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ATMOSPHERIC VENT FOR FUEL INJECTION NOZZLE

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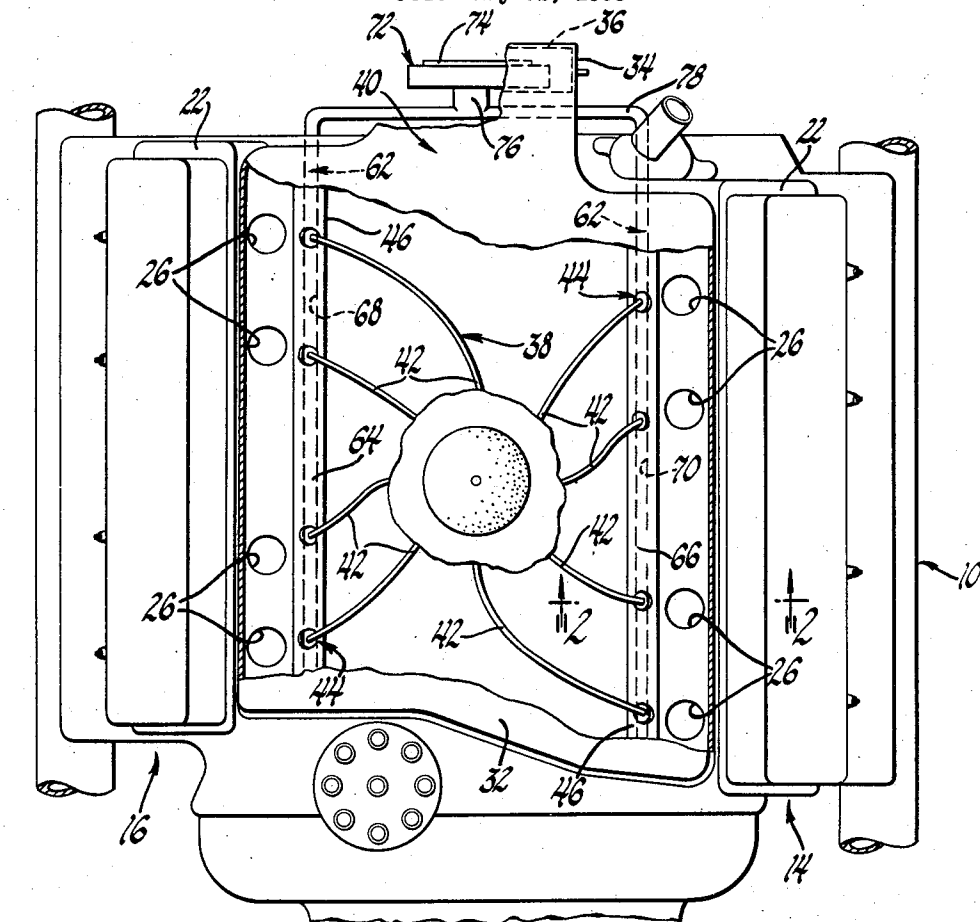


Fig. 1

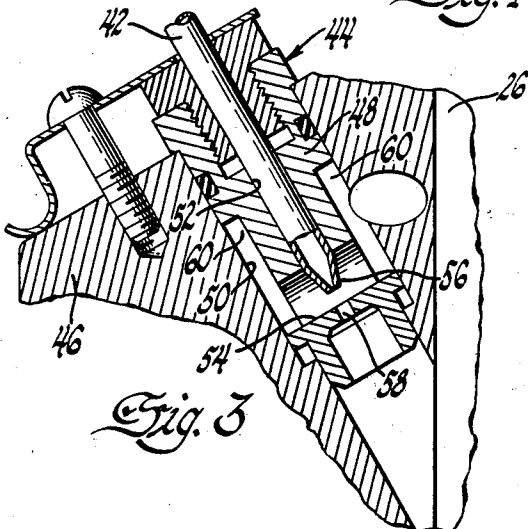


Fig. 3

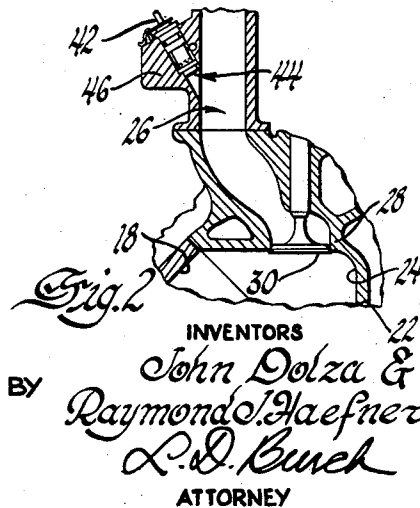


Fig. 2

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ATMOSPHERIC VENT FOR FUEL INJECTION NOZZLE

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4 Claims. (Cl. 123—119)

The present invention relates to internal combustion engines and more particularly to fuel injection systems therefor.

In the operation of an internal combustion engine of the so-called spark ignited type, it may be desirable to employ a fuel injection system which injects fuel directly into the air before it enters the cylinders. Such a fuel injection system may include a fuel pump, fuel metering means and fuel distributing means. The fuel distributing means may include a plurality of fuel lines that have nozzles on the discharge ends thereof. Each of these nozzles may have the discharge end thereof projecting into the induction system so as to inject a quantity of fuel into the air flowing through the induction passages toward the combustion chambers. If the throttle valve for controlling the volume of air flowing therethrough is disposed near the entrance to the induction system and it is closed or nearly closed, the intake vacuum present in the induction system will be very large. Thus if the nozzle is exposed to this vacuum so that the fuel therein is subjected to the effects thereof, the fuel in the fuel lines may vaporize and/or cause the volume of fuel flowing out of the nozzle to be in excess of the volume that the metering means would otherwise provide.

In order to overcome this, the nozzle may include a fuel jet and an atmospheric vent that allows air to flow from the atmosphere through the nozzle and form an envelope of air around the fuel jet having atmospheric pressure. This envelope will thus have a substantially constant pressure and will thus isolate the fuel jet from the effects of the intake vacuum. The air flowing through the vent mixes with the fuel and is consumed during the operation of the engine. Therefore, in order to retain adequate control of the idling speed of the engine, it is necessary to limit the volume of air without interfering with the proper metering of the fuel. One means of restricting the air flow is to employ a restrictive orifice through which the air must pass. It is preferable that this be posterior to the fuel jet rather than anterior thereto so that the air pressure around the fuel jet will be more nearly constant. This orifice may be disposed in alignment with the fuel jet and communicating with the induction system so that the fuel jet may discharge a stream of fuel therethrough into the induction system. Unfortunately, this results in an orifice having a very small diameter.

It is now proposed to provide an atmospheric vent for the nozzles in a fuel injection system which will effectively isolate the fuel jet from the effects of the intake vacuum and still allow adequate control over the idle speed. This is to be accomplished by providing an air system having an air manifold communicating with the atmosphere. This manifold may also include one or more outlets that communicate with the nozzles adjacent the fuel jet therein. It will thus be seen that the air for several nozzles must flow through a common air system. As a result the volume of air flowing through the nozzles may be more easily controlled. In addition, since all of the

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air passes through a common system, it is possible to provide a single air cleaner on the intake to the manifold which will be effective to remove harmful impurities such as dust, etc., which might otherwise injure the engine and/or interfere with the operation of the atmospheric vents and nozzles.

In the drawings:

Figure 1 is a plan view of an engine employing the present invention.

Figure 2 is a fragmentary cross sectional view of a portion of the engine in Figure 1.

Figure 3 is an enlarged cross sectional view of the fuel nozzles in Figure 2.

The present invention may be employed on any suitable engine. However, in the present instance, it is particularly adapted for use on an engine 10 of the so-called V-type having a pair of angularly disposed banks 14 and 16 of cylinders 18. Each of these cylinders 18 may include a piston which is reciprocally disposed therein and is drivingly connected to the crankshaft by means of a piston rod. A cylinder head 22 may be secured to each of the banks 14 and 16 and have cavities 24 therein positioned to register with the open ends of the cylinders 18 to form combustion chambers.

In order to charge these chambers with a combustible mixture, intake passages 26 may be provided that extend through the cylinder heads 22. The inner ends of these passages 26 may open through the walls of the combustion chambers and form valve seats 28 for the intake valves 30. These valves 30 may be opened and closed by any suitable means such as a camshaft to control the flow of the charge into the combustion chamber. An air box 32 may be disposed above the engine 10 with the intake end 34 thereof projecting from the front end thereof. A throttle valve 36 may be disposed in this inlet 34 to control the flow of air therethrough. The intake passages 26 may communicate with the interior of the air box 32 so that the throttled air will flow into the cylinders 18.

In order to form a combustible charge of air and fuel, a fuel injection system 38 may be provided that is adapted to inject fuel into the air flowing through the induction system 40. In the present instance this injection system 38 includes a fuel pump for pumping the fuel through the injection system, metering means responsive to fuel demands of the engine for controlling the volume of fuel injected and distributing means for distributing the metered fuel to the cylinders. The present distributing means includes a plurality of fuel lines 42 which are adapted to receive identical quantities of metered fuel and radiate outwardly towards the various cylinders 18. The outer end of each of the fuel lines 42 may have a nozzle 44 thereon for injecting the fuel into the induction system 40. Although these nozzles may be disposed in any desired location, in the present instance they are mounted on a bracket 46 that projects from the sides of the intake passages 26. These nozzles 44 may be of any suitable type such for example, as those described and claimed in copending application entitled "Fuel Injection Nozzle" invented by Max F. Homfeld and Stephen Kalmar, filed May 31, 1955, with Serial No. 512,175. In the present instance each of these nozzles 44 includes a housing 48 that is disposed in a passage 50 extending through the bracket 46 with the inner end thereof opening into the intake passage 26. The housing 48 may include a passage 52 that extends axially inwardly from the outer end thereof and a transverse passage 54 that intersects the end of the axial passage 52. The discharge end of the fuel line 42 may be disposed in this passage 52. A separate member may be secured to the line or the line may be necked down to form a fuel jet 56 that is disposed in the transverse passage 54 and is adapted to

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discharge a stream of fuel therefrom. An orifice 58 may be provided in the inner end of the housing 48 so as to communicate with the induction system 40. This orifice 58 is preferably disposed in substantial alignment with the fuel jet 56 so that a stream of fuel may be discharged therefrom through the orifice 58 and into the induction system 40. Although the exterior of the housing 48 may be a snug fit in the passage 52, it may have a reduced portion adjacent the ends of the transverse passage 54 that is adapted to form a chamber 60. This chamber 60 will thus be interconnected with the space around the fuel jet 56 by means of the transverse passage 54.

In order to isolate the fuel jet 56 from the effects of the intake vacuum, an atmospheric vent 62 may be provided for allowing atmospheric air to flow into the chamber 60 and through the transverse passage 54. This air will form a protective envelope around the fuel jet 56 having substantially atmospheric pressure before it flows through the orifice 58 and into the induction system 40. Thus, irrespective of the pressure in the induction system 40, the air pressure in the transverse passage 54 will always be substantially constant and the discharge of fuel from the fuel jet 56 will always be opposed by a substantially constant head thus making it possible to more accurately meter the fuel. In addition, the air pressure in the immediate vicinity of the fuel jet 56 will never drop to the point where fuel may flow through the injection system 38 and out of the nozzle in excess of that called for by the metering means.

In order to obtain the desired air flow through the nozzle 44 the atmospheric vent or air system 62 may include air manifolds 64 and 66 that extend along each bank 14 and 16 of cylinders 18. Although the manifolds 64 and 66 may comprise a separate member that extends along each bank of cylinders, in the present instance, each one comprises a passage 68 and 70 extending along the length of each bank 14 and 16. These longitudinal passages 68 and 70 may intersect the passages 50 in the brackets 46 adjacent the chamber 60 so as to communicate therewith. Thus the air in the longitudinal passages 68 and 70 may flow through the air manifolds 64 and 66 and into the chambers 60 in the nozzles 44. This air will then flow from a chamber 60 into a transverse passage 54 from whence it will pass through an orifice 58 and into the induction system 40. Since all of this air passes into the engine 10 in order to prevent damage to the moving parts of the engine or clogging of the restricted passages in the nozzles 44 so as to interfere with the flow of fuel into the combustion chamber, an air cleaner 72 may be provided. In the present instance the air cleaner 72 is disposed below the throttle valve 36 and has a single inlet 74 and a divided outlet 76. A pipe 78 may extend through the outlet 76 to the two manifolds 64 and 66. If desired, the inlet 74 may be connected to the induction system 40 between the inlet and the throttle valve 36.

It should be noted that when the engine 10 is idling and the throttle valve 36 is closed, a considerable volume of the air will flow through the air system 62 and be consumed in the engine 10. Accordingly, it is desirable that sufficient restrictions to the flow of idle air be provided to limit the volume thereof to less than that consumed by the engine 10 when it is idling. Although valve means may be provided in the intake for the air system for controlling the quantity of idle air, it should not create an appreciable vacuum in the manifolds 64 and 66. Instead it is preferable that the size of the orifice 58 be small enough to meter the air and limit the quantity thereof to less than that required during idling. This will place the major restriction to the flow of air posterior to the fuel jet 56. As a consequence the fluctuations in the pressure around the jet 56 will be nominal. The orifice 58, however, must be large enough to allow a free passage of the required amount of fuel at full throttle operation.

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It may thus be seen that the main induction system and the idle air system are independent from each other. As a result the fuel jet will be isolated from the effects of intake vacuum and the throttle valve will still retain control even during idle conditions.

It is to be understood that, although the invention has been described with specific reference to a particular embodiment thereof, it is not to be so limited since changes and alterations therein may be made which are within the full intended scope of this invention as defined by the appended claims.

What is claimed is:

1. In an internal combustion engine having groups of cylinders, an induction manifold having a plurality of induction passages communicating with said cylinders for supplying a charge of air thereto, a throttle for controlling flow through the induction manifold, separate fuel nozzles for each of said induction passages, each of said nozzles having a chamber, an orifice interconnecting said chamber with an induction passage and a fuel jet for discharging metered fuel into said chamber and through said orifice, a second manifold having a separate branch for each of said groups of cylinders, each of said branches communicating with the chambers in the nozzles in one of said groups, said branches being interconnected with each other by means of a common air supply having an air flow therein that will insure a uniform distribution of air between each of said branches, the second air manifold anterior of said nozzles being separate and distinct from said induction manifold whereby the air flow through the second manifold is unaffected by air flow through the induction manifold anterior of the throttle.

2. In an internal combustion engine having two groups of cylinders, an induction manifold having two groups of induction passages, each of said groups including a separate induction passage for the cylinders in one of said groups for supplying a charge of air thereto, a throttle for controlling flow through the induction manifold, separate fuel nozzles for each of said induction passages, each of said nozzles including a chamber, a fuel jet discharging metered fuel into said chamber, and a vent orifice in substantial alignment with said jet and interconnecting said chamber with an induction passage, a second manifold having a separate branch for each of said groups of induction passages, each of said branches communicating with the chambers in the nozzles in one of said groups, said branches being interconnected with each other by means of a common air supply having an air flow therein that will insure a uniform distribution of air to each of said branches, the second air manifold anterior of said nozzles being separate and distinct from said induction manifold whereby the air flow through the second manifold is unaffected by air flow through the induction manifold anterior of the throttle.

3. In an internal combustion engine having a pair of angularly disposed banks of aligned cylinders with an upwardly opening space therebetween, charge forming means comprising an induction manifold having separate induction passages for each of said cylinders, a throttle for controlling flow through the induction manifold, a second manifold having a separate branch for each of said banks of cylinders, each of said branches continuously communicating with each of the induction passages for the cylinders in that bank by means of a separate orifice for each induction passage, fuel means disposed in said space between said banks and including separate fuel jets for continuously discharging metered fuel therefrom and through said orifices and into said induction passages, said branches being interconnected with each other by means of a common air supply having a sufficiently large cross sectional area to insure the velocity of the air there-through being low enough to maintain a uniform distribution of air between said branches, the second air manifold anterior of said nozzles being separate and distinct from said induction manifold whereby the air flow

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through the second manifold is unaffected by air flow through the induction manifold anterior of the throttle.

4. In an internal combustion engine having a pair of angularly disposed banks of aligned cylinders with an upwardly opening space therebetween, charge forming means comprising an induction manifold disposed in said space and having a separate group of induction passages for charging said cylinders, a throttle for controlling flow through the induction manifold, a second manifold having a separate branch extending longitudinally along said banks to continuously communicate with each of the induction passages for that bank by means of a separate orifice for each induction passage, fuel means disposed in said space between said banks and including separate fuel jets for continuously discharging metered fuel therefrom and through said orifices and into said induction

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passages, said branches being interconnected with each other by means of a common air supply having a cross sectional area large enough to insure the velocity of the air therethrough being low enough to maintain a uniform distribution of air between said branches, the second air manifold anterior of said nozzles being separate and distinct from said induction manifold whereby the air flow through the second manifold is unaffected by air flow through the induction manifold anterior of the throttle.

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