Dec. 21, 1954 O. C. BARBERENA 2,697,401

FUEL INJECTION PUMP FOR INTERNAL-COMBUSTION ENGINES

Filed Sept. 15, 1953 2 Sheets-Sheet 1

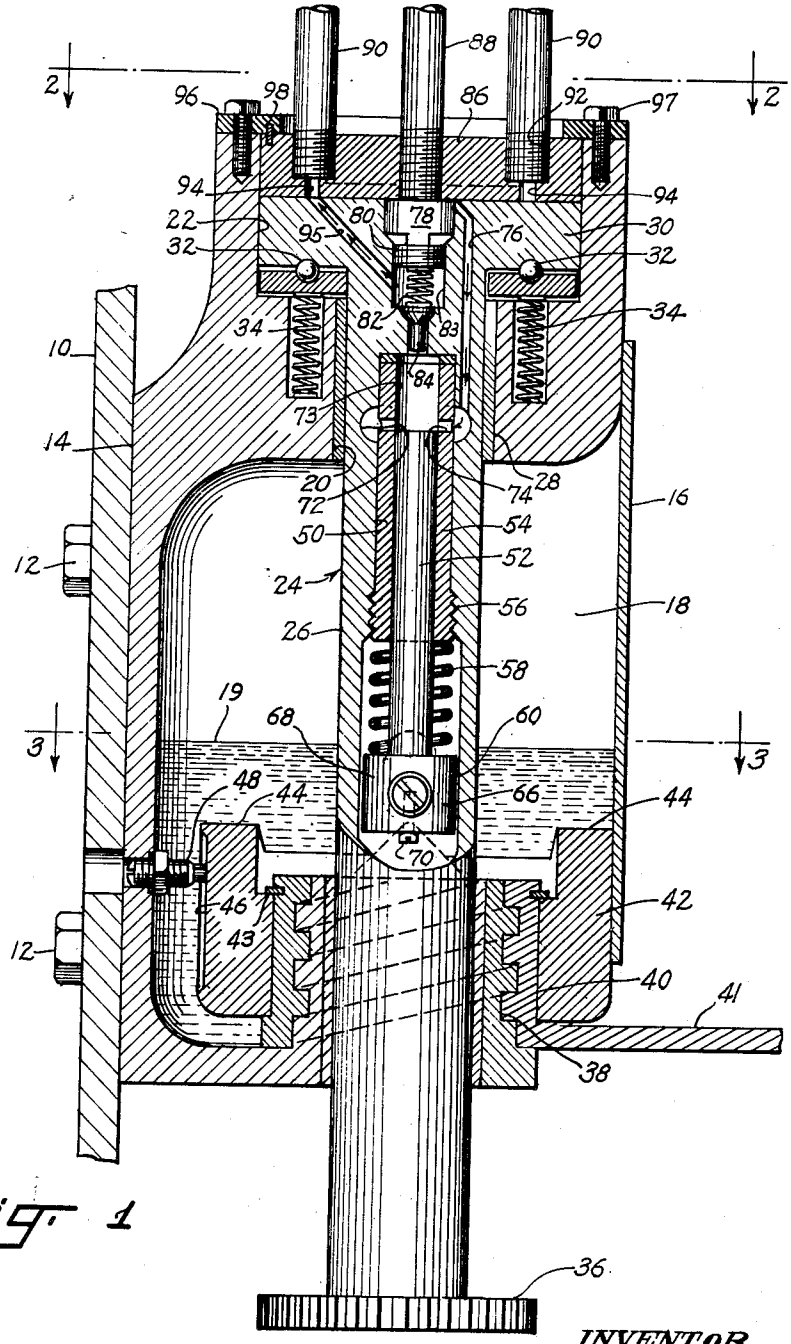


Fig. 1

INVENTOR
Orlando C. Barberena

BY

McMorrow, Berman & Davidson
ATTORNEYS

Dec. 21, 1954 O. C. BARBERENA 2,697,401

FUEL INJECTION PUMP FOR INTERNAL-COMBUSTION ENGINES

Filed Sept. 15, 1953 2 Sheets-Sheet 2

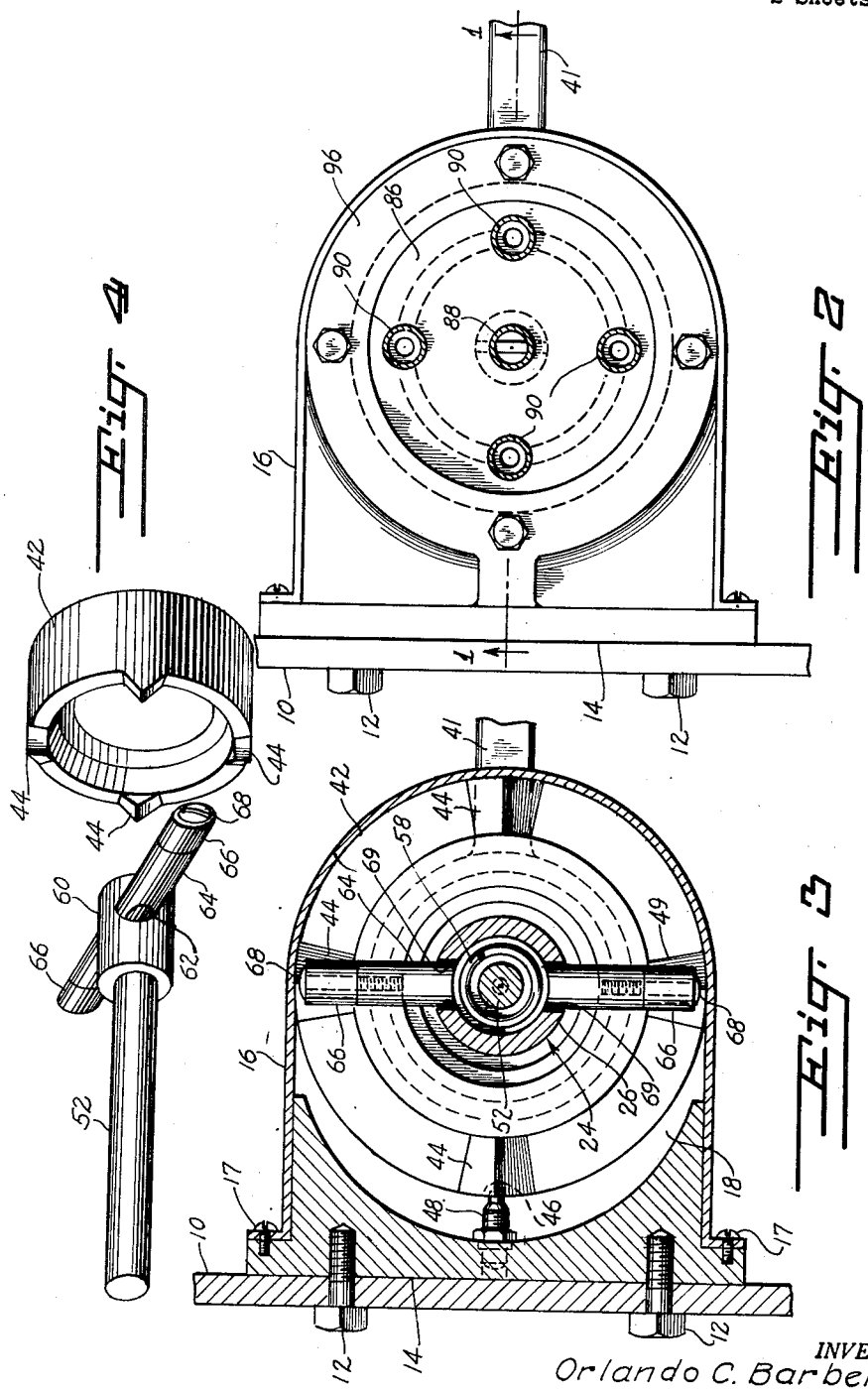


Fig. 4

Fig. 2

Fig. 3

INVENTOR.
Orlando C. Barberena
BY
McMorrow, Berman & Davidson
Attorneys

United States Patent Office

2,697,401

Patented Dec. 21, 1954

2,697,401

FUEL INJECTION PUMP FOR INTERNAL-COMBUSTION ENGINES

Orlando C. Barberena, San Salvador, El Salvador

Application September 15, 1953, Serial No. 380,182

2 Claims. (Cl. 103—2)

One important object of the present invention is to provide a fuel injection pump including a reciprocating plunger that will control the metering of fuel to a plurality of spaced outlets, in succession, with the invention being so designed as to include a novelly arranged means for selectively varying the stroke of the reciprocating plunger.

Another object of importance is to provide, in a fuel injection pump as described, a construction wherein the plunger will be disposed within the rotating main shaft of the device, with said plunger rotating with the main shaft and being at the same time reciprocable relative to the main shaft, the main shaft having a compression chamber with which the inlet and outlet ports are in communication, reciprocation of said plunger being adapted to control the admission of fuel to the compression chamber and being further adapted to control the forcing of fuel from the compression chamber after compression of the fuel.

Another object of importance is to incorporate, in a fuel injection pump as stated, a novel means for effecting controlled reciprocation of the plunger, said means including a cross pin on the plunger and a stationary series of uniformly spaced cam teeth disposed in the path of said cross pin, said cam teeth being adapted to act upon the plunger to reciprocate the same responsive to rotation of the plunger and its associated main shaft.

Yet another object is to provide an externally threaded boss stationarily mounted within the fuel injection pump housing, said boss having threaded engagement with an adjusting nut connected to a sleeve member on which the cam teeth are provided, whereby to adjust the sleeve member longitudinally of the plunger and main shaft responsive to rotary adjustment of the nut means upon the boss, adjustment of the sleeve member in the manner referred to being adapted to controllably vary the reciprocating movements of the plunger.

Other objects will appear from the following description, the claims appended thereto, and from the annexed drawings, in which like reference characters designate like parts throughout the several views, and wherein:

Figure 1 is a longitudinal sectional view through a fuel injection pump formed in accordance with the present invention, the plunger being shown in a rest position, in which there is no fuel injection;

Figure 2 is a sectional view on line 2—2 of Figure 1;

Figure 3 is a sectional view on line 3—3 of Figure 1; and

Figure 4 is an exploded perspective view of the plunger and the sleeve member.

The reference numeral 10 has been applied in the several figures of the drawing to a support member, here shown as a flat plate. The support member can comprise a structural, stationary part of an internal combustion engine installation, or of a vehicle in which an internal combustion engine is mounted. In any event, the support member 10 is apertured at selected locations, for extension of bolts 12 therethrough, said bolts being threadedly engaged in complementarily threaded recesses provided in the outer surface of a block 14.

Block 14 can, in a commereial embodiment of the invention, be cast or otherwise shaped with an elongated recess, said recess being covered over by a transversely curved shell 16 flanged along its opposite side edges, with the flanged edges of said shell being connected by screws 17 or their equivalent, to correspondingly flanged side portions of the block 14. The provision of the recess and shell defines, in the structure, an oil chamber 18 in which

is contained a quantity of oil 19 or other lubricant, said lubricant being provided in order to allow the moving parts of the invention to work in an oil bath. It will be understood that in a commercial embodiment of the structure, the device would be provided with suitable gasket means or sealing rings, whereby to prevent leakage of the oil, and it is thought that the location and particular form of said sealing means is well within the skill of those working in the art, hence requiring no special illustration herein. Further, it is to be understood that the lubricant 19 can be deposited within the chamber 18 in any suitable way, and in a commercial embodiment the device would obviously be provided with suitable fittings, through which said lubricant may be entered in selected quantity.

In the upper end portion of the block 14, I form a longitudinal bore 20, said bore communicating between the chamber 18 and a counterbore 22 opening upon the adjacent end surface of the block. A main shaft 24 has one end portion extending within the bore 20, said end portion or shank of the main shaft being designated by the reference numeral 26 and being encased within a bushing 28 lining the bore 20. Shank 26, within the counterbore 22, is enlarged to provide a flat, circular distributor head 30 the periphery of which is engaged snugly against the side wall of the counterbore.

Interposed between the inner end wall of the counterbore 22 and the underside of the distributor head 30 is a bearing 32, which minimizes frictional engagement between the distributor head and the wall of the counterbore, during rotation of the main shaft. Springs 34, seated in circumferentially spaced recesses provided in the block 14, are tensioned to exert pressure against the bearing, thus to hold the bearing during operation of the device against the distributor head.

That end of the main shaft 24 remote from the distributor head projects beyond the other end of the block, and is provided with a drive gear 36. This is part of a main shaft drive linkage, not shown.

Within the chamber 18, at that end of the structure disposed adjacent the flange 36, there is integral with the block an externally threaded boss 38. The threads provided upon the outer surface of said boss can be of any suitable type or pitch. Preferably, square threads are used, for the purpose of effecting quick adjustment of a nut 40 circumposed about the boss 38. Nut 40 has internal threads complementing the threads of the boss 38, and accordingly, on rotary adjustment of the nut 40, said nut will be shifted longitudinally of the main shaft, for the purpose of metering the fuel.

Rotary adjustment of the nut 40 can be effected in any suitable manner, and for example, can be carried out through the medium of an operating arm or handle 41 integral with and extending radially from the nut 40 exteriorly of the fuel injection pump housing defined by shell 16 and block 14. The operating arm 41 can be manually operated, or alternatively, can be connected by suitable linkage, not shown, to the governor means of the internal combustion engine, whereby to effect rotary adjustments of the nut 40 responsive to changes in engine speed.

In any event, regardless of the manner in which the operating arm 41 is swung to rotatably adjust the nut 40 upon the boss 38, said rotatable adjustment of the nut 40 will effect movement of a sleeve member 42 longitudinally of the main shaft 24. Sleeve member 42 is circumposed about the nut 40, and is connected to the nut for movement therewith longitudinally of the main shaft, by an annular key 43.

The sleeve member 42, at one end, is integrally formed with a circumferential series of cams 44, said cams being spaced ninety degrees apart throughout the circumference of the sleeve member. Thus, the cams are disposed in pairs, with the cams of each pair being diametrically opposed, two pairs of cams being provided upon the sleeve member. Rotary adjustment of nut 40 will, of course, effect adjustment of the series of cam teeth longitudinally of the main shaft.

The number of cams can be varied, and a different number of injections per single cycle can be obtained by changing the number of cams and the number of holes in a receiving disc to be described hereinafter.

For the purpose of preventing rotation of the sleeve

member 42, during rotary adjustment of nut 40, I provide an external, shallow, elongated, slightly helical groove 46 in the sleeve member, receiving the inner end of a set screw 48.

In the shank 26 of the main shaft, an elongated, axial bore 50 is formed, and extending within said bore is a bushing 54 circumposed about a plunger 52 reciprocable within the main shaft. The bushing 54, at one end, is externally threaded as at 56, for engagement with complementary internal threads provided in the bore 50, thereby to hold the bushing 54 against movement relative to shank 26 of the main shaft.

Circumposed about the plunger 52 is a return spring 58, said spring 58 abutting at one end against one end of bushing 54, and abutting at its other end against a plunger head 60 integral or otherwise made rigid with the plunger 52. In the head 60 there is formed a transverse opening 62 (Figure 4) and fixedly engaged in said opening 62 is the mid-length portion of a cross pin 64 the opposite ends of which are reduced for application of removable bushings 66 thereto. The ends of the cross pin are formed with threaded, axial sockets receiving the shanks of screws 68, said screws 68 serving to hold the bushings 66 in place upon the end portions of the cross pin. The cross pin defines, so far as the plunger is concerned, a radial arm on the plunger, and during use of the device, the series of cams 44 will be disposed in the path of rotary movement of said radial arm, thus to cause the plunger to be given reciprocating movement whenever the plunger is rotated with its associated main shaft, while the parts are in a "full" or "intermediate" injection position. The sleeve member 42 only causes longitudinal movement of the plunger while it rotates and never to the main shaft, which has only rotary motion. The plunger will, of course, rotate with the main shaft due to the fact that the plunger is provided with a cross pin that extends through the wall of the main shaft bore 50. The wall of the main shaft bore, in this connection, will be provided with diametrically opposed, longitudinal slots through which the end portions of the cross pin will extend, said slots being designated by the reference numeral 69 in Figure 3.

The slots 69 are so located as to engage the cross pin in one end of the slots, when the sleeve member 42 is adjusted to the "rest" position shown in Figure 1.

For the purpose of fixedly engaging the cross pin within the head 60, a screw 70 is provided. Screw 70 is extended within an axial recess formed in the head 60, the inner end of the screw being engaged in an aligned recess provided in the mid-length portion of the cross pin.

Communicating with the main shaft bore 50, adjacent that end of said bore 50 remote from the head 60 of the plunger, is a circumferential groove opening inwardly upon the bore 50 to define an annular cavity 72. The cavity 72 is desirable for the purpose of storing fuel momentarily, thereby to obtain a fast filling of a feed chamber 73. Feed chamber 73 is defined, as shown in Figure 1, by the bushing 54, and by the adjacent end surface of the plunger. Reciprocation of the plunger will, of course, vary the size of the feed chamber, thereby to effect the ejection of fuel from said chamber.

Communicating between the chamber 73 and the cavity 72 are inlet ports 74. The inlet ports 74 can be provided in any desired number, and in the illustrated example of the invention, a circumferential series of inlet ports is utilized, the ports of said series being spaced equal distances apart about the cavity 72.

Opening into the cavity 72 is a fuel inlet passage 76, said passage 76 extending from a fuel inlet chamber 78 formed in the center portion of the distributor head 30. Chamber 78, at its inner end, is closed by a plug 80 threadedly engaged in the distributor head, the plug 80 forming an abutment for one end of a spring 82. Spring 82 is disposed within a fuel outlet chamber 83 formed in the distributor head, in which outlet chamber there is mounted an outlet check valve 84. Outlet check valve 84 seats in a passage communicating between the feed chamber 73 and the fuel outlet chamber 83, spring 82 exerting pressure against the valve 84 tending to hold the same in a seated position.

Overlying the distributor head 30 is a cover plate or receiving disc 86. Centrally formed in the cover plate is a threaded opening, receiving the complementarily threaded outlet end of a fuel inlet line 88. Inlet line 88 is thus connected in communication with the fuel inlet chamber 78. Spaced circumferentially about the line 88 are fuel outlet lines 90, each of said lines 90 being threaded at its inlet end with the threaded portion of each line being engaged in a complementarily threaded recess 92 of the cover plate 86. In the illustrated example of the invention, four lines 90 are utilized (Figure 2), the number of outlet lines corresponding to the number of cams 44.

In communication with each recess 92 of the cover plate is an outlet passage 94, and formed in the distributor head 30 is a main outlet passage or conduit 95. The conduit 95, at its inlet end, is in communication with the fuel outlet chamber 83, and it will be understood that upon rotation of the head 30, the outlet end of the conduit 95 will be brought into communication with each of the outlet passages 94, in succession.

To hold the cover plate 86 in a stationary position upon the block 14, a retaining ring 96 is utilized, said ring 96 having circumferentially spaced openings receiving connecting bolts 97, the bolts 97 being threaded into aligned recesses formed in the adjacent end surface of the block 14. A key 98 is interlocked with the ring 96 and cover plate 86 to hold these parts against relative movement.

In use of the device, the main shaft 24 will be rotated in any suitable manner, and as a result, the plunger will be rotated with the main shaft. As the plunger rotates, the ends of the cross pin will be engaged by successively following cams 44, and said cams will, as a result, bias the plunger in the direction of its length, thereby cooperating with spring 58 in imparting reciprocating movement to the plunger. The cams 44, as will be understood, will shift the plunger in the direction of the feed chamber 73, thereby momentarily reducing the size of the feed chamber while simultaneously closing the inlet ports 74. The return spring 58, after the plunger has been given this initial stroke, will give the plunger its return stroke, to shift the plunger in a direction toward the cams, thus to locate the ends of the cross arm in position for camming engagement thereof by the next cam 44 disposed in its path.

Each time the plunger 52 shifts toward the sleeve member 42 and its associated cam 44, the inlet ports 74 will be opened, and fuel will move inwardly under low pressure through the line 88, chamber 78, inlet passage 76, cavity 72, and ports 74, into the feed chamber 73. Subsequently, on the upstroke of the plunger, ports 74 will be closed simultaneously with pressurizing of the fuel within the feed chamber 73. The fuel within the chamber 73 will thus be ejected, the ejected fuel passing through the outlet chamber 83 after shifting of the check valve 84 to an unseated position. The ejected fuel travels through the main outlet conduit or passage 95, to a prescribed outline line 90, under high pressure. On the next stroke of the plunger, the fuel will be ejected into the next following outlet line 90, and this functional arrangement will persist, through the full cycle of rotation of the main shaft and plunger.

What is claimed is:

1. A fuel injection pump for internal combustion engines comprising: a housing; a main shaft rotatable therein; a plunger reciprocable in and rotatable with the main shaft, said plunger including a radially extending arm; a sleeve member mounted in the housing for movement longitudinally of the plunger, said sleeve member being disposed in concentric relation to the plunger and main shaft and including, at one of its ends, a circumferential series of equidistantly spaced cams, said cams being disposed in the path of said arm during rotation of the plunger and main shaft to impart successively following reciprocable movements to the plunger responsive to said rotation; an externally threaded boss within said housing apertured for extension of the main shaft therethrough, said boss being stationarily mounted within the housing; and internally threaded means connected to said sleeve member and engaged with said boss, for adjustment of the sleeve member longitudinally of the plunger responsive to rotation of said internally threaded means upon the boss, said adjustment of the sleeve member being adapted to vary the reciprocable movement of the plunger, the main shaft having a fuel feed chamber and having inlet and outlet ports communicating with said chamber, said plunger being disposed to open the inlet port on one stroke to admit fuel to the chamber, and to close the inlet port and force fuel from the chamber through the outlet port on its return stroke.

2. A fuel injection pump for internal combustion engines comprising: a housing; a main shaft rotatable therein; a plunger reciprocable in the main shaft, said plunger including a diametrically arranged cross pin, said plunger being rotatable with the main shaft; a sleeve member mounted in said housing for adjustment longitudinally of the plunger, and including a series of uniformly spaced cams arranged circumferentially thereabout, said cams being arranged in pairs with the cams of each pair being diametrically opposed for disposition in the path of the ends of said pin during rotation of the plunger and the main shaft, thus to act on said plunger in succession to impart successively following reciprocable movements to the same responsive to said rotation of the plunger and main shaft; nut means connected to the sleeve member; an externally threaded, stationary boss in the housing engaged threadedly with the nut means for effecting said longitudinal adjustments

of the sleeve member responsive to rotary adjustment of the nut means; and an operating arm rigid with and projecting radially from the nut means for rotating the same, the main shaft having a fuel feed chamber and having inlet and outlet ports communicating with said chamber, said plunger being disposed to open the inlet port on one stroke to admit fuel to the chamber, and to close the inlet port and force fuel from the chamber through the outlet port, on its return stroke.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,491,795	Bartram	Dec. 20, 1949
2,519,733	Beard	Aug. 22, 1950
2,538,982	Roosa	Jan. 23, 1951
2,544,561	Meyer	Mar. 6, 1951