Sept. 1, 1964 A. DREISIN 3,146,716

FUEL SUPPLYING MECHANISM

Filed Dec. 26, 1961 2 Sheets-Sheet 1

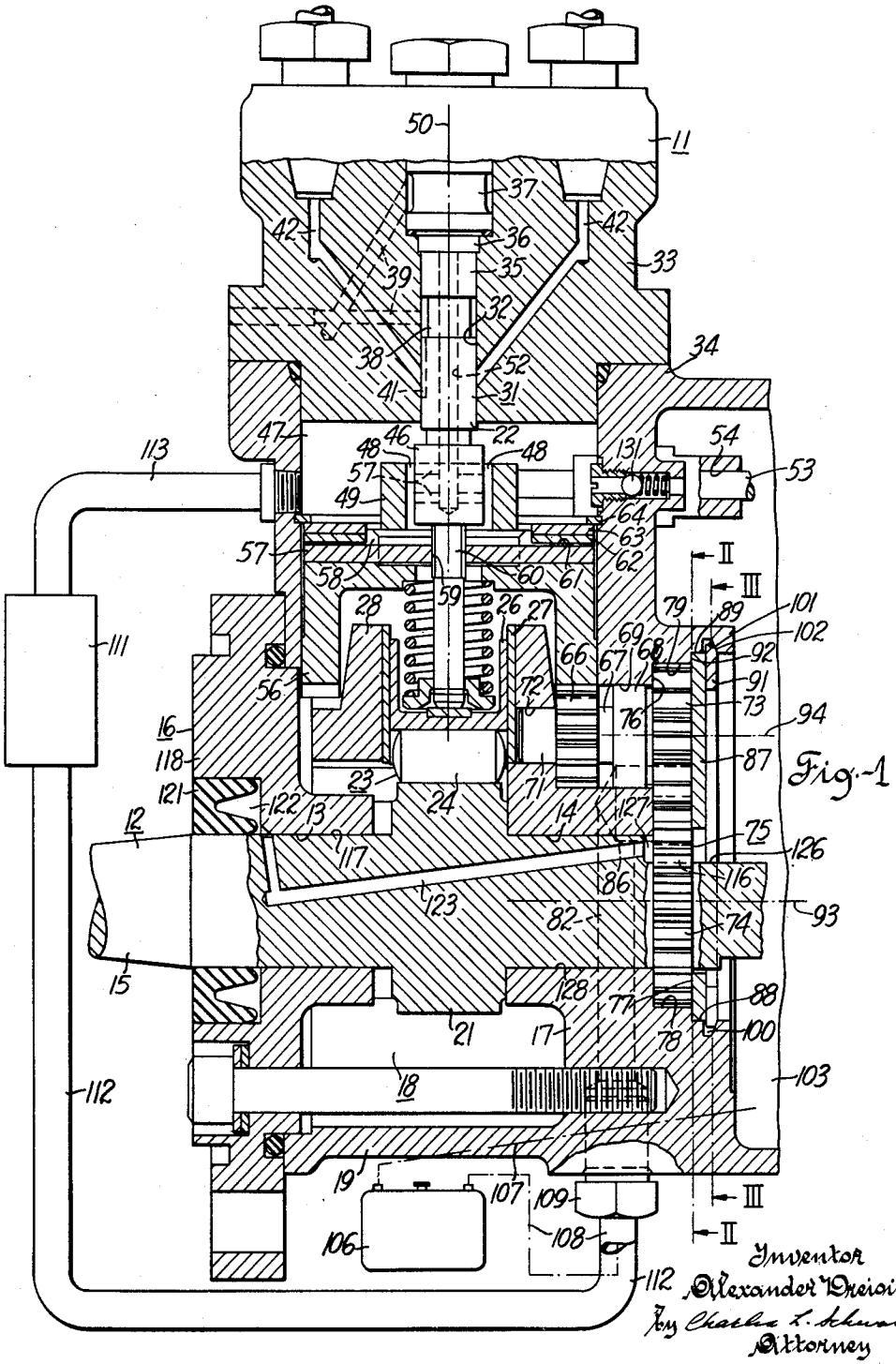


Fig.-1

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Sept. 1, 1964 A. DREISIN 3,146,716

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Filed Dec. 26, 1961 2 Sheets-Sheet 2

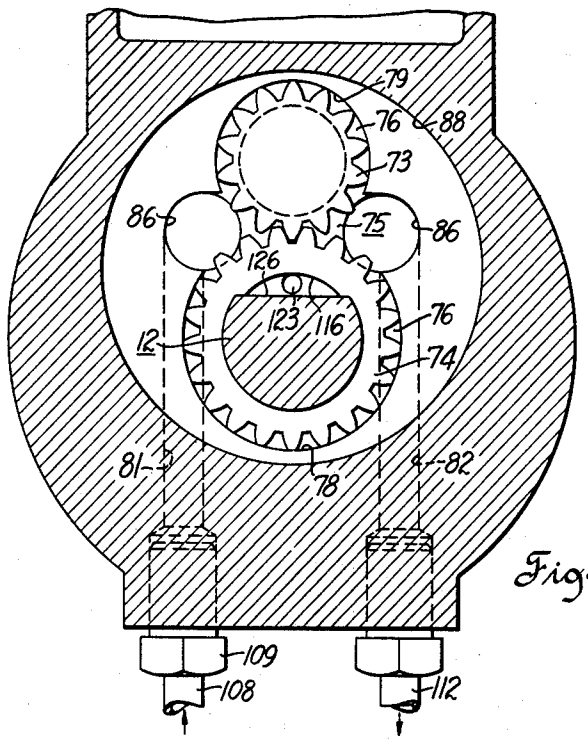


Fig. 2

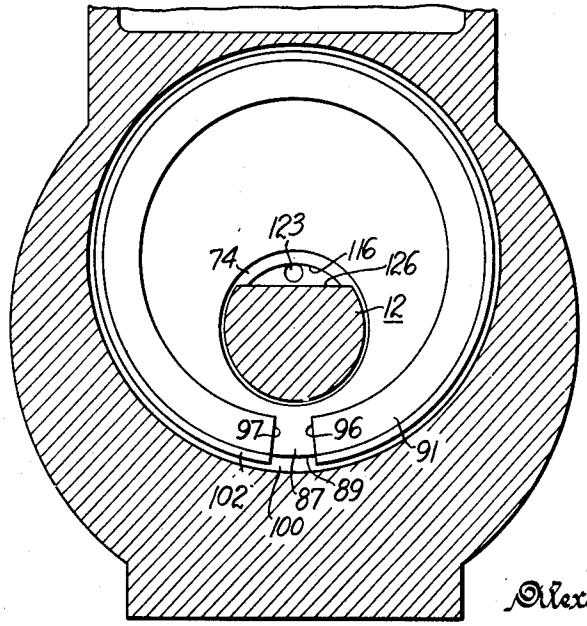


Fig. 3

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3,146,716

FUEL SUPPLYING MECHANISM

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Filed Dec. 26, 1961, Ser. No. 161,863
3 Claims. (Cl. 103—2)

This invention relates to a fuel supplying mechanism of the type including a distributor type fuel injection pump. More particularly, this invention relates to a fuel supply pump for delivering fuel at an intermediate pressure to a fuel injection pump and relates to the gear train for rotating the injection pump plunger.

In a fuel injection system for a compression ignition engine, it is customary to employ a fuel supply pump for delivering fuel to a fuel supply chamber of the fuel injection pump. The fuel supply pump delivers fuel which is maintained at an intermediate pressure, that is, a pressure lower than the pressure of the injected fuel delivered by the injection pump and higher than the atmospheric pressure at which the fuel supply tank is normally maintained. Gear type pumps have heretofore been employed to supply fuel to the fuel supply chamber communicating with the inlet to the injector pump, however, the overall cost and number of parts have been greater than desired.

It is an object of this invention to provide an improved injection pump which is lower in cost and requires less parts than prior injection pumps.

It is an object of the present invention to provide a simplified fuel supply pump arrangement wherein the gear train between the drive shaft and the pump plunger and the supply pump are advantageously interrelated.

It is a further object of this invention to provide an improved gear train for rotating the pump plunger of an injection pump.

It is a further object of this invention to provide an improved relief valve for a gear pump.

It is a further object of this invention to provide an improved relief valve for a pump without requiring additional parts.

It is a further object of this invention to provide an improved fuel supplying system for a fuel injection pump.

These and other objects and advatnages of this invention will be apparent when the following description is read in conjunction with the drawings in which:

FIG. 1 is a section view of a pump incorporating the present invention;

FIG. 2 is a section view taken along the lines II—II of FIG. 1;

FIG. 3 is a section view taken along the lines III—III of FIG. 1.

Referring to FIG. 1, the distributor type fuel injection pump **11** is part of a fuel supply system for a compression ignition engine. A drive shaft **12** is adapted at its front end **15** to be connected to an engine, not shown, is journaled in cylindrical surface type bearings **13, 14** formed in opposite side walls **16, 17**, respectively, of the drive compartment **18** of the pump housing **19**. The drive shaft **12** includes a cam portion **21** which includes a plurality of cams which reciprocate a pump plunger **22** as the shaft **12** is rotated. Reciprocation of the plunger **22** is effected through thrust transmitting means **23** interposed between the cam portion **21** and the plunger. The thrust transmitting means **23** includes a roller **24** and a barrel **26** reciprocably mounted in a sleeve **27**, the latter being press fit into an inwardly disposed portion **28** of the housing **19**. The plunger **22** has a pumping and distributing portion **31** which reciprocably and rotatably fits in fluid tight engagement with a plunger bore **32** in the head portion **33** of the housing **19**. The head portion **33** is rigidly secured to the lower portion **34** of the housing

19 by a plurality of cap screws, not shown. A pumping chamber **36** is disposed at the upper end of the bore **32** and when the fuel is pressurized to a high injection pressure on the upward stroke of the pumping part **35** of the pumping and distributing portion **31**, a delivery valve **37** permits the fluid to pass to the distributing part **38** of the pumping and distributing portion **31** of the plunger **22** through delivery passage **39**. As the plunger **22** rotates, fuel is alternately delivered through an axially extending groove **41** in the periphery of the distributing part **38** of the plunger **22** to the injector supply passages **42**.

A cylindrical fuel inlet portion **46** is coaxially formed in relation to the pumping and distributing portion **31** of the plunger **22**. The fuel inlet portion **46** is disposed within a fuel supply chamber **47** and fluid is permitted to flow to the pumping chamber **36** from the fuel supply chamber **47** when inlet ports in the form of grooves **48** of the control sleeve **49** register with inlet ports **51** in the fuel inlet portion of the plunger. Rotation and reciprocation of the sleeve **49** also controls beginning and ending of injection. The inlet ports **51** are connected with the pumping chamber **36** by an interior passage **52** formed in plunger **22** on the axis **50** thereof. The sleeve is rotatably and reciprocably positioned relative to the housing **19** by a control rod **53** which is reciprocably and rotatably mounted in a bore **54** in wall **17**.

The plunger **22** is rotated by a gear train connected to the drive shaft **12** which includes a gear **56** nonrotatably connected to a drive plate **57** through a pair of gears **58** on gear **56**. Only one of the gears **58** is shown. The plate **57** has a control opening **59** for slidingly receiving a torque transmitting portion **60** of plunger **22**. Opening **59** and portion **60** are so formed as to cause the plunger **22** to rotate with the plate **57**. A bearing surface **61** on the gear **56** is in thrust transmitting relation to a thrust washer **62** which rotates with gear **56** and bears against thrust plate **63** held in place by a snap ring **64**. The gear train for rotating the plunger **22** also includes a gear **66** formed on a countershaft **67** in meshing relation with gear **56** and a gear **73** which meshes with a gear **74** coaxial with and nonrotatively secured to the drive shaft **12**. The countershaft **67** includes a cylindrical journal **68** between gears **66** and **74** which rotates in a bearing surface **69** of wall **17** and a journal surface **71** in bearing engagement with a bearing surface **72** in portion **28** of the housing **19**. The journal portion **68** of the countershaft **67** is of at least as large a diameter as the outside diameter of gear **66**, thereby permitting the gear **66** to pass through the opening presenting bearing surface **69**.

Referring to FIGS. 1, 2 and 3, gears **73, 74** are disposed between a pair of axially facing surfaces **76, 77** and semicylindrical surfaces **78, 79** formed in the wall **17**. An inlet passage **81** and an outlet passage **82** are formed in the wall **17** of the housing. The fuel inlet passage **81** and the fuel outlet passage **82** communicate with the gears **73, 74** at transversely opposite sides, respectively, of the meshing teeth on the gears **73, 74**. The bores **86, 86'** at the end of the passage **81, 82**, respectively, form inlet and outlet chambers in the wall **17** at transversely opposite sides of the teeth of the gears **73, 74** which are in mesh. Thus, the gears **73, 74** and surfaces **76, 77, 78, 79** constitute the essentials of a positive displacement gear type pump **75**. The surface **77** in axially confronting relation to the gears **73, 74** is formed on an annular plate **87** and is axially shiftably supported in the wall **17** of the housing by a cylindrical surface **88**. The outside circumference **89** of the plate **87** is slightly smaller in diameter than the diameter of the cylindrical surface **88**. A resiliently deformable retainer **91** constitutes biasing means for urging the plate **87** against the gears **73, 74** and against a flat surface **92** formed in the wall **17** at right

angles to the axis 93 of the drive shaft 12 and the axis 94 of the countershaft 67. The retainer 91 is a snap ring having circumferentially facing ends 96, 97 defining a gap.

Conically shaped camming surfaces 101, 102 are formed on the housing 19 and retainer 91 in complementary and axially facing relation to one another. Camming surface 101 is formed on one axial side of an annular recess 100. When the pressure in the pump exceeds a predetermined value, the plate 87 will move to the right forcing the retainer 91 to contract through the camming action of the camming surfaces 101, 102. Such axial movement will permit the fuel to escape to the governor compartment 103. Fuel in the governor compartment 103 is at approximately atmospheric pressure and is permitted to return to the fuel tank 106 through a conduit 107, schematically illustrated. Actually conduit 107 may be so positioned that the governor compartment is maintained full of fuel to insure lubrication of parts therein. Fuel is drawn from tank 106 by a conduit 108 which is connected by a suitable fitting 109 to inlet passage 81. The outlet passage 82 is connected to a full flow filter 111 by a conduit 112. Fluid flowing from filter 111 passes to the supply chamber 47 through a conduit 113.

Wear particles of the drive compartment 18 are prevented from passing to the fuel supply compartment 47 The fuel flowing from the supply chamber 47 to the drive compartment 18 is directed to the governor compartment by way of bearings 13, 14. Fuel lubricating journal type bearing 13 and mating bearing surface 117 on shaft 12 flows axially to the left to a cavity 122 defined by a low pressure seal 121, shaft 12 and cap 118 which forms a part of wall 16. The cavity 122 is connected to the governor compartment 103 through a passage 123 formed in the shaft 12 and a recess 116 in gear 74. A flat 126 is formed on the shaft 12 to drivingly connect the gear 74 and this flat extends axially to the left, as viewed in FIG. 1, sufficiently to provide a small connecting chamber 127 at the end of passage 123. Fuel also flows from the drive compartment to the governor compartment between bearing surfaces 14 and journal type surface 128

A pressure regulating valve 131 is provided in the wall 17 intermediate the fuel supply chamber 47 and the governor compartment 103. The governor compartment 103, the fuel tank 106 and fuel supply passage 81 are at a low pressure and may be considered the low pressure zone of the fuel system. The outlet passage 82, conduit 112, filter 111, conduit 113 and fuel supply chamber 47 are at an intermediate pressure as regulated by the valve 131 and these portions of the fuel supplying mechanism may be thought of as being an intermediate pressure zone. The pressure chamber 36, nozzle supply passages 42 and passage 39 are cyclically at a high pressure and may be considered a high pressure zone. When the fuel filter 111 becomes clogged, pressure in conduit 112 and chamber 86' goes up and then the plate 87, retainer 91 and camming surfaces 101 and 102 function as a relief valve for the pump.

An additional relief valve function may be provided by the pressure plate 87. By constructing the pressure plate of suitable resilient material, such as carbon steel of proper thickness, the pressure plate will bulge at its center axially away from the rotary pumping elements or gears 73, 74 to permit fuel to escape to the governor compartment when the pressure of the fuel in the pump reaches a predetermined value. The resilient plate may be used as a relief valve independently of the tapered surface, snap ring arrangement or vice versa. The plate is preferably constructed to relieve pressure at a somewhat lower pressure than required to move the circumference of the plate axially by camming action of surfaces 101, 102. Thus a two step pressure relief valve arrangement is provided which protects the system against damage should the filter 111 become clogged. The resilient plate will deflect to relieve pressure at low output, for instance, and the contracting snap ring will permit additional fuel bypass flow at higher pump output.

The gear type pump 75 utilizes spur gears 73, 74 of the gear train employed to rotate the plunger thereby effecting a savings in cost. By placing the pump 75 in wall 17, the fuel escaping through the pump relief valve, of which pressure plate 87 and retainer 91 are a part, conveniently passes into the governor compartment 103 which is at approximately atmospheric pressure. If pressure plate 87 is removed upon contraction and removal of retainer 91, the gear 74 and the countershaft with its integrally formed gears 66, 73 and bearing surfaces 68, 71 may be easily removed for replacement, if required.

Since a full flow filter is used in the fuel supply zone of the system, it is desirable to provide a relief valve for the supply pump 75. By providing a resilient plate 87 and camming surfaces on the snap ring type retainer 91 and the side wall of recess 100, an effective two step relief valve is provided without increasing the number of parts required for the injection pump. It should be understood that the pump relief valve relieves pressure at a higher pressure than does regulating valve 131.

The illustrated fuel supplying system is also shown in copending patent application of Alexander Dreisin and Walter A. Parrish, Jr., Serial No. 161,862, filed December 26, 1961, Fuel Supplying Mechanism.

It is intended that this invention includes such modifications and other embodiments as are within the scope of the appended claims.

What is claimed is:

1. In a fuel injection pump of the type including a housing with a drive compartment and a governor compartment, the combination of a shaft rotatably mounted in said housing and having a cam within said drive compartment, a bore in said housing, a plunger reciprocated in said bore by said cam to pump fuel, a wall driving said drive and governor compartments and having a cylindrical journal, means for rotating said plunger to distribute fuel to a plurality of outlets including a first gear mounted in said housing in coaxial relation to and rotating with said plunger, a countershaft having a cylindrical bearing portion in cooperative engagement with said journal and having second and third gears formed integrally and coaxially therewith at axially opposite sides, respectively, of said bearing portion, said journal having a diameter at least as great as the outside diameter of said second gear, a fourth gear connected to said shaft for rotation therewith in meshing relation with said third gear, said second gear meshing with said first gear, surfaces in said wall in axially and radially confronting relation to said third and fourth gears, an end plate releasably secured to the governor compartment side of said wall in axially engaging relation to said third and fourth gears and inlet and outlet chambers formed in said wall at transversely opposite sides of the meshing teeth of said third and fourth gears whereby the latter operate as a fuel supply pump.

2. The structure set forth in claim 1 wherein said end plate is annular and resiliently deflects axially to provide pressure relief for said supply pump upon the pressure therein reaching a predetermined value.

3. The structure set forth in claim 2 and further comprising an annular retainer resiliently flexible radially and securing said end plate to said wall and cooperatively engaging annular camming surfaces on said wall and retainer at the radially outer periphery of the latter, said retainer resiliently deflecting radially allowing said outer periphery of said end plate to move axially to permit fluid to escape from said supply pump to said governor compartment upon said pressure in said supply pump exceeding a value greater than said predetermined value.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,146,716 September 1, 1964

Alexander Dreisin

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 37, for "driving" read -- dividing --.

Signed and sealed this 22nd day of December 1964.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents