March 1, 1949. L. J. GARDAY 2,463,374

FUEL INJECTION PUMP

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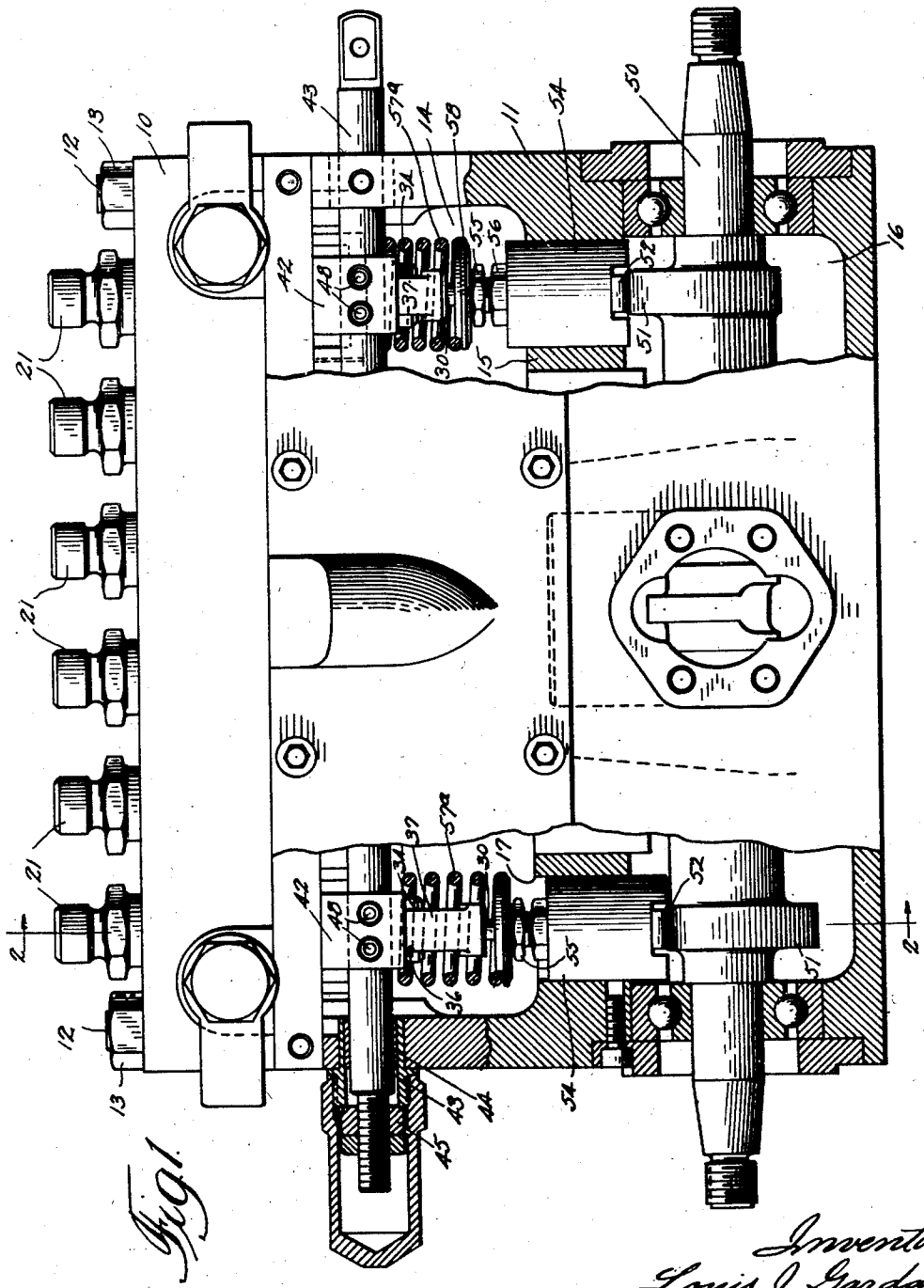


Fig. 1.

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Fig. 2.

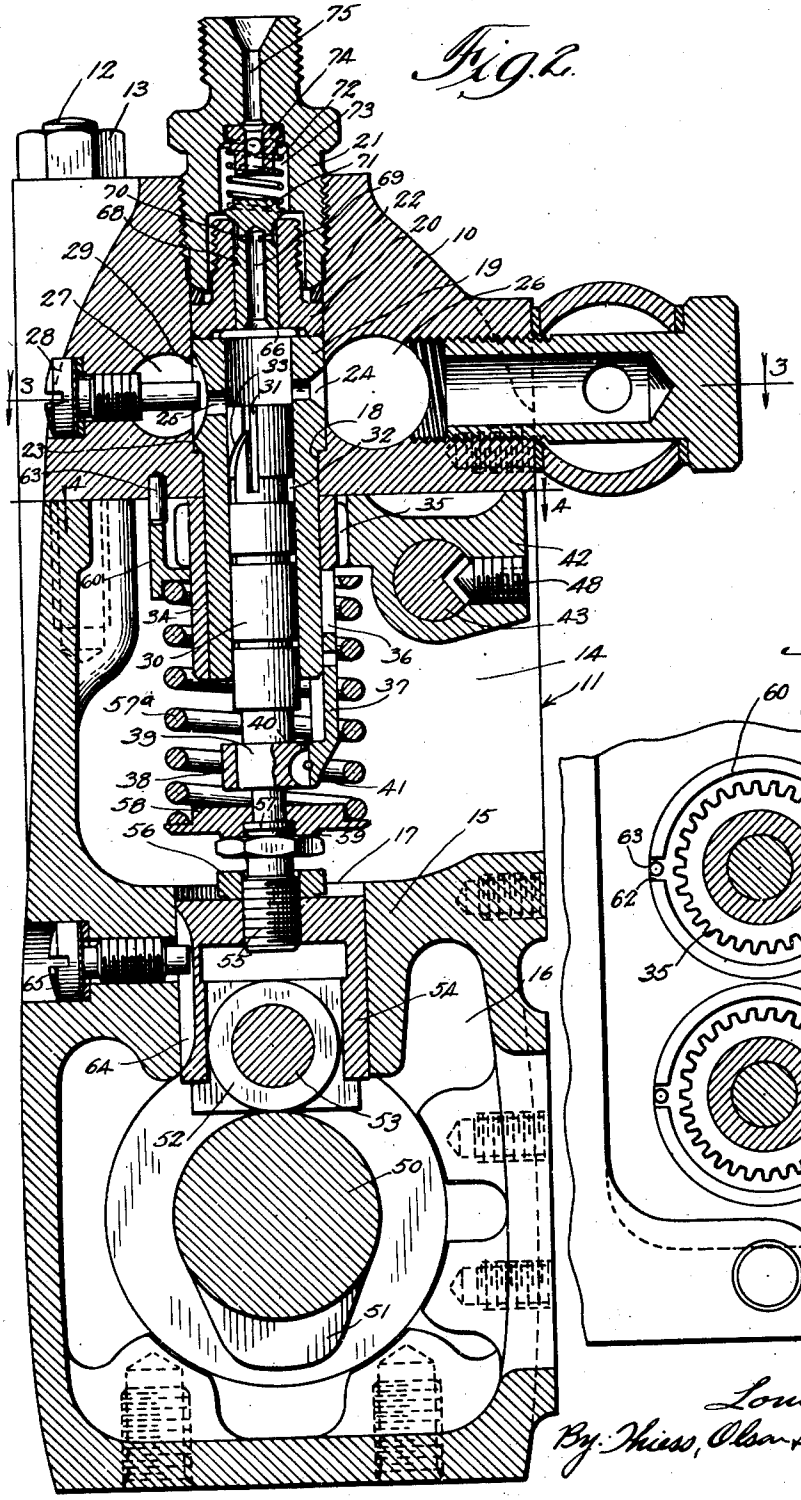
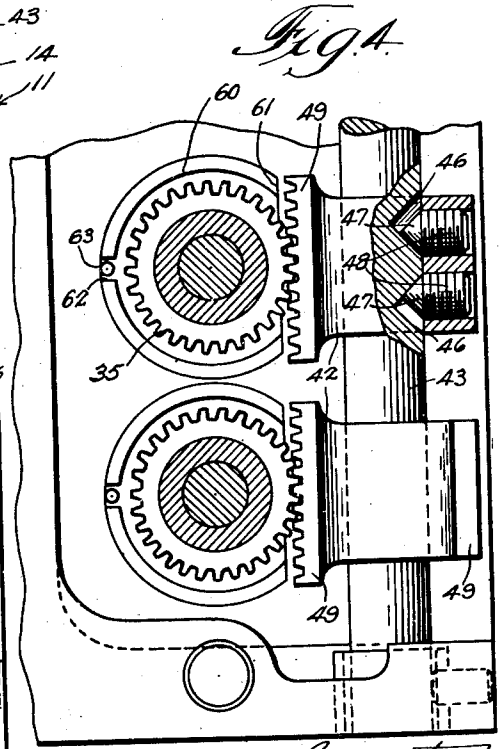


Fig. 4.



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Fig. 3.

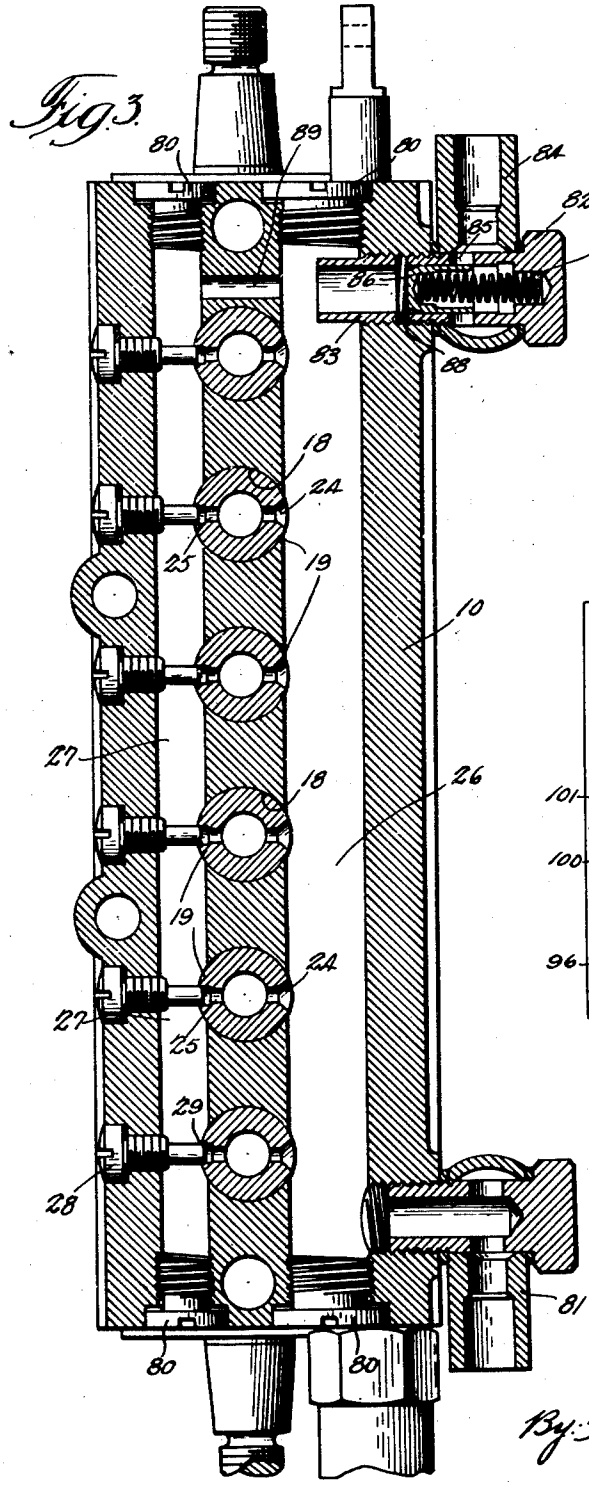
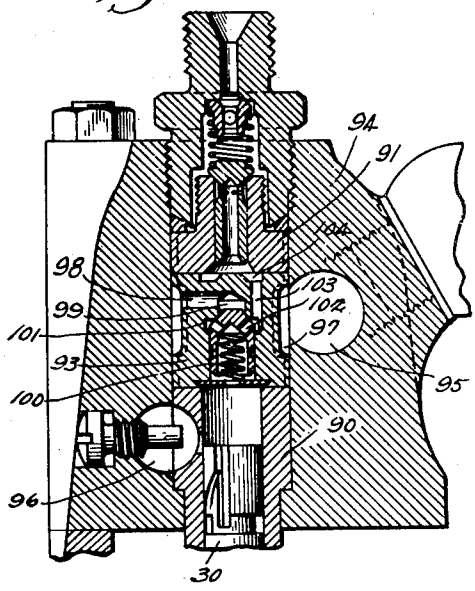


Fig. 5.



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UNITED STATES PATENT OFFICE

2,463,374

FUEL INJECTION PUMP

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Application February 26, 1945, Serial No. 579,784

4 Claims. (Cl. 103—41)

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This invention relates to fuel injection pumps, more particularly to pumps of the type wherein the pump plunger, at a predetermined adjustable point in its pressure stroke, by-passes fuel from the pressure space in the pump cylinder to a suitable overflow port, thereby terminating the fuel injection action. The invention has for an object the provision of a pump of this character which is of compact and simple construction and reliable in its operation, having desirable injection characteristics, and conveniently adjustable in respect of calibration.

Multicylinder fuel injection pumps of the above character have heretofore been proposed wherein the pump plungers are rotatable in their respective cylinders to vary the point in the pressure stroke at which fuel is by-passed through the overflow ports thereby to control the point of cut-off. Means have heretofore been provided in such pumps whereby the plungers may be separately adjusted initially to provide a uniform setting of the various cut-off points, and may thereafter be simultaneously adjusted to control the injection action of the pump. In such pumps the inlet and overflow ports of the various cylinders may respectively communicate with common fuel supply and return passageways, and various expedients have been provided for minimizing or counteracting the turbulence which occurs in these passageways upon high pressure discharge of the fuel by-passed through the overflow ports. Difficulties have been encountered, however, in securing even and regular discharges especially at high speed at the lower quantity range due to hydraulic disturbances, and in many cases calibration of a multicylinder group of this type requires longer time than should be necessary due to inconvenient means available for this purpose. Accordingly, it is a further object of this invention to provide a multicylinder fuel injection pump having a generally improved construction and design with particular relation to the fuel supply and overflow means and to the adjusting and control means for the pump plungers.

In carrying out the invention in one form, a fuel injection pump is provided having a plurality of cylinders in each of which there is disposed a plunger axially displaceable to provide a pumping effect and rotatively displaceable to control the pumping effect in accordance with the angular positions of the plungers. Associated with each cylinder is a rotatable sleeve having external gear teeth thereon and having a slidable but non-rotatable connection with

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the plunger of the piston. In order to provide simultaneous angular adjustment of all of the plungers and to provide individual initial setting of the plungers, a plurality of individual rack members are mounted in meshing relation with the respective sleeves on a longitudinally slidable operating rod, and means are provided for adjustably securing each of the rack members to the rod for longitudinal movement therewith.

Preferably, the rack members are secured to the common operating rod by providing recesses in the rod having oppositely sloping wall portions adapted to engage the extending end portions of adjustable pins carried by each of the rack members. Retraction of one pin of each pair and a corresponding extension of the other pin is effective to cause longitudinal adjustment of the rack member along the rod. The body of the pump is formed of two separate body portions adapted to be fixedly secured together, one of the portions having a cavity in which the above described adjusting means are disposed. The second of the body portions includes an accurately machined lower surface adapted to overlie the cavity when the body portions are secured together. Proper guiding and positioning of the adjusting rack members is obtained by forming each of the rack members with accurately machined portions for engaging the overlying machined surface of the upper body member so that this overlying surface maintains the rack members in proper position and guides the rack members during longitudinal adjusting movement thereof.

Each of the cylinders includes inlet and overflow ports, and a pair of longitudinal passageways extending from end to end of the pump communicate with the respective inlet and overflow ports to provide common inlet and overflow passageways therefor. Suitable fuel supply and return connections are disposed adjacent the opposite ends of the pump in communication with the longitudinally extending inlet passageway, and the longitudinally extending overflow passageway is closed at the end of the pump adjacent the supply connection and is connected by a restricted cross passageway to the inlet passageway at the opposite end of the pump. The cross passageway extends in substantial alignment with the fuel return connection and communicates with the inlet passageway at a point directly opposite the return connection. The restricted cross passageway is thus effective to minimize pressure surges which occur in the

common overflow passageway, and relief valve means, disposed in the fuel return connection and operable in response to pressure surges, are provided for relieving peak pressures and for damping pressure surges of less magnitude which may occur.

For a more complete understanding of the in- tion reference should now be had to the drawings, in which:

Fig. 1 is a front elevational view partly in section of a multicylinder fuel injection pump embodying the present invention;

Fig. 2 is an enlarged sectional elevational view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a longitudinal sectional view taken substantially along the line 3—3 of Fig. 2;

Fig. 4 is a detail view partially in section taken along the line 4—4 of Fig. 2; and

Fig. 5 is a fragmentary sectional view similar to Fig. 2 but illustrating a further embodiment of the invention.

Referring now to the drawings, the invention is shown as embodied in a multicylinder fuel injection pump comprising a pump body formed from an upper body portion 10 and a lower body portion 11 which are adapted to be secured together in fixed relation by suitable bolts 12 and nuts 13. The body portion 11 is formed, as shown, to provide a longitudinally extending cavity 14 which extends inwardly from the upper and front surfaces thereof, and which is separated by a partition wall 15 from a chamber 16 extending longitudinally through the lower part of the body portion 11, the partition wall 15 having a plurality of vertical bores 17 formed therein and providing communication between the cavity 14 and the chamber 16.

The upper body portion 10 is provided with a plurality of vertically extending bores 18 which, when the body portions 10 and 11 are secured together, will be disposed in vertical alignment with the bores 17 in the wall 15 of the body portion 11. Located in each of the vertical bores 18 in the upper body portion 10 is a cylinder body 19, a discharge valve member 20, and a sealing member 21 adapted to be connected to a suitable fuel outlet conduit (not shown). The sealing member 21 is threaded, as shown, to engage a threaded portion of the vertical bore 18, and a sealing ring 22 is provided between the members 20 and 21 so that when the sealing member is tightened down in the body portion 10 the sealing ring 22 will be compressed and the valve member 20 will be pressed downwardly on the upper surface of the cylinder body 19, the cylinder body and the vertical bore 18 being provided with cooperating shoulders 23, as shown in Fig. 2, so that a rigid assembly of the elements 19, 20 and 21 in the body portion 10 will be obtained.

As shown, each of the cylinder bodies 19 is provided with inlet and overflow ports 24 and 25 extending through the walls thereof, and a pair of longitudinal passageways 26 and 27 extend through the body portion 10 from end to end thereof form common inlet and overflow passageways for the various cylinders, as will be more fully described hereinafter. Proper angular positioning of each of the cylinder bodies in the pump body portion 10 is provided by means of positioning pins 28 which are threaded through suitable apertures in the body portion 10 and extend across the longitudinal overflow passageway 27, so that the inner end of each pin extends into a suitable notch 29 formed in the cylinder body.

As shown, each of the cylinder bodies 19 extends downwardly from the lower surface of the pump body portion 10 so as to project into the cavity 14 in the lower body portion 11. Disposed in each of the cylinder bodies and projecting from the lower end thereof is a piston plunger 30 which is adapted to be reciprocated in the cylinder to provide a pumping effect and to be independently rotated in the cylinder to control the pumping effect. As shown, the upper end of the plunger 30 is provided with a vertically extending groove 31 which extends from the upper surface of the plunger downwardly to an annular groove 32 having an upper inclined edge 33. When the plunger 30 is in the position illustrated in Fig. 2, it will be apparent that fuel may flow into the cylinder above the plunger through both the inlet and overflow ports 24 and 25. Upward movement of the plunger in the cylinder will successively close the ports 25 and 24 so as to force the fuel trapped therein upwardly for discharge under high pressure through the discharge valve means which will be more fully described hereinafter. When the plunger 30 reaches a certain point in its upward movement, however, it will be seen that the inclined edge 33 on the groove 32 will pass across the overflow port 25, and thus the pressure space above the plunger will be connected through the grooves 31 and 32 with the overflow port so as immediately to relieve the pressure above the plunger. During the remainder of the pressure stroke, fuel will be by-passed through the overflow port into the overflow passageway 27. Since the annular groove 32 includes the inclined edge 33, the effective delivery stroke of the plunger 33 may be regulated by turning the plunger in its cylinder to vary the point in its pressure stroke at which the overflow port 25 is placed in communication with the grooves 32 and 31.

In order to provide for simultaneous rotation of each of the reciprocating plungers 30 to control the effective stroke of the various plungers and to provide for individual adjustment of each of the plungers so as to make possible a uniform setting thereof, each of the cylinder bodies 19 is provided with a sleeve member 34, which is journaled on the downwardly extending portion of the cylinder body, and is provided adjacent its upper end with external gear teeth 35. The sleeves 34 are provided, as shown, with suitable vertically extending slots 36 adapted to receive upwardly extending fingers 37 which are carried by the plungers 30 so as to provide a nonrotatable but slidable connection between the respective sleeves and plungers.

The structural features of the cooperating sleeves 36 and fingers 37, and the manner in which the fingers 37 are mounted on the plungers 30, form no part of the present invention but are fully described and claimed in a copending application Serial No. 468,772, filed December 12, 1942 now Patent No. 2,414,518, in the name of the present applicant, and entitled Fuel injection pumps. For the purposes of the present application it is sufficient to point out that the finger 37 extends upwardly from an annular portion 38 which surrounds a portion 39 of the plunger 30, the portions 38 and 39 being slotted to receive a vertically extending key 40, the portion 38 and the key 40 being drilled to receive a suitably transversely extending locking pin 41.

It will now be apparent that rotation of the

sleeve 34 on the cylinder bodies 19 will be effective to cause rotation of the plungers 30 while at the same time permitting reciprocation of the plungers 30 in the cylinder bodies. Rotation of the sleeves 34 is effected by the provision of a plurality of individual rack members 42 which are adjustably mounted on a common operating rod 43, which rod extends throughout the length of the pump, the left-hand end of the rod 43 as viewed in Fig. 1 being supported in an end wall of the body portion 11 in a suitable bearing 44 and being threaded, as shown, to receive a stop nut 45 which is effective to limit longitudinal movement of the rod 43 in a right-hand direction. The extending right-hand end of the rod 43 is adapted to be connected in any suitable manner to the usual throttle or other control member for the engine to which the fuel injection pump is applied.

In order to provide for individual securement of the rack members 42 on the common operating rod 43 in longitudinally adjustable positions, each of the rack members 42 is provided with a circular aperture through which the operating rod 43 extends, and the portions of the rod 43 which lie within the apertures in the rack members are provided with substantially conical depressions 46 for receiving the extending substantially conical end portions 47 of a pair of locking pins 48 which are threadedly carried by the rack members. The extending end portions 47 of the pins 48 are adapted to engage oppositely sloping walls of the depressions 46 so as rigidly to secure the rack members in predetermined positions on the operating rod 43, and it will be apparent that longitudinal adjustment of the individual rack members, relative to the operating rod 43, may be accomplished simply by rotating one of the pins 48 so as to withdraw the pin a desired distance ad oppositely rotating the other pin so as to extend the end portion thereof a corresponding distance.

It is of course of primary importance that the various individual rack members 42 be maintained in proper angular relation on the operating rod 43 in order that the individual racks may properly mesh with the gear teeth 35 on the sleeves 34, and consequently the upper surface of each rack member includes a plurality of accurately machined, substantially flat surface portions 49 which are adapted to engage the overlying undersurface of the upper body portion 10. This overlying undersurface of the body portion 10 may be accurately machined prior to assembly of the pump body portions 10 and 11, so that upon assembly of the individual racks on the operating rod 43 proper angular positioning of the racks will be automatically obtained.

Vertical reciprocation of the plungers 30 in proper timed relation is accomplished by means of the usual cam shaft 50 which extends through the chamber 16 in the lower body portion 11 and is provided wtih a plurality of suitably shaped cams 51. As shown best in Fig. 2, the cams 51 respectively engage the cam rollers 52 mounted upen suitable pins 53 which are supported at their opposite ends in cup-shaped tappet members 54 slidably mounted in the apertures 17 in the partition member 15. Threaded into the upper wall of each of the cup-shaped tappet members 54 is an adjustable abutment member 55 having a hardened head thereon, and suitable lock nuts 56 are provided for retaining the abutment members 55 in desired adjusted positions. The hardened heads on the abutment members 55 are adapted to engage enlarged lower end portions 57 on the plungers 30, and in order to maintain the plungers in engagement with the abutment members 55 and to move the plungers through their downward stroke, suitable operating springs 57a are provided for each cylinder. As shown best in Fig. 2, the lower end of each of the springs 57a engages a spring seat 58 having a projecting lower portion 59 which is recessed, as shown, to receive the enlarged end 57 of the plunger. Preferably, the depth of the recess is such that a slight clearance is provided between the end of the plunger and the abutment member 55 when the cams and tappets are in their respective lowermost positions.

At their respective upper ends the springs 57a engage the lower surface of a spring cup 60 which surrounds the gear teeth 35 on the sleeve 34, and the upper surface of the spring cup 60 abuts against the overlying surface of the body portion 10. As shown best in Fig. 4, the spring cups 60 are cut-away at one side, as indicated by the reference numeral 61, to permit the gear teeth 35 to project therethrough into meshing engagement with the associated racks 42, and in order to maintain the spring cups 60 in proper angular positions, each spring cup is provided, at a point substantially opposite the cut-away edge 61, with a slot 62 adapted to receive a dowel pin 63 the upper end of which projects into a suitable aperture in the body portion 10. In order to insure against any tendency of the tappet cups 54 to rotate in the bores 17, each of the tappet cups is provided, as shown best in Fig. 2, with a vertically extending slot 64 into which projects the end of a positioning pin 65 threaded into a suitable aperture in the body portion 11.

The previously mentioned discharge valve member 20, as shown best in Fig. 2, is provided with a recess 66 in the lower wall thereof which overlies the open upper end of the bore in the cylinder body 19, and which communicates with a vertical bore 67 in which is positioned a discharge valve 68. This discharge valve 68 comprises a stem portion which is hollow throughout the major portion of its length, and which communicates through suitable apertuers 69 with an annular recess 70 formed in the peripheral surface of the stem of the valve 68. Immediately above the recess 70 the discharge valve 68 is provided with a valve head 71 which is normally maintained in engagement with the annular upper edge of the vertical bore in the valve member 20 by a valve spring 72 disposed within a suitable bore 73 in the sealing member 21. At its upper end the valve spring 72 engages a hollow spring seat 74 which is centrally apertured, as shown, to provided communication between the bore 73 in the sealing member 21 and a suitable fuel discharge passageway 75 which extends upwardly therefrom. With the valve member 68 in the position shown in the drawing, communication between fuel discharge passageway 75 and the pressure space above the plunger 30 in the cylinder 19 is prevented, but it will be apparent that when a pressure builds up within the cylinder the valve member 68 will be moved upwardly against the force of the spring 72 so as to raise the valve head 71 from the annular upper edge of the valve member 20, whereupon fuel will flow through the hollow stem of the valve 68, the apertures 69, and the annular recess 70 into the space 73 above the valve head, and thence through the hollow spring seat 74 to the fuel discharge passageway 75. As soon as the inclined edge 33

on the plunger 30 passes over the lower edge of the overflow duct 25, however, the pressure above the plunger will be relieved and consequently the valve spring 72 will effect downward movement of the valve 68 to the closed position shown in the drawing.

As soon as communication is established between the pressure space above the plunger 30 and the overflow port 25 of the respective pistons, fuel under high pressure will be by-passed into the common overflow passageway 27, and this passageway, as shown best in Fig. 3, extends throughout the length of the body portion 10 so as to communicate with the respective overflow ports 25 of each of the cylinders. Similarly, the inlet passageway 26 extends throughout the length of the pump, and while these passageways may be formed in any desirable manner, they are preferably drilled or otherwise extended throughout the entire length of the body portion and closed at their opposite ends by suitable threaded plugs 80.

Adjacent one end of the pump the inlet passageway 26 is provided, as shown, with a fuel supply connection 81 which is adapted to be connected to a suitable source, by means of which fuel is supplied to the inlet passageway 26 under relatively low pressure, such for example as 10 pounds. Adjacent its opposite end the passageway 26 is provided with a fuel return connection 82 which includes a conduit section 83, one end of which projects into and substantially half way across the inlet passageway 26. Communication between this conduit 83 and an angularly extending conduit 84 of the return connection 82 is provided by means of suitable ports 85 formed in the walls of the conduit 83. Normally the ports 85 are maintained closed by a plunger type relief valve which comprises a piston or plunger 86 which is normally urged toward a port closing position by a spring 87, movement of the plunger in this direction being limited by a cross pin 88.

It will be observed, upon reference to Fig. 3, that the overflow passageway 27 is entirely closed at the end of the pump adjacent the fuel supply connection 81 but is placed in communication with the overflow passageway 26 adjacent the opposite end of the pump by a cross passageway 89 having a reduced diameter as compared to the respective diameters of the passageways 26 and 27. Thus only a restricted communication is provided between the passageways 26 and 27, and high pressure surges occurring in the overflow passageway 27, due to the discharge of high pressure fuel thereinto, will be damped or throttled in the cross passageway 89 so as to minimize disturbances or turbulence which would otherwise occur in the inlet passageway 26. The cross passageway 89, as shown, is located in alignment with the conduit 83 of the return fuel connection 82, so that high pressure surges will be projected directly into the conduit 83 and against the end of the plunger 86 of the relief valve. Surges of relatively low value will be effective to move the plunger rearwardly in the conduit 83, but not sufficiently to cause opening of the ports 85. This rearward movement, however, is effective to increase the volume of the conduit 83 and will thus damp and dissipate such pressure surges. Upon the occurrence of high pressure surges of greater magnitude, however, the relief valve plunger 86 will be moved sufficiently rearwardly to uncover the ports 85 and relieve the high pressure which would otherwise be created within the overflow passageway 26.

It has been found that with the above described arrangement of the restricted passageway 89 in conjunction with the relief valve 86, turbulence in the inlet passageway 26 may be substantially avoided. At the same time, a communication between the inlet and overflow passageways 26 and 27 is provided so that the passageways are at all times substantially filled with fuel. On the suction stroke of the plunger fuel will be drawn into the cylinders through both the inlet and overflow ports 24 and 25 so as to insure that the cylinders are fully charged.

While the invention has been described above in connection with a port type pump, wherein the suction and pressure strokes are controlled entirely by the pump plunger covering and uncovering the ports in the cylinder walls, it will of course be understood that the invention is not limited thereto, and in Fig. 5 the invention is shown as applied to a pump of the type having a spring-pressed suction valve. The construction shown in Fig. 5 is in general similar to the previously described embodiment of the invention except as that there is interposed between the upper end of the cylinder body 90, which corresponds to the cylinder body 19, and the lower surface of the outlet valve member 91, which corresponds to the valve member 20 of Fig. 2, a suction valve member 93.

As shown, the upper portion 94 of the pump body in the embodiment of Fig. 5 is of considerably greater height than the corresponding portion 10 of Fig. 2, and is provided with longitudinally extending inlet and overflow passageways 95 and 96 which correspond to the passageways 26 and 27 of Fig. 2 but are arranged at different levels. The inlet passageway 95 is disposed to communicate with an annular recess 97 in the suction valve member 93, and a transverse passageway 98 extends from this annular recess 97 to a vertical bore 99 in which is disposed a spring-pressed suction valve 100. An upper tapered surface of the suction valve 100 normally engages a shoulder 101 in the bore 99 so as to seal the pressure space in the cylinder 90 from the inlet passageway 95. It will be apparent, however, that during the suction stroke of the plunger 30 the suction valve 100 will move downwardly against the force of the valve spring so as to disengage the valve 100 from the shoulder 101 and permit fuel to flow through apertures 102 in the hollow valve 100 and thus into the pressure space. During the pressure stroke of the piston 30 the suction valve will of course close and fuel will then be forced through the apertures 102 in the valve 100 and through a suitable vertically extending discharge duct 103 into an annular recess 104 in the upper surface of the suction valve member 93, which annular recess 104 communicates with the vertical bore in the discharge valve member 91.

While the cylinder body 90, shown in Fig. 5, differs from the cylinder body 19 of Fig. 2 in that it includes no inlet port corresponding to the port 24 of Fig. 2, it will of course be apparent that identical cylinder bodies may be employed, although in the construction of Fig. 5 the inlet port 24 would have no useful function. In all other respects the embodiment illustrated in Fig. 5 is identical with the embodiment of Figs. 1 to 4, inclusive.

While I have shown particular embodiments of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I, therefore, contemplate by the appended claims to

cover any such modifications as fall within the true spirit and scope of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A fuel injection pump comprising a plurality of cylinders each having inlet and overflow ports, said pump having a pair of longitudinal passageways extending therethrough from end to end forming inlet and overflow passages respectively communicating with the inlet and overflow ports of said cylinders, fuel supply and return connections respectively communicating with said inlet passageway adjacent the opposite ends thereof, said overflow passageway being closed at the end of said pump adjacent said supply connection, said pump having a cross passageway of restricted cross section extending between said longitudinal passageways, said cross passageway being in substantial alignment with said fuel return connection and communicating with said inlet passageway at a point directly opposite said return connection.

2. A fuel injection pump comprising a plurality of cylinders each having inlet and overflow ports, said pump having a pair of longitudinal passageways extending therethrough from end to end forming inlet and overflow passages respectively communicating with the inlet and overflow ports of said cylinders, fuel supply and return connections respectively communicating with said inlet passageway adjacent the opposite ends thereof, said overflow passageway being closed at the end of said pump adjacent said supply connection, said pump having a cross passageway of restricted cross section extending between said longitudinal passageways, said cross passageway being in substantial alignment with said fuel return connection and communicating with said inlet passageway at a point directly opposite said return connection, and normally closed relief valve means in said fuel return connection operable in response to pressure surges transmitted from said overflow passage through said cross passage to relieve peak pressures and to damp pressure surges of less magnitude than said peak pressures.

3. A fuel injection pump comprising a plurality of cylinders each having inlet and overflow ports, said pump having a pair of longitudinal passageways extending therethrough from end to end forming inlet and overflow passages respectively communicating with the inlet and overflow ports of said cylinders, fuel supply and return connections respectively communicating with said inlet passageway adjacent the opposite ends thereof, said overflow passageway being closed at the end of said pump adjacent said supply connection, said pump having a cross passageway of restricted cross section extending between said longitudinal passageways, said cross passageway being in substantial alignment with said fuel return connection and communicating with said inlet passageway at a point directly opposite said return connection, said fuel return connection including a conduit extending partially across said inlet passageway with the extending open end thereof disposed to directly receive pressure surges from said cross passageway, whereby disturbances in said inlet passageway are minimized.

4. A fuel injection pump comprising a plurality of cylinders each having inlet and overflow ports, said pump having a pair of longitudinal passageways extending therethrough from end to end forming inlet and overflow passages respectively communicating with the inlet and overflow ports of said cylinders, fuel supply and return connections respectively communicating with said inlet passageway adjacent the opposite ends thereof, said overflow passageway being closed at the end of said pump adjacent said supply connection, said pump having a cross passageway of restricted cross section extending between said longitudinal passageways, said cross passageway being in substantial alignment with said fuel return connection and communicating with said inlet passageway at a point directly opposite said return connection, said fuel return connection including a conduit extending partially across said inlet passageway with the extending open end thereof disposed to directly receive pressure surges from said cross passageway, said conduit having a port in the walls thereof establishing communication with said return connection, and a spring-pressed valve plunger normally closing said conduit and slidable longitudinally therein between a plurality of port-closing positions and an extreme port-opening position, whereby pressure surges of less than peak pressure effect movement of said valve plunger between its respective port-closing positions to vary the effective volume of said conduit and damp said surges, and whereby peak pressure surges effect movement of said valve plunger to said extreme port-opening position to relieve said peak pressure.

LOUIS J. GARDAY.

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The following references are of record in the file of this patent:

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Certificate of Correction

Patent No. 2,463,374. March 1, 1949.

LOUIS J. GARDAY

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 1, lines 39 and 40, for "Ascordingly" read *Accordingly*; column 3, lines 7 and 8, for "intion" read *invention*; line 67, before the word "form" insert *to*; column 5, line 40, for "ad" read *and*; line 66, for "upen" read *upon*; column 6, line 47, for "apertuers" read *apertures*; line 58, for "provided" read *provide*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 9th day of August, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.