Nov. 19, 1940. A. K. ANTONSEN 2,222,274

FUEL SYSTEM FOR INTERNAL COMBUSTION ENGINES

Filed Nov. 19, 1938

FIG. 1

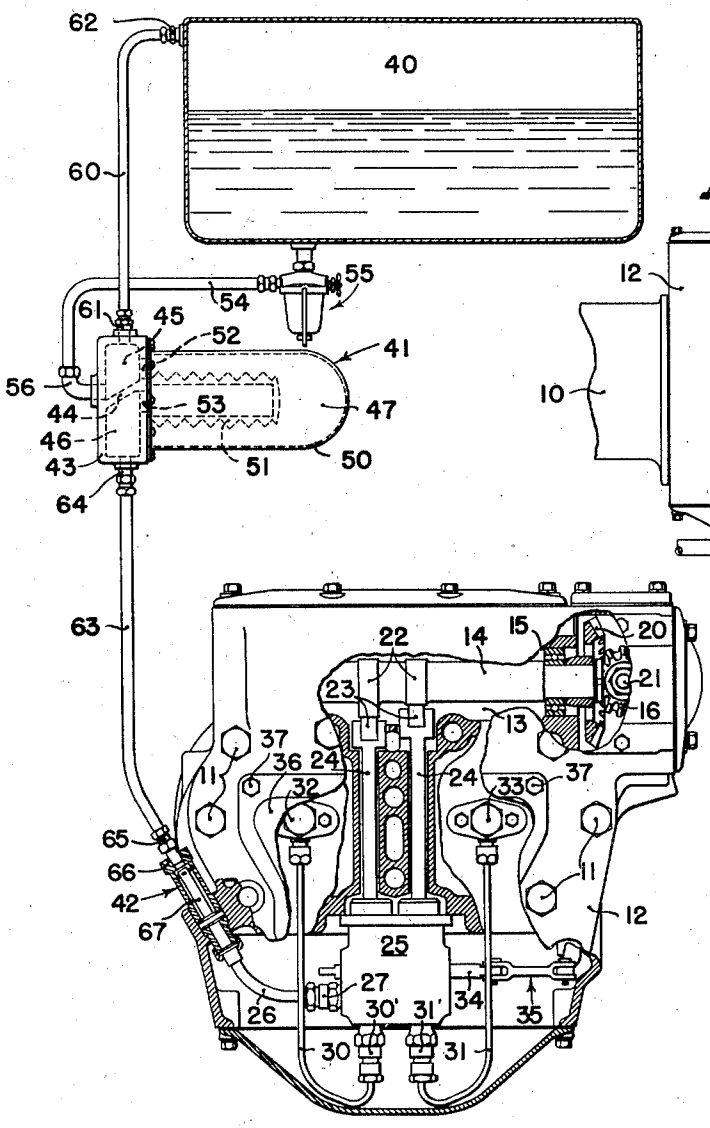


FIG. 2

INVENTOR.
ANKER K. ANTONSEN.

ATTORNEYS

Patented Nov. 19, 1940 2,222,274

UNITED STATES PATENT OFFICE

2,222,274

FUEL SYSTEM FOR INTERNAL COMBUSTION ENGINES

Anker K. Antonsen, Waterloo, Iowa, assignor to John Deere Tractor Company, Waterloo, Iowa, a corporation of Iowa

Application November 19, 1938, Serial No. 241,353

4 Claims. (Cl. 123—139)

The present invention relates generally to internal combustion engines and more particularly to fuel systems for engines of the compression-ignition type.

Heretofore a certain amount of difficulty has been experienced in priming the fuel system and ridding the filter and injection pump of air when initially filling the system or after running the system dry, and it has been the practice in the past to manually vent both the filter and injection pump to overcome this objection.

The principal object of the present invention is to provide a self-priming fuel system which will vent itself of all entrapped air as soon as fuel is poured into the tank and the engine is rotated for starting.

Another object of the present invention is to provide a removable cylinder head of novel design embodying a fuel injection pump mounted bodily on the head and removable therewith so that only the low pressure fuel line need be disconnected when the cylinder head is taken off.

Still another object is to provide a protective filter between the injection pump and the point at which the fuel line is disconnected to prevent any dirt which might enter the fuel line during dismantling operations from clogging or otherwise damaging the pump or injection nozzles.

These and other objects and advantages of the present invention will become apparent after a consideration of the following detailed description of a preferred embodiment thereof, reference being had to the appended drawing, in which

Figure 1 is an elevational view, partially sectioned, of the fuel system and cylinder head of a two cylinder Diesel engine of the horizontal type, embodying the principles of my invention; and

Figure 2 is a fragmentary side view, drawn to reduced scale, of the cylinder head shown in Figure 1.

Referring now to the drawing, the reference numeral 10 indicates the cylinder block of a horizontal Diesel type engine having two cylinders arranged side by side, and fixedly secured to the end thereof, as by bolts 11, is a cylinder head 12. The cylinder head 12 is provided with a cam shaft compartment 13 within which is disposed a transversely arranged cam shaft 14 journaled in suitable bearings 15 and driven through a bevel pinion 16 and gear 20 by a shaft 21. The shaft 21 is driven, in turn, from the engine crankshaft (not shown) with which it is operatively connected by any suitable driving means. A pair of cams 22 on the cam shaft 14 engage rollers 23 journaled in the bifurcated ends of push rods 24 to actuate the pistons of a fuel injection pump 25 which is fixedly mounted on the cylinder head 12. The fuel pump 25 is mounted in an inverted position, receiving the fuel through an intake pipe 26 which enters the side of the pump through a connection 27 and pumping the fuel under pressure through fuel lines 30 and 31 which are connected by fittings 30' and 31' to the bottom or under side of the pump housing. The fuel lines 30 and 31 carry the fuel to injection nozzles or valves 32 and 33 which open into the combustion chambers (not shown) of their respective cylinders and the fuel is injected in a finely atomized state into each of the said combustion chambers near the peak of their compression cycles. As is well understood in the art, the finely divided fuel is ignited by the heat of compression and expands to drive the engine. The speed and power output of the engine are regulated in a conventional manner by means of a by-pass control rod 34 projecting laterally from the pump 25 and which operates to meter the fuel for each injection, the control rod 34 being connected by linkage 35 to any suitable governor or control lever (not shown). In the embodiment illustrated, the injection pump, fuel lines, nozzles, and control linkage are enclosed and protected against dust and dirt by a cover plate 36 which is secured to the cylinder head by bolts 37.

Fuel for operating the engine is carried in a fuel tank 40 and passes first through a primary fuel filter 41 and then a secondary or protective filter 42 before reaching the pump 25. The purpose of the primary filter 41 is to remove the particles of dirt or other foreign matter from the fuel and thus prevent clogging or fouling of the minute passageways and apertures in the pump 25 and injection nozzles 32, 33. The secondary filter 42 acts to catch any dirt that might get through the first filter, although its principal function is to prevent the entrance of dirt into the intake pipe 26 whenever the cylinder head 12 is removed for the purpose of an overhaul, as will become apparent presently.

The primary fuel filter 41 consists of a body or housing 43 which is divided by a wall 44 into two vertically spaced chambers, the upper one comprising an intake chamber 45 and the lower one an outlet chamber 46. A domed cylindrical case 50 is fixed to and extends laterally from one side of the housing 43, enclosing a filter chamber 47, and disposed within the chamber 47 is a filter element or cartridge 51 of conventional design. A passage 52 connects the intake chamber 45 with

the filter chamber 47, and an orifice 53 connects the filter cartridge 51 serially with the outlet chamber 46. A fuel pipe line 54 is connected through a suitable valve and sediment bowl fitting 55 to the lowest portion of the fuel tank 40 and is joined by a connection 56 with the intake chamber 45. A vent pipe 60 is connected at 61 to the highest point in the intake chamber and also at 62 to the highest point on the fuel tank 40, providing a continuous upward path for air to flow from the filter 41 to the air space in the tank 40, thus by-passing the line 54 and the fitting 55 which is not self-priming.

The filter 41, as shown, is actually a commercial filter of the type originally intended to operate in a vertical position, but I have placed it in a horizontal position to make it self-priming, as will be explained presently. The fuel inlet connection 56 is made at the opening which was originally used for the vent valve. The opening that was originally intended for fuel inlet, I have used for the continuous vent connection 61. Thus, a continuous upward path for air is provided through the filter 41.

A fuel pipe line 63 is connected at 64 to the lowest point in the outlet chamber 46 of the primary fuel filter 41 and is joined by a disconnectable fitting 65 to the secondary filter 42. The latter comprises a cylindrical housing 66 fixedly secured in any suitable manner to the cylinder head 12 and having a filter element 67 contained therewithin, the intake pipe 26 being connected to the outlet of the filter 42.

For the proper operation of my invention, it is necessary that the primary filter 41 be placed at an elevation higher than the secondary filter 42, and that the fuel tank 40 be higher than the primary filter 41 so that the fuel lines 26, 63 and 54 all slope upwardly or extend vertically from the injection pump 25 to the fuel tank 40.

When the fuel tank 40 is filled after assembly or after running the system dry, the fuel flows by gravity down through the line 54 to the filter 41; filling the intake chamber 45 and casing 50, then passing through the filter cartridge 51 and filling the outlet chamber 46. The air in the lines and filter meanwhile escapes through the vent line 60 back to the fuel tank 40. As the oil continues to flow by gravity down through the fuel line 63, filter 42, intake pipe 26, and into the injection pump 25, the air bubbles trapped in the system below the primary filter 41 work their way up through the lines and filters, escaping through the vent line 60. By reason of the inverted position of the cylinders of the injection pump 25, the pistons being forced downwardly in the cylinders during compression and the fact that the outlet lines 30 and 31 are connected to the compression chambers of the pump below the intake pipe 26, any entrapped air tends to escape back through the upwardly sloping line 26, filter 42 and pipe 63, while the fuel is retained. In the case of pumps mounted in a conventional manner with the pistons acting upwardly during compression and the fuel lines connected with the tops of the cylinders, it is necessary to vent the cylinders by loosening the high pressure fuel line connections. Moreover, in my arrangement, it will be evident to those skilled in the art, that the inverted pump forces the fuel through the outlet lines and by-passes air, while in the conventional arrangement, the air is forced into the fuel lines and fuel is by-passed. While I have shown and described the pump as being substantially vertical in its inverted position, it is possible to obtain the self-priming action at angles between this position and a substantially horizontal position.

To remove the cylinder head 12 from the cylinder block 10, the only fuel line disconnection is at the low pressure fitting 65 where the pipe line 63 connects into the secondary filter 42, and the fuel pump 25 together with the high pressure lines 30, 31, and injection valves 32, 33 and the low pressure pipe 26 and protective filter 42, remain intact with the cylinder head and are removed bodily therewith. Thus, the injection pump and nozzles are protected against the entrance of dirt which might cause clogging since any such dirt that might get into the intake end of the filter 42 would be caught and retained by the filter element 67.

While I have shown and described my invention as applied to a solid injection compression-ignition engine, I do not intend my invention to be limited to this particular type nor to the precise details shown and described herein, for certain of the broader principles of my invention may be applied to other kinds of internal combustion engines.

What I claim as my invention is:

1. In an engine of the class described having a removable cylinder head, the combination of a fuel injection pump fixedly mounted on said cylinder head for removal therewith, at least one injection nozzle mounted on said cylinder head, a high pressure fuel conduit connecting said pump and said nozzle, a protective fuel filter device associated with said cylinder head and removable therewith, said device being connected with the low pressure side of said pump, a fuel supply means, and a disconnectable fuel supply pipe connecting said supply means and said filter device.

2. In an engine of the class described having a removable cylinder head, the combination of a fuel injection pump fixedly mounted on said cylinder head for removal therewith, at least one injection nozzle mounted on said cylinder head, a high pressure fuel conduit connecting said pump and said nozzle, a protective filter carried on said cylinder head, an intake pipe connecting said protective filter with said pump, a primary fuel filter disposed at an elevation higher than said pump, a fuel tank disposed higher than said primary fuel filter, fuel pipe lines connecting said protective filter with said primary filter and said primary filter with said fuel tank, and means for disconnecting said fuel pipe line between said protective filter and said primary fuel filter.

3. In a compression-ignition engine, the combination of a cylinder head having injection nozzles, an injection pump fixedly mounted on said cylinder head in inverted position, fuel lines connecting said pump with said nozzles, an intake pipe connected with said pump above said fuel line connections, a protective filter mounted on said cylinder head above the point of connection of said intake pipe with said pump, said intake pipe being connected with said protective filter, a primary fuel filter disposed above said protective filter, a fuel tank disposed above said primary filter, fuel pipe lines connecting said protective filter with said primary filter and said primary filter with said fuel tank, an air vent pipe connecting said primary filter with said fuel tank, and means for disconnecting said fuel pipe line between said protective filter and said primary fuel filter.

4. In an engine of the class described having a removable cylinder head, a fuel injection pump supported in fixed relation on said cylinder head in inverted position with its piston adapted to be forced downwardly during the pressure stroke, an injector nozzle mounted on said cylinder head, a high pressure discharge conduit connected to said nozzle and to said pump at the lower portion thereof, a protective filter mounted on said cylinder head, conduit means connecting said filter with said pump at a point on the latter higher than the discharge conduit connection, a fuel reservoir, and a supply conduit detachably connected to said protective filter and sloping upwardly toward said reservoir.

ANKER K. ANTONSEN.