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ACCUMULATOR INJECTION APPARATUS

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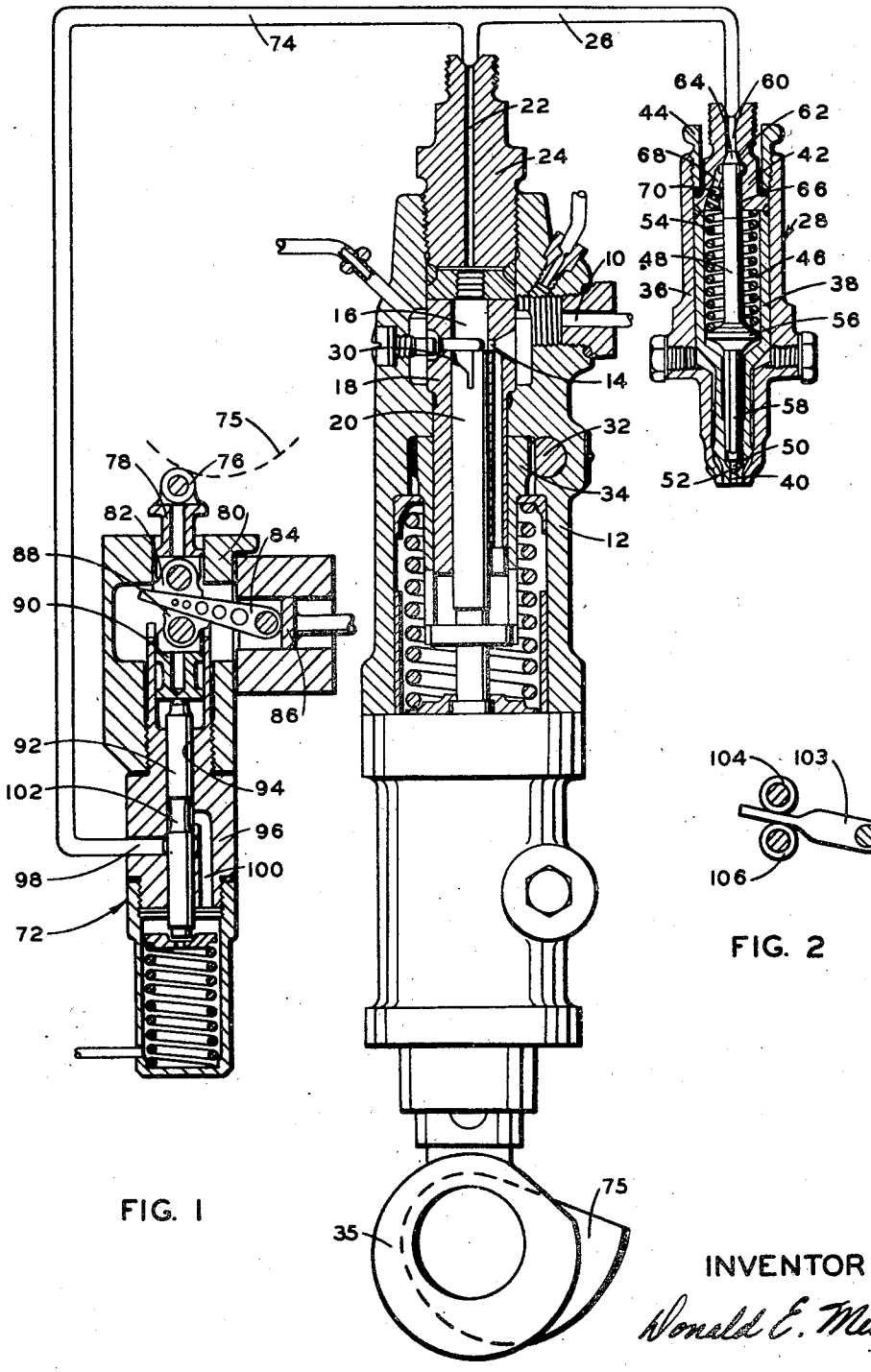


FIG. 1

FIG. 2

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ACCUMULATOR INJECTION APPARATUS

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10 Claims. (Cl. 103—41)

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This invention relates to injection apparatus for internal combustion engines.

In the accumulator type of fuel injection system a pump delivers fuel to a chamber in which it is accumulated under pressure and from which it is injected into the engine cylinder in response to a drop in pressure between the chamber and the pump. This drop in pressure may be obtained by constructing the pump plunger to uncover a vent port at a predetermined point in the plunger stroke. With this arrangement the time of the injection is dependent entirely on the position of the plunger and can be controlled only by axial or angular adjustment of the plunger. In certain installations, such adjustment of the plunger may be undesirable or difficult. The feature of this invention is the control of the injection timing by a separate plunger which may be operated entirely independently of the pump plunger.

In free-piston units the injection pump has been driven from the oscillating element of the restraining linkage that intersects the opposed pistons. Since the piston stroke is variable the stroke of the pump plunger is also variable. If the injection is timed from this plunger to occur at a predetermined distance from the extreme inner end position of the piston the timing may be improper as the stroke changes in length. A feature of this invention is the control of the injection from a separately actuated plunger which by adjustment may cause the injection to occur at any desired point in the piston stroke.

Another feature is a wider range of adjustment of the injection timing by making the timing independent of the position of the pump plunger.

In this type of injection system the plunger may have a helical or obliquely extending shoulder which controls the quantity of fuel injected by covering the filling port during a greater or less part of the pumping stroke. With such a shoulder, the adjustment is obtained by angular adjustment of the plunger, making difficult an independent angular adjustment for the fuel timing. A feature of the invention is the control of the timing independently of the pump plunger, especially where the latter is adapted by adjustment for controlling the fuel quantity.

Another feature is an arrangement by which the timing characteristics may be readily changed so that the change in timing is not necessarily a direct function of the motion of the controlling member.

Other objects and advantages will be apparent from the specification and claims, and from the

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accompanying drawings which illustrate an embodiment of the invention.

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

Fig. 2 is a fragmentary sectional view of a modification.

The injection system is the accumulator type of system, one example of which is described in the copending Meitzler application, Serial No. 486,623, filed May 11, 1943, now Patent No. 2,405,043, July 30, 1946. Fuel under pressure entering a port 10 in a casing 12 passes through a filling port 14 into the end of the bore 16 in a casing 18 in which a plunger 20 reciprocates. The end of this bore communicates through a passage 22 in a cap 24 and a conduit 26 with an injection nozzle 28.

Pump plunger 20 has a helical shoulder 30 which by covering port 14 controls the quantity of fuel delivered to the injection nozzle for each injection. The quantity may be adjusted by turning the plunger angularly by means of a rack 32 engaging a pinion 34 having a sliding connection with the plunger. The plunger may be reciprocated from the cam 35, the plunger moving upward on the pumping stroke.

The injection nozzle 28 includes a housing 36 having a portion adapted to engage a bore in a wall of an engine cylinder. A sleeve 38 fits within the hollow housing and at the inner end is reduced in diameter to define a delivery port 40 through which fuel is delivered into the engine cylinder. A cap 42 engages the opposite end of sleeve 38 and is clamped within housing 36 by a threaded ring 44. Sleeve 38 forms an accumulator chamber 46 in which fuel is accumulated under pressure in readiness for injection.

Within chamber 46 is an accumulator valve including a plunger 48 having a valve element 50 at one end engaging a valve seat 52 in sleeve 38 for closing delivery port 40. This plunger is normally held against seat 52 by a coil spring 54 surrounding a plunger and extending between a flange 56 on the plunger and cap 42. Plunger 48 is slidable within sleeve 38 and has a groove 58 to permit a flow of fuel from chamber 46 to discharge port 40.

An inlet passage 60 in cap 42 has a concentric valve seat 62 engaged by a valve element 64 on the end of plunger 48 remote from valve element 50. Between seat 62 and the accumulator chamber, cap 42 has a bore 66 forming a continuation of passage 60 and in which the end of plunger 48 is guided. A bypass channel 68 in cap 42 permits the flow of fuel from passage 60 into the accumu-

lator chamber. Channel 68 has a check valve 70 to prevent escape of fluid from chamber 46.

During delivery of fuel under pressure to the accumulator chamber the pressure acting on valve element 64 assists spring 54 in holding the pressure against seat 52. Upon a drop in pressure in passage 60 to which conduit 26 from the pump is connected the pressure within the accumulator chamber causes the plunger to move endwise to engage seat 62 and to open delivery port 40 for injection of fuel from the chamber into the engine cylinder.

An automatic timing device 72 which may be manually or automatically controlled is connected by a conduit 74 to conduit 26 for causing the drop in pressure in this conduit at the desired time for the injection of fuel into the engine cylinder. The automatic timing device may be actuated by a cam 75 on the same shaft as cam 35. The timing device is shown beside the pump, although it will be understood that it is so located as to be actuated by cam 75.

Cam 75 engages a follower 76 on the end of a rod 78 reciprocating in a housing 80. The lower end of rod 78 carries a bearing shoe 82 engaging with a wedge 84 pivoted on a block 86. The other side of the wedge-shaped cam 84 engages a shoe 88 on the end of a reciprocating rod 90.

The lower end of rod 90 engages a plunger 92 reciprocating in a bore 94 in a casing 96 mounted on housing 80. This casing has an inlet port 98 connected to conduit 74. A discharge port 100 in casing 96 is in a position to be connected with the port 98 by a groove 102 in the plunger as the latter is moved downward during the pumping stroke of the plunger 20. Opening of conduit 74 by connecting ports 98 and 100 causes a drop in pressure in conduit 26 with the resultant injection of fuel from the nozzle.

The point at which injection takes place may be adjusted manually by endwise movement of wedge 84 or automatically by means not shown. A mechanism adapted for automatic control of the fuel timing is claimed in the copending Meitzler application, Ser. No. 550,897, filed August 23, 1944. It is sufficient to note that fluid under pressure acting directly or through a servo-motor may control the position of the wedge 84. By movement of the wedge to the right the time of injection with respect to the plunger stroke will be retarded and by movement of the wedge to the left the time of injection may be advanced.

Wedge 84 and shoes 82 and 88 may be replaced by a contoured cam 103, Fig. 2, and rolls 104 and 106. By adjusting the contour of this cam the change in timing may be controlled to any desired extent. With wedge 84 the change in timing is a linear function of the wedge movement; with cam 102 the change in timing is not necessarily a function of the cam movement.

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 claims.

I claim:

1. An accumulator injection system including a pump plunger, a chamber into which fuel is pumped under pressure by said plunger, a delivery port connected to said chamber, and a valve normally closing the connection between the chamber and the delivery port and movable by a drop in pressure between the plunger and chamber for opening said connection and for closing the connection from the chamber to the plunger, in combination with means independent of the plunger for procuring said drop in pressure.

2. An accumulator injection system including a pump plunger, a chamber into which fuel is pumped under pressure by said plunger, a delivery port connected to said chamber, and a valve normally closing the connection between the chamber and the delivery port and movable by a drop in pressure between the plunger and chamber for opening said connection and for closing the connection from the chamber to the plunger, in combination with another plunger separate from said first plunger and adapted to cause said drop in pressure at a predetermined point in its reciprocation.

3. An accumulator injection system including a pump plunger, a chamber into which fuel is pumped under pressure by said plunger, a delivery port connected to said chamber, and a valve normally closing the connection between the chamber and the delivery port and movable by a drop in pressure between the plunger and chamber for opening said connection and for closing the connection from the chamber to the plunger, in combination with another plunger separate from said first plunger and adapted to cause said drop in pressure at a predetermined point in its reciprocation, and means for adjusting said second plunger for controlling the time of injection of fuel through said delivery port.

4. An accumulator injection system including a pump plunger, a chamber into which fuel is pumped under pressure by said plunger, a delivery port connected to said chamber, and a valve normally closing the connection between the chamber and the delivery port and movable by a drop in pressure between the plunger and chamber for opening said connection and for closing the connection from the chamber to the plunger, in combination with another reciprocating plunger, a casing for said plunger, a connection from a port in said casing to the connection between said first plunger and the chamber, and means on the second plunger for uncovering said port at a predetermined point in its stroke.

5. An accumulator injection system including a pump plunger, a chamber into which fuel is pumped under pressure by said plunger, a delivery port connected to said chamber, and a valve normally closing the connection between the chamber and the delivery port and movable by a drop in pressure between the plunger and for opening said connection and for closing the connection from the chamber to the plunger, in combination with another reciprocating plunger, a casing for said plunger, a connection from a port in said casing to the connection between said first plunger and the chamber, means on the second plunger for uncovering said port at a predetermined point in its stroke, and means for adjusting the position of the stroke of the second plunger.

6. An accumulator injection system including a casing, a pump plunger reciprocating in said casing, a chamber into which fuel is pumped under pressure by said plunger, a delivery port connected to said chamber, and a valve normally closing the connection between the chamber and delivery port, said plunger having means thereon for controlling the quantity of fuel pumped on each stroke, in combination with a second plunger movable independently of the first plunger for causing said valve to open.

7. An accumulator injection system including

a casing, a pump plunger reciprocating in said casing, a chamber into which fuel is pumped under pressure by said plunger, a delivery port connected to said chamber, and a valve normally closing the connection between the chamber and delivery port, said plunger having means thereon for controlling the quantity of fuel pumped on each stroke, and being adjustable for varying the quantity pumped, in combination with a second plunger movable independently of the first plunger, said second plunger having means for procuring opening of said valve at a predetermined point in the reciprocation of said second plunger.

8. An accumulator injection system including a casing, a pump plunger reciprocating in said casing, a chamber into which fuel is pumped under pressure by said plunger, a delivery port connected to said chamber, and a valve normally closing the connection between the chamber and delivery port and movable by a drop in pressure in the connection between the plunger and chamber for opening said first connection and for closing the connection between the plunger and chamber, said plunger having means thereon for controlling the quantity of fuel pumped on each stroke and being adjustable for varying the quantity pumped, in combination with a separate plunger having means thereon for procuring said drop in pressure, and means for adjusting said second plunger.

9. An accumulator injection system including a pump plunger, a chamber into which fuel is pumped under pressure by said plunger, a delivery port connected to said chamber, and a valve normally closing the connection between the chamber and the delivery port and movable by a drop in pressure between the plunger and chamber for opening said connection, in combination with another plunger separate from said first plunger and adapted to cause said drop in pressure at a predetermined point in its reciprocation, and means for adjusting said second plunger for controlling the time of injection of fuel through said delivery port.

10. An accumulator injection system including a pump plunger, a chamber into which fuel is pumped under pressure by said plunger, a delivery port connected to said chamber, and a valve normally closing the connection between the chamber and the delivery port and movable by a drop in pressure between the plunger and chamber for opening said connection, in combination with another reciprocating plunger, a casing for said plunger, a connection from a port in said casing to the connection between said first plunger and the chamber, and means on the second plunger for uncovering said port at a predetermined point in its stroke.

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