July 30, 1946. D. E. MEITZLER 2,405,043

INJECTION SYSTEM

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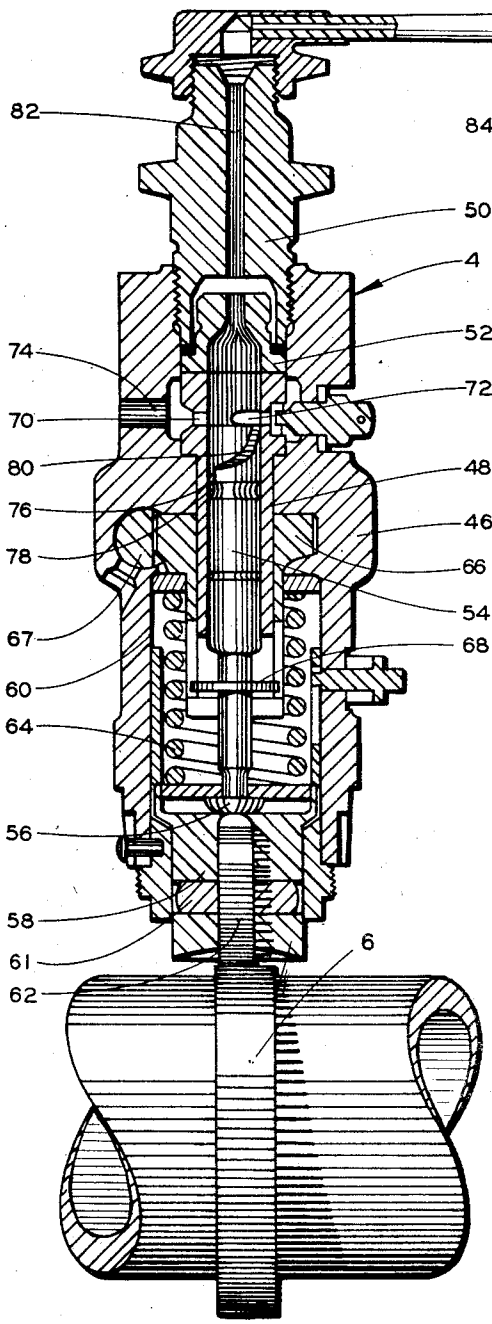

FIG. 1

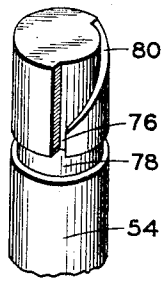

FIG. 3

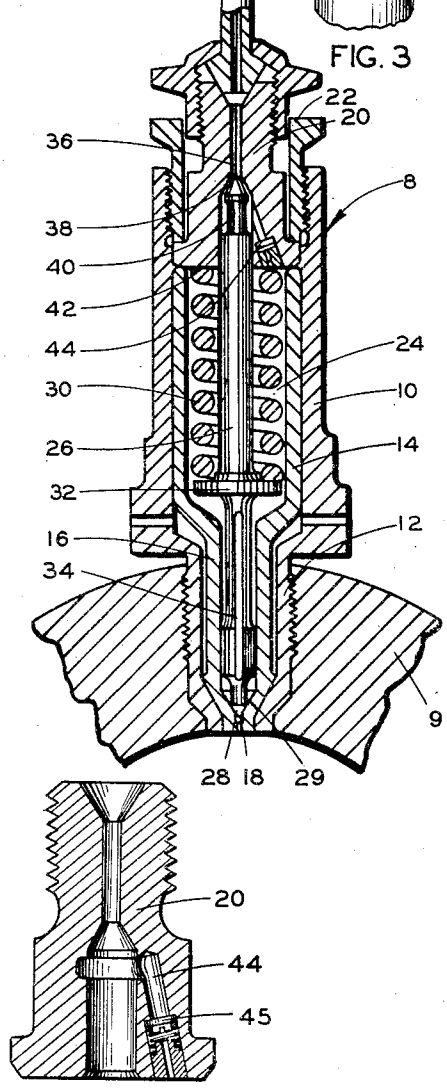

FIG. 2

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INJECTION SYSTEM

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1 Claim. (Cl. 137—153)

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This invention relates to injection systems of the type in which fuel is accumulated under pressure in a chamber, the outlet of which is controlled by a spring-pressed valve which is opened by a drop in the fuel supply pressure.

In prior devices of this character, the accumulator valve is held closed by the fuel pressure, and the pressure drop, which has caused the valve to open, has been obtained by opening a relief valve in the fuel supply connection. A check valve is generally incorporated in the inlet to the accumulator chamber to maintain pressure in this chamber when the supply pressure drops. An object of this invention is to avoid the necessity for the relief valve by controlling the accumulator valve for the chamber by a pump plunger which, during its stroke, relieves the pressure in the pump and causes the discharge of fuel from the chamber.

Another feature of this invention is the control of the quantity of fuel discharged from the chamber on each injection, by an adjustment of the pump plunger. This adjustment does not change the position of the plunger stroke at which the pump pressure is relieved.

Other objects and advantages will be apparent from the specification and claim, and from the accompanying drawing which illustrates what is now considered to be a preferred embodiment of the invention.

Fig. 1 is a sectional view through the pump and the injection nozzle.

Fig. 2 is a fragmentary sectional view of the check valve in the nozzle.

Fig. 3 is a perspective view of the end of the injection plunger.

The injection system is adapted for use with an engine having a cylinder in which air is compressed by a piston, with fuel injected into the cylinder at or near the end of the compression stroke of the piston.

The pump 4 is actuated by a cam 6, the movements of which may be synchronized with the piston stroke of the engine. The pumping stroke normally occurs during the compression stroke of the engine. During this period, the pump delivers fuel under pressure to an accumulator nozzle 8, and at a predetermined point, a sudden drop in pump pressure causes injection of fuel from nozzle 8 into the engine cylinder 9.

The injection nozzle 8 includes a housing 10 threaded at 12 to engage a threaded bore in the wall of the engine cylinder. A sleeve 14 fits within the hollow housing and at the end adjacent to the threads 12 is reduced in diameter at 16 to

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define a delivery port 18 through which fuel is discharged into the engine cylinder. A cap 20 engages the opposite end of sleeve 14 and is clamped within housing 10 by a threaded ring 22. Sleeve 14 forms an accumulator chamber 24 in which fuel is accumulated under pressure in readiness for injection.

Within chamber 24 is an accumulator valve including a plunger 26 having a valve element 28 at one end engaging a valve seat 29 in sleeve 14 for closing delivery port 18. This plunger is normally held against seat 29 by a coil spring 30 surrounding the plunger and extending between flange 32 on the plunger and cap 20. Plunger 26 is a sliding fit within sleeve 14 between flange 32 and valve element 28 and has a longitudinal groove 34 to permit a flow of fuel from chamber 24 to discharge port 18.

An inlet passage 36 in cap 20 has a concentric valve seat 38 engaged by a valve element 40 on the end of plunger 26 remote from valve element 28. Between seat 38 and the accumulator chamber, cap 20 has a bore 42 forming a continuation of passage 36 and in which the end of plunger 26 is guided. A bypass channel 44, Fig. 2, in cap 20 permits the flow of fuel from passage 36 into the accumulator chamber. Channel 44 has a check valve 45 which prevents reverse flow from chamber 24 into passage 36.

During delivery of fuel under pressure to the accumulator chamber, the pressure acting on valve element 40 assists spring 30 in holding the plunger against seat 29 for closing port 18. Upon a sudden drop in pressure in passage 36, the greater pressure within the accumulator chamber causes the plunger to move endwise until valve element 40 engages seat 38. This endwise movement of the plunger opens port 18 for injection of fuel from the accumulator chamber into the engine cylinder. Injection continues until the plunger is moved by spring 30 to close port 18.

The operation of the injection nozzle is controlled by the pump 4. This pump has a housing 46 in which a sleeve 48 is clamped by a threaded holder 50. A nipple 52 is clamped between the end of the holder and the sleeve.

The pump plunger 54 is reciprocated in sleeve 48 by the cam 6. This plunger has a head 56 engaging a cup 58 reciprocating in a bore 60 in the housing. Cup 58 has a pin 61 supporting a roller 62 which engages cam 6. A coil spring 64 engaging a washer carried by the plunger head 56 holds this head against the cup and keeps the cam roller in engagement with the cam.

In addition to its reciprocation, plunger 54 may

be turned within the sleeve for adjusting the quantity of fuel injected on each stroke. For this purpose a ring 66 surrounds the lower end of sleeve 48 and is notched to engage with projections 68 on the plunger. Ring 66 has teeth engageable with a rack 67 slideable in housing 46. The position of this rack determines the angular position of the pump plunger.

Sleeve 48 has a filling port 70 and a spill or discharge port 72 both communicating with a fuel supply port 74 in the housing. Plunger 54 has a longitudinal groove 76 extending from the upper end of the plunger to an annular groove 78 in the plunger. Between groove 78 and the end of the plunger, one side wall of groove 76 forms an obliquely extending shoulder 80 by which to control the quantity of injected fuel by adjusting the position of the stroke at which the filling port is covered by the plunger.

The end of the pump bore above plunger 54 is connected to passage 36 in the injection nozzle by a passage 82 in cap 50 and a pipe 84.

As the plunger begins its pumping stroke, filling port 70 is first covered by plunger 54. As the plunger movement continues, shoulder 80 covers the spill port 72 and prevents further escape of fuel from the sleeve 48 at the end of the plunger. Continued plunger movement forces fuel under pressure into the accumulator chamber until ports 70 and 72 are uncovered by groove 78. When this occurs, pressure at the end of the pump plunger drops suddenly by reason of the discharge of fuel through grooves 76 and 78 and through ports 70 and 72. Port 72 is larger than filling port 70 and the greater part of the fuel spills through this port. A corresponding drop in pressure on the end of valve plunger 26 causes this plunger to move against valve seat 38. Check valve 45 is closed at this time and prevents escape of fluid from chamber 24 through channel 44. Movement of valve plunger 26 opens port 18, and fuel accumulated in chamber 24 discharges

through the port until spring 30 returns the plunger 26 into the position shown, in which port 18 is again closed.

By this arrangement, injection results from a drop in pressure at the end of the pump plunger, although this drop in pressure does not materially affect the fuel pressure in the accumulator chamber. Injection continues until spring 30 overcomes the pressure in the chamber and closes port 18. Angular adjustment of the pump plunger, which changes the effective pumping stroke of the plunger, thereby controls the quantity of fuel forced into the accumulator chamber and accordingly controls the quantity of fuel discharged from the chamber on each injection.

Spill port 72, as shown, is an elongated slot in sleeve 48 to provide a large flow area when this port is uncovered. The large port area makes possible a rapid drop in the pressure in passage 82 to provide the desired movement of the valve plunger 26.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claim.

I claim:

Injection apparatus including a housing, a sleeve within said housing having a valve seat at one end, a cap within said housing closing the opposite end of the sleeve and defining therein a chamber, said cap having a passage therethrough and a valve seat in said passage in alignment with the valve seat at the opposite end of the sleeve, a plunger within the sleeve having one end fitting within and guided by the passage in the cap and engageable with the valve seat therein, the other end of the plunger engaging the seat at the end of the sleeve, and a spring surrounding said plunger and urging said plunger against the seat in the sleeve.

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