April 22, 1952 N. FODOR 2,593,550

MULTIPLE UNIT FUEL INJECTION PUMP

Filed March 28, 1946 2 SHEETS—SHEET 1

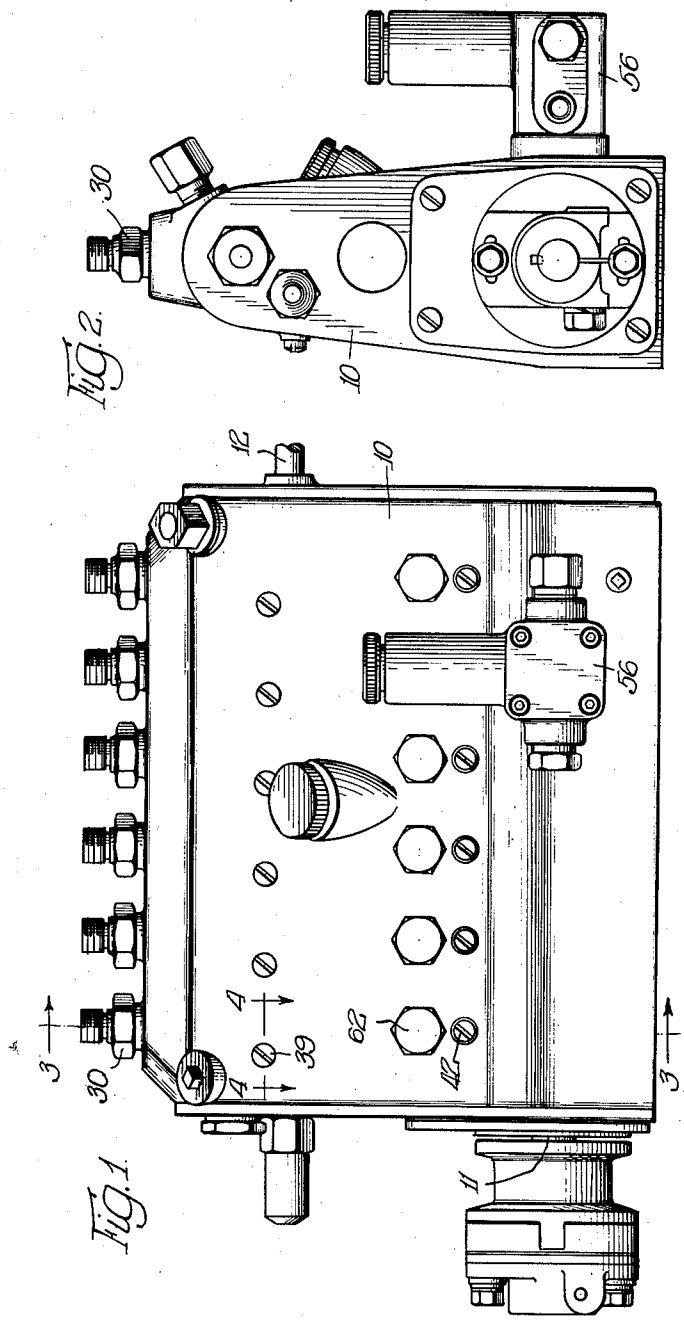


Fig. 1.

Fig. 2.

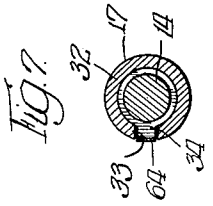


Fig. 7.

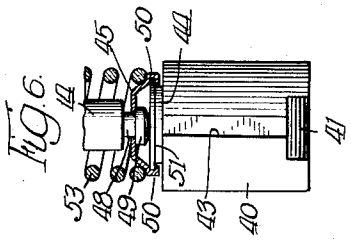


Fig. 6.

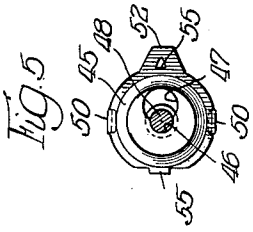


Fig. 5.

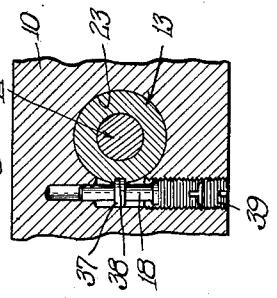


Fig. 4.

INVENTOR.
Nicholas Fodor,
BY
Cromwell, Greist & Warden
Attys.

April 22, 1952 N. FODOR 2,593,550

MULTIPLE UNIT FUEL INJECTION PUMP

Filed March 28, 1946 2 SHEETS—SHEET 2

Fig. 10.

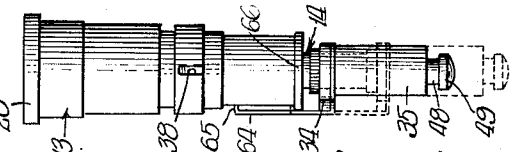


Fig. 9.

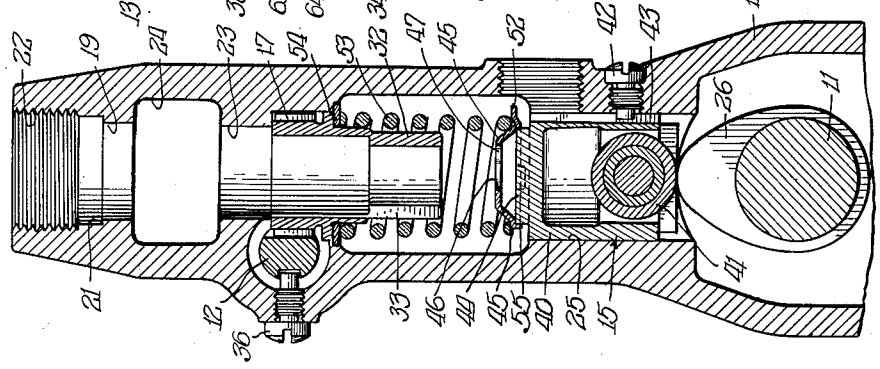


Fig. 8.

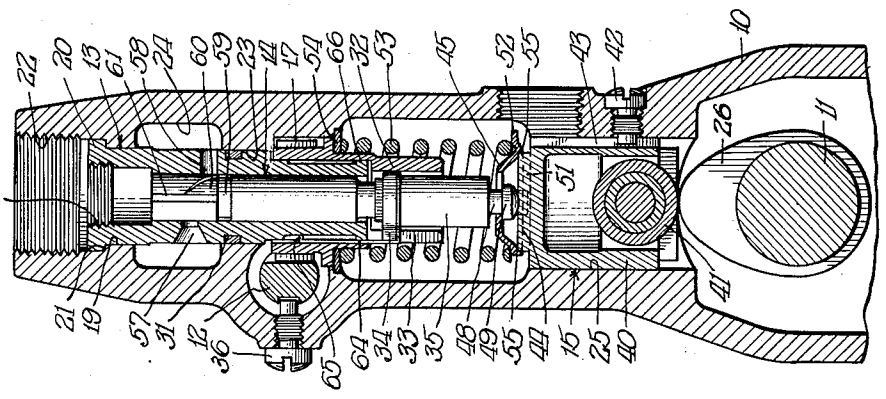
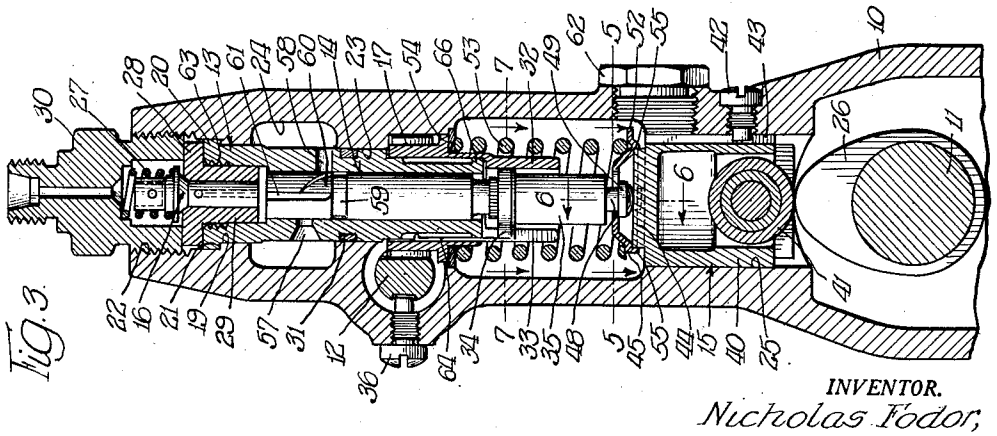


Fig. 3.



INVENTOR.
Nicholas Fodor,
BY
Cromwell, Greist + Wardin
ATTYS.

Patented Apr. 22, 1952

2,593,550

UNITED STATES PATENT OFFICE

2,593,550

MULTIPLE UNIT FUEL INJECTION PUMP

Nicholas Fodor, Wilmette, Ill.

Application March 28, 1946, Serial No. 657,723

3 Claims. (Cl. 103—41)

1

This invention is concerned with a multiple unit fuel injection pump of the constant-stroke cam-operated type, in which the fuel is discharged from each unit by a reciprocating plunger mounted in that unit, and in which the quantity of fuel discharged upon each stroke of the plunger is controlled by the angular position of the plunger relative to the barrel in which it reciprocates.

The object of the invention is to provide an improved pump of the character described in which any one of the several pumping units can be easily removed for purposes of cleaning or repair and can be replaced without either disturbing the calibration of the unit or the adjustment of the pump as a whole.

Other more specific objects and advantages of the invention will be apparent to those skilled in the art upon a full understanding of the construction, arrangement and operation of the new structural organization constituting the invention.

A preferred embodiment of the invention is presented herein by way of exemplification but it will of course be appreciated that the invention is susceptible of incorporation in other structurally modified forms coming equally within the scope of the appended claims.

In the accompanying drawings:

Fig. 1 is a side view of a multiple unit pump constructed in accordance with the invention;

Fig. 2 is an end view of the pump;

Fig. 3 is a vertical section through one of the pumping units, taken on the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary horizontal section through the same pumping unit, taken on the line 4—4 of Fig. 1;

Fig. 5 is a fragmentary horizontal section, taken on the line 5—5 of Fig. 3;

Fig. 6 is a fragmentary vertical section, taken on the line 6—6 of Fig. 3;

Fig. 7 is a fragmentary horizontal section, taken on the line 7—7 of Fig. 3;

Fig. 8 is a view which corresponds to Fig. 3, with the delivery union, delivery valve assembly and tappet inspection plug of the pumping unit removed;

Fig. 9 is a similar view, with the plunger and barrel of the pumping unit removed; and

Fig. 10 is a side view of the plunger and barrel upon removal from the pumping unit.

The pump shown in the drawings contains six pumping units, for connection with each of the cylinders of a six-cylinder engine, but the pump may of course contain a larger or smaller number

2

of units, depending upon the number of cylinders in the engine with which used.

The pumping units are mounted in a row in spaced parallel relation in a housing 10. They are operated by a rotatable cam shaft 11 which is journaled in bearings in the ends of the housing, and they are controlled by a longitudinally shiftable rack 12 which is likewise journaled in bearings in the ends of the housing. The pumping units are all of the same construction.

Each of the pumping units includes primarily a barrel 13, a reciprocable plunger 14 in the barrel, a tappet 15 at the lower end of the plunger, a delivery valve 16 at the upper end of the barrel, a control pinion 17 connected with the plunger, and a calibration screw 18 connected with the barrel.

The upper end of the barrel 13 is positioned in a closely fitting bore 19 in the upper portion of the housing 10 and is provided with a narrow radially extending flange 20 which is seated on a shoulder 21 located at the lower end of a threaded counterbore 22. The lower end of the barrel 13 is positioned in another closely fitting bore 23 in the housing. The portion of the barrel 13 between the bores 19 and 23 is positioned in a fuel chamber 24, which chamber is common to all of the pumping units. The tappet 15 is positioned in another bore 25 in the housing, directly above one of several cams 26 on the cam shaft 11.

The delivery valve 16, which is located at the upper end of the barrel 13, is of conical form and is urged downwardly by a compressed coil spring 27 into engagement with a centrally apertured disk 28. The disk 28 seats against the upper edge of the barrel 13 and is provided with a tubular centering portion 29 which extends downwardly a short distance into the upper open end of the barrel. The disk 28 serves to clamp the flange 20 of the barrel snugly against the shoulder 21 and is in turn clamped in position by a delivery union 30 which is screwed into the threaded counterbore 22. The union 30 also serves to hold the spring 27 compressed with respect to the valve 16.

The barrel 13 is provided intermediate the ends of the bore 23 with a small annular groove in which a sealing ring 31 of suitable material is mounted. Below the bore 23 the barrel 13 is reduced somewhat in diameter to accommodate the control pinion 17, which pinion is journaled on the reduced portion of the barrel and is provided with a downwardly extending tubular extension 32. This extension is provided with a longitudinally extending slot 33 for the reception of a lock-

ing finger 34. The finger 34 projects radially into the slot 33 from a collar portion which is press-fitted onto a longitudinally serrated section of the plunger 14. A sleeve 35 is similarly secured to the serrated section of the plunger 14 below the collar portion of the locking finger. The lug 34 prevents the plunger 14 from turning relative to the pinion 14 while allowing the plunger to reciprocate freely within the barrel 13. The pinion 17 meshes with the previously described control rack 12, which rack is free to move endwise but is prevented from turning by means of a guide screw 36.

The barrel 13 is prevented from turning in the housing by means of the previously described calibration screw 18 (see Fig. 4). The screw 18 intersects the bore 23 and is provided with a small annular rib 37 which engages within a short longitudinally extending slot 38 in the periphery of the barrel 13. The screw 18, which is clamped against inadvertent movement by a locking plug 39, is employed to turn the barrel 13 slightly one way or the other, whereby to obtain accurate equalization of delivery as between each of the several pumping units.

The tappet 15 includes a cylindrical member 40 which reciprocates in the bore 25 and is proprovided at its lower end with a roller 41 which follows one of the cams 26 on the cam shaft 11. The member 40 is prevented from turning in the bore 25 by a guide screw 42 which operates within a longitudinally extending slot 43 in the periphery of the member. The upper end 44 of the member 40 is reduced somewhat in diameter and forms an abutment for the lower end of the plunger 14.

The plunger 14 is detachably coupled to the upper portion 44 of the member 40 by means of a sheet metal disk 45 (see Fig. 5), which disk is provided with a keyhole slot having a small diameter portion 46 and a large diameter portion 47. The small diameter portion 46 is located at the center of the disk 45 and is adapted to engage with a reduced portion 48 of the plunger, which portion is located immediately above the relatively large button-like lower extremity 49 of the plunger. The disk 45 fits over the reduced upper portion 44 of the member 40 and is held against axial separation from the same by tongues 50 on the disk which extend downwardly and inwardly from opposite sides of the disk into grooves 51 in corresponding sides of the upper portion 44 of the member 40. The disk 45 is cupped upwardly at its center to receive the headed end 49 of the plunger between the disk and the top of the portion 44. To disconnect the plunger 14 from the tappet 15, the disk 45 is pried upwardly a little at one side by engagement of the screw driver or other tool with a projection 52 on the disk and is then shifted laterally far enough to bring the large diameter portion 47 of the keyhole slot into register with the end 49 of the plunger, whereupon the plunger may be withdrawn upwardly away from the tappet.

Upon each pumping stroke the tappet 15 and plunger 14 are caused to move upwardly by means of the cam 26, and upon each return stroke they are caused to move downwardly by means of a compressed coil spring 53. The spring 53 is located in a hollow portion of the housing between the bores 23 and 25. The upper end of the spring 53 is seated against a washer 54 which is disposed beenath the toothed portion of the pinion 17 in abutment with the housing at the lower end of the bore 23, while the lower end of the spring 53

is seated against the disk 45. The spring 53 serves to hold the disk 45 in snug engagement with the upper portion 44 of the cylindrical member 40 of the tappet, with a shallow projection 55 on the underside of the disk in centering engagement with the edge of the portion 44.

The fuel which is pumped by the several pumping units is delivered to the chamber 24 from a primary pump 56, which pump forms no part of the present invention and therefore will not be described. The pump 56 serves to maintain the fuel in the inlet chamber 24 under substantial pressure.

In each of the pumping units the plunger 14 is of the well known helix type; and the amount of fuel delivered by the plunger is controlled entirely by rotating the plunger relative to the barrel, the stroke of the plunger being constant at all times. The fuel enters the barrel 13 through an inlet port 57 and that portion of the entering fuel which is not discharged past the delivery valve 16 leaves the barrel through a spill port 58, returning through that port to the inlet chamber 24. The plunger 14 is provided near its upper end with an annular groove 59 and with a helical groove 60 which coacts with the spill port 58 to meter the fuel. The cut-off groove 60 preferably opens into a vertically extending groove 61. As the operation of a constant stroke plunger of this type is well known in the fuel pumping art the same will not be described.

A salient feature of the novel pump construction herein described is the fact that the barrel 13 and plunger 14 of any one of the pumping units can be easily removed without having to disassemble any of the major parts and can thereafter be replaced without disturbing the existing adjustment of that barrel and plunger or of any of the other barrels and plungers. To remove the barrel 13 and plunger 14 it is merely necessary to first remove the delivery union 30, lift out the delivery valve 16 with its associated seating disk 28, and remove an inspection plug 62 to give access to the locking disk 45. Fig. 8 shows the pumping unit after the above described parts have been removed.

A tool having a threaded end may then be screwed into threads 63 on the inside of the upper end of the barrel 13, and a screw driver or other tool may be used to unlach the disk 45 from the lower end of the plunger 14, after which the barrel 13 may be withdrawn upwardly, carrying with it the plunger 14, leaving the remaining parts intact within the housing, in still adjusted position, as illustrated in Fig. 9.

The barrel 13 and plunger 14 are shown in Fig. 10 after being removed. The plunger 14 is caused to be removed at the same time at the barrel 13 by means of a leaf spring member 64 which encircles the sleeve 35 on the plunger 14 below the lug 34 and extends upwardly from the lug against the outer side of the lower portion of the barrel 13. The upper end of the leaf spring member 64 is bent inwardly to form a hook 65, which hook will engage with a small rib 66 on the lower end of the barrel to prevent the plunger 14 from dropping away from the barrel beyond the position shown in dotted lines in Fig. 10 when the barrel is lifted out of the pump. To thereafter disengage the plunger 14 from the barrel 13 it is merely necessary to momentarily spring the hooked end 65 of the member 64 outwardly far enough to clear the rib 66 on the barrel. When the barrel 13 and plunger 14 are in operating position in the pump, with the plunger recipro-

cating in the barrel, the free end of the leaf spring member 64 will slide freely up and down alongside the barrel, within the pinion 17.

It will be appreciated that when the barrel 13 and plunger 14 are removed from the pump in the manner above described the connection of the control pinion 17 with the control rack 13 will not be disturbed in any way and that likewise the relationship of the barrel 13 to the calibration screw 18 will not be disturbed, with the result that the barrel 13 and plunger 14 can be returned to the pump or a new barrel and plunger substituted without in any way affecting the existing adjustment.

I claim:

1. In a fuel injection pump, a pump housing containing a plurality of upwardly opening bores, a plurality of cam-operated constant-stroke pumping units positioned in said bores, each of said units including a barrel, a plunger in the barrel, means controlled by the angular position of the plunger relative to the barrel for determining the amount of fuel pumped by the plunger on each stroke, and a position limiting connection between the barrel and the plunger for causing the plunger to move upwardly with the barrel when the barrel is withdrawn vertically from within its bore in the housing, exteriorly accessible control means mounted in the housing and connected with the plungers for varying the angular positions of all of the plungers relative to the barrels simultaneously and to the same extent, said connection beings freely separable axially from the plungers, whereby to permit the plungers when withdrawn vertically with the barrels from within the bores in the housing to be returned with the barrels to the bores without changing the previous settings of the plungers with respect to the housing, and exteriorly accessible calibration means mounted in the housing and connected with the barrels for individually varying the angular position of each barrel relative to the housing and to the plunger in such barrel independently of the angular positions of the other barrels, said last mentioned connections being freely separable axially from the barrels, whereby to permit the barrels with the plungers to be withdrawn vertically from within the bores in the housing and returned to the bores without changing the original angular positions of the barrels with respect to the housing, each barrel with its plunger being removable vertically as a unit from its bore in the housing and thereafer replaceable as a unit in such bore without disturbing the existing adjustment of either said control means or said calibration means.

2. A fuel injection pump of the construction set forth in claim 1, wherein said calibration means includes a single adjusting screw in threaded engagement with the housing at right angle to the axis of the barrel, and a key connection between the screw and the barrel, which connection consists of a vertical slot in the outside of the barrel and an annular rib in keyed association with the slot, said connecting being freely separable in a direction lengthwise of the barrel.

3. A fuel injection pump of the construction set forth in claim 1, wherein each of the plungers is reciprocated by its cam through an interposed tappet and the tappet is detachably latched to the plunger by a laterally shiftable disk having a keyhole slot connection with a groove in the plunger.

NICHOLAS FODOR.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,079,660	Olin	May 11, 1937
2,079,821	Scribner	May 11, 1937
2,126,985	Buckwalter	Aug. 16, 1938
2,131,779	Zwick	Oct. 4, 1938
2,185,144	Edwards	Dec. 26, 1939
2,187,732	De Juhasz	Jan. 23, 1940
2,192,387	Schlaupitz	Mar. 5, 1940
2,258,655	Links	Oct. 14, 1941
2,260,414	Thaheld	Oct. 28, 1941
2,322,356	Hahn	June 22, 1943