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Eisenberg

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[54] **FUEL INJECTION NOZZLE HOLDER INSTALLATION**

[75] Inventor: **Eugene Eisenberg,** Hagerstown, Md.

[73] Assignee: **Mack Trucks, Inc.,** Allentown, Pa.

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[52] **U.S. Cl.** ..... **123/32 R**

[51] **Int. Cl.** **F02m 51/00**

[58] **Field of Search** 123/32; 285/13

[56] **References Cited**

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Primary Examiner—Charles J. Myhre
Assistant Examiner—Cort Flint
Attorney, Agent, or Firm—Brumbaugh, Graves, Donohue & Raymond

[57] **ABSTRACT**

A fuel line installation for a fuel injection nozzle holder comprises two intercommunicating bores formed in the cylinder head, the first of which receives the nozzle holder. A fuel delivery tube, received within the second bore, communicates with the nozzle holder through a conical fitting at the end of the tube. A distance tube encircles the fuel delivery tube and engages the fitting to maintain it in a conical opening in the nozzle holder. The distance tube, in turn, is held against the conical fitting by an elongated annular fitting also encircling the fuel delivery tube and screwed into the free end of the second bore. The second bore and the tubes are dimensioned to provide an annular passage betweeen the distance tube and the interior surface of the bore. In operation, fuel is delivered to the nozzle holder through the fuel delivery tube and return fuel is conducted away from the nozzle holder through the annular passage.

16 Claims, 2 Drawing Figures

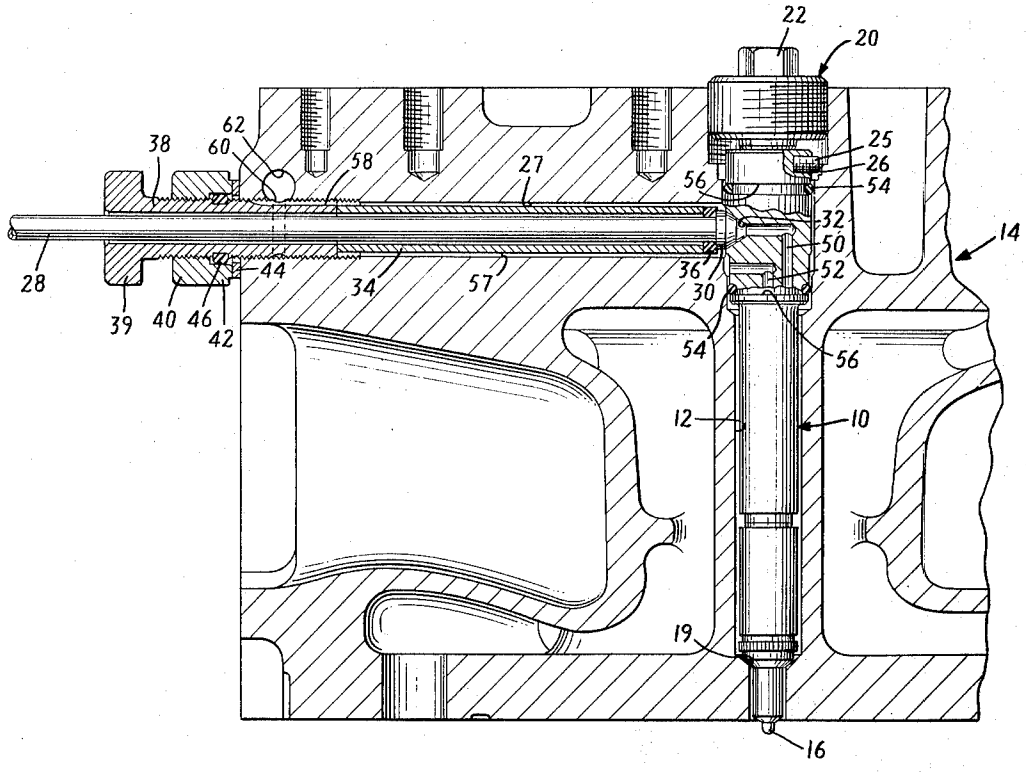
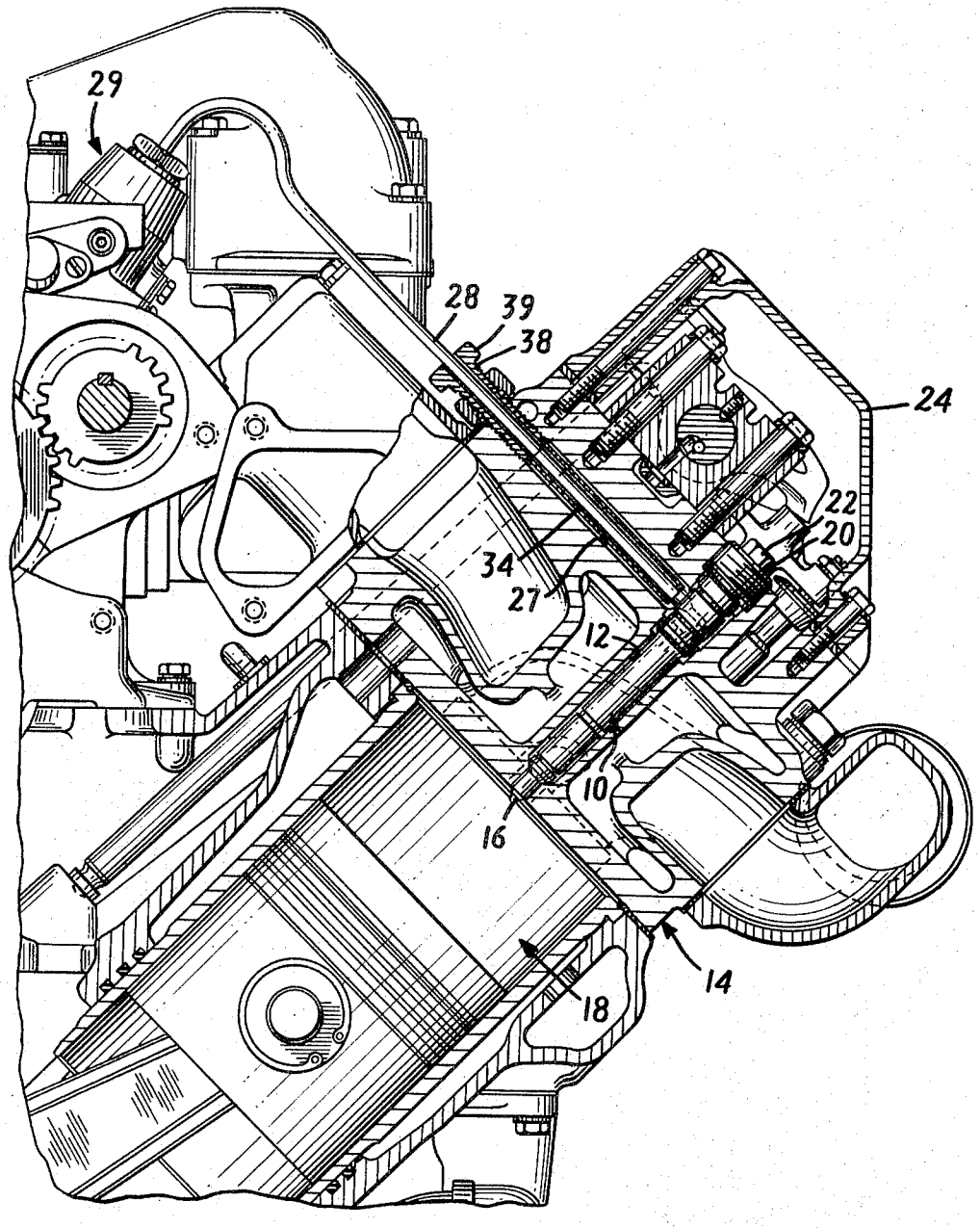


FIG. 1



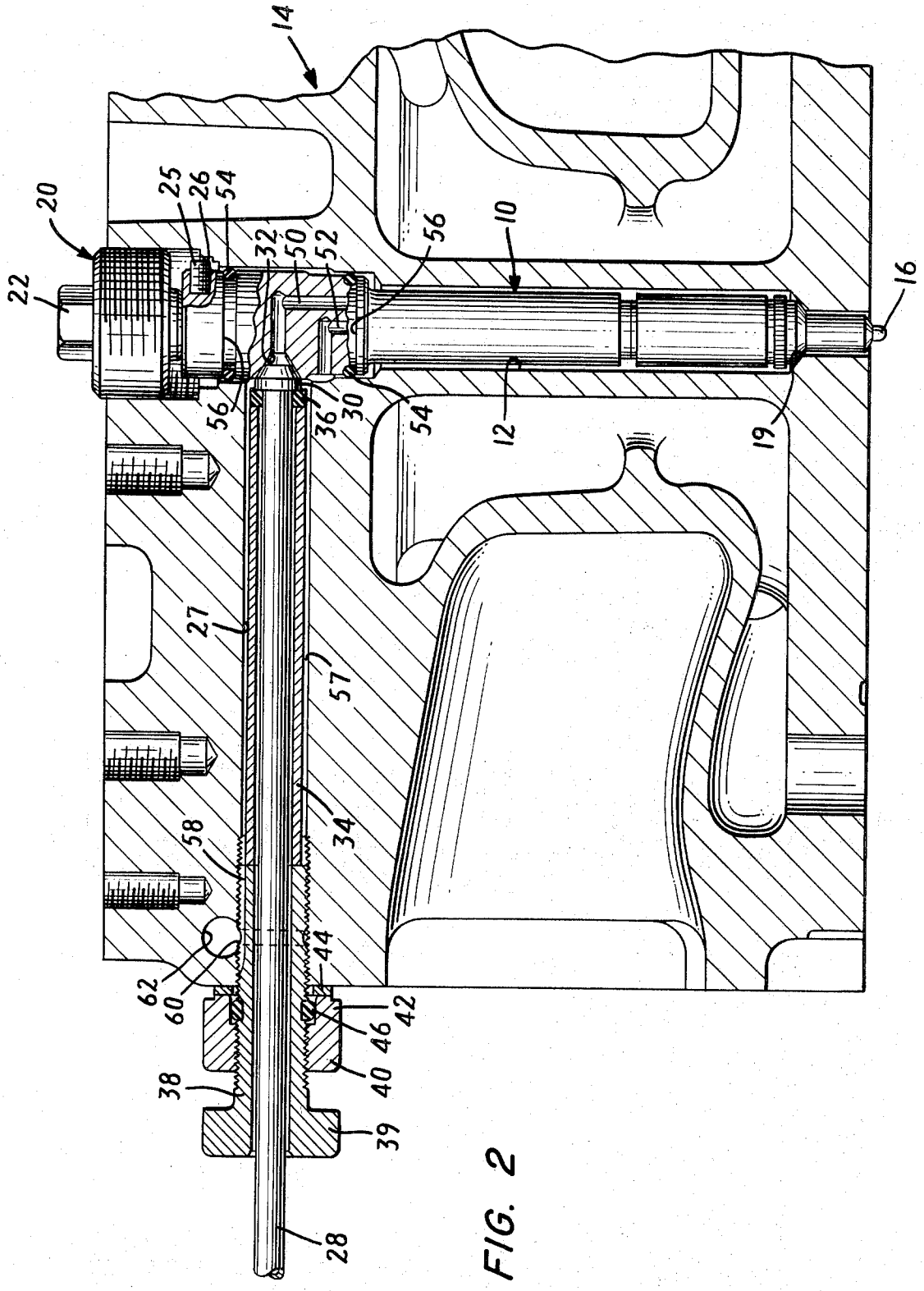

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FIG. 2

FUEL INJECTION NOZZLE HOLDER INSTALLATION

BACKGROUND OF THE INVENTION

Generally, in a compression ignition engine, the fuel injection nozzle holder is inserted into a vertical bore formed in the cylinder head, the nozzle protruding into the cylinder and the upper end of the holder projecting from the head for connection to the fuel lines. Ductile metal tubes are used to deliver fuel to the nozzle holder from the fuel injection pump and to conduct return fuel away from the holder to the fuel tank. The tubes pass either through the wall of the cylinder head or the cylinder head cover. A common practice is to connect the fuel lines permanently to the nozzle holder, for example by soldering or brazing, and to provide a break in the lines at the point where they pass through the cylinder head or cover. A connecting fitting is provided at the break point and is constructed so that any fuel leaking from the connection is collected and drained to the outside of the cylinder head to avoid contamination of the lubricating oil inside the engine. The installation requires two separate lengths of tubing and two connecting fittings, on each for fuel delivery and for fuel return. Such an installation is illustrated in Dickerson et al U.S. Pat. No. 3,402,703.

Although careful manufacture of the fuel line components and careful assembly may substantially eliminate fuel leakage in a new engine incorporating the above installation, subsequent wear and tear causing loosening of the fittings, breaking down of the soldered connections and cracking of the metal tubing may eventually result in undesirable leakage of fuel into the engine lubrication oil compartment. In addition, extra care involves extra expense. If the assembly is not careful, even a relatively minor leak occurring under the cylinder head cover results in leakage fuel that is trapped on the cylinder head and will seek to escape through any opening, possibly into the lubrication oil compartment.

One attempt to avoid the leakage problem involves the use of a very long nozzle holder protruding from a sealed hole in the cylinder head cover. This installation permits the fuel line connections to be made outside the cover, away from the engine oil compartment. The installation is, however, very complicated, difficult to service and occupies more space.

SUMMARY OF THE INVENTION

The present invention comprises two intercommunicating bores formed in a cylinder head, one receiving the nozzle holder and the second providing the fuel connections for the holder. A tube received within the second bore delivers fuel to the nozzle holder through a conical fitting at the end of the tube. The fitting is held tightly against a conical opening in the nozzle holder by a second tube encircling the fuel delivery tube. The second or distance tube, in turn, is held against the conical fitting by an elongated annular fitting, also encircling the fuel delivery tube and screwed into the free end of the second bore. A retaining device is threaded on the portion of the annular fitting protruding from the cylinder head to hold the fitting in position and seal it. The distance tube is smaller in diameter than the second bore, thereby affording an annular passage between the tube and the surface of the bore

for conducting return fuel away from the nozzle holder.

In operation, fuel is delivered from the fuel injection pump through the fuel delivery tube and the conical fitting to the upper end of the nozzle holder. The fuel is injected into the cylinder and return fuel travels back up through the nozzle holder, passing into the bore for the nozzle holder adjacent its intersection with the second bore. Two seal members, encircling the holder one on either side of the intersection of the bores, prevent the return fuel from passing along the holder and direct the fuel into the annular passage surrounding the distance tube. The fuel travels along the passage to the annular fitting, where it is directed into longitudinal grooves formed in the outer surface of the fitting. The longitudinal grooves conduct the fuel to a groove that encircles the fitting and channels the fuel to a passageway in the cylinder head, through which the fuel is returned to the fuel tank. Any fuel that might escape between the annular fitting and the second bore toward the exterior surface of the cylinder head is sealed in the bore by the retaining device on the fitting. The retaining device includes a gasket, an annular seal and a nut, the nut being threaded on the portion of the fitting protruding from the cylinder head to seal the gasket against the exterior surface of the head and the annular seal against the fitting.

Applicant's installation, by providing a second bore in the cylinder head, conveniently delivers fuel to a fuel injection nozzle holder while eliminating the possibility of fuel leakage into the lubrication oil. The fuel lines are completely isolated from the rest of the engine. The installation also eliminates much of the tubing and fittings normally required for the return fuel line, reducing material and assembly costs. In addition, the invention eliminates the necessity of bending the fuel line tubing to mate with the inlet in the cylinder head or cover and the nozzle holder. The tubing may now remain unbroken and generally straight from the fuel injection pump to the nozzle holder. The invention further eliminates brazing or soldering the fuel line tubing to the nozzle holder, and any fuel leakage which might occur at the connection between the high pressure fuel line tubing and the nozzle holder flows directly into the return fuel line.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention, reference may be made to the following description of an exemplary embodiment, taken in conjunction with the figures of the accompanying drawings in which:

FIG. 1 is a view of a fuel line installation for a fuel injection nozzle holder according to the invention, taken partly in section; and

FIG. 2 is an enlarged view of the installation of FIG. 1.

DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 of the drawings shows a fuel injection nozzle holder **10** installed in a bore **12** formed in a cylinder head **14** of a conventional diesel engine. The entire holder **10** is received within the bore **12**, the nozzle **16** protruding into the cylinder **18** below the head. The holder **10** is centrally clamped to a seat **19** (see FIG. 2) formed in the head **14** by means of a plug **20**, which threadedly engages the head **14** and which has a raised

portion 22 that projects above the top deck of the head. The raised portion 22 may be engaged by a wrench or other tool, after the cylinder head cover 24 is removed from the head 14, to remove the plug 20 so that the nozzle holder 10 may be removed from or inserted into the bore 12. The holder 10 is correctly positioned in the bore 12 by a pin 25, which projects laterally from the holder 10 and is received in a slot 16 formed in the head 14.

A second bore 27 is also formed in the cylinder head 14, communicating with the first bore 12 and an exterior lateral surface of the head 14. A tube 28 of ductile metal, for example, is received within the second bore 27 and communicates at one end with the nozzle holder 10 and at the other end with a conventional fuel pump 29 for delivering fuel to the holder. As shown in the drawings, the tube 28 is unbroken and generally straight throughout its length from the fuel pump to the nozzle holder, thereby eliminating the fitting and the resultant leakage problems of a fuel line that is broken at the cylinder head wall. Secured to the end of the fuel delivery tube 28 adjacent the nozzle holder 10, is a conical fitting 30, which is received in a complementary conical opening 32 formed in the lateral wall of the holder. The fitting 30 is held in sealing engagement with the opening 32 by a distance tube or sleeve 34 that encircles the tube 28. One end of the distance tube 34 contacts a collar 36, also encircling the fuel delivery tube 28, and the collar 36, in turn, engages the conical fitting 30. This assembly eliminates the necessity of soldering the fuel line to the holder and eliminates the leakage problems of a soldered connection that fails. Furthermore, any leakage which might occur between the fitting 30 and the holder opening 32 merely flows into the return fuel line to be described below. The other end of the distance tube 34 engages one end of an elongated annular clamping screw 38 which encircles the tube 28. The clamping screw 38 is screwed into the bore 27 to engage the distance tube 34 and drive the fitting 30 into sealing engagement with the holder opening 32, maintaining the screw 38, the distance tube 34, the collar 36 and the fitting 30 in intimate contact with each other. The exposed end of the clamping screw 38 has an enlarged portion 39 of a hexagonal or other configuration for engagement by a wrench.

To hold the clamping screw 38 tightly in place and to prevent any fuel from escaping outside the cylinder head 14 between the clamping screw and the bore 27, a clamping nut 40 is threaded onto the screw 38 outside the cylinder head 14. The clamping nut 40 has a shoulder 42 and is mounted on the clamping screw 38 with the shoulder 42 facing the cylinder head 14. The nut 40 is tightened against a gasket 44 encircling the clamping screw 38 and disposed between the nut 40 and the adjacent lateral surface of the cylinder head 14, so as to prevent any escape of fuel between the nut 40 and the cylinder head. This also locks the clamping screw 38. An O-ring seal 46 between the exterior surface of the clamping screw 38 and the shoulder 42 of the nut 40 prevents any leakage of fuel therebetween.

Assembly on the tube 28 of the elements carried thereby is accomplished by first slipping the clamping screw 38 and nut 40, the distance tube 34 and the collar 36 over the end of the tube 28, and thereafter securing the fitting 30 to the end of the tube 28 by a press-fit, for example.

Fuel is delivered under pressure through the fuel delivery tube 28 and the conical fitting 30 into the opening 32 of the nozzle holder 10. The fuel is then conducted to the nozzle 16 by a conduit 50 running generally lengthwise of the holder 10. Return fuel is directed back through the holder 10 through a second conduit 52, also running generally lengthwise of the holder 10, and is emptied into the bore 12 adjacent its intersection with the second bore 27. Two O-ring seals 54, disposed in two grooves 56 formed in the lateral surface of the holder 10, engage the surface of the bore 12 on opposite sides of the intersection of the two bores 12 and 27 and prevent any leakage of fuel into the cylinder 18 or onto the top deck of the head 14.

The return fuel is then directed through an annular passage 57 between the distance tube 34 and the surface of the bore 27. When the return fuel reaches the clamping screw 38, it flows through a plurality of longitudinal grooves 58 formed in the screw 38, the grooves communicating with an annular groove 60 formed in the screw 38. The fuel flowing into the annular groove 60 is channelled away from the groove by a passageway 62 formed in the cylinder head, from which the fuel is conducted to the fuel tank (not shown) through a suitable conduit (not shown).

Thus, the present installation permits delivery of fuel to the nozzle holder and return fuel to the fuel tank without any possibility of leakage into the engine lubrication oil compartment. In particular, the high pressure and return fuel lines connected to the nozzle holder pass through a single bore in the cylinder head. The arrangement is such that should there be any leakage of fuel at the connection between the high pressure line and the nozzle holder, leakage fuel will merely flow into the return fuel line. Furthermore, the nozzle holder is located entirely below the top deck of the cylinder head, and there are no fuel lines above the top deck, providing a compact design which is easy to service.

It will be understood that the above-described embodiment is merely exemplary and that those skilled in the art may make many variations and modifications without departing from the spirit and scope of the invention. All such modifications and variations are intended to be included within the scope of the invention as defined in the appended claims.

I claim:

1. A fuel line installation for a fuel injection nozzle holder used in an internal combustion engine having at least one cylinder head comprising a first bore formed in the cylinder head for receiving the nozzle holder, a second bore formed in the cylinder head communicating with the first bore, and a tube received within the second bore and adapted to communicate with the nozzle holder for delivering fuel thereto, an annular passage being afforded between the tube and the surface of the second bore for conducting return fuel away from the nozzle holder.

2. The fuel line installation according to claim 1, wherein the second bore communicates with an exterior surface of the cylinder head.

3. The fuel line installation according to claim 2, further comprising an elongated annular fitting received in the second bore and encircling the fuel delivery tube, the fitting generally closing one end of the annular passage, and a passageway in the cylinder head communicating with the annular passage for conducting return

fuel from the annular passage to an exterior surface of the cylinder head.

4. The fuel line installation according to claim **3**, wherein the annular fitting has at least one groove formed in the exterior surface thereof adapted to communicate with the annular passage and the cylinder head passageway for carrying return fuel therebetween.

5. The fuel line installation according to claim **3**, further comprising means for locking the annular fitting in position.

6. The fuel line installation according to claim **5**, wherein the fitting is threadedly received in the second bore and has a portion protruding therefrom, and wherein the locking means includes a locking member threadedly mounted on the protruding portion of the fitting, a gasket disposed between the locking member and the cylinder head, and sealing means disposed between the locking member and the protruding portion of the fitting, whereby locking the annular fitting in position places the locking member in sealing relation with the cylinder head and the fitting.

7. The fuel line installation according to claim **1**, further comprising a second tube received within the second bore and encircling the fuel delivery tube, the annular passage being afforded between the second tube and the surface of the second bore, and a fitting secured to the end of the fuel delivery tube adapted to communicate with the nozzle holder for directing fuel from the fuel delivery tube to the holder.

8. The fuel line installation according to claim **7**, further comprising an elongated annular fitting received in the second bore and encircling the fuel delivery tube, the annular fitting threadedly engaging the cylinder head and engaging one end of the second tube so as to maintain the second tube in sealing relation with the fuel directing fitting, and to maintain the fuel directing fitting in sealing relation with the nozzle holder.

9. The fuel line installation according to claim **7**, further comprising a collar disposed between the second tube and the fuel directing fitting.

10. The fuel line installation according to claim **1**, wherein the fuel delivery tube is adapted to communicate with the nozzle holder intermediate its ends, and including seal means for engaging the holder and the surface of the first bore on opposite sides of the point at which the first bore communicates with the second bore so as to prevent fuel from escaping between the holder and the surface of the first bore.

11. The fuel line installation according to claim **1**, further comprising pin means mounted on one of the nozzle holder and the cylinder head, and wherein the other of the nozzle holder and the cylinder head is formed with a complementary slot adapted to receive the pin means, whereby the nozzle holder when installed in the first bore is in the correct position to enable communication with the fuel delivery tube.

12. A fuel line installation for a fuel injection nozzle holder used in an internal combustion engine having at least one cylinder head comprising:

a. a first bore formed in the cylinder head for receiving the nozzle holder;

b. a second bore formed in the cylinder head communicating with the first bore;

c. a first tube received within the second bore and adapted to communicate with the nozzle holder for delivering fuel thereto;

d. a first fitting secured to the end of the first tube adapted to communicate with the nozzle holder for directing fuel from the first tube to the nozzle holder;

e. a second tube received within the second bore and encircling the first tube, the second tube adapted to engage the first fitting to maintain it in sealing relation with the nozzle holder; and

f. a second fitting received in the second bore and encircling the first tube, the second fitting threadedly engaging the cylinder head and engaging one end of the second tube so as to maintain the second tube in sealing relation with the first fitting, an annular passage being afforded between the second tube and the surface of the second bore for conducting return fuel away from the nozzle holder.

13. The fuel line installation according to claim **12**, wherein the second bore communicates with an exterior surface of the cylinder head and the second fitting protrudes from the second bore beyond the exterior surface.

14. The fuel line installation according to claim **12**, further comprising a passageway in the cylinder head communicating with the annular passage for conducting return fuel from the annular passage to an exterior surface of the cylinder head.

15. The fuel line installation according to claim **12**, further comprising means for sealingly locking the second fitting in position.

16. The fuel line installation according to claim **12**, wherein the first tube is adapted to communicate with the nozzle holder intermediate its ends, and including seal means for engaging the holder and the surface of the first bore on opposite sides of the point at which the first bore communicates with the second bore so as to prevent fuel from escaping between the holder and the surface of the first bore.

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