

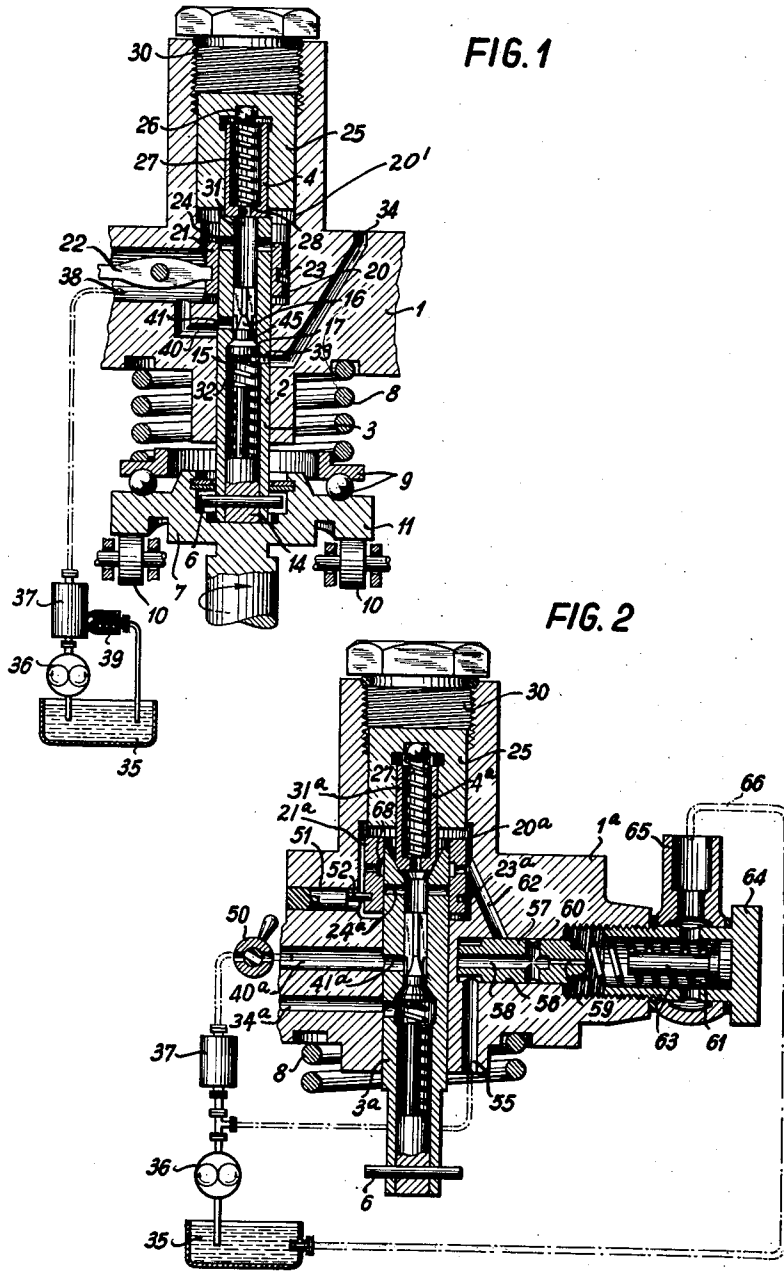
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INJECTION PUMP

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INJECTION PUMP

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The present invention relates to injection pumps for supplying fuel to the cylinders of internal combustion engines.

One of the objects of the present invention is to provide a pump of this type which is capable of having parts thereof easily exchangeable either when the parts become worn or when it is desired to change the size of the parts.

Another object of the present invention is to provide an injection pump with a means for varying the cross section of a passage through which the fuel flows.

A further object of the present invention is to provide an injection pump with a member controlling the volume pumped during each cycle of the pump and capable of being easily exchanged.

It is also an object of the present invention to provide an injection pump with exchangeable parts which are of a simple and inexpensive construction.

Still another object of the present invention is to provide the return flow passage of an injection pump with a means for varying the cross section of this passage whenever the speed of the engine goes beyond or below a predetermined speed.

Furthermore, it is an object of the present invention to provide a fuel injection pump capable of supplying to an engine, when it is being started, an amount of fuel greater than that required for normal operation.

With the above objects in view the present invention mainly consists of an injection pump which includes an elongated cylinder means and a passage means formed in the cylinder means for leading fuel to and from the cylinder means. A combined distributor and pump means is axially and turnably movable in the cylinder means for controlling the flow of fuel along the passage means to and from the cylinder means. This combined distributor and pump means includes a first elongated member accommodating a valve and cooperating with the passage means for opening and closing the same, a second elongated member formed with an axial bore and determining the size of a chamber of the pump means into which fuel is drawn, this second member having an end which engages an end of the first member, and a spring means engaging one of these elongated members for urging the same toward the other of the members to maintain the ends of the members in engagement with each other during axial and rotational movement of the combined pump and distributor means. The cylinder means is in the form of a housing formed with an elongated bore, and a passage means is partly formed in this housing. This passage means has a first portion leading to the bore of the housing and a second portion leading from the bore of the housing for guiding the fuel respectively to and from this bore. The combined pump and distributor means is axially and turnably movable in the bore of the housing which forms the cylinder means for controlling the flow of fuel through the passage means. A control means is located in the above-mentioned second portion of the passage means for increasing the cross section of

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a part of this second portion of the passage means as the speed of an engine operatively connected to the injection pump increases and for decreasing this cross section as the engine speed decreases.

5 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 advantage thereof, will be best understood from the following description of specific 10 embodiments when read in connection with the accompanying drawings, in which:

15 Fig. 1 is a partly diagrammatic, fragmentary sectional elevational view of one injection pump arrangement constructed in accordance with the present invention, the section of Fig. 1 being taken centrally through the injection pump; and

20 Fig. 2 is a partly diagrammatic, sectional elevational view of another embodiment of a fuel injection pump according to the present invention, the section of Fig. 2 also being taken along a central plane passing through the injection pump.

Referring to Fig. 1, the structure illustrated therein includes a cylinder means formed by the fragmentarily 25 illustrated housing 1 which is formed with an elongated stepped bore having the bore portions 2, 20, and 20' of different diameters. In the bore portion 2 an elongated member 3 forming part of a combined pump and distributor means is axially slidable and turnable. The elongated member 3 has a close sliding fit in the bore portion 2 so that the slidable engagement of member 3 and housing 1 is fluidtight. The elongated member 3 has a pin 6 extending transversely through and beyond 30 the same adjacent its bottom end, as viewed in Fig. 1, and this pin 6 extends at its free ends with very little clearance into notches formed in the cam disc 7 so that the elongated member 3 is constrained in this way to rotate with the cam disc 7. This cam disc 7 is driven in a known way by the engine operatively connected to the injection pump. A coil spring 8 extends about the member 3 at the exterior of the housing 1, bears at one end against the housing 1, and bears at its opposite end against a race and thrust ball bearing 9. The other race of this thrust bearing is formed by an annular groove 35 formed at the top face of the cam disc 7. The camming portions 11 of the cam disc 7 are maintained in engagement with rollers 10 by the spring 8, and these rollers 10 are turnable about stationary axes so that as the cam disc 7 turns about its axis it moves up and down in order to reciprocate the member 3 axially as well as to rotate the same, this member 3 being urged downwardly toward the cam disc 7 to follow the axial movement of the latter in a manner described below. The number of camming 40 portions 11 of the cam disc 7 are chosen so that the elongated member 3 reciprocates along its axis during one revolution a number of times equal to the number of cylinders of the internal combustion engine. The bottom end of the axially bored elongated member 3, as viewed in Fig. 1, is closed by the larger portion of an elongated stepped pin 14 formed with a bore through which the pin 6 extends. The shoulder of this stepped pin engages the bottom end of a coil spring 15 whose top end engages a valve 16 to urge the latter upwardly 45 against a valve seat 17 formed by a conical shoulder within the bored member 3. This valve 16 is connected to a piston portion 45 slidable in a cylindrical portion of the member 3 for a purpose described below, and above the piston portion 45, as viewed in Fig. 1, the valve 16 is formed with axial grooves so that the interior chamber 31 located within the member 3 above the valve

16, as viewed in Fig. 1, communicates with the top face of the piston 45.

A cylindrical sleeve 21 is located within the bore portion 20 of the housing 1, and the elongated member 3 extends slidably through the sleeve 21, the slidable engagement between elements 3 and 21 being such as to prevent passage of fluid between elements 3 and 21. A lever 22 is turnably carried by the housing 1 in the chamber 38 which communicates with the bore portion 20, and this lever 22 extends at its right free end, as viewed in Fig. 1, into an outer angular groove 23 formed in the sleeve 21 so that turning of the lever 22 will shift the sleeve 21 axially along the member 3. This sleeve 21 cooperates with a pair of bores 24 which overlap the top edge of the sleeve 21, in the position of the parts shown in Fig. 1, in order to control the flow of fluid through the bores 24, these bores passing through the wall of the elongated member 3.

The combined pump and distributor means of the present invention includes, in addition to the above-described elongated member 3, an elongated member 4 which is coaxial with member 3 and which is slidable within an elongated cylindrical recess of a cylindrical block 25, in the manner indicated in Fig. 1. The elongated member 4 determines the cross sectional size of the pump chamber into which fuel is drawn, as will be apparent from the description below. A spring 27 extends axially along the interior of the axially bored member 4 and presses at its top end against a ball member 26 which is thus urged against the closed end of the elongated recess formed in the block 25. The member 4 has at its bottom end an inwardly extending annular flange against which the bottom end of the spring 27 bears. Thus, this spring 27 urges the member 4 toward the member 3 so as to maintain the bottom flat end of member 4 against the top flat end of member 3, as viewed in Fig. 1. This spring 27 in addition urges the member 3 downwardly toward the cam disc 7 so that the spring 27 on the one hand guarantees that the members 3 and 4 shift together axially, and on the other hand that the members 3 and 7 shift together axially. The cylindrical block 25 is slidable within the cylindrical bore portion 20' of the cylinder means formed by the bored housing 1, and a plug 30 is threaded into the top open end of the bore portion 20' in order to close this bore portion in a fluidtight manner. The spring 27 in addition to serving the functions mentioned above urges the block 25 against the plug 30.

The valve 16 separates the pump chamber 31 from the chamber 32 formed by the bore portion in member 3 located beneath the valve 16, as viewed in Fig. 1. A radial bore 33 passing through the wall of member 3 communicates with the chamber 32 and with a plurality of fuel delivery passages 34 formed in the housing 1 and distributed about the axes of the member 3. Only one fuel delivery passage 34 is shown in the drawing. These fuel delivery passages lead to unillustrated conduits which convey the fuel to the several cylinders, and the rotating member 3 communicates through bore 33 successively with the fuel delivery passages 34.

A reservoir 35 contains the fuel and a pump 36 communicates with the reservoir to pump the fuel therefrom, this pump 36 being driven by the engine which is not shown in the drawing. The fuel discharged from the pump 36 passes through a filter 37 and from the latter along a suitable conduit into the chamber 38 which communicates with the bore portion 20. The fuel which overflows the filter 37 moves through an overflow valve 39 back to the reservoir 35. From the chamber 38 the fuel flows into a passage 40 formed in the housing 1, and this passage 40 communicates with the bore portion 2 in which the member 3 is axially and turnably movable. A plurality of suction bores 41 located in the same plane and passing radially through the wall of tubular member 3 cooperate in succession with the passage 40 for draw-

ing fuel into the chamber 31 and of course through the open bottom end of member 4 into the interior of the latter, the interior of member 4 and the portion of member 3 above valve 16 forming the chamber of the pump into which the fuel is drawn. Only one suction bore 41 is shown in the drawing, but it is to be understood that there are as many suction bores 41 as there are fuel delivery passages 34. The above-described structure operates in the following manner:

The parts of the fuel injection pump of Fig. 1 are shown in that position which they take when they reach the uppermost end position, as viewed in Fig. 1, that is, at the end of the pressure stroke and at the beginning of the suction stroke. After a small angular turning of the disc 7, which is rotated by the engine, the communication between the bore 33 and fuel delivery passage 34 is interrupted. At the same time, since the cam disc 7 moves downwardly as well as turns about its axis, the member 3 moves downwardly and fuel flows through bore 41 which communicates with passage 40 into the chamber 31. Also, fuel flows into the chamber 31 through the bores 24 as long as the latter are not closed by the sleeve 21. At the end of the suction stroke when the movable parts reach their lowermost position, the bore 41 is closed and the opening 33 communicates with one of the fuel delivery passages 34, and at this time the pressure stroke begins during which parts 3 and 4 move upwardly, as viewed in Fig. 1, so as to reduce the volume of the chamber in which fuel has been drawn and thus force the valve 16 to open so that the fuel located in the chamber 32 beneath the valve 16 is forced by the decreasing volume of the chamber 32 to move along one of the fuel delivery passages 34. As soon as the piston 45 becomes located at its top edge below the top edge of the conical seat 17, as viewed in Fig. 1, the fuel flows freely from the chamber 31 into the chamber 32. The valve 16 is formed below the conical part thereof which cooperates with seat 17, as viewed in Fig. 1, with axial grooves in its outer surface so that the chambers 31 and 32 can communicate with each other when the spring 15 has been compressed sufficiently. As soon as the valve member 3 has moved upwardly, as viewed in Fig. 1, through a distance sufficient to uncover the bores 24 by movement of these bores 24 above the sleeve 21, the delivery of fuel to the passage 34 ends. At this moment the valve 16 is urged back to its closed position by the spring 15, and the cooperation of piston portion 45 with the cylindrical portion of member 3 just above valve seat 17 reduces the pressure in the fuel fed to the cylinder of the engine and provides a quick closing of the injection valve which is not shown. The fuel which is displaced from the interior of chamber 31 until the end of the pressure stroke simply flows back into the chamber 38.

The above-described cycle of operations repeats itself during one revolution of cam disc 7 a number of times equal to the number of cylinders so that all of the cylinders of the engine are supplied with fuel. Thus, the suction passage 40 communicated successively with the suction bores 41 and in the same way the opening 33 communicates successively with the fuel delivery passages 34.

By turning the lever 22 it is possible to adjust the quantity of fuel delivered to the engine. A governor may be operatively connected to the lever 22 to control the latter or this lever 22 may be manually controlled by a suitable linkage connected to the lever. By turning the lever 22 in a clockwise direction, as viewed in Fig. 1, the amount of fuel delivered to the engine will be diminished because the openings 24 will be uncovered at an earlier time during the pressure stroke, and on the other hand, turning of the lever 22 in a counterclockwise direction, as viewed in Fig. 1, will result in an increase in the amount of fuel delivered to the engine.

In the embodiment of the invention which is shown in Fig. 2, the cam disc 7 and rollers 10 are identical with that

of Fig. 1, and the thrust bearing 9 also is identical so that these parts are not illustrated. The cam disc 7 is in driving engagement with the pin 6 shown in Fig. 2 which is identical with the pin 6 of Fig. 1. Furthermore, the valve structure within the tubular member 3a of Fig. 2 is identical with that in the tubular member 3 of Fig. 1 so that this valve structure need not be described again. Also, the cylindrical block 25 and plug 30 of Fig. 2 are identical with elements 25 and 30 of Fig. 1. The elongated member 4a of Fig. 2 is identical with elongated member 4 except that the bottom end of the elongated member 4a is formed with a conical face which cooperates with the conical surface of a recess formed in the top end of member 3a, in the manner shown in Fig. 2. The spring 27 is identical with spring 27 of Fig. 1 and cooperates in the same way with the ball member 26 to urge member 4a toward member 3a so as to maintain their end faces in engagement with each other, this spring 27 also keeping the block 25 in engagement with the plug 30. As is apparent from Fig. 2 the elongated member 4a forms part of the chamber 31a of the pump into which the fuel is drawn. The conical shape of the cooperating end faces of members 3a and 4a of Fig. 2 guarantees a proper fit between these cooperating end faces, these end faces cooperating with each other in a fluidtight manner. An important difference of the embodiment of Fig. 2 over that of Fig. 1 resides, however, in the manner in which the amount of fuel delivered to the engine is adjusted. In the embodiment of Fig. 1 the amount of fuel delivered to the engine is controlled by adjusting the position of the sleeve 21 so as to adjust the length of the effective part of the pressure stroke. With the embodiment of Fig. 2 the amount of fuel delivered to the engine is regulated by controlling the amount of fuel sucked into the fuel pump. Thus, the suction passage 40a formed in the housing 1a of Fig. 2 communicates directly with the filter 37, instead of with the chamber 33 as in Fig. 1, and in the conduit which leads from the filter 37 to the suction passage 48 a throttle valve 50 is provided. This throttle valve 50 may be controlled in the same way as lever 22 either manually or by a suitable governor.

The sleeve 21a of Fig. 2 is used only to regulate the maximum amount of fuel delivered during operation of the engine. The adjustment of the sleeve 21a is provided by a pin 51 turnable within a suitable bore of the housing 1a and carrying an eccentric pin 52 which extends into the annular groove 23a of sleeve 21a. It is apparent that by turning the pin 51 the axial position of the sleeve 21a will be determined, and once the sleeve 21a is thus positioned axially, lead or the like is used to block up the hole in which the pin 51 is located so that undesired turning of the pin 51 is prevented.

The filter 37 of Fig. 2 has no over flow valve. The overflow from the pump 36 which communicates with the reservoir 35 in the embodiment of Fig. 2 flows along a conduit to the passage 55 formed in the housing 1a. This passage 55 communicates with the elongated hollow portion 56 formed in the housing 1a, this hollow portion 56 being in the form of an elongated stepped bore, the larger part of which is threaded, as is indicated in Fig. 2. A slide member 57 is slidable along the section of hollow portion 56 which is of smaller diameter. This slide member 57 is formed with a passage which includes an inlet portion 58 leading from the left end face of slide member 57, as viewed in Fig. 2, and an outlet portion 59 leading from inlet portion 58 to the right end of the slide member 57, as viewed in Fig. 2. It will be noted that the outlet portion 59 of this passage is of a smaller cross section than inlet portion 58 so that when fuel flows along inlet portion 58 through outlet portion 59 the flow of the fuel is necessarily throttled. Furthermore, it will be noted that the elongated slide member 57 is formed with a transverse bore 60 extending across the axial bore 58, this transverse bore 60 forming a second outlet pas-

sage which leads from the inlet passage 58 to the exterior of the slide member 57 at an intermediate part thereof. It will be noted that the transverse bore 60 is of a larger cross section than the axial outlet portion 59. An elongated tubular member 64, which is closed at its right end, as viewed in Fig. 2, is threaded into the enlarged threaded bore portion of the stepped bore in the smaller part of which the slide member 57 is slidable. This slide member 57 is slidable into and out of the larger bore portion, and a spring 61 in the larger bore portion urges the member 57 out of the larger bore portion into the smaller portion of the stepped bore 56, so that the spring 61 tends to maintain the slide member 57 in the position illustrated in Fig. 2. In this position the transverse bore 60 is closed. Furthermore, in the illustrated position of slide member 57 a passage 62 formed in the housing 1a is closed at its bottom end by the slide member 57. This passage 62 communicates with the hollow portion 56 and with the bore portion 20a of the housing 1a. The spring 61 is coiled about an elongated pin 63 and bears against the enlarged head end thereof shown at the right end of pin 63, as viewed in Fig. 2. This pin 63 is located within the hollow tubular member 64. This tubular member 64 is formed with openings passing through its wall and communicating with a conduit portion 65 which communicates with a conduit portion 66 leading back to the reservoir 35.

It is evident from Fig. 2 that as the speed of pump 36 increases so as to increase the pressure of the fuel delivered from the pump 36, this fuel under pressure will move through the passage 55 into the hollow portion 56 and will tend to shift the slide member 57 to the right, as viewed in Fig. 2. This movement of the slide member 57 to the right into the larger portion of bore 56 is resisted by the spring 61. This spring 61 exerts on the slide member 57 a force which is insufficient to maintain the slide member 57 in the illustrated position during normal operation of the engine. However, when the engine is being started and thus turns very slowly the engine does not drive the pump 36 with a speed sufficient to provide a fuel pressure capable of shifting member 57 against the force of spring 61 through a distance sufficient to uncover the passage 62 and locate the transverse bore 60 within the larger portion of bore 56. Only when the engine attains the speed greater than its starting speed does the pump 36 provide sufficient pressure in the fuel to shift the slide member 57 to a point where its right end, as viewed in Fig. 2, engages the pin 63 so that the bore portion 20 communicates through the passage 62 with the inlet passage 58 and from the latter through the outlet passage 60 with the larger bore portion to provide an unrestricted flow of fuel from passage 62 back to reservoir 35. Thus, the slide member 57 in cooperation with the pump 36 and spring 61 as well as the stepped bore 56 provides a control means which automatically increases the cross section of the return flow passage when the engine turns at a speed above its starting speed and which automatically decreases the cross section of this passage when the engine turns at a speed below its idling speed.

The embodiment of Fig. 2 operates in the following manner:

During the suction stroke of elements 3a and 4a a greater or lesser amount of fuel is drawn into the chamber 31a from suction passage 40a through one of the openings 41a formed in member 3a in accordance with the position of the valve 50. The feeding of fuel during the pressure stroke begins as soon as the volume of chamber 31a decreases. When the valve 50 is fully opened the pump chamber 31a is completely filled with fuel. In this event the delivery of the fuel from the injection pump begins simultaneously with the pressure stroke of elements 3a and 4a. This delivery of fuel to the engine ends when the bores 24a of member 3a, which correspond to bores 24 of member 3 described above, communicate with the

inner annular groove 68 formed in the sleeve 21a, this inner groove 68 communicating with the bore portion 20a through openings which pass through the wall of sleeve 21a to the groove 68, as shown in Fig. 2. The fuel displaced from the chamber 31a during the remainder of the pressure stroke after openings 24a communicate with groove 68 overflows through the passage 62 back to the reservoir 35. At the very low engine speeds which take place during starting of the engine, the supply of fuel to the engine ends only at the end of the pressure stroke since at this time the passage 62 is closed by the slide member 57. In other words, when slide member 57 closes passage 62 the fuel displaced from chamber 31a by the reduction in the volume thereof can only cause the valve within the member 3a to remain open so that the fuel continues to flow from the chamber beneath this valve along one of the fuel delivery passages 34a to a particular cylinder of the engine. In this way, the embodiment of Fig. 2 provides during starting of the engine an amount of fuel which is greater than the greatest amount of fuel delivered to the engine during normal operation thereof.

With both of the above-described embodiments of the invention the part of chamber 31 or 31a located within member 3 above the valve 16 cannot have its volume changed. The remaining portion of this chamber 31 or 31a is determined by the member 4 or 4a, respectively, and since this member 4 or 4a may be easily exchanged, this member 4 or 4a determines the volume of the pump chamber into which the fuel is drawn. By removing the plug 30 it is a very simple matter to remove elements 25 and 4 or 4a together with the spring 27 in the latter, so that member 4 or 4a may be exchanged for another member of a different size to change the volume of the suction chamber of the pump. Inasmuch as elements 4 and 25 are simple and inexpensive, the modification of the injection pump provided by exchanging these members involves but little cost, and furthermore, since these members are subject to great wear the replacement of worn parts 4 or 4a and 25 with new parts also involves but little cost.

It is pointed out that with both embodiments of the invention it is not essential that the member 4 or 4a participate in the rotation of the parts 3 or 3a, respectively. However, the parts 4 or 4a must participate in the axial movement of the parts 3 or 3a, respectively.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of injection pumps differing from the types described above.

While the invention has been illustrated and described as embodied in injection pumps having easily exchangeable parts, 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. In an injection pump, in combination, elongated cylinder means; passage means formed in said cylinder means for leading fuel to and from said cylinder means; and combined distributor and pump means axially and turnably movable in said cylinder means for controlling the flow of fuel along said passage means to and from said cylinder means, said combined distributor and pump means including a first elongated member accommodating a valve and cooperating with said passage means for

opening and closing the same, a second elongated member formed with an axial bore and determining the size of a chamber of the pump means into which fuel is drawn, said second member having an end which engages an end of said first member, said first and said second elongated member reciprocate to provide the pumping action, and spring means engaging one of said members for urging the same toward the other of said members to maintain said ends of said members in engagement with each other during axial and rotational movement of the combined pump and distributor means.

2. In an injection pump, in combination, elongated cylinder means; passage means formed in said cylinder means for leading fuel to and from said cylinder means; and combined distributor and pump means axially and turnably movable in said cylinder means for controlling the flow of fuel along said passage means to and from said cylinder means, said combined distributor and pump means including a first elongated member accommodating a valve and cooperating with said passage means for opening and closing the same, a second elongated member formed with an axial bore and determining the size of a chamber of the pump means into which fuel is drawn, said second member having an end which engages an end of said first member, said first and said second elongated member reciprocate to provide the pumping action, a block located in said cylinder means and formed with an elongated bore into which said second member slidably extends, and a spring located within said second member and bearing against the same and said block for urging said second member toward said first member to maintain said ends of said members in engagement with each other during axial and rotational movement of the combined pump and distributor means.

3. In an injection pump, in combination, elongated cylinder means; passage means formed in said cylinder means for leading fuel to and from said cylinder means; and combined distributor and pump means axially and turnably movable in said cylinder means for controlling the flow of fuel along said passage means to and from said cylinder means, said combined distributor and pump means including a first elongated member accommodating a valve and cooperating with said passage means for opening and closing the same, a second elongated member formed with an axial bore and determining the size of a chamber of the pump means into which fuel is drawn, said second member having an end which engages an end of said first member, said first and said second elongated member reciprocate to provide the pumping action, a block slidably located in said cylinder means and formed with an elongated bore into which said second member slidably extends, plug means removably carried by and closing an open end of said cylinder means, said plug means engaging an end of said block, and a spring located within said second member and bearing against the same and said block for urging said block against said plug means and for urging said second member toward said first member to maintain said ends of said member in engagement with each other during axial and rotational movement of the combined pump and distributor means, whereby upon removal of said plug means from said cylinder means said block and second member may be removed.

4. In an injection pump, in combination, a housing; a fuel reservoir; a supply pump communicating with said reservoir for pumping fuel therefrom, said supply pump being driven by the engine to which the injection pump is connected; passage means formed in part in said housing and communicating with said housing, reservoir and supply pump for leading fuel from said supply pump to said housing and from said housing back to said reservoir; and control means located in a return portion of said passage means leading fuel toward said reservoir for increasing the cross section of said passage means as the speed of operation of said supply pump increases and for

decreasing said cross section as the speed of operation of said supply pump decreases, so that when said supply pump is driven by an engine operatively connected to the injection pump said cross section increases when the engine speed increases and decreases when the engine speed decreases.

5. In an injection pump, in combination, a housing; a fuel reservoir; a pump communicating with said reservoir for pumping fuel therefrom; passage means formed in part in said housing and communicating with said housing, reservoir and pump for leading fuel from said pump to said housing and having a return portion for leading fuel from said housing back to said reservoir, said return portion of said passage means including an elongated hollow portion having a first section of a smaller cross section than a second section of said hollow portion adjoining said first section thereof; a slide member slidably located in said first section of said hollow portion for movement from the latter into and out of said second section thereof, said slide member having one end in constant communication with said first section and an opposite end in constant communication with said second section of said hollow portion, said slide member being formed with an elongated passage having an inlet portion leading from said one end of said slide member, a first outlet portion leading from said inlet portion to said opposite end of said slide member and being of a smaller cross section than said inlet portion, and a second outlet portion leading from said inlet portion to a part of said slide member intermediate said ends thereof and having a cross section larger than said first outlet portion so that the flow of fluid through said passage of said slide member from said first to said second section of said hollow portion will take place through said inlet portion and first outlet portion of said slide member passage until said slide member shifts into said second section of said hollow portion to an extent sufficient to place said second outlet portion in communication with said second section; a conduit leading from said pump to said first section of said hollow portion for delivering fuel under pressure thereto for urging said slide member into said second section of said hollow portion; and spring means urging said slide member into said first section of said hollow portion with a force great enough to prevent movement of said slide member into said second section of said hollow portion at those times when an engine driving said pump operates below its idling speed.

6. In a fuel injection pump, in combination, a housing formed with a passage along which fuel is returned to a fuel reservoir, said passage having a portion formed with a stepped bore having adjoining bore portions of different diameters; an elongated slide member slidable in the smaller of said bore portions for movement into and out of the larger of said bore portions, said slide member being formed with an axial bore communicating at one end with said smaller bore portion and at its opposite end with said larger bore portion, said opposite end of said axial bore being of a smaller cross section than said one end thereof, and said slide member being formed intermediate its ends with a transverse bore communicating with said axial bore and being of a larger cross section than said opposite end of said axial bore, said transverse bore being closed except when said slide member has shifted to a predetermined extent into said larger bore portion; a conduit communicating with said smaller bore portion for supplying thereto fuel under pressure for urging said slide member into said larger bore portion; a pump driven by an engine operatively connected to the injection pump and communicating with said conduit for delivering fuel under pressure thereto; and spring means in said larger bore portion engaging said slide member for urging the same into said smaller

bore portion with a force sufficient to prevent movement of said slide member into said larger bore portion when the engine driving said pump operates below idling speed.

7. In an injection pump, in combination, elongated cylinder means; passage means formed in said cylinder means for leading fuel to and from said cylinder means; and combined distributor and pump means axially and turnably movable in said cylinder means for controlling the flow of fuel along said passage means to and from said cylinder means, said combined distributor and pump means including a first elongated member accommodating a valve and cooperating with said passage means for opening and closing the same, a second elongated member formed with an axial bore and determining the size of a chamber of the pump means into which fuel is drawn, said second member having a flat end which engages a flat end of said first member, said first and said second elongated member reciprocate to provide the pumping action, and spring means engaging one of said members for urging the same toward the other of said members to maintain said ends of said members in engagement with each other during axial and rotational movement of the combined pump and distributor means.

8. In an injection pump, in combination, elongated cylinder means; passage means formed in said cylinder means for leading fuel to and from said cylinder means; and combined distributor and pump means axially and turnably movable in said cylinder means for controlling the flow of fuel along said passage means to and from said cylinder means, said combined distributor and pump means including a first elongated member accommodating a valve and cooperating with said passage means for opening and closing the same, a second elongated member formed with an axial bore and determining the size of a chamber of the pump means into which fuel is drawn, said second member having a conical end which engages and mates with a conical end of said first member, said first and said second elongated member reciprocate to provide the pumping action, and spring means engaging one of said members for urging the same toward the other of said members to maintain said ends of said members in engagement with each other during axial and rotational movement of the combined pump and distributor means.

9. In an injection pump, in combination, elongated cylinder means; passage means formed in said cylinder means for leading fuel to and from said cylinder means; and combined distributor and pump means axially and turnably movable in said cylinder means for controlling the flow of fuel along said passage means to and from said cylinder means, said combined distributor and pump means including a first elongated member accommodating a valve and cooperating with said passage means for opening and closing the same, a second elongated member of a different diameter of said first elongated member formed with an axial bore and determining the size of a chamber of the pump means into which fuel is drawn, said second member having an end which engages an end of said first member, said first and said second elongated member reciprocate to provide the pumping action, and spring means engaging one of said members for urging the same toward the other of said members to maintain said ends of said members in engagement with each other during axial and rotational movement of the combined pump and distributor means.

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