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FUEL INJECTION NOZZLE

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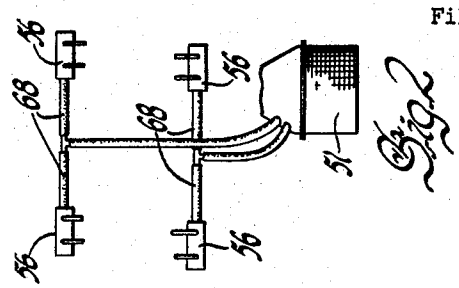


Fig. 2

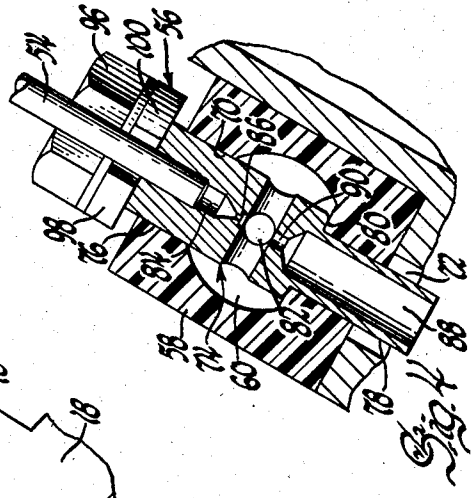


Fig. 4

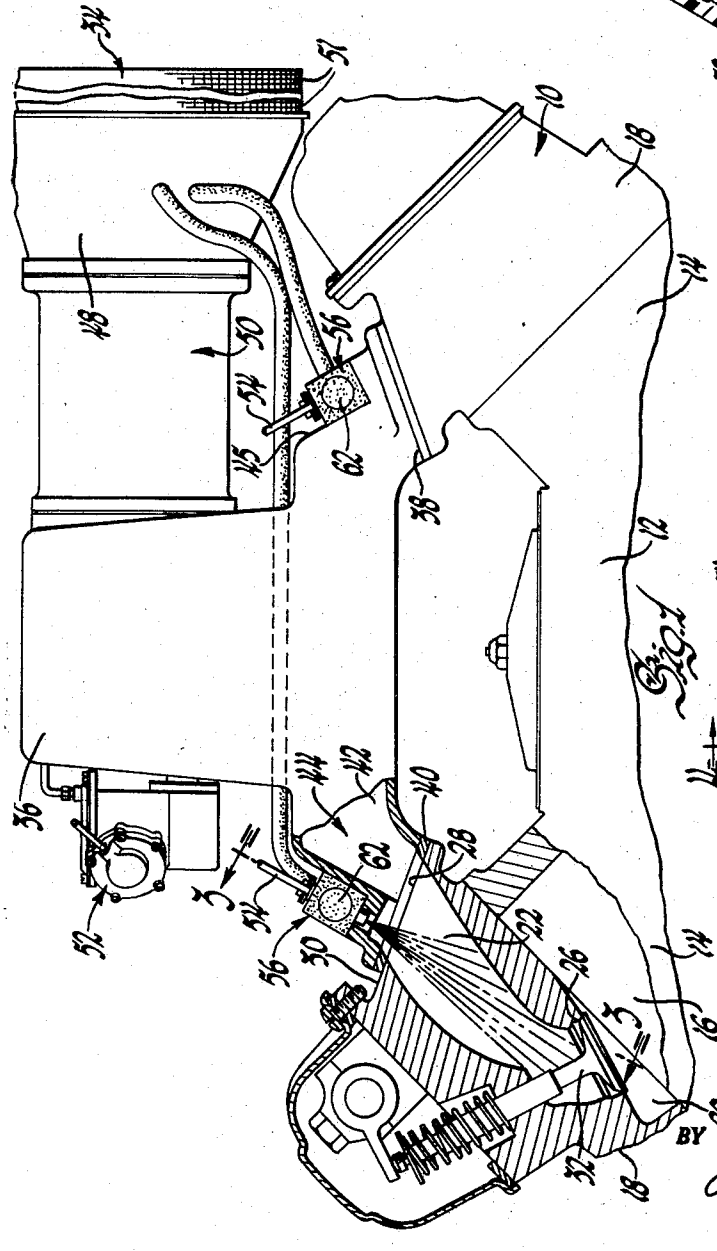


Fig. 1

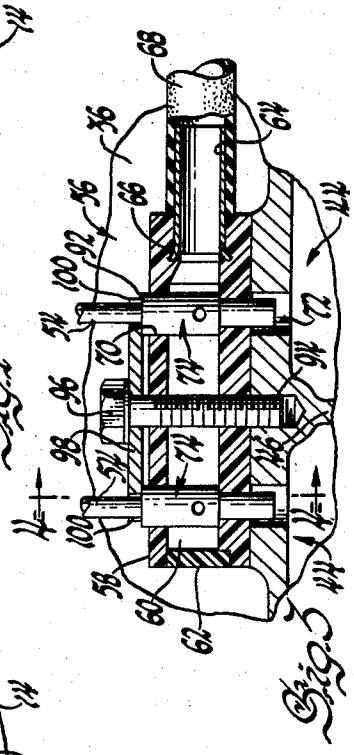


Fig. 3

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FUEL INJECTION NOZZLE

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5 Claims. (Cl. 261—78)

The present invention relates to charge forming means for an internal combustion engine and more particularly to means for injecting metered quantities of fuel into the charge.

In the operation of an internal combustion engine of the so-called spark ignited variety, it is very advantageous to form a combustible mixture of air and fuel by injecting metered quantities of fuel into the charge immediately adjacent the intake valves. However, one of the more serious problems encountered in injecting fuel at such a location results from the wide fluctuations in the air pressure in the induction system at this location. If this pressure opposes the discharge of fuel from the nozzles, the wide fluctuations therein will materially effect the accuracy of the metering action. Accordingly, in order to isolate the fuel in the injection system from the effects of this pressure, it has been a common practice to employ a pressure responsive check valve in the nozzle which will open when the fuel pressure exceeds some predetermined amount. However, such nozzles are expensive and troublesome in operation and are not entirely effective in isolating the fuel from the effects of the induction vacuum. As an alternative, the fuel may be injected into the charge by means of a nozzle having a fuel jet that discharges the fuel into an envelope of air at substantially constant pressure so that the air in this envelope and the fuel pass through an orifice into the induction system. In an engine such as employed in mass produced automobiles the proportioning of such a nozzle is very important and in order to satisfy the requirements of the engine at all operating conditions including idle and full load, the proportions are such as to necessitate some very small openings, for example, in the jet and in the orifice. This presents problems in mass producing and mounting the nozzles and, in addition, the heat from the engine has a tendency to cause the fuel therein to vaporize very readily.

It is now proposed to provide fuel discharge means which have means therein for forming an envelope of substantially atmospheric air around the fuel jet and which is not only easily manufactured but is also easy to install on the engine and is troublefree in operation. More particularly this discharge means includes a block of heat insulating material that may be secured to the induction manifold and which will receive the nozzle and retain it in position for injecting the metered fuel into the induction passage. Thus the jets, orifices, etc. in the nozzle requiring precision location etc. may be formed in a single body so that they will always remain in the desired relative positions even though mounted on the engine by conventional mass production techniques. In addition the nozzle will be isolated from the undesirable effects of heat.

In the one sheet of drawings:

Figure 1 is a fragmentary end view, with portions thereof being broken away, of an internal combustion engine employing a fuel injection system having fuel discharge means, and embodying the present invention.

Figure 2 is a diagrammatic view of the installation of the fuel discharge means and the means for supplying air thereto.

Figure 3 is a cross-sectional view, on an enlarged scale, of the fuel discharge means taken substantially along the plane of line 3—3 in Figure 1.

Figure 4 is a cross-sectional view taken substantially along the plane of line 4—4 in Figure 3.

Referring to the drawings in more detail the present invention is particularly adapted for use on an internal combustion engine 10 of the so-called spark ignited variety of the V-type having a cylinder block 12 with a pair of angularly disposed banks 14 of aligned cylinders 16. A cylinder head 18 is secured to each of the banks 14 to close the upper ends of the cylinders 16 and thereby form combustion chambers 20. Intake passages 22 extend transversely through the heads 18 with the inner ends thereof forming intake valve seats 26 opening into the combustion chambers 20 and the outer ends thereof forming intake ports 28 in the faces 30 on the sides of the cylinder heads 18. Intake valves 32 are disposed in these seats 26 and are actuated by the camshaft to control the admission of the charge into the cylinders 16.

An induction system 34 is provided in the space between the two banks 14 for supplying the charge of air to the cylinders 16. This system 34 includes an intake manifold 36 having plane surfaces 38 extending along the opopsite sides thereof to be secured to the faces 30 of the cylinder heads. It has been found desirable to employ a gasket 40 between the faces 30 and the plane surfaces 38 to seal the junction therebetween and to thermally isolate the manifold 36 from the heat in the engine 10. This manifold 36 includes passages 42 that form openings in the plane portions 38 to register with the intake ports 28 and thus form the induction passages 44. Although these passages 44 may be arranged in any suitable manner, in the present instance it has been found convenient to place the intake passages 22 in groups having a pair of passages in each group 45. Thus there will be pairs of passages 44 in the manifold separated by a single wall 46.

The inlet 48 to the induction system 34 and to the intake manifold 36 includes a tube that projects from the side thereof to form an air meter 50. This air meter 50 may include an air cleaner 51 and a throttle valve for regulating the amount of air flow through the induction system 34 and also means such as a venturi for developing a signal indicative of the amount of this air flow.

A fuel metering mechanism 52 may be mounted on the opposite side of the intake manifold 36 so as to be responsive to the signal developed in the venturi and thereby effective to meter the fuel in proportion thereto. A plurality of injector lines 54 are interconnected with the fuel meter 52 for distributing equal increments of metered fuel to the fuel discharge means 56 which are effective to inject the metered fuel into the charge for the cylinders.

In the present instance the discharge means 56 are adapted to be mounted on the sides of the intake manifold 36 for discharging the fuel directly into the induction passages 44 toward the intake valves 32 so as to mix with the air in the passages 44 and form the charges of air and fuel. The discharge means 56 include elongated blocks 58, each of which is adapted to be secured to the intake manifold 36 adjacent one of the groups 45 to serve the induction passages 44 in that group 45. The blocks 58 are preferably molded out of a thermal insulating material such as Bakelite, to thereby minimize the transfer of engine heat therethrough. Each block 58 comprises a hollow body having a passage ex-

tending longitudinally the length thereof to form a vent chamber **60**. One end of the passage is closed by a plug **62** while the opposite end forms an entrance to the vent chamber. This entrance may include a tube **64** having a flared inner end **66** that is embedded in the molded block **58** and an outer end that is adapted to receive a flexible hose **68**.

In addition, the blocks **58** may include a plurality of passageways **70** corresponding in number to the number of induction passages **44** in the group **45** and extending transversely through the block **58** with the centers thereof communicating with the vent chamber **60**. The lower ends of the passageway are positioned to register with openings **72** formed in the sides of the manifold **36** and to communicate with the induction passages **44**.

The nozzles **74** are mounted in the passageways **70** so as to extend across the vent chamber **60** and discharge directly into an induction passage **44** toward an intake valve **32**. Each of these nozzles **74** comprises a single member which has an enlarged hub **76** on the upper end and a reduced shroud **78** on the lower end. The lower end of the hub **76** which is separated from the shroud **78** by a shoulder **80** includes an air chamber **82** which may be formed by one or more transverse passages through the hub **76**. An axial passage **84** extends longitudinally through the hub **76** and terminates in a fuel jet **86**. This passage **84** is adapted to receive the end of an injector line **54** so that the jet **86** may discharge a stream of metered fuel therefrom and across the air chamber **82**.

The shroud **78** is adapted to project from the block **58** and extend into the opening **72** in the side of the manifold **36** and be retained in spaced relation to any surfaces forming the induction passages **44**. The shroud **78** includes an enlarged passage **88** which opens into the induction passage **44** and also communicates with the air chamber **82** by means of a small orifice **90**. This orifice **90** is preferably disposed in substantial alignment with the fuel jet **86** so that the stream of fuel discharged therefrom may pass directly through the orifice **90** without impinging on anything solid that might tend to break up the fuel stream before it passes through the orifice **90**.

The blocks **58** have flat surfaces thereon that are adapted to rest in seats formed in the sides of the manifold **36** so that the passageways **70** will register with the openings **72** in the sides of the manifold **36**. The nozzles **74** will thus be disposed in the passageways **70** with the shoulders **80** resting on the bottom of the vent chamber **60** while the end **92** of the hub **76** projects slightly above the top of the block **58** and the shroud **78** projects into the openings **72** in spaced relation therewith. In order to retain the block **58** and nozzles **74** in position a bolt **94** may extend through a bolt hole in the block **58** and be threaded into the intake manifold **36**. The head **96** of this bolt **94** engages the center of a spring clamp **98** that extends longitudinally of the block **58** with bifurcated ends **100** straddling the fuel lines **54** and resting on the ends **92** of the hubs **76**. Thus tightening of the bolt **94** will force the shoulders **80** on the nozzles **74** against the bottom of the vent chamber **60** and retain the blocks **58** on the seats.

It will be seen that during operation of the engine **10** the air will flow through the induction passages **44** and into the cylinders and the fuel jet **86** will discharge a stream of metered fuel through the orifice **90** and into the air to form the charge. The air flowing through the induction passages **44** will be under a vacuum that will cause the air to flow from the vent chamber **60** in the block **58** into the air chamber **82** in the nozzle **74** and thence through the orifice **90** into the induction passage **44**. If there is little restriction to the flow of this air anterior to the air chamber **82**, the pressure of the air in the air chamber **82** will be substantially constant. Thus the discharge of fuel from the jet **86** will be opposed by a constant pressure. If desired, the inlet tubes

64 for the blocks **58** for each bank **14** may be interconnected with each other by flexible hoses **68** which, in turn, are interconnected with the induction system posterior to the air cleaner **51** but at a point where the air flow will be suitable for an equal distribution of vent air to the nozzles. However, it should be noted that the air passing through the nozzle **74** will be consumed in the engine and, consequently, this flow of vent air must be sufficiently restricted to allow the throttle to retain control over the engine speed even during idle. This is best accomplished by limiting the orifice **90** to a sufficiently small size for restricting the flow of air therethrough to less than the amount required for idling. It should be noted that since the vacuum is very high during idling, the orifice **90** must of necessity be very small and as a consequence the jet **86** and orifice must be in exact alignment with each other. Due to the thermal insulation in the gasket **40** and the blocks **58**, the transfer of heat from the engine to the nozzles **74** will be greatly reduced and as a result, the temperature of the nozzles **74** will be retained low enough to prevent trouble in the operation thereof.

I claim:

1. Fuel discharge means for use in a fuel injection system for an internal combustion engine having induction passages for charging the engine cylinders, said means comprising a mounting block of heat insulating material having a passageway extending therethrough, said mounting block being adapted to be secured to said engine with said passageway opening into said induction passage, a fuel nozzle disposed in said passageway and adapted to be interconnected with said fuel injection system for injecting metered fuel therefrom and into said induction passage, and fastening means for retaining said nozzle and said block in position.

2. Fuel discharge means for use in a fuel injection system for an internal combustion engine having an intake manifold with induction passages therein for charging the engine cylinders, said means including a mounting block adapted to be secured to said manifold, said block including a vent space in the center thereof adapted to receive a substantially unrestricted supply of air, said block comprising a heat insulated material and having a passageway extending therethrough to intersect said space and open into said induction passage, a nozzle disposed in said passageway and having a fuel jet adapted to discharge a stream of metered fuel through an orifice disposed in substantial alignment therewith and communcating with said induction passage, said jet and orifice being separated from each other by a chamber opening into said vent space to allow the air therein to flow through said chamber and out said orifice with said stream of fuel.

3. In an internal combustion engine having an induction system with passages therein for charging the cylinders in said engine, the combination of a mounting block of thermal insulating material secured to said induction system and including a vent space in the center thereof adapted to receive a supply of air, a fuel nozzle extending through said block and being thermally insulated from said engine by said block, said nozzle including a fuel jet aimed at an orifice communicating with said induction passage for discharging fuel therethrough and into said induction passage, said jet and orifice being separated from each other by a chamber communicating with said vent space and with the induction passage by said orifice.

4. In an internal combustion engine having an induction system including an intake manifold having separate groups of induction passages therein for charging separate groups of cylinders in said engine, the combination of a separate mounting block of thermal insulating material for each of said groups of induction passages secured to said intake manifold and having a vent space in the center thereof, a separate passageway for each of

said induction passages extending transversely through said block to intersect said vent space and to open into said induction passage, a fuel nozzle disposed in each of said passageways and supported by said block to be thermally insulated from said manifold, each of said nozzles having a fuel jet aimed at an orifice communicating with said induction passages for continuously discharging fuel therethrough and into said induction passages, said jet and orifice being separated from each other by a chamber communicating with said vent space and said induction passage by said orifice.

5. In an internal combustion engine having an intake manifold with pairs of induction passages therein for charging adjacent cylinders in said engine, the combination of a mounting block secured to said induction system and extending across said induction passages, said block including an opening extending longitudinally in

the center thereof to form a vent space and adapted to receive a supply of air, a pair of separate passageways spaced from each other extending transversely through said block to intersect said vent space and to open into said induction passages, a fuel nozzle disposed in each of said passageways and having a fuel jet aimed at an orifice communicating with an induction passage for discharging fuel through said orifice and into said passage, said jet and orifice being separated from each other by a chamber communicating with said vent space in said block and with the induction passage by said orifice.

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