May 21, 1957 W. E. BRILL 2,793,078

FUEL INJECTION

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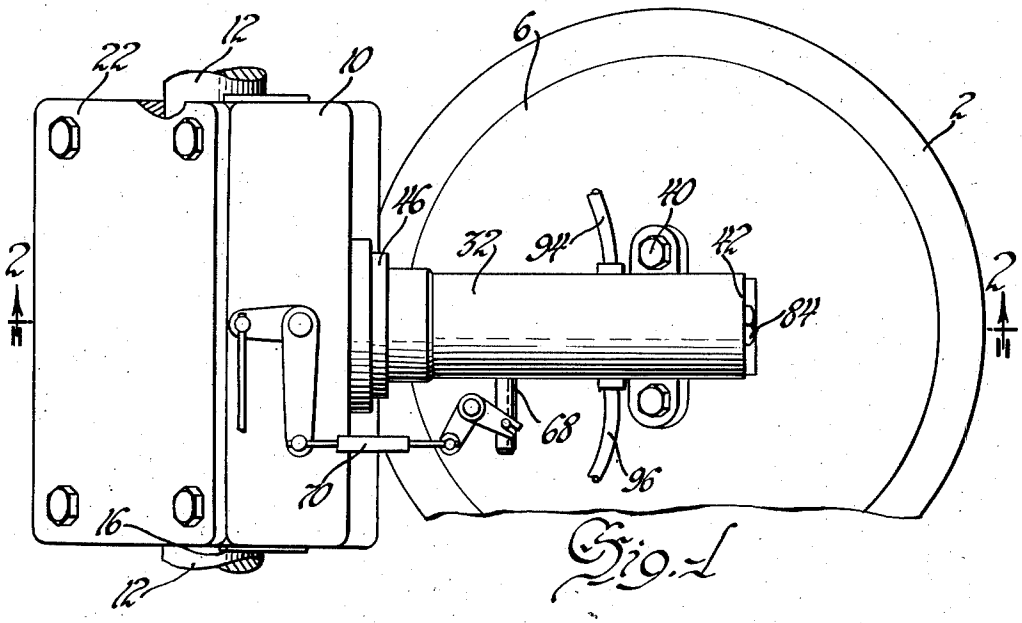


Fig. 1

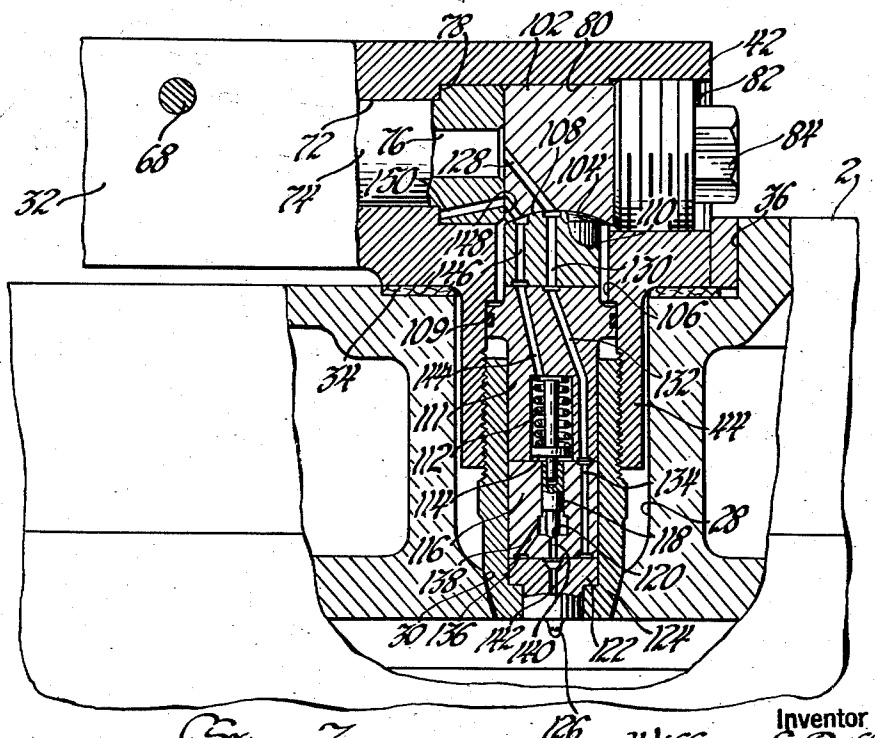


Fig. 3

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FUEL INJECTION

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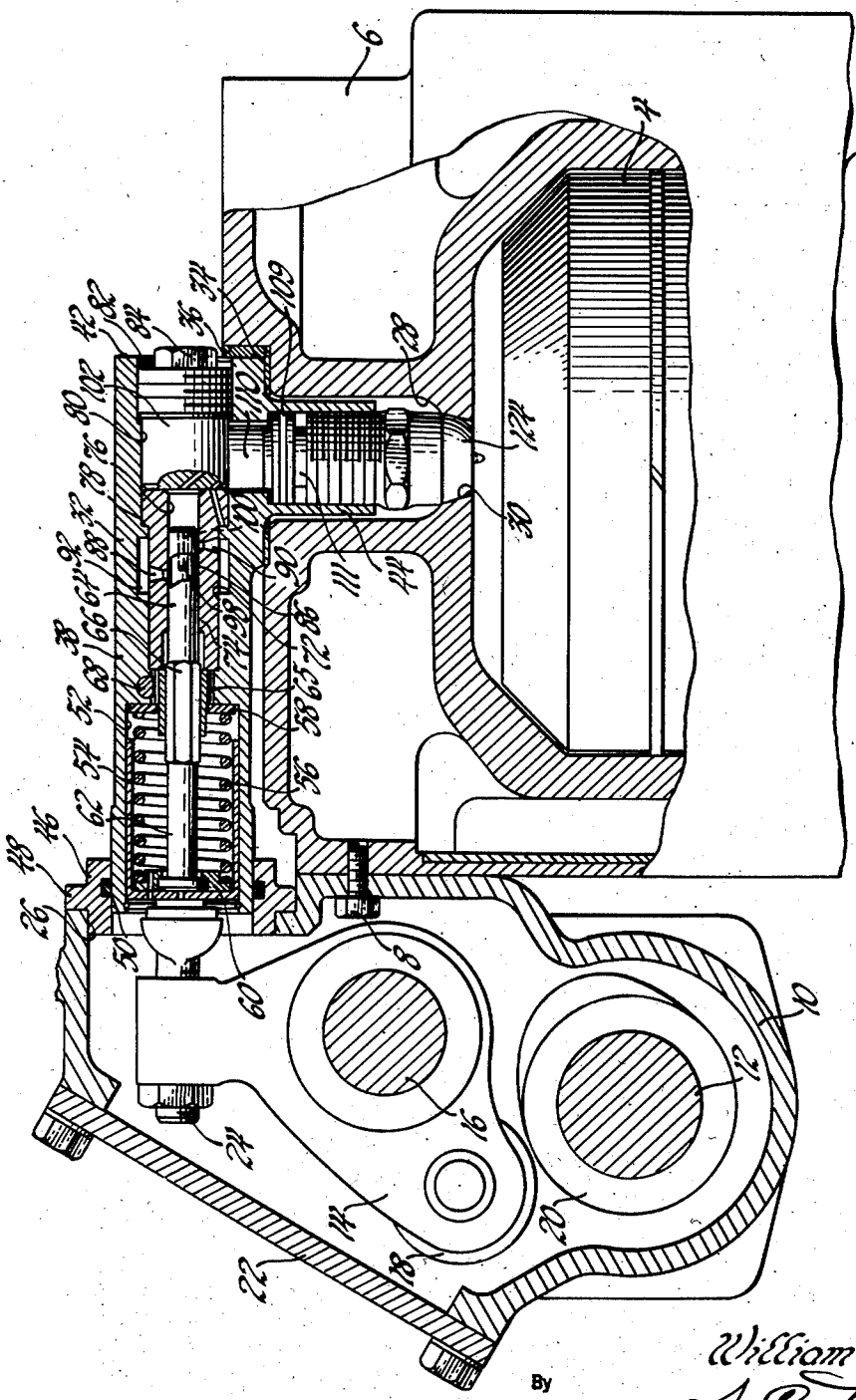


Fig. 2

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FUEL INJECTION

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2 Claims. (Cl. 299—107.2)

This invention relates to internal combustion engines and particularly to fuel injection means therefor.

One of the principal objects of the invention is to provide an engine whose fuel is injected through the cylinder head by a unit fuel injector pump which adds a minimum to the overall length of the cylinder and head assembly and is engine operated by cam means located adjacent the head and to one side of the cylinder.

A further principal object of the invention is to provide a unit fuel injector pump which is adapted to be engine driven from a cam-shaft extending transversely of the engine cylinder adjacent one side of the cylinder head, and having its fuel nozzle extending longitudinally of the cylinder.

Additional objects of the invention include novel means for supporting the injector pump unit which facilitates its removal, with or without the cylinder and head, without disturbing the pump drive, and which provides for relative angular displacement between the pump and nozzle axes during operation without imposing excessive stresses on the parts.

One preferred embodiment illustrative of means for accomplishing these objects will now be described, having reference to the drawings wherein:

Figure 1 is an elevational view of the internal combustion engine with its fuel injector pump and driving means, as viewed from above the cylinder head.

Figure 2 is an enlarged sectional-elevational view taken substantially on line 2—2 of Figure 1.

Figure 3 is a further enlarged fragmentary view similar to Figure 2, showing the internal parts of the injector nozzle assembly and its connection to the pumping chamber of the injector pump unit.

An engine working cylinder 2 having the usual piston 4 is shown closed at its upper end by a cylinder head 6. Removably secured as by bolting 8 to one side of the cylinder head is a housing 10 in which are suitably journaled a camshaft 12 and a rocker 14, the latter having its axis defined by a rocker shaft 16. As shown, the rocker is preferably located outwardly of the axis of the engine cylinder 6 from the camshaft 12 so that the camshaft which is suitably driven from the engine crankshaft (not shown) may have its axis at the minimum distance from the crankshaft axis. The rocker has a roller 18 which contacts the operating surface of a cam 20 on the camshaft. This camshaft 12 may be of extended length to serve a plurality of similar engine cylinders arranged longitudinally thereof in laterally spaced relation to the cylinder 2. Each camshaft and rocker housing 10, however, is supported individually by its associated cylinder head. A cover plate 22 closes an access opening in the side of the housing remote from the engine cylinder. The opposite end of the rocker carries an adjustable stud 24 extending toward the cylinder through an opening 26 therefor in the housing 10.

The transverse wall of the cylinder head is provided with an opening 28 extending longitudinally therethrough and terminating at its inner or cylinder end with a tapered

seat 30. Adjacent the opposite end of the opening 28 the cylinder head is provided with an abutment surface for the body 32 of an injector pump. One portion 34 of this abutment surface surrounds the opening 28 and faces axially thereof, and a second portion 36 faces transversely of the opening 28 toward the housing 10. The pump body 32 is shown as being generally L-shaped with one leg 38 extending transversely of the cylinder head and in substantial alignment with the opening 26 in the housing 10. This leg 38 of the body is clamped diagonally of the cylinder head opening 28 as by inclined bolts 40 which are suitably anchored in the cylinder head structure and maintain the under side and the end 42 of the body rigidly in abutment with the surface portions 34 and 36, respectively.

The other leg 44 of the pump body extends into the cylinder head opening 28 and has substantial lateral clearance with the side walls of that opening, as shown. The extended end of the transverse leg 38 of the pump body is slidably embraced with a gland member 46 which is flanged to seal against the face of the housing surrounding its opening 26. Any suitable means such as a threaded engagement with the opening 26 or a bolted connection with the housing through its flange 48, etc. may be employed to removably secure the gland in place. Between the inner periphery of the gland and the exterior of the pump body leg 38 is a suitable packing 50 to prevent passage of foreign material into the housing and escape of lubricant therefrom.

The transverse leg 38 of the pump body is formed with a spring pocket 52 at its end opposite the rocker stud 24, in which pocket a cup shaped sleeve 54 is slidably guided and encloses a plunger return spring 56. The inner end of this spring seats on a washer 58, and its outer end seats against a plunger spring retaining washer 60 through which the stem 62 of the pump plunger 64 extends and maintains the end wall of the cup 54 in abutment with the adjacent end of the stud 24. Axially adjacent the inner end of the pocket 52 is a pinion 65 having clearance for rotation within the body and splined to rotate with and to slidably pass a poly-sided section 66 of the stem. In connection with the pinion is a toothed rack 68 extending transversely through the pump body wall and connected externally of the engine through suitable linkage 70 with a governor or mechanical control means. Axially adjacent the pinion the pump body is bored as at 72 to receive a bushing 74 whose bore 76 forms the pumping chamber for the plunger 64. One end of the bushing 76 cooperates with the spring seat washer 58 in axially locating the pinion 65, and the other end of the bushing is flanged and rests against the shoulder 78 which forms the bottom end of a counterbore 80 whose other end is internally threaded at 82 to receive a closure plug 84.

The periphery of the plunger is relieved by an annular helically edged metering groove 86 which controls fill and by-pass ports 88 and 90 extending through the side walls of the bushing 74 and communicating with an annular fuel receiving chamber 92 formed in the pump body and connected with suitable delivery and return lines 94, 96 of a fuel transfer pump (not shown). Connecting radial and longitudinal fuel passages 98, 100 are drilled in the plunger to provide communication between the plunger metering groove 86 and the pumping chamber 76.

Closely fitting the counterbore 80 and located axially thereof by being clamped between the plug 84 and the bushing 74 is a spacer block 102 which as best shown in Figure 3 has a spherically concave side surface 104 facing axially of the cylinder head opening 28. Loosely fitting within a side opening 106 in the wall of the pump body and having a corresponding convex surface 108 is a second spacer block 110. The side opening 106 extends

into a counterbore in the leg 44 of the pump body and closely fitting and sealed to the walls thereof by a packing 109 is a spring chamber block 111. Recessed into the lower end of this block 111 is a delivery valve biasing spring 112 and its guiding pin 114. Below the block 111 is a delivery valve housing 116 having a bore fitted with a needle valve 118 which is connected to the pin 114 and normally held on its seat 120 by the spring 112. Below the valve housing 116 is a fuel delivery nozzle 122 seated in a cup shaped holder 124, which in turn has its lower end abutting the seat 30 at the inner end of the cylinder head opening 28. The nozzle 122 extends through the end wall of the cup and terminates in a plurality of small spray orifices 126 which are open to the combustion chamber space above the piston 4 in the engine cylinder 2. The side walls of the cup 124 are threadedly engaged within the lower end of the pump body leg 44 so as to clamp the nozzle, delivery valve housing, spring chamber block and spacer block 110 in end to end relation against the upper spacer block 102. Fuel delivery passages 128, 130, 132 and 134 connect with each other to conduct fuel from the pumping chamber 76 to an annular groove 136 formed in the bottom of the valve housing 116, and a second passage 138 in the latter leads from this groove to the pressure side of the delivery valve 118. Passages 140 and 142 in the valve housing and nozzle connect with each other to deliver the fuel to the spray orifices 126 when the needle valve opens in response to a predetermined pumping chamber pressure. Return fuel passages 144, 146, 148 and 150 in the blocks 111, 110, 102, and bushing 74 connect with each other to vent the spring chamber in the block 111 to the fuel receiving chamber 92 in the pump body leg 38.

In operation, it will be appreciated that with rotation of the camshaft 12 the rocker 14 oscillates to reciprocate the pump plunger 64. As the pump plunger is driven against its return spring 56 from its fully retracted position shown, it first displaces fuel from the pumping chamber 76 through the plunger passages 100 and 98 to the metering groove 86, from where it escapes through the fill port 88 to the fuel receiving chamber 92. No pressure is built up below the plunger, therefore, sufficient to raise the metering valve 118 from its seat to begin injection, until the upper edge of the metering groove 86 closes off the fill port 88 in the bushing. After such further advancement of the plunger has taken place the fuel pressure builds up rapidly to open the metering valve and thereby initiate the start of fuel injection. Injection then continues with further advancement of the plunger until the metering groove 86 uncovers the by-pass port 90, again relieving the pressure in the pumping chamber with resultant closure of the delivery valve 118 to end injection. On the return stroke, fuel flows into the pumping chamber through the fill and by-pass ports and the passages 98 and 100 in the plunger. Rotation of the plunger, as adjusted by axial movement of the rack 68 through the linkage 70, varies the covering and uncovering of the ports 88 and 90 by the plunger metering groove edges and thereby varies the duration and timing of the injection period.

The L-shape of the pump body 32 with its nozzle supporting leg 44 extending longitudinally of the cylinder axis and its pump enclosing leg 38 extending transversely of the cylinder serves to minimize the overall length of the engine cylinder and head assembly from that of the conventional in-line injector pump units. This arrangement also enables the rocker and camshaft driving means

to be located adjacent the side of the cylinder head, rather than above, with the advantage of reducing the length of the cam driving train between the camshaft and the engine crankshaft. Further, the injector pump unit is adapted to be advantageously supported by reason of the nozzle end of its body 32 being diagonally clamped against displacement both axially and transversely of the cylinder head, and its extended end of the transverse leg 38 being anchored to the rocker and camshaft housing. Removal of the injector pump unit, without disturbing the pump drive means or its housing, requires merely retracting the gland 48 from the latter housing by sliding it along the pump body transverse leg and then removing the diagonal clamping bolts 40. Any distortions which may occur in the pump body as the result of angular displacement between the legs 38 and 44 thereof during engine operation are accommodated the spherically socketing engagement of the spacer block 110 and the spacer block 102, thereby avoiding any excessive stressing of the internal parts which might otherwise occur.

While only a single preferred embodiment of the invention has been disclosed, it is appreciated that numerous minor changes in the construction and arrangement of the parts may be made without departing from the spirit and scope of the invention as defined in the following claims.

I claim:

1. In a generally L-shaped unit fuel injector pump assembly having fuel pumping means and injecting means, an elongated housing for the pumping means having a bore open at both ends, said housing having an opening in one side thereof, said bore intersecting intermediate its ends with said opening, a fuel nozzle spaced from the housing opposite said opening, supporting means for said nozzle including spacer members having spherically shaped co-abutting surfaces, one of said members being disposed in said bore with its spherical surface facing said opening and the other of said members being located in said opening.

2. In a unit fuel injector pump, a generally L-shaped hollow body having a pumping chamber extending longitudinally of one leg of the L and an injector nozzle and valve assembly extending longitudinally of the other leg, and fuel passage defining means connecting said nozzle and valve assembly with said chamber, said means including a first block closely fitting the internal surfaces of said one leg of the body opposite the adjacent end of said other leg, and a second block extending axially of said other leg and spherically socketed by said first block, said one leg of the body having a shoulder facing the chamber end of said first block, a member threadedly engaging said one leg of the body and cooperating with said shoulder in clamping said first block against movement endwise of said one leg, and means threadedly engaging said body and clamping said nozzle and valve assembly to said second block and said second block in socketed engagement with said first block.

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