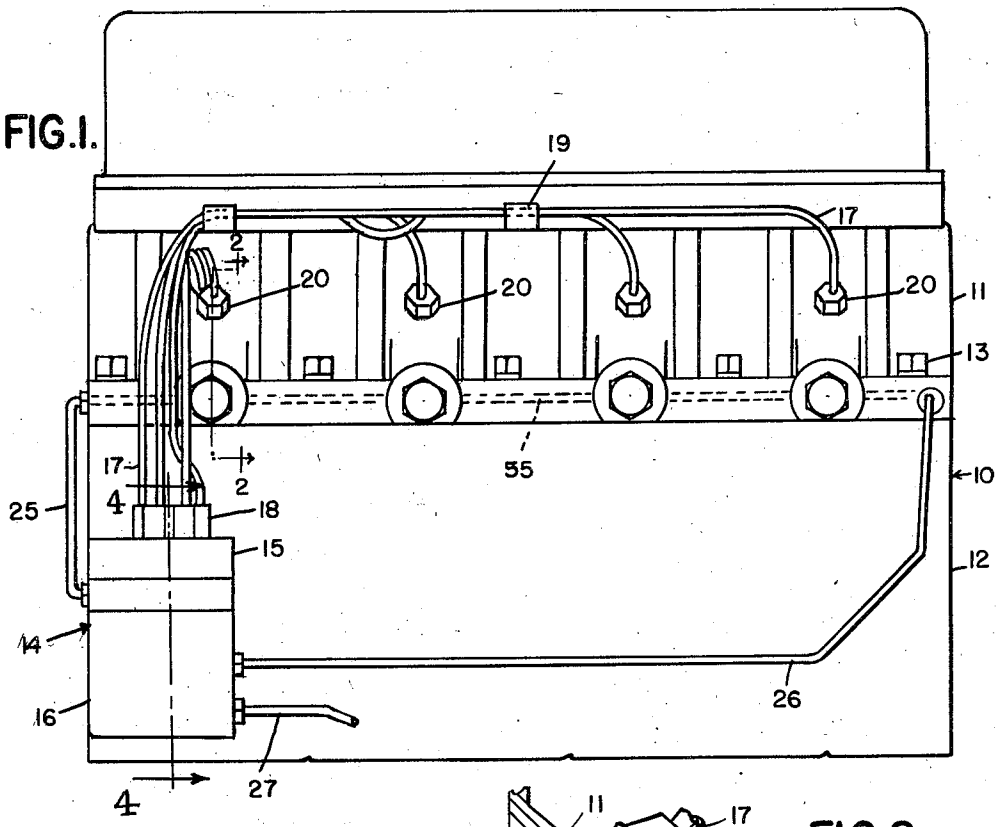
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CYLINDER HEAD CONSTRUCTION

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FIG.1.



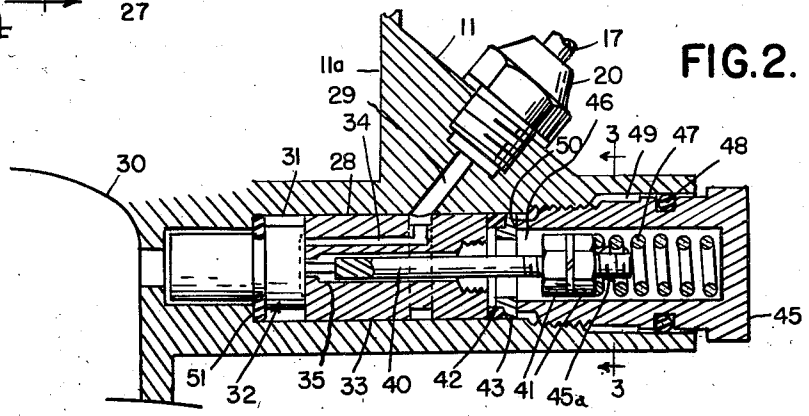


FIG.2.

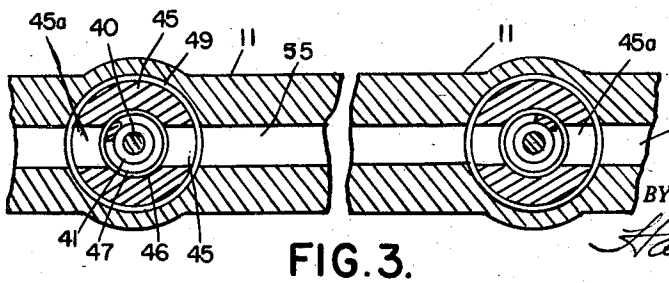


FIG.3.

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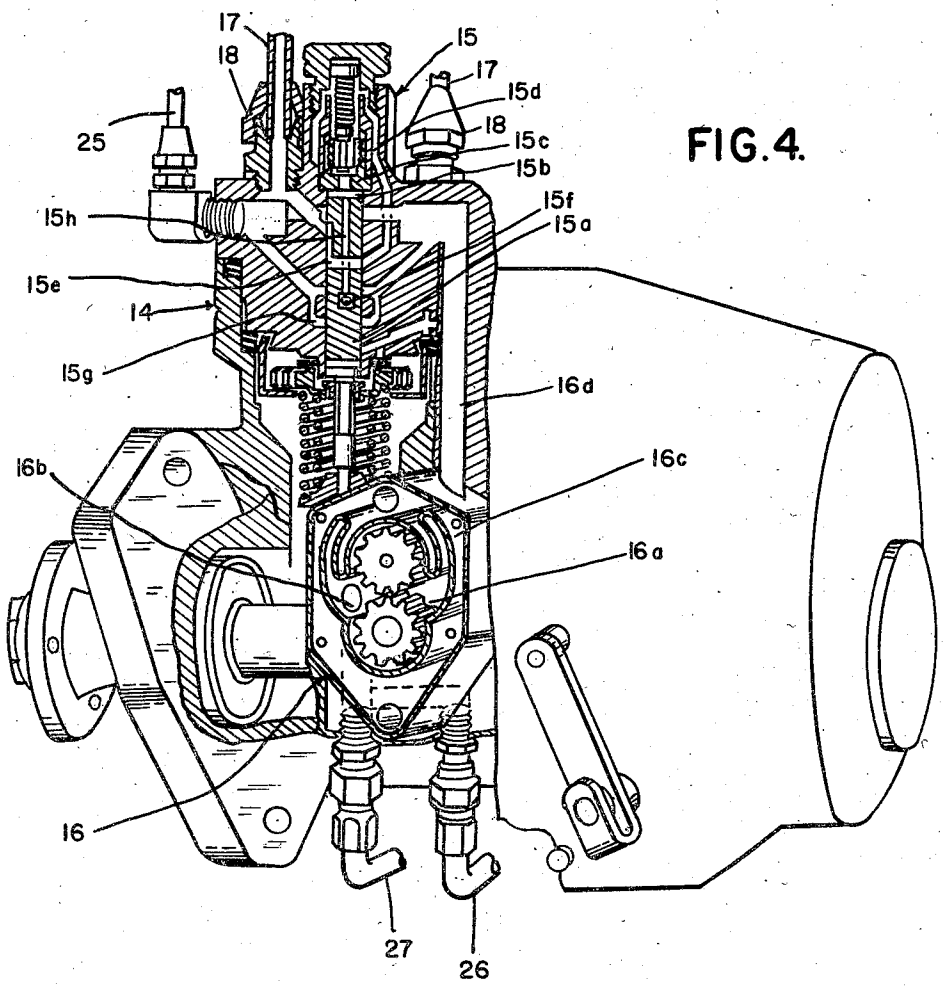


FIG.4.

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2,818,840

CYLINDER HEAD CONSTRUCTION

Frank McGowen, Muskegon, Mich., assignor to Continental Motors Corporation, Muskegon, Mich., a corporation of Virginia

Application August 3, 1955, Serial No. 526,267

7 Claims. (Cl. 123—32)

My invention relates to an internal combustion engine of the compression ignition type and more particularly to a cylinder head assembly for same.

Heretofore in the manufacture of engines of the compression ignition type, the fuel injection nozzles including their various operating parts, pump pressure inlets, and leak-off means have been made as assemblies separate from the cylinder head. This resulted in a rather complicated arrangement and installation, comprising separate leak-off conduits and fittings for returning fuel leakage from the nozzles to the fuel pump sump or suction portion and externally mounted nozzles, all subject to damage in handling and necessitating an additional accessory installation step after the basic engine assembly had been accomplished.

An inspection of any engine heretofore in use reveals a multitude of fuel pressure pipes and fittings, drain lines and fittings, and expensive externally mounted injection nozzles with a plurality of hold down bolts, and all of this equipment from time to time becomes damaged, necessitating costly replacement subject to maintaining of all these parts in stock.

In addition, the parts of the nozzle assembly were to a certain extent insulated from the cooling system of the engine by virtue of the housing in which they were enclosed. This results in a definite limitation on the service life of the nozzle and associated equipment.

Therefore, an object of my invention is to facilitate the cooling of the fuel injection nozzles and other parts by eliminating the separate housing incorporating its function into the basic assembly in closer communication with the engine cooling system and in providing supplementary cooling means by circulating normal fuel pump overflow through a passage in the cylinder head and around the nozzle parts.

Another object of my invention is to eliminate the complex installation of pipes and equipment associated with fuel injection nozzles by connecting a passage through the cylinder head with drainage of injector leak-off fuel from each nozzle to the fuel pump overflow, and by providing each nozzle with a plug portion installed directly on the cylinder head and serving the multifold purpose of sealing the nozzle section, housing some of the parts, and retaining the whole installation in the cylinder head.

For a more detailed understanding of my invention, reference may be had to the accompanying drawing illustrating a preferred embodiment of my invention in which like characters refer to like parts throughout the several views and in which:

Fig. 1 is a vertical elevation view of an engine with the fuel injection system installed,

Fig. 2 is a section on line 2—2 of Fig. 1, and

Fig. 3 is a section on line 3—3 of Fig. 2, and

Fig. 4 is a cross-section perspective view taken substantially on the line 4—4 of Fig. 1.

Referring first to Fig. 1 of the drawing, an internal combustion engine **10** of the compression ignition type is shown having a cylinder head **11** suitably secured to the

cylinder block **12** by bolts **13** or the like. A fuel injection pump **14** of conventional design is suitably installed or mounted on the engine and has a fuel pressure distribution head **15** and suction intake means **16**. A plurality of fuel pressure pipes **17** are installed or otherwise secured at the pressure distribution head **15** of the pump by fittings **18** or the like, said pipes **17** conventionally mounted on the cylinder head by mounting blocks **19** or any other means, and leading to fuel pressure inlet fittings **20**, the quantity depending on the number of fuel injectors installed.

A fuel overflow conduit **25** is installed between the pump **14** and the cylinder head **11**, and serves to direct normal overflow fuel from the pump into a longitudinal passage **55** within the cylinder head **11**. A fuel drain line **26** similarly connects the other end of the longitudinal passage **55** with the suction intake means **16** of the pump **14**. Fuel intake to the pump **14** is through intake pipe **27**.

The conventional fuel pump **14** is shown in Fig. 4, in which the suction intake means **16** may comprise a gear type pump **16***a* having an intake port **16***b* connected with the fuel drain line **26** and the intake pipe **27**, and an outlet port **16***c* connected through a passage **16***d* to the pressure distribution head **15**. The pressure distribution head **15** preferably comprises a plunger **15***a* vertically reciprocated and rotated by any suitable drive from the engine. In operation, the plunger **15***a* moves downward and fuel from the passage **16***d* enters a chamber **15***b*. The plunger **15***a* moves upward, forcing the fuel from chamber **15***b* under high pressure through a delivery valve **15***c* into a passage **15***d* and to an annular groove **15***c* in the plunger **15***a* from which it is distributed to the fuel pressure pipes **17**. As the plunger **15***a* reciprocates, a port **15***f* will come into alignment with overflow passages **15***g*, and overflow fuel from the chamber **15***b* will pass down through a central plunger passage **15***h* thereto and flow to the fuel overflow conduit **25**.

Fig. 2 showing a section through the cylinder head **11** illustrates an inner wall **11***a* of the cooling system, a high pressure fuel passage **29**, a combustion chamber **30** and a step drilled and reamed bore **31** open to the combustion chamber **30** and containing a fuel injector nozzle assembly **28**.

The fuel injector nozzle assembly **28** comprises a conventional fuel injector nozzle tip **32**, a spool **33** having a passage **34** in open connection with the nozzle tip **32** and with the high pressure fuel passage **29** in the cylinder head **11** for directing inlet pressure fuel to the nozzle tip, the spool also having a step drilled and reamed bore **35** through its center. A fuel injector pintle **40** is constructed to fit within the bore **35** of the spool **33**, and is threaded at its outer end for the installation of two adjusting nuts **41** or suitable adjusting means. The preferred structure of the injector nozzle embodied in my invention also comprises an expanding washer **42** and a backup washer **43** installed outwardly of the spool **33**, however the backup washer **43** may be eliminated. A hold down plug **45** or cap is suitably screwed or otherwise secured into the cylinder head bore **31**. This plug has a recess **46** which contains a pressure spring **47**. A standard O-ring **48** or other sealing device prevents leakage from escaping past the plug **45**. Also, each plug forms with the cylinder head bore or recess **31** an annular passage **49**. One or more ports **45***a* connect the annular passage **49** with the interior of the plug **45**.

When installed, the inner end **50** of the plug **45** bears against the back up washer **43** or the expanding washer **42**, serving to secure the spool **33** inward against the nozzle tip **32**. The spring **47** serves to retain the pintle **40** and provide pressure to insure proper operation. A washer **51** is installed at the inner end of the second

step of bore **35** and serves to seal the major portion of the bore **35** from the compression chamber pressure.

All of the above parts comprise the essential structure of the fuel injector nozzle assembly **28** operating in the conventional manner. The distinction between applicant's assembly and formerly employed types is that the cylinder head **11** and nozzle assembly are completely assembled before assembly of the head to the cylinder block. The cylinder head **11**, moreover, is longitudinally bored as at **55**, said bore or passage intersecting and in open communication with annular passages **49** and ports **45***a*.

When the fuel pump **14** is operating, the excess or overflow fuel, instead of being directly connected to the sump or suction side of the pump as heretofore, is directed through conduit **25** to one end of the longitudinal passage or bore **55**. This fuel subsequently circulates within all the recesses **46** of the plugs **45**, and around the parts of the fuel injector nozzle described above, thus serving as an efficient cooling means for these parts. In addition, any leak-off fuel which passes from the injector nozzle tip **32** into the central sleeve bore **35** and past the pintle **40**, is subsequently carried through passage **55** with the overflow fuel. This fuel then passes out the other end of the longitudinal passage **55** into the drain line **26** and thence to the suction intake means **16** of pump **14**.

An additional cooling characteristic of this improved fuel injector nozzle installation is the proximity of the injector parts and the bore **33** to the wall **11***a* of the engine cooling system.

While I have illustrated but one embodiment of my invention, it will be apparent, however, to those skilled in the art to which my invention pertains that various changes and modifications may be made therein without departing from the spirit of my invention or from the scope of the appended claims.

I claim:

1. In a multi cylinder internal combustion engine of the compression ignition type having a cylinder head, a fuel induction system for said engine including a fuel injection pump having fuel discharge means and a fuel overflow means, and a plurality of fuel discharge lines leading respectively from said fuel discharge means to the engine cylinders, a plurality of fuel injection nozzle assemblies, said fuel discharge lines carrying fuel under pressure to said fuel nozzle assemblies, said cylinder head having a plurality of transverse bored openings and in each of which a nozzle assembly is fitted, a hollow plug secured in the outside portion of each bored opening to back up the nozzle assembly and to seal against leakage of fuel therefrom, said cylinder head having a longitudinal bore intersecting each of said bored openings, each of said plugs having openings placing the interior of said longitudinal plugs into open communication with said longitudinal bore, means connecting the fuel pump overflow means with one end of said longitudinal bore to flow said overflow fuel therethrough and in heat exchange relation with respect to each of said fuel nozzle assemblies, and means connecting the other end of said longitudinal bore with the fuel supply system on the suction side of said pump.

2. In a multi-cylinder internal combustion engine of compression ignition type having a cylinder, a fuel induction system for said engine including a fuel supply and a fuel injector means including a fuel pump having fuel discharge means and a fuel oveflow means, a plurality of fuel feed lines leading respectively from said fuel discharge means to the engine cylinders, a plurality of fuel injection nozzle assemblies respectively associated with the engine cylinders and each connected with one of the fuel lines aforesaid, said cylinder head having a plurality of recesses for housing said nozzle assemblies and a longitudinal passage intersecting said recesses and having inlet and outlet ports, and means connecting said longitudinal passage with said fuel injector means and connecting the inlet port thereof with the fuel pump overflow means to circulate said overflow fuel through the passage and recesses, the outlet port means connected with the fuel supply on the suction side of the pump, the circulation of said overflow fuel aforesaid serving to cool the fuel nozzle assemblies and to drain fuel leakage from said recesses.

3. In a multi cylinder internal combustion engine of the compression ignition type having a cylinder, a fuel induction system for said engine including a fuel supply and a fuel injector means including a fuel pump having fuel discharge means and a fuel overflow means, a plurality of fuel feed lines leading respectively from said fuel discharge means to the engine cylinders, a plurality of fuel injection nozzle assemblies respectively associated with the engine cylinders and each connected with one of the fuel lines aforesaid, said cylinder head having a plurality of recesses for housing said nozzle assemblies and a longitudinal passage intersecting said recesses and having inlet and outlet ports, and means connecting said longitudinal passage with said fuel injector means and connecting the inlet port thereof with the fuel pump overflow means to circulate said overflow fuel through the passage and recesses, the outlet port means connected with the fuel supply on the suction side of the pump, the circulation of said overflow fuel aforesaid serving to cool the fuel nozzle assemblies and to drain fuel leakage from said recesses, said fuel nozzle assemblies each comprising a spring loaded pressure actuated nozzle valve and extended into said head recess, a plug for closing each recess and provided with an interior recess for housing the extended portion of the fuel nozzle assembly, and provided with openings placing the interior of the plug in open communication with said passage.

4. In a multi cylinder internal combustion engine of the compression ignition type having a cylinder, a fuel induction system for said engine including a fuel supply and a fuel injector means including a fuel pump having fuel discharge means and a fuel overflow means, a plurality of fuel feed lines leading respectively from said fuel discharge means to the engine cylinders, a plurality of fuel injection nozzle assemblies respectively associated with the engine cylinders and each connected with one of the fuel lines aforesaid, said cylinder head having a plurality of recesses for housing said nozzle assemblies and a longitudinal passage intersecting said recesses and having inlet and outlet ports, and means connecting said longitudinal passage with said fuel injector means and connecting the inlet port thereof with the fuel pump overflow means to circulate said overflow fuel through the passage and recesses, the outlet port means connected with the fuel supply on the suction side of the pump, the circulation of said overflow fuel aforesaid serving to cool the fuel nozzle assemblies and to drain fuel leakage from said recesses, said fuel nozzle assemblies each comprising a spring loaded pressure actuated nozzle valve and extended into said head recess, a hollow plug for closing each recess and having an annular seal to seal off leakage from the cylinder head recess to the outside and provided with an annular passage communicating with the cylinder head passage, each of said plugs having ports placing said annular groove in open communication with the interior of the hollow plug.

5. In a multi-cylinder internal combustion engine of the compression ignition type having a cylinder, a fuel induction system for said engine including a fuel supply and a fuel injector means including a fuel pump having fuel discharge means and a fuel overflow means, a plurality of fuel feed lines leading respectively from said fuel discharge means to the engine cylinders, a plurality of fuel injection nozzle assemblies respectively associated with the engine cylinders and each connected with one of the

fuel lines aforesaid, said cylinder head having a plurality of recesses for housing said nozzle assemblies, said cylinder head provided with passage means connecting each of said cylinder head recesses, and connecting ducts connecting the cylinder head passage at one end to the fuel overflow means of said pump and the other end to the fuel supply on the suction side of the fuel pump.

6. In a multi-cylinder internal combustion engine of the compression ignition type having a cylinder, a fuel induction system for said engine including a fuel supply and a fuel injector means including a fuel pump having fuel discharge means and a fuel overflow means, a plurality of fuel feed lines leading respectively from said fuel discharge means, to the engine cylinders, a plurality of fuel injection nozzle assemblies respectively associated with the engine cylinders and each connected with one of the fuel lines aforesaid, said cylinder head having a plurality of recesses for housing said nozzle assemblies, said cylinder head provided with passage means connecting each of said cylinder head recesses, and connecting ducts connecting the cylinder head passage at one end to the fuel overflow means of said pump and the other end to the fuel supply on the suction side of the fuel pump, said passage extending longitudinally of the cylinder head substantially normal to the axes of said recesses and comprising a longitudinally drilled passage intersecting each of said recesses.

7. In a multi-cylinder internal combustion engine of the compression ignition type having a cylinder, a fuel

induction system for said engine including a fuel supply and a fuel injector means including a fuel pump having fuel discharge means and a fuel overflow means, a plurality of fuel feed lines leading respectively from said discharge means to the engine cylinders, a plurality of fuel injection nozzle assemblies respectively associated with the engine cylinders and each connected with one of the fuel lines aforesaid, said cylinder head having a plurality of recesses for housing said nozzle assemblies, said cylinder head provided with passage means connecting each of said cylinder head recesses, and connecting ducts connecting the cylinder head passage at one end to the fuel overflow means of said pump and the other end to the fuel supply on the suction side of the fuel pump, said passage extending longitudinally of the cylinder head substantially normal to the axes of said recesses and comprising a longitudinally drilled passage intersecting each of said recesses, means plugging the recesses, and means providing for flowing the fuel circulated in said passage through said recesses in heat exchange relation with each of said fuel nozzle assemblies.

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