May 29, 1945. J. W. HATCH 2,376,856

PUMPING MECHANISM

Filed March 3, 1942 3 Sheets-Sheet 1

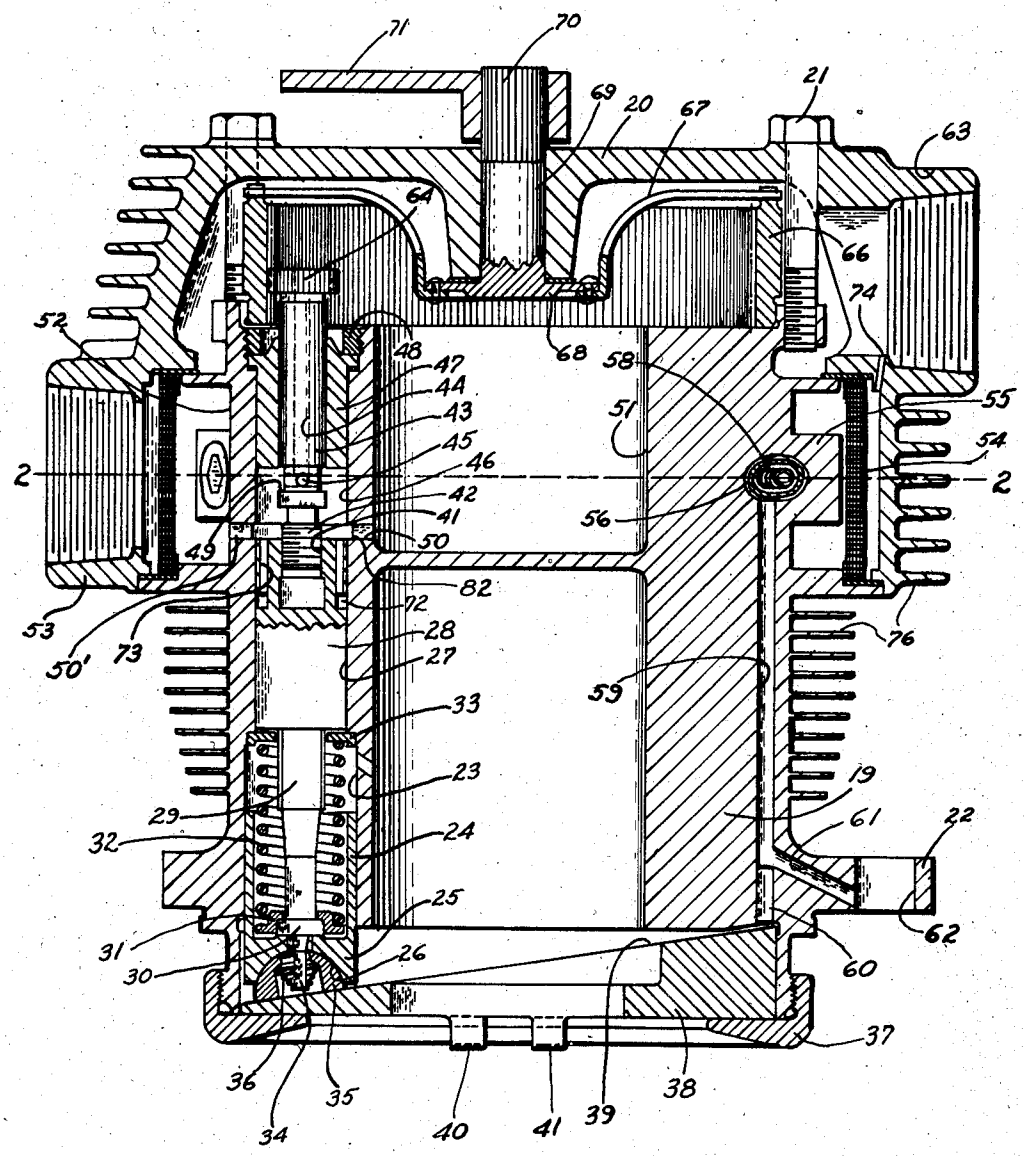


Fig 1

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PUMPING MECHANISM

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Fig 2

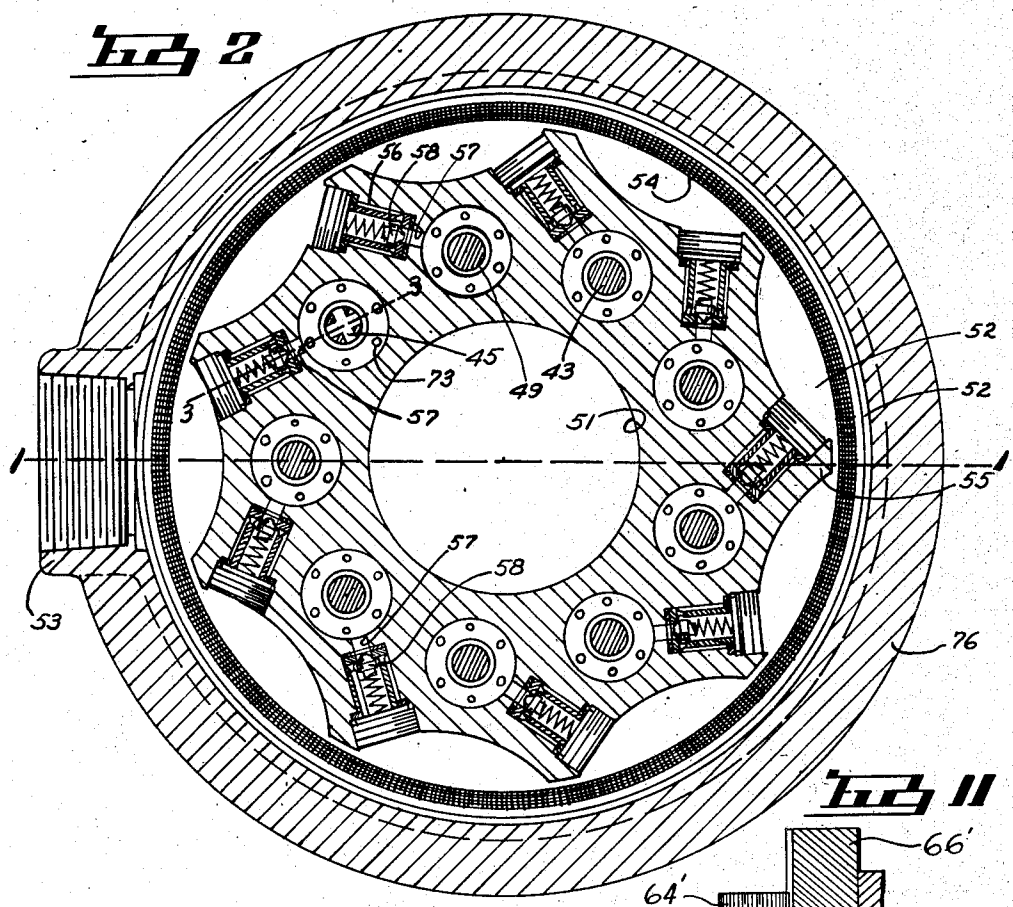


Fig 3

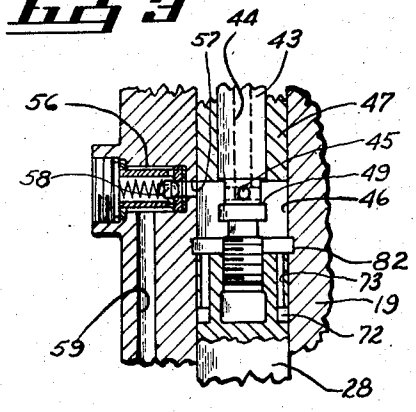
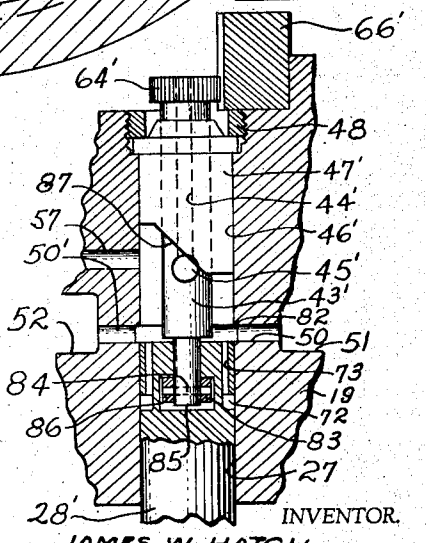


Fig 11



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May 29, 1945. J. W. HATCH 2,376,856

PUMPING MECHANISM

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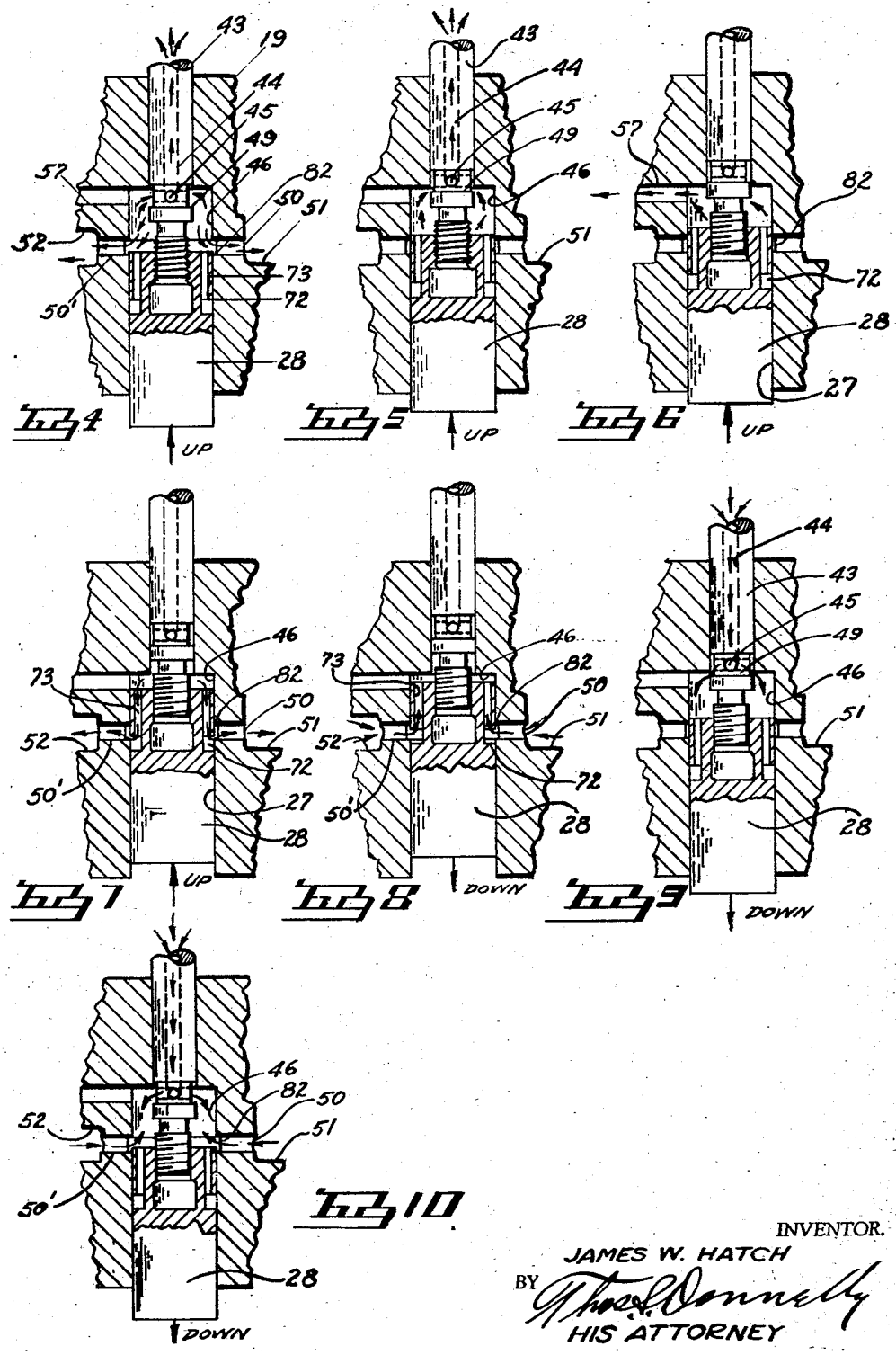


Fig 4 Fig 5 Fig 6

Fig 7 Fig 8 Fig 9

Fig 10

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Patented May 29, 1945

2,376,856

UNITED STATES PATENT OFFICE

2,376,856

PUMPING MECHANISM

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Application March 3, 1942, Serial No. 433,135

34 Claims. (Cl. 103—41)

My invention relates to a new and useful improvement in a pump mechanism and particularly to fuel injection type pumps. Heretofore fuel injection pumps have been inefficient in the handling of volatile fuels, because of the lack of means for bleeding out the gaseous formations which accumulate within the pumping cylinder chambers. When these gaseous formations are present continued delivery of a low temperature and constant flow of fluid cannot be accomplished because of the compressibility and elasticity of the gaseous formations. It is the object of the present invention to provide a pumping structure of this type so arranged that the gaseous formations are removed and only liquid is pumped to the injection nozzles.

In a pumping mechanism of this class it is also desirable, when injecting volatile fuels, that the beginning of the injection be controllable while the termination of the injection remains constant with the throttling being accomplished by changing the starting of the injection and thereby lengthening or shortening the duration of the injection, it is an object of the present invention to provide a structure whereby this may be accomplished.

It is another object of the invention to provide a pumping mechanism of this class whereby a low operating temperature may be maintained.

Another object of the invention is a provision of a novel mechanism for controlling the delivery of the fluid from the pump cylinder wherein the end point of the delivery remains constant and the beginning of the delivery may be variably controlled.

Another object of the invention is a provision of a novel means whereby the fuel delivered from each pump cylinder of a multiple fuel injection unit may be adjusted for assuring equal volumetric displacement of the cylinders.

Another object of the invention is the provision of a pumping mechanism whereby the excess amount of fuel pumped is circulated thru the pumping unit for heat transfer purposes.

Other objects may appear hereinafter.

It is recognized that various improvements or changes may be made in the detail of the structure illustrated without departing from the spirit of the invention, and it is intended that such variations and modifications shall be embraced within the scope of the claims which form a part hereof.

Incorporated and made a part of this specification are drawings in which

Fig. 1 is a longitudinal central sectional view of the invention taken on substantially line 1—1 of Fig. 2.

Fig. 2 is a transverse sectional view of the invention taken on substantially line 2—2 of Fig. 1.

Fig. 3 is a fragmentary sectional view taken on line 3—3 of Fig. 2.

Fig. 4 is a longitudinal sectional view of a pump cylinder showing one position of operation.

Fig. 5 is a view similar to Fig. 4 showing another position of operation.

Fig. 6 is a view similar to Fig. 5 showing another position of operation.

Fig. 7 is a view to Fig. 6 showing another position of operation.

Fig. 8 is a view similar to Fig. 7 showing another position of operation.

Fig. 9 is a view similar to Fig. 8 showing another position of operation.

Fig. 10 is a view similar to Fig. 9 showing another position of operation.

Fig. 11 is a fragmentary sectional view showing a slightly modified form of plunger.

As shown in Fig. 1 the invention comprises a housing 19 secured to which is an end plate or head 20 by means of the bolts 21, lugs 22 projecting outwardly from this housing for the reception of securing means whereby the housing may be fixedly attached to a stationary supporting body. A plurality of axially directed passages which serve as cylinders are formed in the housing. In each of these passages, adjoining one end thereof, is slideably mounted a tappet or guide sleeve 24, having a head 25, in which is formed a spherical surface 26, substantially semi-spherical in contour. A cylinder 27 is provided for a piston 28 which is slideably mounted therein. Projected downwardly from this piston 28 is a push rod 29 provided with a collar 30 upon which rests a washer 31 against which bears one end of a spring 32, the other end bearing against the washer 33 fixedly mounted in passage 23. A pin 34 projects from the end of rod 29 and extends thru a substantially semi-spherical shoe 35 which is positioned in the spherical surface 26. Embracing this pin 34 is a spring 36 which serves to normally resist rocking movement of the shoe 35 and tends to maintain the shoe 35 aligned with the push rod 29.

Threaded to the lower end of the housing 19 is a retaining ring 37 which serves to engage and retain in position the swash plate or actuating cam 38, having an inclined surface 39 on its inner face. Projecting outwardly from the swash plate 38 are the spaced apart lugs 40 and 40' between

which are engaged a rotating driving bar, the construction being such that as the swash plate 38 is rotated, the piston 28 will be forced upwardly positively and returned by the action of the spring 32. Thus there is afforded a means for reciprocating the piston 28.

The piston 28 is provided with a threaded socket 41 into which is threaded a depending portion 42 of a control plunger 43 which may be termed a bleed passage bearing member. This plunger 43 is provided with the axial passage 44 opening into the diametrically extending passage 45 so as to communicate with chamber 46 beneath the bushing 47 or guide sleeve. This bushing is held in position by the ring 48. Where the passages 45 open into chamber 46 the control plunger or piston 43 is cut away on its periphery to provide a chamber forming groove 49. The chamber 46 communicates thru the opening 50 with the chamber 51 in the housing 19.

Extending around the housing 19 is the chamber 52 communicating with which is an inlet pipe 53 carried by the end plate or head 20 for the purpose of delivering liquid to the chamber 52, this liquid being filtered thru the filter 54.

Formed on the housing 19 at spaced intervals are the bosses 55, in each of which is formed a cavity 56 for reception of a spring pressed check valve 58. This check valve controls communication of passage 57 with cavity 56. Leading from the cavity 56 is the outlet passage 59 closed at its lower end by the plug 60 and having the lateral extension 61 communicating with the bore 62 formed in the lug 22, this bore 62 being suitably connected in communication with the injection nozzle, which is not shown and which, of itself, forms no part of the present invention.

The construction is such that as the swash plate 38 is rotated the control plunger 43 is reciprocated. As the piston 28 moves upwardly the volume of the chamber 46 is reduced and the openings 50 and 50' are gradually closed and the liquid and gaseous formations in the chamber 46 are forced outwardly thru the passage 44 where they may fill the chamber 51 and the space above it from which they will leak under gentle pressure through the outlet nipple 63 which is connected either back to the source of supply or to a suitable vapor eliminator, said liquid carrying heat and gaseous formations with it. As the control plunger 43 moves into the bushing or guide sleeve 47 so that the lower edge of the groove 49 cuts off communication of the openings 45 with the chamber 46 the continued upward movement of the piston 28 will force the liquid outwardly thru the passage 57 into the cavity 56, from which it is delivered to the injection nozzle thru passages 59 and 61. The bushing or guide sleeve 47 may be termed a cylinder for reception of the plunger 43 which operates in the nature of reciprocating piston.

It is obvious that by threading the plunger 43 inwardly or outwardly of the threaded socket 41, the length of time during which the passages 45 will be in communication with the interior of the chamber 46 may be varied. As the member 43 is threaded inwardly of the socket 41 the piston 28 will move upwardly a predetermined distance into chamber 46 before the openings 45 are closed by the bushing 47, thus reducing the volume which would be delivered to the cavity 56. As the regulating plunger 43 is threaded in the opposite direction, the volume of liquid delivered to the cavity 56 would be accordingly increased. Thus it becomes possible by this adjustment to regulate the amount of liquid which is delivered at each impulse to the injection nozzle.

A peripheral groove 72 is formed on the piston 28 communicating with which is a plurality of axial passages 73 formed in this piston 28 which communicate with the chamber 46. Formed in the inner surface of cylinder 27 at the location of the openings 50 and 50' is the groove 82 communicating with chambers 51 and 52. As the piston 28 moves upwardly as shown in Fig. 4 fluid is forced from chamber 46 through the groove 82 and openings 50' and 50 into chambers 52 and 51 and will likewise flow thru the groove 49, openings 45 and 44 into chamber 51. As the piston 28 reaches the position shown in Fig. 5 chamber 46 communicates with chamber 51 only through the groove 49, openings 45 and 44. As the piston 28 moves upwardly from the position in Fig. 5 gaseous formations will be forced from chamber 46 to chamber 51 since the groove 49 communicates with chamber 46 at the highest point in chamber 46 when cut-off occurs. As the piston 28 reaches the position shown in Fig. 6 injection begins and continues until the spill groove 72 on piston 28 communicates with groove 82 in cylinder 27 as shown in Fig. 7 at which time injection ends, since communication is established between chamber 46 and chambers 51 and 52 through openings 73, spill groove 72, groove 82 and openings 50' and 50.

As the piston 28 continues past top center and starts its downward travel as illustrated in Fig. 8 the flow of fluid reverses, flowing from chambers 51 and 52 into chamber 46 through the openings 50' and 50, grooves 82 and 72, and openings 73. The piston 28 continues its downward travel until the groove 49 on the control plunger 43 communicates with chamber 46 as shown in Fig. 9 at which time communication is established between chamber 51 and chamber 46 through the openings 44 and 45, and groove 49. As the piston 28 continues farther on its down travel as shown in Fig. 10 communication is also established from chamber 51 to chamber 46 through opening 50 and groove 82 as likewise through the opening 50' and groove 82 with chamber 52.

It is obvious that when injection begins, as shown in Fig. 6 a large area of fluid around groove 49 on control plunger 43 is substantially shut off from communicating with chamber 46 and at this point the injection starts as shown by the arrows in the opening 57 in Fig. 6. This would effect a beginning of injection on a closely defined point of time. As the point of upward travel, as shown in Fig. 7 is reached, termination of injection period is substantial and well defined since a large area of fluid around groove 72 communicates with the groove 82 which provides a large free communication from chamber 46 to chambers 51 and 52 as previously described. This structure and method of starting and finishing injection assures a sharp, well defined start and termination of the injection, and assures complete atomization of the fluid at the injection nozzle.

It is obvious from Fig. 1 that the control plunger 43 may be selectively adjusted in relation to control member 66 by means of their toothed engagement. This adjustment provides a means of setting control plungers 43 in relation to pistons 28 in a multiple cylinder fuel injection unit and assures equal displacement of all the cylinders, the adjustment being made at the time the unit is assembled.

In order to effect the threading of the member 43 inwardly or outwardly of the socket 41, I

have provided a mechanism which will now be described.

A pinion 64 is fixedly mounted on the upper end of plunger 43. This pinion 64 meshes with the teeth of the internal gear 66. This internal gear is connected by the spring arms 67 to a hub 68 carried by shaft 69 projecting centrally outwardly thru end plate or head 20. A splined portion 70 is formed on the shaft 69 on which a suitable handle 71 may be mounted. By moving the handle 71 the shaft 69 may be rotated for effecting a rotation of the pinion 64 and thus accomplishing the desired control.

A passage 74 for the escape of gases from the chamber 52 is provided. The presence of the liquid in the chamber 51 and the space above it serves to maintain the operating mechanism cool. This is further accomplished by the fins 76 which are mounted on the housing or the head or the end wall.

The threaded connection between the members 43 and 28 is sufficiently loose so that any mis-alignment between these members will be compensated for by the clearance in the threads. It will be noted that the upper portion of the push rod 29 is formed flat faced. This flat faced portion engages in a corresponding hole in washer 33 which is fixed in the cylinder 23 and thus rotation of the member 28 is prevented.

In Fig. 11 is shown a modification of the invention wherein a piston 28' is slidably mounted in the bore 27 of housing 19. Fixedly mounted in the bore 27 is the bushing 47' retained in its position by the lock nut 48. Slideably mounted in the bushing 47' is a control plunger 43' having a longitudinal passage 44' communicating with a diametrically extending passage 45' extending through said control plunger and provides communication between chamber 46' and chamber 51. Said control plunger 43' is adapted for engagement with plunger 28' by the extended portion 85 and secured to which is the retaining collar 86 by means of pin 84, said control plunger 43' having free rotational engagement relative to piston 28' and relatively no axial displacement. Between the piston 28' and the lower face of the bushing 47' is the chamber 46' communicating with the outlet passage 57. Chamber 51 and 52 communicates with chamber 46' through the passages 50 and 50' and a recessed groove 82 in the cylinder wall 27. Fixedly mounted on the upper end of control plunger 43' is a gear 64' meshing with a toothed rack or control member 66'. The construction is such that as the piston 28' is reciprocated, the control plunger 43' reciprocates substantially in unison. At the position where the control plunger 43' engages with piston 28', a radial clearance is provided so that any misalignment of one member with the other is taken up by this clearance.

It is obvious that as the control member 66' is axially displaced, the control plunger 43' is rotationally displaced in relation to plunger 28' and bushing 47'. The lower face of the bushing 47' is provided with an irregular surface 87. For purposes of illustration, this surface 87 is a straight surface on an angle to the axis of said control plunger 43'. It is obvious that by rotating plunger 43' relative to the bushing 47', that the point of cut-off of communication between chamber 46' and 51 through the passage 45' and 44' may be varied by the angular surface 87 and the passage 45' as the said control plunger 43' is reciprocated, thus it becomes possible by this rotational adjustment of plunger 43' to regulate the amount of liquid that is delivered from chamber 46' at each impulse to the injection nozzle.

It is obvious also that the control plunger 43' and the piston 28' could be made integral in which case the piston 28' would not be restrained from rotational displacement.

It is, of course, believed obvious that as the member 28 moves inwardly the pressure developed on the fuel in the compression chamber 46 is insufficient to move the check valve 58 off of its seat until, after the openings 50 and 50' have been closed and the bleed passage opening 45 is also closed against communication with compression chamber 46.

What I claim as new is:

1. A fuel injection pump comprising: a compression chamber for the reception of fuel fluid and having an inlet opening and an outlet opening; a reciprocating plunger slideable into said compression chamber for reducing the cubical contents thereof and forcing liquid therefrom, the location of said inlet opening being such that said plunger will close the same upon its initial entrance into said chamber; a cylinder spaced from and in axial alignment with said plunger; a bleed-passage-bearing member carried by said plunger and engageable in said cylinder and having a bleed passage therein communicating with said chamber for bleeding fluid therefrom, the movement of said plunger into the said chamber a pre-determined distance effecting a movement of said bleed member into said cylinder sufficiently for enclosing said bleed passage therein and closing communication of said bleed passage with said chamber; a relief passage carried by said plunger for, upon movement of said plunger into said chamber a pre-determined distance, relieving the pressure on the fluid being forced outwardly of said chamber.

2. A fuel injection pump comprising: a compression chamber for the reception of fuel fluid and having an inlet opening and an outlet opening; a reciprocating plunger slideable into said compression chamber for reducing the cubical contents thereof and forcing liquid therefrom, the location of said inlet opening being such that said plunger will close the same upon its initial entrance into said chamber; a cylinder spaced from said plunger; a bleed-passage-bearing member carried by said plunger and engageable in said cylinder and having a bleed passage therein communicating with said chamber for bleeding fluid therefrom, the movement of said plunger into the said chamber a pre-determined distance effecting a movement of said bleed member into said cylinder sufficiently for enclosing said bleed passage therein and closing communication of said bleed passage with said chamber; and means for, upon movement of said plunger inwardly of said chamber a pre-determined distance, establishing communication of said outlet opening with the exterior of said chamber and relieving the pressure on the fluid being expelled thru said outlet opening.

3. A fuel injection pump comprising: a compression chamber for the reception of fuel fluid and having an inlet opening and an outlet opening; a reciprocating plunger slideable into said compression chamber for reducing the cubical contents thereof and forcing liquid therefrom, the location of said inlet opening being such that said plunger will close the same upon its initial entrance into said chamber; a cylinder spaced from said plunger and in substantial axial alignment therewith; a bleed-passage-bearing mem-

ber carried by said plunger and slideably engaging in said cylinder and having a bleed passage therein communicating with said chamber for bleeding fluid therefrom, the movement of said plunger into the said chamber a pre-determined distance effecting a movement of said bleed member into said cylinder sufficiently for enclosing said bleed passage therein and closing communication of said bleed passage with said chamber; and means for adjusting the relative position of said bleed-passage-bearing member and said plunger for varying the position of the inward movement of said plunger into said chamber at which the communication of said bleed passage with said chamber is dis-established; a relief passage carried by said plunger for, upon movement of said plunger in said chamber a predetermined distance, relieving the pressure on the fluid being forced outwardly of said chamber.

4. A fuel injection pump comprising: a compression chamber for the reception of fuel fluid and having an inlet opening and an outlet opening; a reciprocating plunger slideable into said compression chamber for reducing the cubical contents thereof and forcing liquid therefrom, the location of said inlet opening being such that said plunger will close the same upon its initial entrance into said chamber; a cylinder spaced from and in substantial axial alignment with said plunger; a bleed-passage-bearing member carried by said plunger and slideably engaging in said cylinder and having a bleed passage therein communicating with said chamber for bleeding fluid therefrom, the movement of said plunger into the said chamber a pre-determined distance effecting a movement of said bleed-passage-bearing member into said cylinder sufficiently for enclosing said bleed passage therein and closing communication of said bleed passage with said chamber; and means for adjusting the relative position of said bleed-passage-bearing member and said plunger for varying the position of the inward movement of said plunger into said chamber at which the communication of said bleed passage with said chamber is dis-established; and means for, upon movement of said plunger inwardly of said chamber a predetermined distance, establishing communication of said outlet opening with the exterior of said chamber and relieving the pressure on the fluid being expelled thru said outlet opening.

5. A fuel injection mechanism of the class described comprising a fuel receiving chamber having an inlet opening and an outlet opening, a plunger slideably projectable into said chamber for closing its inlet opening and forcing fluid forcibly from an outlet opening; a bleed-passage-bearing member movable in unison with said plunger for bleeding fuel from said chamber through the bleed passage; and means for closing said bleed passage upon movement of said plunger into said chamber a predetermined distance; and means for adjusting the relative position of said bleed passage bearing member to said plunger for varying the extent of movement of said plunger at which said bleed passage is closed.

6. In a mechanism of the class described a plurality of liquid receiving chambers each having inlet and outlet openings; a plunger projectable into each of said chambers for closing an inlet opening and forcing liquid outwardly thru an outlet opening; a bleed mechanism associated with each of said plungers for bleeding liquid from the chamber; a pinion associated with each of said bleed mechanisms; and means operative on said pinion for adjusting the relative position of the bleed mechanism to its plunger.

7. In a fuel injector of the class described a housing having a plurality of liquid receiving chambers formed therein, each provided with inlet and outlet openings, each of said chambers, while in communication with the inlet openings being, in communication with a chamber in the interior of said housing and a bleed mechanism for bleeding liquid from said first-mentioned chamber outwardly into the said second-mentioned chamber.

8. In a fuel injector of the class described a housing having a plurality of liquid receiving chambers formed therein provided with inlet and outlet openings, each of said chambers while in communication with the inlet opening being in communication with a chamber in the interior of said housing, and a bleed mechanism for bleeding liquid from said first-mentioned chambers outwardly into the said second-mentioned chamber; and means for venting gases having formed in second-mentioned chamber.

9. In a fuel injector of the class described a housing having a plurality of liquid receiving chambers formed therein provided with inlet and outlet openings, each of said chambers, while in communication with the inlet openings, being in communication with a chamber in the interior of said housing, and a bleed mechanism for bleeding liquid from said first-mentioned chambers outwardly into the said second-mentioned chamber; and cooling fins on said housing.

10. In a fuel injector of the class described a housing having a plurality of liquid receiving chambers formed therein provided with inlet and outlet openings; a chamber surrounding said liquid receiving chambers and communicating therewith; an inlet conduit communicating with said second-named chamber; a third chamber in the interior of said housing communicating with said first-named chamber; and an outlet conduit communicating with said third named chamber.

11. In a mechanism of the class described a plurality of liquid receiving compression chambers each having inlet and outlet openings; a plunger projectable into each of said chambers for closing the inlet opening and forcing liquid outwardly thru an outlet opening; a bleed mechanism associated with and movable in unison with each of said plungers; means for adjusting each of said bleed mechanisms individually relatively to its plunger for controlling the amount of liquid ejected from the compression chamber at a single operation; and means for simultaneously adjusting a plurality of said bleed mechanisms to their plungers for effecting relative re-location of said bleed mechanisms to said plungers.

12. A fuel injection mechanism of the class described comprising: a fuel receiving chamber having an inlet opening and an outlet opening; a plunger slideably projectable into said chamber for closing its inlet opening and forcing fluid forcibly from said outlet opening; a bleed-passage-bearing member connected to and moveable in unison with said plunger for bleeding fuel from said chamber through a bleed passage; and means for closing said bleed passage upon movement of said plunger into said chamber a predetermined distance; and means for adjusting relative position of said bleed-passage-bearing member to said plunger for varying the extent of movement of said plunger at which said bleed passage is closed; and means for preventing rotation of said plunger.

13. A fuel injection mechanism of the class described comprising: a liquid receiving chamber having an inlet and an outlet opening, a plunger slideably projectable into said chamber for closing said inlet opening and forcing liquid outwardly from said chamber through said outlet opening; a bleed mechanism, having a bleed passage, and connected to said plunger for bleeding liquid from said chamber; and means for closing the bleed passage, in said bleed mechanism, upon movement of said plunger into said chamber a pre-determined distance; means for axially adjusting said bleed mechanism relative to said plunger for varying the duration of operativeness of said bleed mechanism; and means resisting rotation of said plunger.

14. In a fuel injection pump of the class described; a plurality of liquid receiving chambers each having inlet and outlet openings; a plunger reciprocating in each of said chambers for closing said inlet openings and forcing liquid from said outlet openings; a bleed-passage-bearing member carried by each of said plungers for bleeding liquid from said chambers through the bleed passage; means for closing said bleed passages upon movement of said plungers into said chambers a pre-determined distance; means for adjusting the relative positions of said bleed-passage-bearing members to said plungers for varying the extent of movement of said plungers at which said bleed passages are closed; means for adjusting said bleed members; and means for preventing rotation of said plungers.

15. In a pumping mechanism of the class described; a plurality of liquid receiving chambers, each having inlet and outlet openings; a reciprocating plunger projectable into each of said chambers and closing an inlet opening and forcing liquid outwardly through an outlet opening; a bleed mechanism associated with each of said plungers and provided with a bleed passage for bleeding liquid from the chamber into which said plunger projects; means for closing said bleed passage upon projection of said plunger into said chamber a predetermined distance; a pinion associated with each of said bleed mechanisms; means operative on said pinions for adjusting the relative positions of the bleed mechanism to its plunger; and means for reciprocating said plungers.

16. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a smaller cylinder extending beyond said chamber; a plunger slideable into said chamber; a bleed member yieldably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said smaller cylinder to close said bleed passage at a predetermined position of said plunger.

17. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a smaller cylinder extending beyond said chamber; a plunger slideable into said chamber to close said inlet opening and to provide pumping effect; a bleed member yieldably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said smaller cylinder to close said bleed passage at a predetermined position of said plunger.

18. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a reduced cylinder extending beyond said chamber; a plunger reciprocative in said chamber to close said inlet opening and to provide pumping effect; a bleed member adjustably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said reduced cylinder to close said bleed passage at a predetermined position of said plunger; and means to prevent rotation of said plunger.

19. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a reduced cylinder extending beyond said chamber; a plunger slideable into said chamber and having a relief passage adapted to establish communication between said chamber and said inlet opening at a predetermined position of said plunger; a bleed member adjustably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said reduced cylinder to close said bleed passage at a predetermined position of said plunger; and means to prevent rotation of said plunger.

20. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a smaller cylinder extending beyond said chamber; a plunger slideable into said chamber to close said inlet opening and to provide pumping effect; said plunger having a relief passage adapted to establish communication between said chamber and said inlet opening at a predetermined position of said plunger; an adjustable bleed member carried by said plunger and having a bleed passage communicating with said chamber and slideable into said smaller cylinder to close said bleed passage at a predetermined position of said plunger; and means to prevent rotation of said plunger.

21. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a reduced cylinder extending beyond said chamber; a plunger slideable into said chamber; a bleed member adjustably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said reduced cylinder to close said passage at a predetermined position of said plunger; means to adjust said bleed member; and means to prevent rotation of said plunger.

22. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet ports; a smaller cylinder extending beyond said chamber; a plunger slideable into said chamber to close said inlet port and to provide pumping effect; an adjustable bleed member carried by said plunger and having a bleed passage communicating with said chamber and slideable into said smaller cylinder to close said passage at a predetermined position of said plunger; means to adjust said bleed member; and means to restrict rotation of said plunger.

23. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet ports; a reduced cylinder extending beyond said chamber; a plunger slideable into said chamber and having a relief passage adapted to establish communication between said chamber and said inlet port at a predetermined position of said plunger; an adjustable bleed member carried by said plunger and having a bleed passage communicating with said chamber and slideable into said reduced cylinder to close said bleed passage at a predetermined position of said plunger; means to adjust said bleed member; and means to prevent rotation of said plunger.

24. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet ports; a smaller extending cylinder beyond said chamber; a plunger slideable into said chamber to close said inlet port and to provide pumping effect; said plunger having a relief passage adapted to establish communication between said chamber and said inlet port at a predetermined position of said plunger; an adjustable bleed member carried by said plunger and having a bleed passage communicating with said chamber and slideable into said extending cylinder to close said bleed passage at a predetermined position of said plunger; means to adjust said bleed member; and means to prevent rotation of said plunger.

25. A fuel injection mechanism of the class described comprising a fuel receiving chamber, having inlet and outlet ports; a reduced cylinder extending beyond said chamber; a plunger reciprocative in said chamber to close said inlet port and to provide pumping effect; a bleed-passage-bearing member carried by said plunger and having a bleed passage communicating with said chamber, and slideable into said reduced cylinder to close said bleed passage at a predetermined position of said plunger; and means for adjusting the relative position of said bleed-passage-bearing-member and said plunger for varying the extent of movement of said plunger into said chamber at which the communication of said bleed passage with said chamber is dis-established.

26. A fuel injection mechanism of the class described comprising a fuel receiving chamber having inlet and outlet ports; a cylinder extending beyond said chamber; a plunger slideable into said chamber to close said inlet port and to force fuel from said outlet port; a bleed-passage-bearing-member, adjustably engaged with said plunger and provided with a peripheral relieved portion communicating with said passage and guided in said cylinder for closing said passage upon movement of said plunger into said chamber a predetermined distance.

27. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a smaller cylinder extending beyond said chamber; a plunger slideable into said chamber; a bleed member adjustably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said smaller cylinder to close said bleed passage at a predetermined position of said plunger; means to axially adjust said bleed member relative to said plunger; and means to prevent rotation of said plunger.

28. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a smaller cylinder extending beyond said chamber; a plunger slideable into said chamber; a bleed member adjustably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said smaller cylinder to close said bleed passage at a predetermined position of said plunger; means to rotationally adjust said bleed member.

29. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a smaller cylinder extending beyond said chamber; a plunger slideable into said chamber; a bleed member adjustably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said smaller cylinder to close said bleed passage at a predetermined position of said plunger; means to rotationally adjust said bleed member relative to said plunger; and means to prevent rotation of said plunger.

30. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a smaller cylinder extending beyond said chamber; a plunger slideable into said chamber; a bleed member axially adjustably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said smaller cylinder to close said bleed passage at a predetermined position of said plunger; means for rotating said bleed member for effecting said axial adjustment; and means to prevent rotation of said plunger.

31. A fuel injection mechanism of the class described comprising a fuel receiving chamber having inlet and outlet ports; a cylinder extending beyond said chamber; a plunger slideable into said chamber to close said inlet port and to force fuel from said outlet port; a bleed-passage-bearing member engaged with said plunger and provided with a peripheral relieved portion communicating with said passage, and guided in said cylinder for closing said passage upon movement of said plunger into said chamber a predetermined distance; means to adjust said bleed member; and means to prevent rotation of said plunger.

32. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a smaller cylinder extending beyond said chamber; a plunger slideable into said chamber; a bleed member adjustably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said smaller cylinder to close said bleed passage at a predetermined position of said plunger; and means to adjust the axial relationship of said plunger and said bleed member.

33. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a smaller cylinder extending beyond said chamber; a plunger slideable into said chamber; a bleed member adjustably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said smaller cylinder to close said bleed passage at a predetermined position of said plunger; and means to adjust the rotational relationship of said plunger and said bleed member.

34. A fuel injection pump comprising; a cylinder having a compression chamber provided with inlet and outlet openings; a smaller cylinder extending beyond said chamber; a plunger slideable into said chamber; a bleed member adjustably engaged with said plunger and having a bleed passage communicating with said chamber and slideable into said smaller cylinder to close said bleed passage at a predetermined position of said plunger; and means to adjust the rotational relationship of said bleed member and said smaller cylinder.

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