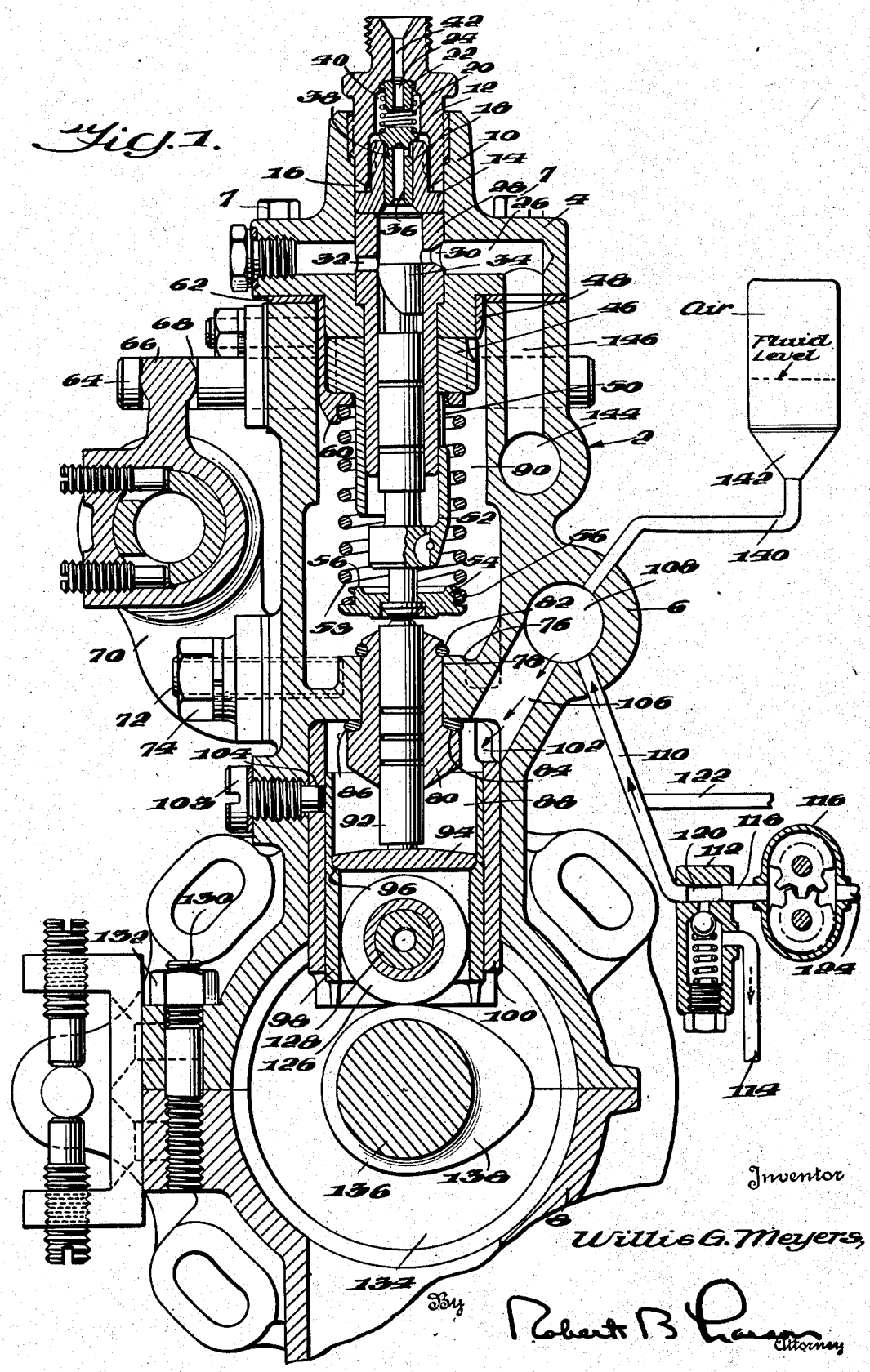
April 23, 1946. W. G. MEYERS 2,398,798

FUEL INJECTION PUMP

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Fig. 1.



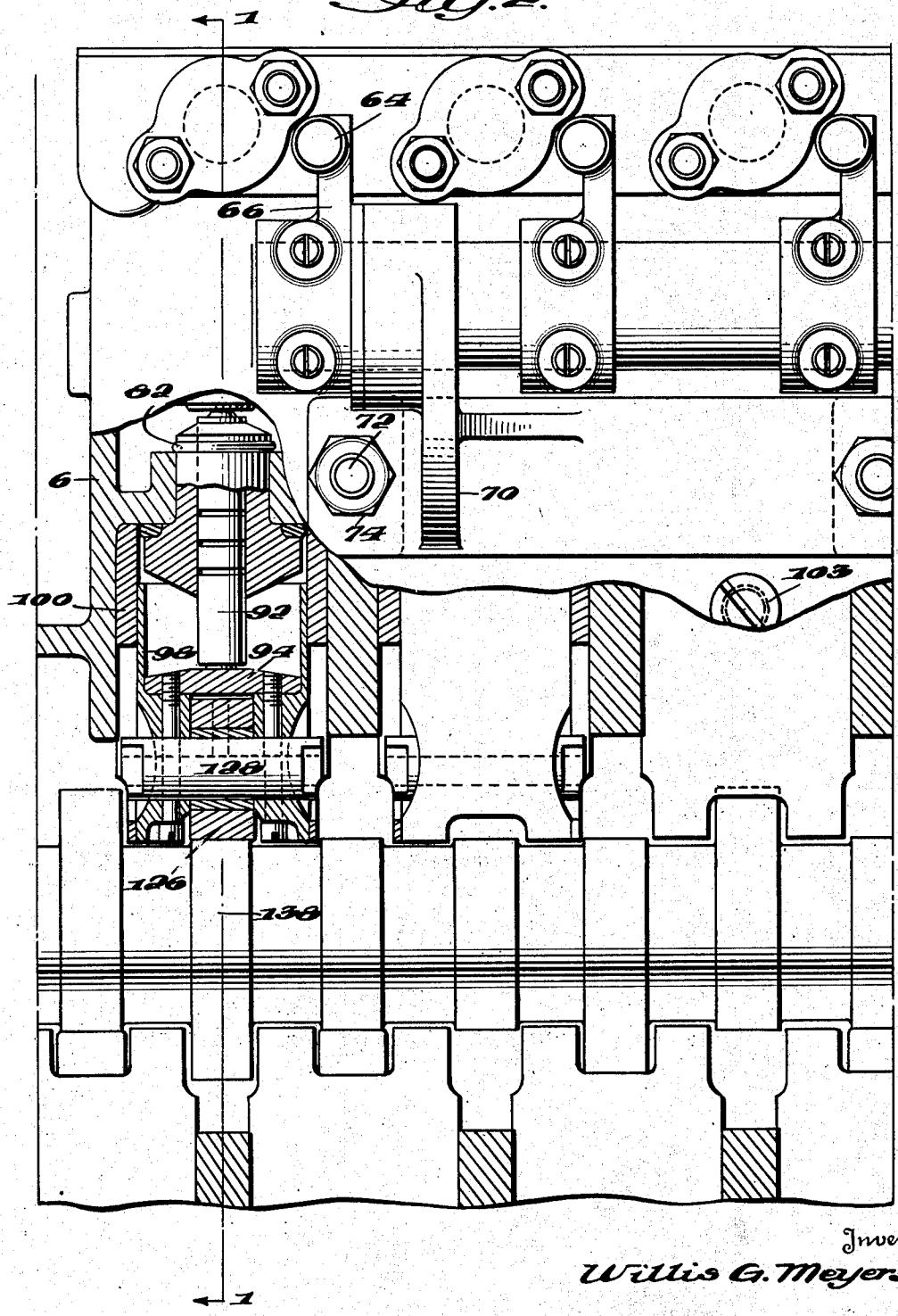
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Fig. 2.



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Fig. 3.

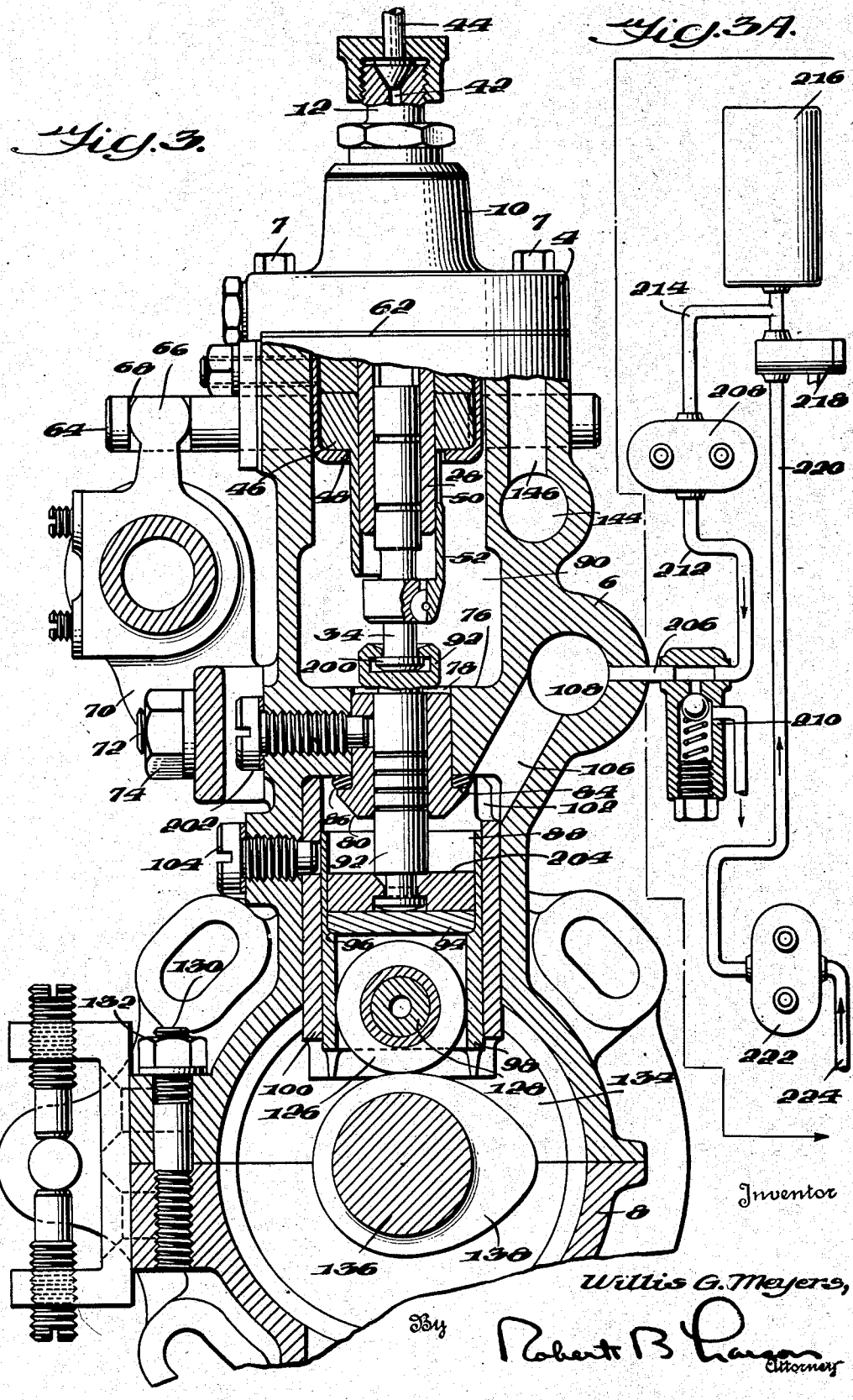


Fig. 3A.

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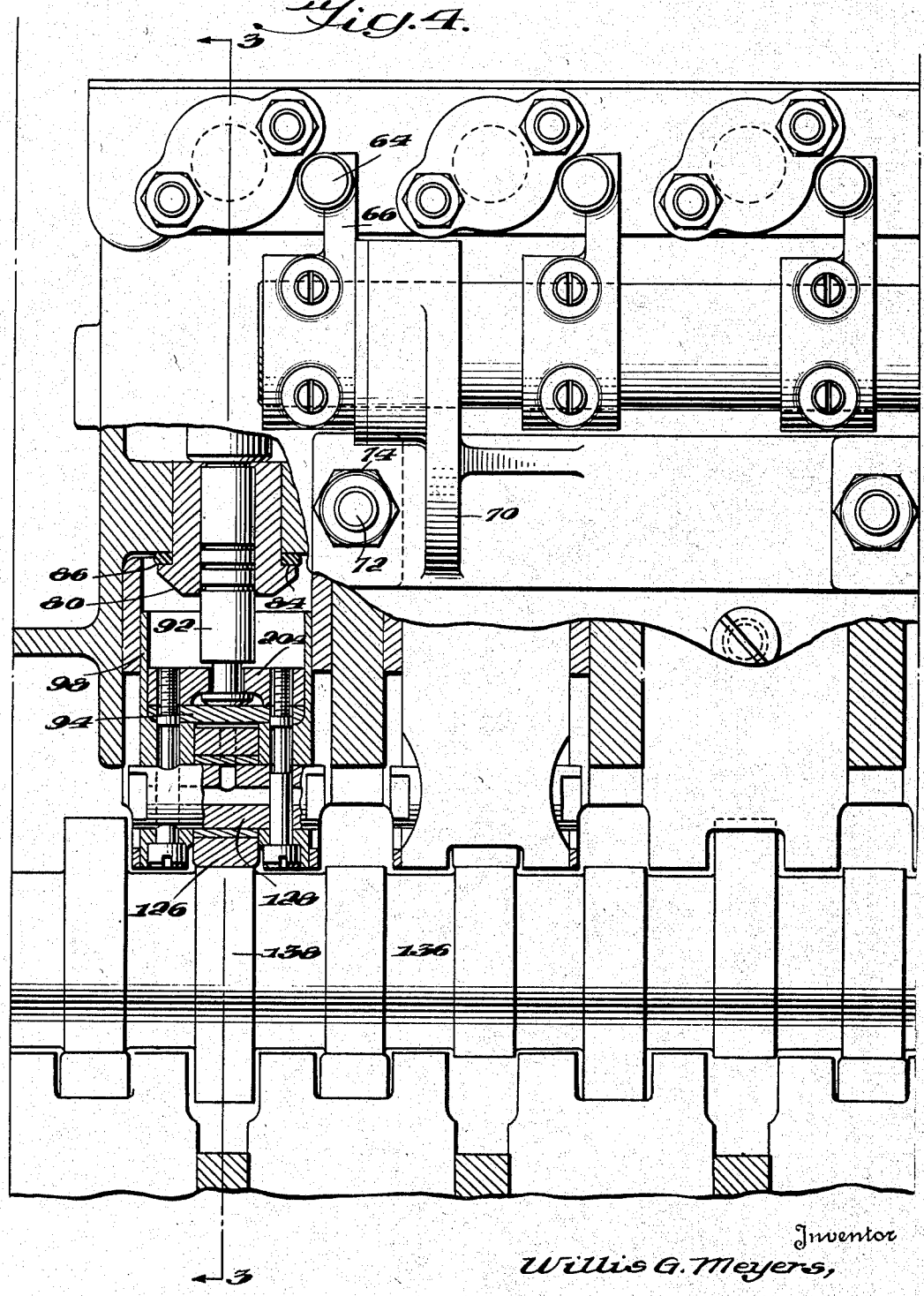
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Fig. 4.



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FUEL INJECTION PUMP

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Application May 22, 1944, Serial No. 536,779

10 Claims. (Cl. 103—154)

This invention relates to internal combustion engines, and more specifically to fuel injection pumps therefor.

One of the principal objects of the invention is to provide means for reducing the chatter of the reciprocating elements of fuel injection pumps.

A further important object of the invention is to provide means for reducing the breakage of tappet springs in spring-type fuel injection pumps, such means acting to reduce the tappet spring surge.

A further object of this invention is to provide pressure lubrication for the reciprocating elements of fuel injection pumps.

An object of one embodiment of the invention is to provide a springless hydraulically operated fuel injection pump. This embodiment of the invention has for a further object the provision of a hydraulically operated springless fuel injection pump with means for stopping said pump upon the failure of the hydraulic system.

Other objects and advantages of this invention will become more apparent from a consideration of the following specification when read in the light of the drawings annexed hereto in which:

Figure 1 is a vertical cross section taken on the lines 1—1 of Figure 2, showing the details of a fuel injection pump constructed in accordance with this invention and including a diagrammatic illustration of a hydraulic system therefor.

Figure 2 is a side elevation partly in section of the fuel injection pump shown in Figure 1.

Figure 3 is a vertical cross section taken on the lines 3—3 of Figure 4, showing a modification of this invention and including a diagrammatic representation of a hydraulic system therefor.

Figure 3—A is a diagrammatic representation of a hydraulic system which may be used with either of the devices shown in Figures 1 and 2, or Figures 3 and 4.

Figure 4 is a side elevation partly in section, of the embodiment of the fuel injection pump shown in Figure 3.

The fuel injection pumps shown and described herein relate to those types of pumps which are provided with plunger controlled ports, but the principles involved can be applied to any pump having reciprocating plungers.

Referring now more particularly to the embodiment of the invention shown in Figures 1 and 2, the reference numeral 2 indicates in general a housing unit for the elements of a fuel injection pump. The housing 2 is substantially hollow and comprises a head 4 secured to a main housing section 6 by the head bolts 7, and a lower or base portion 8.

The head 4 is formed with a boss 10 in which is secured the nozzle 12. The nozzle 12 is provided with a substantially hollow interior adapted to receive a flanged sleeve 14. A sealing ring 16 is disposed between the nozzle 12 and the flange of the sleeve 14. The sleeve 14 is provided with a spring loaded check valve 18, which is held in its downward or closed position in the sleeve 14 by means of the spring 20. As is seen in Figure 1, the upper end of the spring 20 abuts against a valve stop 22 provided with a central bore 24.

The head 4 is also provided with a fuel chamber 26 which surrounds the pump barrel 28 rigidly mounted in the head 4. The barrel 28 is formed with inlet ports 30 and 32, which provide communication between the chamber 26 and the interior of the pump barrel 28. The plunger 34 is mounted for reciprocation within the barrel 28. It will be noted that fuel entering the chamber 26 and passing through the ports 30 and 32 will be, upon the compression stroke of the plunger 34, forced upwardly through the passage 36 formed in the check valve 18, and the pressure thereof will cause the valve to rise against the tension of the spring 20. In so moving, the ports 38 become uncovered, permitting the fuel to enter the chamber 40 and to pass upwardly through the valve stop bore 24, the passageway 42 formed in the nozzle 12, and outwardly through the tube 44. The tube 44, in turn, is connected with a fuel injection nozzle disposed in the cylinder head of the engine.

A gear 46 abuts a depending portion of the head 4 and is secured thereto by means of an outer sleeve 48 fixedly mounted on the head in any desired manner. The gear 46 is slotted as at 50 to receive and guide the reciprocating element 52, which is secured to the plunger 34 by a joint adjacent its lowermost end. The plunger 34 carries on its lowermost end a collar 54 having a flanged portion 56 adapted to receive and retain the lower end of a light spring 58; the upper end of the spring 58 abuts against and is retained by a flange 60 formed on the lower end of the collar 48.

The head 4 is separated from the main housing section by means of a gasket or shims 62.

It is apparent from the above description that the reciprocating plunger, the barrel, the nozzle, and all its associated elements are mounted upon the head 4 in such a manner as to facilitate the assembling thereof during the manufacturing process. The maintenance of this unit is quite simple as one needs but to remove the head bolts 7 and lift the head 4 and its accompanying ele-

ments from the interior of the main housing section 6. A control rack 64 is mounted in the wall of the main housing section 6 and is provided with gear teeth adapted to engage complementary gear teeth formed on the collar 46 which is rotatably secured to the barrel 28. The control rack 64 may be reciprocated through the wall of the main housing section by means of a toggle member 66 which pivots in a slot 68 formed in one end of the gear rack. The toggle member 66 is mounted for rotation in a support 70 which is adapted to be secured to the side of the main housing portion 6 by means of the bolts 72 and the lock nut 74. Any conventional control means may be employed to rotate the toggle member 66.

The main housing section 6 is provided with an inwardly extending shoulder portion 76 having a central opening 78 formed therein. A tappet rod guide 80 is mounted in the opening 78 and is secured in position by a spring clamp 82. The lower end of the tappet rod guide 80 is formed with a shoulder 84. An oil seal 86 serves as packing to prevent the leakage of oil from the chamber 88 into the upper spring chamber 90.

The reciprocating tappet rod 92 is mounted in the tappet rod guide 80 and is adapted to engage the lower end of the plunger 34. The lower end of the tappet rod 92 abuts a tappet plate 94 which is supported at its edge by a shoulder 96 formed in the tappet member 98. The tappet member 98 is slidably mounted within a sleeve 100 which is maintained in its position within the housing portion 6 by means of set screw 103 which extends into an aperture 104 formed in the wall of the sleeve 100. A roller 126 is rotatably mounted on the tappet 98 by means of a pin 128 secured to the wall of the tappet.

The sleeve 100 is provided with a slot 102 which affords communication between the chamber 88 and the oil passageway 106 formed in the housing 6. The other end of the passageway 106 communicates with the passage 108 connecting with one end of a conduit 110. The other end of conduit 110 terminates in an overflow valve 112, which is of the ordinary spring tension, ball type, having an outlet pipe 114 connecting the valve with the engine lubricating oil reservoir. A pump 116 has its high pressure side connected with the overflow valve 112 and the conduit 110 by means of the pipe 118 and the passageway 120. A pipe 122 is connected with the pipe 110 and serves to deliver part of the oil under pressure to the engine lubricating oil system. The engine lubricating oil supply is connected with the suction side of the pump 116 by means of the conduit 124. If desired, the passage 108 may be connected with a conduit 140 which is provided at its outermost end with an air cushion container 142.

The base portion 8 of the housing 2 is secured to the main housing section 6 by means of the casing bolts 130 and the lock nuts 132. The upper portion of the housing portion 8 and the lower portion of the main housing portion 6 are so formed as to provide a substantially circular chamber 134, adapted to receive for rotation therein the cam shaft 136 upon which is integrally formed or otherwise fastened a cam 138. The periphery of the roller 126 is adapted to engage against the periphery of the cam 138 in such a manner that upon rotation of the cam shaft 136, the tappet 98 is forced upwardly against the tension of the spring 58, the spring assisting in maintaining the engagement of the roller 126 with the periphery of the cam 138 after the apex of the cam 138 has passed beneath the roller.

The passage 144 is connected with the fuel line from the low pressure transfer pump and is in turn connected with the fuel chamber 26 by means of the vertical passage 146.

The operation of the device now becomes apparent.

The cam shaft 136 is directly or indirectly connected to the drive shaft of the engine and when operated causes the cam 138 to rotate under the roller 126. As the cam 138 rotates the roller 126 rises and, since the roller is secured to the tappet 98, the tappet will move upwardly in the sleeve 100. In moving upwardly, the tappet carries with it the tappet plate 94 which abuts against the lower end of the tappet rod 92 and therefore imparts to this rod a corresponding upward movement. Since the upper end of the tappet rod 92 engages the lower end of the reciprocating plunger 34, the plunger 34 will also be moved upwardly against the action of the spring 58. As the plunger rises in the barrel 28, it compresses fuel entering the ports 30, 32 from the fuel chamber 26, and then closes the ports against further entry of fuel.

During the above-described operation, the pump 116 has been actuated and has forced oil under pressure into the chamber 88 through the conduits 118, 120, 110, 108, 106 and the slot 102. This pressure is not sufficient, however, to interfere with the compression stroke, since said pressure is automatically relieved and controlled by valve 112.

After the apex of the cam 138 has passed beneath the roller 126, the tappet 98 is driven downwardly under the action of the hydraulic system in such a manner as constantly to maintain engagement of the roller 126 with the cam 138. Simultaneously with this movement, the spring 58 acts to urge the withdrawal of the plunger 34 from the barrel 28 and to force the tappet rod 92 downward against the tappet plate 94.

The downward movement of the plunger opens the ports 30, 32 and the cycle is repeated.

It will be noted that the hydraulic pressure assists the spring, thus allowing use of a light spring and reducing surge at high speeds.

Fuel injection pumps constructed according to this modification have the advantage that at high speeds, if the hydraulic system should for any reason fail, indication of that failure will at once become obvious as the light spring will be unable to actuate the reciprocating elements at a high speed and the engine will therefore miss fire and slow down.

It is to be noted furthermore that in this arrangement the hydraulic system provides the reciprocating elements 98 and 92 with lubrication under pressure, and pin 128 can also be pressure lubricated through suitable passages (not shown) connecting with chamber 88.

Another form of this invention is disclosed in Figures 3 and 4 of the drawings. These drawings illustrate a hydraulically operated springless fuel injection pump. Figure 3—A discloses a hydraulic system which may be employed if so desired, wherein the pressure for operating the fuel injection pump is provided by a separate oil pump.

Referring now more specifically to Figures 3 and 4, the similar parts are indicated by the same reference numerals as employed in Figures 1 and 2.

The lower end of the plunger 34 is provided

with a flange 200 which engages a T slot in the end of the tappet rod 92. In this embodiment the tappet guide 80 is retained in its respective position within the main housing section 6 by means of a set screw 202. The lower end of the tappet rod 92 is retained by a plate 204 adapted to reciprocate with the tappet 98. The passage 108 is connected with oil under pressure from the engine lubricating oil system in the manner shown in Figure 1 or alternatively as shown in Figure 3—A, and may also be connected to a pump driven from the engine starting equipment in order to assure pressure during the starting operation.

The operation of this device is quite similar to the modification described above, except that the downward stroke of the tappet rod is caused only by virture of the oil pressure existing on the plate 204 after the apex of the cam 138 has passed beneath the roller 126. Here again, it is seen that the several reciprocating elements are all lubricated by oil under pressure.

In the alternative form mentioned above, the fuel injection pump shown in Figure 3 may be provided with the hydraulic system illustrated in Figure 3—A. In carrying out this conception of the invention, a conduit 206 connects the passage 108 with a hydraulic circuit which includes a pressure regulating valve 210, the conduit 212, a pump 208, pipe 214, the internal combustion engine 216, the pressure regulating valve 218, and a conduit 220 which is connected in turn with an engine lubricating oil pump 222 which has its suction side connected to the oil supply by means of the pipe 224.

In this system it is possible to use a higher oil pressure for operating the pump than is used in the engine lubricating system.

It should be noted that if the lubricating system should fail, the reciprocating elements of the fuel injection pump will stop operating and the engine will stop because the oil supply to pump 208 has been cut off. In all other respects, the operation of this device is similar to that of Figures 1, 2, 3 and 4 of the drawings.

It is clear from the foregoing specification that the hydraulic system shown in Figure 3—A may, if desired, be substituted for that shown in Figure 1, and vice versa.

The several embodiments of this invention as described above and as illustrated in the drawings are to be considered as examples only, and the invention is only to be limited in scope as indicated in the following claims.

I claim:

1. A fuel injection pump of the type described comprising, a housing, a nozzle mounted on said housing and communicating with the interior thereof, a barrel secured within said housing, said barrel having one of its ends connected with the inner end of said nozzle, a plunger slidably mounted within said barrel, resilient means cooperating with said plunger, said resilient means tending to urge said plunger from said barrel, means for sliding said plunger inwardly in said barrel against the tension of said spring, and hydraulic means cooperating with said spring whereby said plunger is urged outwardly by said spring from said barrel.

2. A fuel injection pump of the type described comprising, a housing, a nozzle mounted in said housing and having one of its ends communicating with the interior of said housing, a chamber formed in said housing, a reciprocating plunger disposed within said chamber, a resilient means cooperating with said plunger to urge movement thereof in one direction, a cylinder formed in said housing, a tappet slidably mounted in said cylinder and in contact with said plunger, means for operating said plunger and said tappet against the action of said resilient means in one direction, and fluid pressure means, said fluid pressure means acting on said tappet to urge it in the opposite direction.

3. A fuel injection pump as defined in claim 2, and fluid sealing means disposed between said chamber and said cylinder.

4. A fuel injection pump of the type described comprising, a housing having a compression chamber, means for supplying fuel to said chamber, a reciprocating compression plunge mounted in said compression chamber, tappet means connected with said plunger for moving said plunger in one direction, and hydraulic means acting on a surface of said tappet means for moving said plunger in the other direction.

5. A fuel injection pump of the type described comprising, a housing having a compression chamber, means for supplying fuel to said chamber, resilient means for urging said plunger in one direction in said chamber, tappet means cooperating with said plunger to move said plunger in the other direction, and hydraulic means acting on a surface of said tappet means for moving said tappet means in said first direction.

6. A fuel injection pump for an internal combustion engine comprising, a compression chamber, means for supplying fuel to said chamber, a reciprocating plunger slidably mounted in said chamber, a reciprocating tappet connected with said plunger, means for driving said plunger and said tappet in one direction, and hydraulic means for driving said plunger and said tappet in the other direction.

7. A fuel injection pump as defined in claim 6, said hydraulic means comprising, a hydraulic system including a pressure pump, means connecting said fluid pressure pump with said tappet and with the lubricating oil system of said engine, a lubricating oil pump driven by said engine, an oil supply and means connecting said lubricating oil pump with said oil supply.

8. A fuel injection pump of the type described comprising, a housing having a compression chamber, means for supplying fuel to said compression chamber, a reciprocating plunger mounted in said chamber, a tappet rod having one of its ends fixedly secured to one end of said plunger, a tappet, said tappet being secured to the other end of said tappet rod, and hydraulic means acting on said tappet to constantly urge it in one direction.

9. A fuel injection pump, as defined in claim 8, a roller mounted on said tappet, a cam shaft, means for driving said cam shaft, a cam fixedly mounted on said shaft, said roller engaging the cam surface, whereby, when said cam shaft is rotated, said tappet is driven against the force exerted by said hydraulic means.

10. A fuel injection pump of the type described having a compression chamber, means for supplying fuel to said chamber, a reciprocating plunger mounted in said chamber, a tappet, means for maintaining said plunger in constant engagement with said tappet, means for moving said tappet and said plunger in one direction, and hydraulic means operating directly on said tappet for moving said tappet in the opposite direction.

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