the fuel mixture to a plurality of manifold branches, insuring that each branch receives the same amount of fuel as do each of the others. It may be noted in passing that the arrangement described permits fuel to be injected into the intake orifice of the distribution rotor without the necessity of a packed swivel joint between the fuel feeding pipe and the rotor. As previously pointed out, the manifold branches 18 are preferably made all the same length and passage area. Since the fuel so equally fed to the equal manifold branches will be carried along the branches by the flow of air therethrough, and cannot back out of said branches, the cylinders will receive equal quantities of fuel, and uniform fuel distribution will be achieved.

Since the fuel distributing member 19 is rotated at one-half the engine crank shaft speed, and since there are as many ports 17 as there are cylinders, for a 6-cylinder engine the orifice 25 of passage 23 will align itself with any one manifold branch port 17 for 120 degrees of crank shaft rotation. On the other hand, in an 8-cylinder engine, orifice 25 will align itself with any one manifold port 17 for only 90° of crank shaft rotation. It is preferred to time rotor 19 with respect to the crank shaft so that the alignment of orifice 25 of passage 23 with the various manifold ports 17 takes place during the mid-part of the opening of the inlet valve of the engine cylinder connected to the manifold. With this arrangement, every cylinder will draw into its manifold, first a charge of air only, then an air-fuel mixture over-rich in fuel, and finally air only, which will sweep out of the manifolds and into the cylinders any fuel which has precipitated on the walls of the manifolds. This action will leave the manifolds free of fuel and thus prevent any fuel from being carried into the cylinders during the first part of the succeeding intake stroke.

This manner of timing is desirable due to the fact that engines of high specific power output require a considerable overlapping of the openings of the inlet and exhaust valves, and with such overlapping there is a tendency, under some conditions of operation, for some of the indrawn charge to pass directly out of the exhaust valve. With the present fuel distributing system and with the rotor 19 properly timed as described above, the escape through the exhaust valve of some of the initially drawn-in charge will result in a waste principally of air rather

than fuel. Thus the present system will permit the use of greater valve overlap, yielding higher specific outputs.

Various modifications within the spirit of the present invention will occur to those skilled in the art. The apparatus is not to be thought of as limited to the precise embodiments disclosed.

I claim:

1. A fuel distributing system for feeding fuel and air into a plurality of manifold branch pipes, comprising, in combination: an air induction pipe, walls forming a distributor chamber for fuel and air in the form of a surface of revolution joined to said air induction pipe, a portion of said surface of revolution being defined by a wall portion having an annular series of fuel and air discharge ports symmetrically disposed about and equally spaced from the axis of said surface of revolution, said ports opening into the infeed ends of said manifold branches, a distributor rotor rotatably mounted in said chamber on the axis of said surface of revolution, said rotor having an uninterrupted fuel passage therethrough having an axially positioned fuel intake port at one end and an eccentrically positioned discharge spout at the other directed toward said ported wall portion of said chamber, so as to register successively with said fuel and air discharge ports of said distributor chamber, and means for feeding a continuous stream of fuel to said axially positioned intake port of said rotor, whereby a continuous stream of fuel issues from said rotor spout and passes successively through successive fuel and air discharge ports of said distributor chamber when said rotor is revolved, said rotor occupying a portion only of said distributor chamber and being positioned therein so as to afford a constant air flow space through said distributor chamber from said induction pipe around the outside of said rotor to said fuel and air discharge ports, whereby said ports successively receive both air from said induction pipe through said chamber and fuel spouting from said rotor.

2. The subject matter of claim 1, wherein said air induction pipe joins said distributor chamber coaxially of the surface of revolution of said chamber.

3. The subject matter of claim 2, wherein said axially positioned fuel intake port of said rotor faces upstream of said air induction pipe, and wherein said fuel feeding means comprises a fuel injector nozzle discharging into said fuel intake port.

4. The subject matter of claim 1, wherein said fuel and air discharge ports of said distributor chamber are in a peripheral side wall thereof, and wherein said discharge port at the end of said rotor fuel passage is directed generally autwardly with respect to the axis of revolution of the rotor.

5. The subject matter of claim 4, wherein said fuel and air ports are separated by relatively narrow partitions.

6. The subject matter of claim 4, wherein said fuel and air ports are separated by relatively narrow partitions, and wherein the end portions of said partitions are inclined from planes radial to the axis of the rotor and oppositely to the direction of rotation of the rotor.

7. The subject matter of claim 1, wherein said rotor is substantially in the form of a surface of revolution coaxial with the surface of revolution of the distributor chamber, so as to give to said air flow space through said distributor chamber a substantially annular form that is symmetrical with reference to said axis of revolution.

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