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PUMPING AND DISTRIBUTING MECHANISM

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2 Sheets-Sheet 2

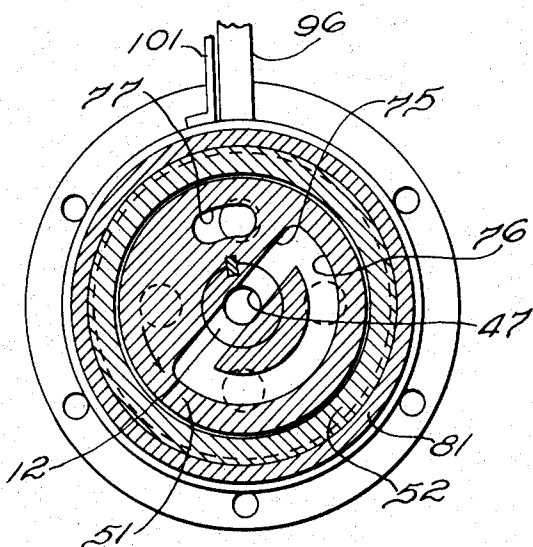


FIG. 4.

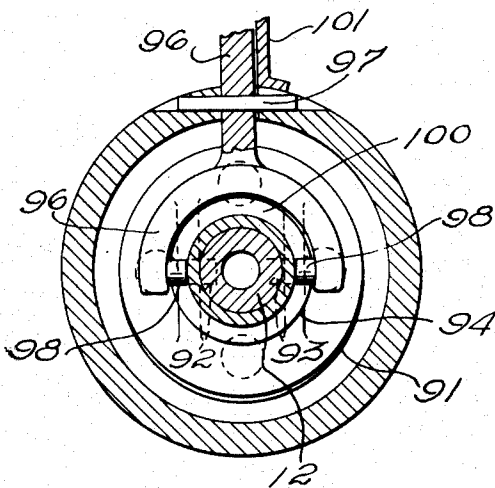


FIG. 5.

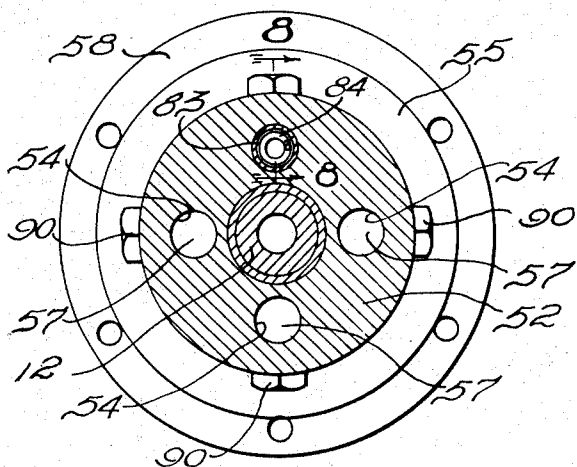


FIG. 6.

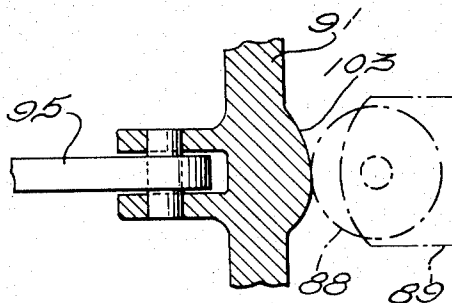


FIG. 7.

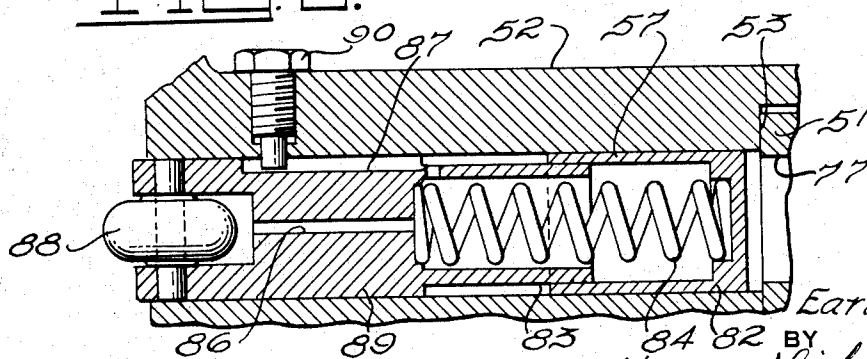


FIG. 8.

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PUMPING AND DISTRIBUTING
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10 Claims. (Cl. 103—5)

This invention relates to pumping and distributing mechanism more especially adapted to inject fuel to the individual cylinders of an internal combustion engine.

5 The principal object of the invention is to provide an improved pumping and distributing apparatus for injecting controlled amounts of fuel to the individual cylinders of an internal combustion engine.

10 Another object is to provide for the uniform distribution of fuel to the individual cylinders of an internal combustion engine.

Other objects are to provide a pumping and distributing mechanism which is light and compact; which requires but a small amount of power to operate the same; which is efficient in its operation, and which is economical to manufacture.

Other objects and advantages will become apparent from the following description and appended claims taken in connection with the accompanying drawings.

According to one aspect the invention involves a source of fluid fuel under pressure, a distributor head having a port communicating between
25 such source and a plurality of pressure chambers and another port communicating between the pressure chambers and the individual cylinders of an internal combustion engine, and manual control means for regulating the amount of fuel admitted to and discharged from said pressure
30 chambers.

According to another aspect the invention involves a rotary pump adapted to deliver fluid fuel under pressure through its shaft to a distributor head provided with a port for delivering fuel to a plurality of pressure chambers individual to the cylinders of an internal combustion engine and provided with compressible pistons, and another
35 port for delivering the fuel under pressure to the individual cylinders of the engine, and mechanism for controlling the position of the compressible pistons in the pressure chambers during the admission and discharge of fuel to and from these chambers.

45 In the drawings:

Figure 1 is a medial, vertical, and longitudinal section of a pumping and distributing mechanism constructed in accordance with this invention.

Fig. 2 is an enlarged horizontal section taken
50 on the line 2—2 of Fig. 1.

Figs. 3, 4, 5 and 6 are enlarged transverse vertical sections taken on the lines 3—3, 4—4, 5—5 and 6—6 respectively of Fig. 1.

Fig. 7 is an enlarged detail section taken on the
55 line 7—7 of Fig. 1, and

Fig. 8 is an enlarged detail section taken on the line 8—8 of Fig. 6.

For the purpose of illustrating the genus of the invention, a typical concrete embodiment is shown in the accompanying drawings wherein 10 is a

pump casing provided with a pump chamber 11 opening upon one face thereof. The chamber 11 is of cylindrical formation and has journaled eccentrically therein a shaft 12 and a rotor 13
65 mounted on this shaft, the shaft 12 being journaled in a bearing portion 14 extending from the pump casing 10 and provided with a bearing bushing 15. The open face of the casing 10 is closed by means of a cap member 16 secured to the casing by means of bolts 20 and provided with a bearing
70 portion 17 extending therefrom and having a bushing 18 adapted to journal the shaft 12. The bearing portion 17 has securing flanges 21 formed thereon whereby the cap member and pump may be secured to the crank case wall 22 of an internal combustion engine (not shown), so that shaft
75 12 may be operatively connected with any desired driving means within the internal combustion engine.

The rotor 13 may be fixed against relative
80 movement to the shaft 12 by means of a key 19. The rotor is provided with slots 23 in which are disposed blades 24 adapted to contact the peripheral wall of the chamber 11. The shaft 12 and rotor 13 are provided with registering openings 25 and 26 communicating between the slots
85 23 and in which are disposed springs 27 adapted to bias the blades 24 into engagement with the peripheral wall of chamber 11. Pins 28 may be disposed within the springs 27 to prevent buckling of the springs and binding between these
90 elements and the openings 25 and 26. The casing 10 is provided with oppositely disposed inlet and outlet cavities 30 and 31 which form slot-like extensions of the chamber 11. The inlet
95 cavity 30 communicates through an inlet passage 33 with an inlet conduit 32 adapted to communicate with a source of supply of fluid fuel for an internal combustion engine. The outlet cavity 31 communicates with an outlet passage 34
100 which in turn communicates with an annular slot 35 on the shaft 12. The inlet and outlet passages 33 and 34 are connected by a bypass 36. The outlet passage 34 is enlarged as indicated at 37 to receive a bushing 38 against which a ball
105 valve 40 may be biased by means of a spring 41. The outer end of spring 41 is adapted to engage a plug 42 threaded to the casing member 10. Excessive pressures developed within the pump will lift the ball valve 40 from its seat on the bushing
110 38 against the tension of spring 41 to bypass the fuel to the inlet passage 33. The tension of the spring 41 determines the pressure at which the fuel will be by-passed to the inlet passage. The tension of spring 41 may be regulated by disposing
115 shims or gaskets 43 between the head of the plug 42 and the casing 10, or the plug 42 may be removed to substitute a spring of a different tension for the spring 41.

Referring particularly to Figs. 1, 2 and 3, it 120

will be noted that fuel is conducted from the outlet cavity 31 to a longitudinally extending passage 45 (Fig. 2) formed in casing member 10 and through a radially extending passage 46 intersecting the passage 45 and communicating with the annular slot 35 on shaft 12. The shaft 12 is bored from the forward end (right end as viewed in Fig. 1) to provide a central passage extending to a point slightly in rear of the annular slot 35. Radially extending passages 48 communicate between the central passage 47 in shaft 12 and the annular slot 35. Plugs 44 and 50 are threaded into casing 10 at the ends of the by-pass passage 36 and the radially extending passage 46 to close the exterior ends of these passages.

A distributor head 51 is fixed to the shaft 12 adjacent its forward end and housed in a casing member 52. This casing member is provided with a distributing chamber 53 opening on the forward face of casing 52 and is provided with a number of pressure chambers 54, the number of these pressure chambers being the same as the number of cylinders into which fuel is to be injected. The casing 52 has an enlarged portion 55 at the rear end thereof to provide a chamber 56 for the accommodation of control and actuating elements for collapsible pistons 57 mounted in the pressure chambers 54. The enlarged portion 55 is provided with securing flanges 58 adapted to cooperate with securing flanges 60 formed on the bearing portion 14 for securing casings 10 and 52 in assembled relation, the flanges secured by means such as bolts 61. A drain conduit 62 communicates with the chamber 56 to conduct any fuel which may leak by the bearing bushing 15 and by the collapsible pistons 57 back to the source of supply of the fuel.

To provide seals about the sides of the rotor 13 of the fuel pump, coil springs 63 are disposed about the shaft 12 on each side of the rotor. At their outer ends these springs abut against washers 64 and gaskets 65 interposed between the bearings 15 and 18 and the springs 63. Collars 66 are disposed about the shaft 12 and the latter is rotatable therein. The collars are actuated toward the rotor by reason of the engagement of the outer ends of the collars with the springs 63 and a limited amount of axial movement of these collars with respect to the shaft 12 is permitted by flexible diaphragms 67, the inner peripheries of which are sealed in slots 68 extending peripherally about the collars 66. The outer peripheries of the diaphragms 67 are pressed against shoulders 70 formed by the faces of recesses 71 remote from the rotor 13. The seals between the outer peripheries of the diaphragms 67 and the shoulders are effected by means of gaskets 72 (shown in Fig. 2) and cylindrical rings 73 which are pressed into the recesses 71 to effectively clamp the outer margins of the diaphragms 67 against the gaskets 73. The fuel delivered from the fuel pump in passing from the radially extending passage 46 to the annular slot 35 passes between the coils of a spring 63. The abutting edges of the collars 66 which engage the rotor 13 may be beveled or rounded, as indicated at 74, to provide a relatively narrow line of contact with the face of the rotor. The springs 63 resiliently urge the abutting edges of collars 66 against the rotor and also slightly compress the gaskets 65 to seal the sides of the pump rotor and also to prevent leakage between the shaft 12 and the bearings 18 and 15. Should the gaskets 65 become worn so that a slight amount of leakage occurs between the bearing 15 and the shaft 12,

the fuel which would escape between the bushing 15 and shaft 12 would be returned by the drain conduit 62 to the source of fuel supply.

Referring particularly to Figs. 1, 4, 6 and 8, the construction of the distributor head 51, the pressure chambers 54 and the elements immediately associated therewith will be explained. The shaft 12 and distributor head 51 are provided with oppositely extending radially disposed passages 75 which extend from the central passage 47 within the shaft 12 to an annular port 76 within the distributor head 51. The annular port 76 is open to the rear face of the distributor head 51 and extends for approximately 180 degrees around the distributor head. The distributor head 51 is provided with a longitudinally extending port 77 which, as the distributor head rotates, communicates between the pressure chambers 54 and passages 78 leading to conduits 80 which convey fuel to the individual cylinders of the internal combustion engine. The distributor illustrated is adapted to inject fuel into the cylinders of a four cylinder engine. The port 77 is so disposed in the distributor head 51 that it lags the port 76 by an angle of approximately 135 degrees in registering with the compression chamber. The angle of lag between the ports 75 and 77 would be varied according to the number of cylinders to which fuel is to be distributed. The cap member 79 may be secured to the casing member 52 to close the distributing chamber 53 by means of a sleeve 81 threaded to the casing member 52, a pin 85 being employed to align the passages 78 with respect to the compression chambers 54. The compressible piston members 57 comprise telescoping cylindrical members 82 and 83 which are normally adapted to be biased into extended relation by means of springs 84 disposed within the cylindrical members. Each member 82 has a closed end and is of such diameter that it makes a close fit within the pressure chambers 54. The cylindrical members 83 have rearwardly disposed extensions 89 each provided with a vent passage 86, a guide slot 87 and each has mounted at the rear extremity thereof an anti-friction roll 88, the purpose of which will presently appear. Bolts 90 are threaded through the casing member 52 so that their inner ends cooperate with the slots 87 to limit the forward and rearward movement of the cylindrical members 83.

Referring particularly to Figs. 1, 5 and 7, the construction of the control and actuating mechanism for the compressible pistons 57 will be described. This mechanism comprises a wobble plate pivoted on a transverse axis by means of lugs 92 extending inwardly from the plate and engaging bearing openings 93 in the shaft 12. The inclination of the wobble plate 91 with respect to the shaft 12 is controlled by means of a sleeve member 94 keyed to the shaft 12 so as to be non-rotatably secured thereto but with the desired amount of longitudinal play relative to the shaft. The wobble plate and sleeve are connected by a link 95 pivoted to each of these elements, the pivotal connection between the link and wobble plate being arranged at a point adjacent the periphery of the wobble plate and on a line normal to the axis of the pivotal connection between the wobble plate and shaft 12 and passing through the axis of shaft 12. The forward and rearward movement of the sleeve 94 relative to the shaft 12 is controlled by means of a forked lever 96 pivoted at 97 to the enlarged portion 55. The lever 96 is provided at its lower end with inturned lugs 98 adapted to cooperate with an

annular slot 100 formed in the sleeve member 94. A ratchet segment 101 fixed to the enlargement 55 is adapted to cooperate with a spring pressed detent 102 mounted on the lever 96 to maintain the sleeve 94 in adjusted position relative to the shaft 12. Any other desired control means for maintaining the sleeve 94 in adjusted position and for maintaining the wobble plate 91 in its desired inclination with respect to the shaft 12 may be employed. The wobble plate 91 may be provided with a cam surface 103 on its face opposite the connection with the link 95 to give the compressible pistons 57 an added impulse when the port 77 registers with the pressure chambers 54 and with the discharge passages 78.

In the operation of the device, fuel supplied through the fuel inlet 32 has its pressure increased by the pump disposed within casing 10. When excessive pressures are developed within the pump the fuel is by-passed by the ball valve means 40 back to the inlet passage 33 of the pump. The fuel discharged by the pump is conducted through passages 45 and 46 to the annular passage 35 formed on shaft 12 and thence through the radial passages 48 to the interior of the shaft 12 and to the distributor head 51. The distributor head 51 delivers fuel under pressure through the passages 75 and port 76 to the pressure chambers 54 through approximately one-half of each revolution of the distributor head. As viewed in Fig. 1, the fuel is being discharged from the uppermost pressure chamber 54 through the port 77 in the distributor head 51 and through the uppermost outlet passage 78 leading to a cylinder of the internal combustion engine. At this time the upper half of wobble plate 91 is pressing the uppermost piston 57 to its position farthest forward relative to the distributor head 51 for a given inclination of the wobble plate 91. At the same time the lower half of wobble plate 91 is retracted so that the lowermost piston 57 is in its rearmost position so that fuel may be forced into the pressure chamber 54 at the bottom of the distributing device. Each pressure chamber 54 admits fuel therein during the time the retracted half of the wobble plate contacts the roll 88 on the rearward extension 89 of the piston. During one half of each revolution of distributor head 51 the fuel is either trapped within each pressure chamber 54 and under the pressure of springs 84 or is being discharged through the port 77 in the distributor head 51. During the time the fuel is under pressure within the pressure chambers the springs 84 allow the telescoping members 82 to enclose the inner telescoping members 83. As the discharge port 77 in the distributor head 51 comes into registry with the pressure chambers 54, the springs 84 expand and discharge the fuel within the pressure chambers through the discharge port and through the discharge passages 78 to the conduits 80 leading to the cylinders of the engine. At the time of discharge from the pressure chambers the cam 103 on wobble plate 91 gives an added impulse to the pistons 57 to aid in discharging the fluid from the compression chambers. The variation of the angle which the wobble plate 91 forms with the shaft 12 changes not only the admission of fluid to the compression chambers, but also modifies the force applied to the compressible pistons for discharging the fluid from the chambers. The angularity of the wobble plate 91 is varied by sliding the sleeve 94 forwardly and rearwardly relative to the shaft 12 by the manual control means comprising the pivoted forked lever 96. The spring pressed de-

tent 102 and ratchet segment 101 may be employed to retain the wobble plate 91 in the desired angular position relative to the shaft 12.

As many changes could be made in the above described construction, and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or showing shall be interpreted as illustrative and not in the limiting sense.

What is claimed is:

1. A pumping and distributing mechanism for a multi-cylinder internal combustion engine comprising a shaft rotatable by said engine and provided with a passage extending through a portion of its length, a distributor head fixed to said shaft, a rotary pump comprising a rotor fixed to said shaft and a pump casing having a pump chamber provided with an outlet communicating with the passage in said shaft, said distributor head being provided with a port communicating with the passage in the shaft, a plurality of pressure chambers adapted during rotation of the distributor head to communicate with said port, said distributor head being provided with another port adapted during rotation of the head to communicate between said chambers and the individual cylinders of said engine, pistons movably positioned in each of said pressure cylinders, means operable by said shaft for moving said pistons and means controlling the movement of said pistons for regulating the admission and discharge of fuel to and from said pressure chambers.

2. A pumping and distributing mechanism for a multi-cylinder internal combustion engine comprising, a shaft rotatable by said engine and provided with a passage extending through a portion of its length, a distributor head fixed to said shaft, a rotary pump comprising a rotor fixed to said shaft and a pump casing having a pump chamber provided with an outlet communicating with the passage in said shaft, said distributor head being provided with a port communicating with the passage in said shaft, a plurality of pressure chambers adapted during rotation of the distributor head to communicate with said port, said distributor head being provided with another port adapted during rotation of the head to communicate between said chambers and the individual cylinders of said engine, compressible pistons movably positioned in each of said pressure chambers, means secured to said shaft for moving said pistons to discharge fuel from said chambers and manual control means for regulating the amount of fuel admitted to and discharged from said pressure chambers.

3. A pumping and distributing mechanism for a multi-cylinder internal combustion engine comprising a shaft rotatable by said engine and provided with a passage extending through a portion of its length, a distributor head fixed to said shaft, a rotary pump comprising a rotor fixed to said shaft and a pump casing having a pump chamber provided with an outlet communicating with the passage in said shaft, said distributor head being provided with a port communicating with the passage in the shaft, a plurality of pressure chambers adapted during rotation of the distributor head to communicate with said port, said distributor head being provided with another port adapted during rotation of the head to communicate between said chambers and the individual cylinders of said engine, a compressible piston movably positioned in each of said pressure chambers, a wobble plate pivotally con-

5 nected to said shaft so as to be rotated thereby and engageable with said pistons for moving the latter to discharge fuel from said chambers and manual means for rotating said wobble plate about its
 10 pivotal connection to said shaft for regulating the amount of fuel admitted to and discharged from said pressure chambers.

4. In a fuel injection device for a multi-cylinder internal combustion engine, in combination,
 15 a source of fuel under pressure, a plurality of pressure chambers, a compressible piston movably positioned in each of said chambers, a rotatable distributor head provided with a port adapted during rotation of the head to communicate between said source and said chambers, said head
 20 being provided with another port adapted during rotation of the head to communicate between said chambers and the individual cylinders of said engine, means for rotating said head, and means for adjustably moving said pistons in said chambers to regulate the admission and discharge of fuel to and from said pressure chambers.

5. In a fuel injection device for a multi-cylinder internal combustion engine, in combination, a
 25 source of fuel under pressure, a plurality of pressure chambers, a compressible piston movably positioned in each of said pressure chambers, a rotatable distributor head provided with a port adapted during rotation of the head to communicate between said source and said chambers, said head being provided with another port adapted during rotation of the head to communicate between said chambers and the individual cylinders of said engine, means operable by said engine for rotating said head, means operable by said engine for moving said pistons to discharge fuel from said chambers, and manual control means for regulating the amount of fuel admitted to and discharged from said pressure chambers.

40 6. In a fuel injection device for a multi-cylinder internal combustion engine, in combination, a source of fuel under pressure, a plurality of pressure chambers, a compressible piston movably positioned in each of said chambers, a rotatable distributor head provided with a port adapted during rotation of the head to communicate between the source and said chambers to admit fuel under pressure to said chambers, said head being provided with another port adapted during rotation of the head to communicate between said chambers and the individual cylinders of said engine, a shaft operable by said engine for rotating said head, a wobble plate pivotally connected to said shaft so as to be rotated thereby and engageable with said pistons for moving the latter to discharge fuel from said chambers, and manual control means for rotating said wobble plate about its pivotal connection to said shaft for regulating the amount of fuel admitted to and discharged from said pressure chambers.

7. In a fuel injection device for a multi-cylinder internal combustion engine, in combination, a source of fuel under pressure, a plurality of pressure chambers, a compressible piston movably positioned in each of said chambers, a rotatable distributor head provided with a port adapted during rotation of the head to communicate between said source and said chambers to admit fuel under pressure to the chambers, said head being provided with another port adapted during rotation of the head to communicate between said chambers and the individual cylinders of said

engine, a shaft operable by said engine for rotating said head, a wobble plate pivotally connected to said shaft so as to be rotated thereby and engageable with said piston for moving the latter to discharge fuel from said chambers, a sleeve slidably but non-rotatably mounted on said shaft, a link pivotally connected to said wobble plate and said sleeve, and a lever for manually sliding said sleeve along said shaft to rotate said wobble plate about its pivotal connection to said shaft for regulating the amount of fuel admitted to and discharged from said pressure chambers.

8. In a fuel injection device for a multi-cylinder internal combustion engine, in combination, a source of fuel under pressure, a plurality of pressure chambers, a compressible piston movably positioned in each of said pressure chambers, each compressible piston comprising a pair of telescoping cylindrical members and a spring disposed in said members for urging the latter into extended relation, a rotatable distributor head provided with a port adapted during rotation of said head to communicate between said source and said chambers, said head being provided with another port adapted during rotation of said head to communicate between said chambers and the individual cylinders of said engine, means for rotating said head, and means for adjustably moving said pistons in said chambers to regulate the amount of fuel admitted to and discharged from said pressure chambers.

9. In a fuel injection device for a multi-cylinder internal combustion engine, in combination, a source of fuel under pressure, a plurality of pressure chambers, a piston movably positioned in each chamber, a rotatable distributor head provided with a port adapted during rotation of said head to communicate between said source and said chambers, said head being provided with another port adapted during rotation of said head to separately communicate each of said chambers and a separate and corresponding individual cylinder of said engine, means for rotating said head, means for reciprocating said pistons in said pressure chambers, and means for varying the length of stroke of said pistons to control the amount of fuel admitted to and discharged from said pressure chambers.

10. In a fuel injection device for a multi-cylinder internal combustion engine, in combination, a source of fuel under pressure, a plurality of pressure chambers, a piston movably positioned in each chamber, a rotatable distributor head provided with a semi-annular port adapted during rotation of said head to admit fluid therethrough from said source to each of said pressure chambers for approximately one-half of each revolution of the distributor head relative to said chamber, said head being provided with another port lagging said first named port by an angle of from 90 to 180 degrees and adapted during rotation of said distributor head to admit fuel therethrough from each pressure chamber to a separate and corresponding one of the cylinders of said engine, means for rotating said distributor head, means for reciprocating said pistons in said pressure chambers, and means for varying the length of stroke of said pistons to control the amount of fuel admitted to and discharged from said pressure chambers.

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