

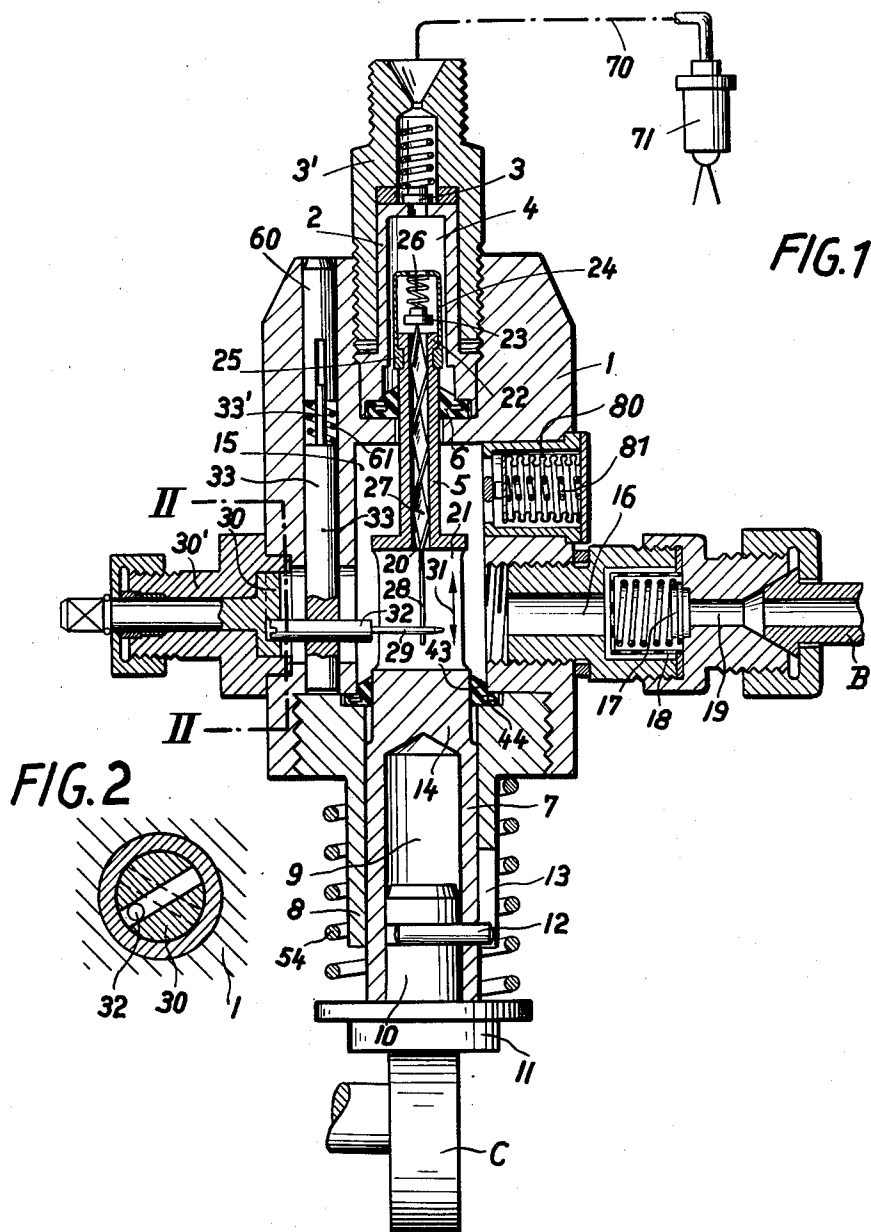
Oct. 1, 1957

W. STAEGE

2,808,003

INJECTION PUMPS

Filed April 2, 1952



INVENTOR.

Werner Staeger

BY

Michael S. Stricker
at.

1

2,808,003

INJECTION PUMPS

Werner Staeger, Karlsruhe-Durlach, Germany, assignor to
Firma Kugelfischer Georg Schäfer & Co., Schweinfurt,
Germany

Application April 2, 1952, Serial No. 280,017

Claims priority, application Germany October 31, 1949

7 Claims. (Cl. 103—40)

The present invention relates to injection pumps for internal combustion engines and the like.

One of the objects of the present invention is to provide an injection pump which has an extremely simple construction as compared to conventional injection pumps.

Another object of the present invention is to greatly reduce the cost of the pump by enabling most of the parts thereof to be made from materials other than hardened steel.

A further object of the present invention is to provide an injection pump in which most of the parts need not be made to close tolerances so that manufacturing costs are greatly reduced.

An additional object of the present invention is to provide an injection pump which is capable of injecting a very small amount of fuel into an engine cylinder.

A still further object of the present invention is to provide an injection pump with a low pressure chamber which simultaneously serves as a supply chamber for a high pressure chamber of the pump.

The objects of the present invention also include the provision of a very simple control means for a valve which regulates the flow of fluid through the pump.

Also, the objects of the present invention include the provision of a sturdy injection pump which has relatively few moving parts and which is capable of giving reliable service over a long period of time.

Yet another object of the present invention is to locate parts of the pump which are likely to wear in an easily accessible position so that these parts may be conveniently changed when required.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a side sectional view of an injection pump constructed in accordance with the present invention and showing all of the working parts thereof; and

Fig. 2 is a fragmentary view taken along line 2—2 of Fig. 1.

Referring now to the drawings, there is shown in Fig. 1 the pump body 1 having an outlet portion 3' threadedly connected—as diagrammatically shown in dot-dash lines—to a high pressure injection conduit 70 leading to an injection nozzle 71 preferably mounted in a cylinder of an internal combustion engine. The outlet portion 3' of the pump is provided with a spring pressed outlet valve 3, as is clearly shown in Fig. 1. A high pressure chamber 4 formed by the cylinder 2 is located within the pump body 1, this high pressure chamber 4 communicating at its upper end with the outlet valve 3.

An end portion 5 of the pump piston extends into the high pressure chamber 4 through a resilient, annular seal-

2

ing member 6. As is apparent from Fig. 1, the piston is stepped along its length, and, when used in pumps of very small engines requiring only a small amount of fuel, the smallest part 5 of the piston would have a diameter of 2–4 mm., for example. The largest diameter of the stepped piston is located opposite the end portion 5 thereof at the actuating end portion 7 which is slidably mounted in a sleeve 8.

The actuating end portion 7 of the piston is manufactured so as to have a nice sliding fit with the sleeve 8. The sealing member 6 is originally of a smaller diameter than part 5 of the piston so that it presses against the latter and compensates for any inaccuracies in the manufacture of part 5 of the piston. In this way, the cost of manufacture of the piston is greatly reduced, and, in fact, part 5 of the piston may be made of a non-ferrous, light material such as aluminum, brass, or even plastics, since it need not be made of a hard alloy steel, so that the cost of manufacture also is greatly reduced in this way. The only requirement is that the outer surface of the piston portion 5 have a smooth, highly polished surface which slides through the sealing member 6 with a minimum of friction. The sealing member 6 is, on its circumferential surfaces, completely out of contact with the pump body. Also the part 5 of the piston extending through the sealing member 6 may have a considerable amount of play with respect to the pump body. Thus the sealing member 6 is brought into axial alignment with the part 5 of the piston which determines its radial position within the pump body, and this radial position of the sealing member 6 is secured by screwing the outlet member 3' into the pump body 1.

It will be noted that the wear resulting from operation of the pump will in this way be limited to the resilient sealing member 6, and this member may easily be changed simply by unscrewing the outlet 3' of the pump and removing the cylinder 2 therewith. The sealing member 6 is in this way made conveniently accessible for quick changing when required so that operation and maintenance costs are extremely low.

The actuating end portion 7 of the piston is formed with an axial bore 9 extending into the same from the outer free end thereof so as to reduce the mass of the piston. A transmission member 11, adapted to be engaged by a cam C, diagrammatically shown, has a central shank 10 located within the bore 9. The shank 10 is provided with a bore located in alignment with an opening passing through the wall of bore 9, and a pin 12 extends through the opening in the wall of bore 9 and into the bore of the shank 10 so as to maintain the transmission member 11 fixed to the piston portion 7. The sleeve 8 is formed with an elongated slot 13 having a lower open end, and the pin 12 has an outer end portion located in this slot 13 so as to prevent rotation of the piston about its axis while permitting free axial movement thereof. A coil spring 54 is located about the sleeve 8 and bears against the transmission member 11 to maintain the latter against the cam C so that the piston will be moved in accordance with the shape of the cam.

The intermediate part 14 of the piston is of a slightly smaller diameter than the actuating portion 7 of the piston and does not engage the sleeve 8. The portions 5 and 14 of the piston may be made of one piece and from a non-ferrous metal, as described above, while the portion 7 may be made of a harder material. All portions 5, 7 and 14 of the piston may also be made of the same material.

This intermediate portion 14 of the piston extends into a low pressure suction chamber 15 of the pump body 1, this low pressure chamber 15 being interconnected by the pipe joints 16 and 19 to a fuel supply duct B, shown diagrammatically. At the connection between the parts 16

3

and 19, there is located a spring pressed check valve 17, to prevent flow of fuel from the chamber 15 to the line B, and a fine filter 18 to filter foreign matter from the fuel before it enters the low pressure suction chamber 15.

The end portion 5 of the piston is formed with an axial bore 20 extending therethrough and providing a communication between the low pressure chamber 15 and the high pressure chamber 4. The intermediate pump portion 14 is formed with an elongated slot 21 communicating with the bore 20.

The top extremity of the portion 5 of the piston forms a seat 22 for a check valve member 23 located in the high pressure chamber 4, this check valve member 23 being loosely located in a tubular cage 24 which is of a larger diameter than check valve member 23 so that fuel may flow about this valve member when it is located off the valve seat 22 formed by the extremity of piston portion 5. The piston portion 5 is formed, adjacent to its upper end, with an annular groove and the tubular cage 24 is provided with an inner annular projection 25 located within this annular groove of the piston portion 5 to fixedly connect the cage 24 to the piston for movement therewith. The cage 24 may be provided with axially extending slits adjacent to its lower end, as viewed in Fig. 1, so that the projection 25 may be formed from a plurality of springy portions of the cage 24 which are capable of expanding over the extremity of piston portion 5 and resiliently entering into the groove on the latter to connect the cage 24 to the piston portion 5. As is apparent from Fig. 1, the cage 24 has a partially closed top end which forms a seat for one end of a spring 26 which bears at its other end against the valve member 23 to urge the latter against the piston portion 5 and over the axial bore 20 thereof. This partially closed top end of cage 24 may be formed from an inwardly bent annular flange of the tubular cage.

When the valve member 23 is in its closed position against the valve seat 22 formed by the extremity of piston portion 5, this valve member forms the working face of the piston in the high pressure chamber 4 so that this valve member 23 serves a dual purpose. The valve 22, 23 located in the high pressure chamber 4 thus forms a check valve capable of cooperating with member 27, described below, for regulating the quantity of fuel trapped in the high pressure chamber 4. For this purpose, a valve opening member 27 is provided, this valve opening member 27 in the example illustrated in Fig. 1, taking the form of a relatively thin, helically twisted strip of sheet metal. The twisting of the strip 27 stiffens the same and at the same time permits the strip to have a thickness on the order of 0.5 mm. The top end of the strip 27 is adapted to engage the valve 23 during the downward suction stroke of the piston, as viewed in Fig. 1, so as to positively open the valve 23 and permit fuel from low pressure chamber 15 to flow very quickly and easily into high pressure chamber 4.

An adjusting means is provided to adjust the position of the stationary valve opening member 27 so that the valve 22, 23 may be positively opened at a desired point in the stroke of the piston. This adjusting means takes the form, in the example shown in Fig. 1, of a pin member 29 extending transversely to the length of the piston into the opening 21 thereof and being connected to the lower end portion 28 of the strip 27 so as to support the latter. This pin 29 is fixedly connected to a screw member 32 which passes through a threaded opening in an elongated member 33 slidably mounted in a bore of the pump body 1.

A sleeve 30' is mounted on the pump body 1 and rotatably supports an adjusting member 30 which is provided at its right hand end, as viewed in Fig. 1, with an elongated recess in which an end of screw 32 is located (Fig. 2). The member 33 has fixedly mounted on its upper end an extension 33' which extends slidably into an opening of a plug member 60 located in the bore of pump

4

body 1 to close the same. About the extension 33' of member 33, and between the latter and plug 60, there is located a spring 61 which resiliently urges the member 33 in a downward direction, as viewed in Fig. 1, so that the screw member 32 is urged against the lower part of the elongated recess of the adjusting member 30, as viewed in Fig. 2. Thus, the member 33 constrains the pin 29 to an adjusting movement which is parallel to the axis of the piston, and the position of the valve opening member 27 may be very easily adjusted by turning the adjusting member 30, the latter having an outer end of non-circular cross-section which may be conveniently engaged by a wrench or the like. The member 33 is shown in Fig. 1 in its lowermost position against the sleeve 8, and upon turning of the adjusting member 30, the pin 29 and the strip 27 will be moved upwardly and then, if desired, downwardly, as shown by the double ended arrow 31.

In order to further promote the quick opening of the suction valve 22, 23 during the suction stroke of the piston, the valve member 23 is made of a fairly light material so as to have a small mass and the spring 26 urges it with a very weak force toward the seat 22. In small pumps the force of spring 26 may be as low as 5 grams.

In order to seal the chamber 15 from the outer atmosphere, a non-metallic, annular, yieldable sealing member 43, similar to the sealing member 6, is located about the intermediate portion 14 of the piston and resiliently presses inwardly toward the axis thereof so that this portion 14 of the piston may also be made of a light but wear-resisting material and with a low degree of accuracy, the only requirement being that it have a highly polished outer surface to reduce as much as possible the wear of the sealing member 43. This intermediate portion 14 is of a smaller diameter than the actuating end portion 7 of the piston, as was mentioned above, so that the intermediate portion 14 does not engage the sleeve 8, and the central part of the sealing member 43 is free and located out of contact with any part of the pump except the piston portion 14.

The sealing ring 6 is clamped at its outer peripheral portion between the cylinder 2 and pump body 1, and the sealing ring 43 is clamped at its outer periphery between the sleeve 8 and the pump body 1. These outer peripheral portions of the sealing rings 6 and 43 may be made stiffer than the yieldable, central apertured portions thereof, for example by vulcanizing a relatively non-yieldable annular ring portion at the peripheries of the sealing rings 6 and 43, as shown at 44 on ring 43. These sealing rings 6 and 43 may have, in their unstressed conditions, central openings of a slightly smaller diameter than the piston portions 5 and 14, respectively, and the portions of the rings located about their central openings may simply be bent upwardly from the peripheral portions of the rings when the latter are slipped over the piston so as to provide a central, annular, upwardly extending sealing ring portion resiliently pressing inwardly toward the axis of the piston, as is illustrated in Fig. 1.

As was mentioned above the low pressure suction chamber 15 serves also as a supply chamber for the high pressure chamber 4 of the pump so that a conventional supply chamber may be omitted. In order that the low pressure chamber 15 may better perform its function as a storage chamber for the fuel, it may be provided with a yieldable wall portion formed by the left end of bellows 80, as viewed in Fig. 1, this bellows being urged to the left by the spring 81 located within bellows 80. The bellows is mounted in a tubular housing whose left end wall, as viewed in Fig. 1, is apertured to provide communication between bellows 80 and the low pressure chamber 15. Instead of the bellows 80 a spring-pressed piston located in a bore in the wall of chamber 15 may be used, if desired.

While the invention has been illustrated and described as embodied in injection pumps adapted to be used with

small, high-speed engines, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. An injection pump, comprising, in combination, a pump body having a low pressure chamber and a high pressure chamber; a resilient, flexible sealing member formed with an opening passing therethrough and being mounted in said pump body between said chambers to separate the same from each other, said sealing member, at a portion located about said opening thereof, being free and out of contact with said pump body; an elongated piston passing at one end portion thereof slidably through said opening of said sealing member and being formed with an axial bore passing through said one end portion thereof and communicating with said low pressure chamber, and said piston being formed with an annular groove on the outer surface thereof adjacent the extremity of said one end portion thereof; tubular cage means located in said high pressure chamber and having a projecting portion located in said annular groove to fix said cage means to said piston for movement therewith; a valve member movably mounted in said cage means and being located over the extremity of said one end portion of said piston; and spring means mounted in said cage means and bearing against said valve member to urge the same against said piston.

2. An injection pump, comprising, in combination, a pump body having a low pressure chamber formed with a bore passing through a wall thereof, and a high pressure chamber; a resilient, flexible sealing member formed with an opening passing therethrough and being mounted in said pump body between said chambers to separate the same from each other, said sealing member, at a portion located about said opening thereof, being free and out of contact with said pump body; an elongated piston passing at one end portion thereof slidably through said opening of said sealing member and having an opposite actuating end portion slidably mounted in said bore of said low pressure chamber, said piston engaging said pump body only at said bore in said wall of said low pressure chamber and being formed with an axial bore passing through said one end portion thereof and communicating with said low pressure chamber; valve means mounted on said piston over said axial bore thereof to control the flow of fluid therethrough and being located in said high pressure chamber of said pump body; and valve opening means adjustably mounted in said pump body and having an operative connection with said valve means to open the same at a predetermined point in the stroke of said piston.

3. An injection pump, comprising, in combination, a pump body having high pressure and low pressure chambers which are separated from each other; an elongated piston slidably mounted in said pump body, located in said low pressure chamber and having an end portion extending into said high pressure chamber for reciprocating movement in the same, said piston being formed with an axial bore passing through said end portion thereof and communicating with said low pressure chamber; a check valve member located in said high pressure chamber at the extremity of said end portion of said piston for closing said axial bore; and an elongated, stationary valve opening member mounted in said pump body and extend-

ing through said axial bore of said piston beyond the latter into said high pressure chamber when said piston is at the end of its suction stroke to positively separate said valve member from said piston and open said bore at a predetermined point in the stroke of said piston.

4. An injection pump, comprising, in combination, a pump body having high pressure and low pressure chambers which are separated from each other; an elongated piston slidably mounted in said pump body, located in said low pressure chamber and having an end portion extending into said high pressure chamber for reciprocating movement in the same, said piston being formed with an axial bore passing through said end portion thereof and communicating with said low pressure chamber; a check valve member located in said high pressure chamber at the extremity of said end portion of said piston for closing said axial bore; an elongated, stationary valve opening member mounted in said pump body and extending through said axial bore of said piston beyond the latter into said high pressure chamber when said piston is at the end of its suction stroke to positively separate said valve member from said piston and open said bore at a predetermined point in the stroke of said piston; a pin member extending transversely to the length of said piston and being connected to said valve opening member to support the same; and adjusting means operatively connected to said pin member for adjusting the same in a direction parallel to the length of said piston to regulate the position of said valve opening member.

5. An injection pump, comprising, in combination, a pump body having high pressure and low pressure chambers which are separated from each other; an elongated piston slidably mounted in said pump body, located in said low pressure chamber and having an end portion extending into said high pressure chamber for reciprocating movement in the same, said piston being formed with an axial bore passing through said end portion thereof and communicating with said low pressure chamber and said piston being formed in an intermediate part thereof located in said low pressure chamber with an elongated opening extending along the length of said piston and communicating with said axial bore thereof; a check valve member located in said high pressure chamber at the extremity of said end portion of said piston for closing said axial bore; an elongated, stationary valve opening member mounted in said pump body, extending through said axial bore of said piston beyond the latter into said high pressure chamber when said piston is at the end of its suction stroke to positively separate said valve member from said piston and open said bore at a predetermined point in the stroke of said piston, and having an end portion located in said elongated opening of said piston; a pin member extending into said elongated opening of said piston transversely to the length of said piston and being connected to said valve opening member to support the same; and adjusting means operatively connected to said pin member for adjusting the same in a direction parallel to the length of said piston to regulate the position of said valve opening member.

6. An injection pump, comprising, in combination, a pump body having high pressure and low pressure chambers which are separated from each other; an elongated piston slidably mounted in said pump body, located in said low pressure chamber and having an end portion extending into said high pressure chamber for reciprocating movement in the same, said piston being formed with an axial bore passing through said end portion thereof and communicating with said low pressure chamber; a check valve member located in said high pressure chamber at the extremity of said end portion of said piston for closing said axial bore; and a twisted stationary of metal mounted in said pump body and extending through said axial bore of said piston beyond the latter into said high pressure chamber when said piston is at the end of its suction stroke to positively separate said valve mem-

ber from said piston and open said bore at a predetermined point in the stroke of said piston.

7. An injection pump, comprising, in combination, a pump body having a high pressure chamber and a low pressure chamber, the latter being formed with a bore 5 passing through a wall thereof; a first annular, radially yieldable sealing member mounted in said pump body between said chambers to separate the same from each other; an elongated piston extending slidably through said 10 sealing member from said low pressure chamber into said high pressure chamber and having an end portion provided with two adjacent parts of different diameters and the larger of said parts extending slidably through said bore of said low pressure chamber; and a second annular, radially yieldable sealing member located in said 15 low pressure chamber adjacent said bore thereof, about the smaller of said parts of said piston and slidably engaging the latter, said piston having in said pump body

an outer surface which is entirely free except for its contact with said first and second sealing members and with said pump body at said bore thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

355,669	Watkins	Jan. 4, 1887
789,430	Jewson	May 9, 1905
833,457	Hammond	Oct. 16, 1906
1,430,956	De Ville	Oct. 3, 1922
1,940,524	Billem et al.	Dec. 19, 1933
2,230,622	L'Orange	Feb. 4, 1941
2,470,540	Young	May 17, 1949
2,576,263	Pielstick	Nov. 27, 1951
2,612,842	Steven et al.	Oct. 7, 1952

FOREIGN PATENTS

39,056	Denmark	July 16, 1928
--------	---------	---------------