April 16, 1935. F. A. THAHELD 1,997,985

FUEL PUMPING MECHANISM FOR INTERNAL COMBUSTION ENGINES

Original Filed Nov. 26, 1930 4 Sheets-Sheet 1

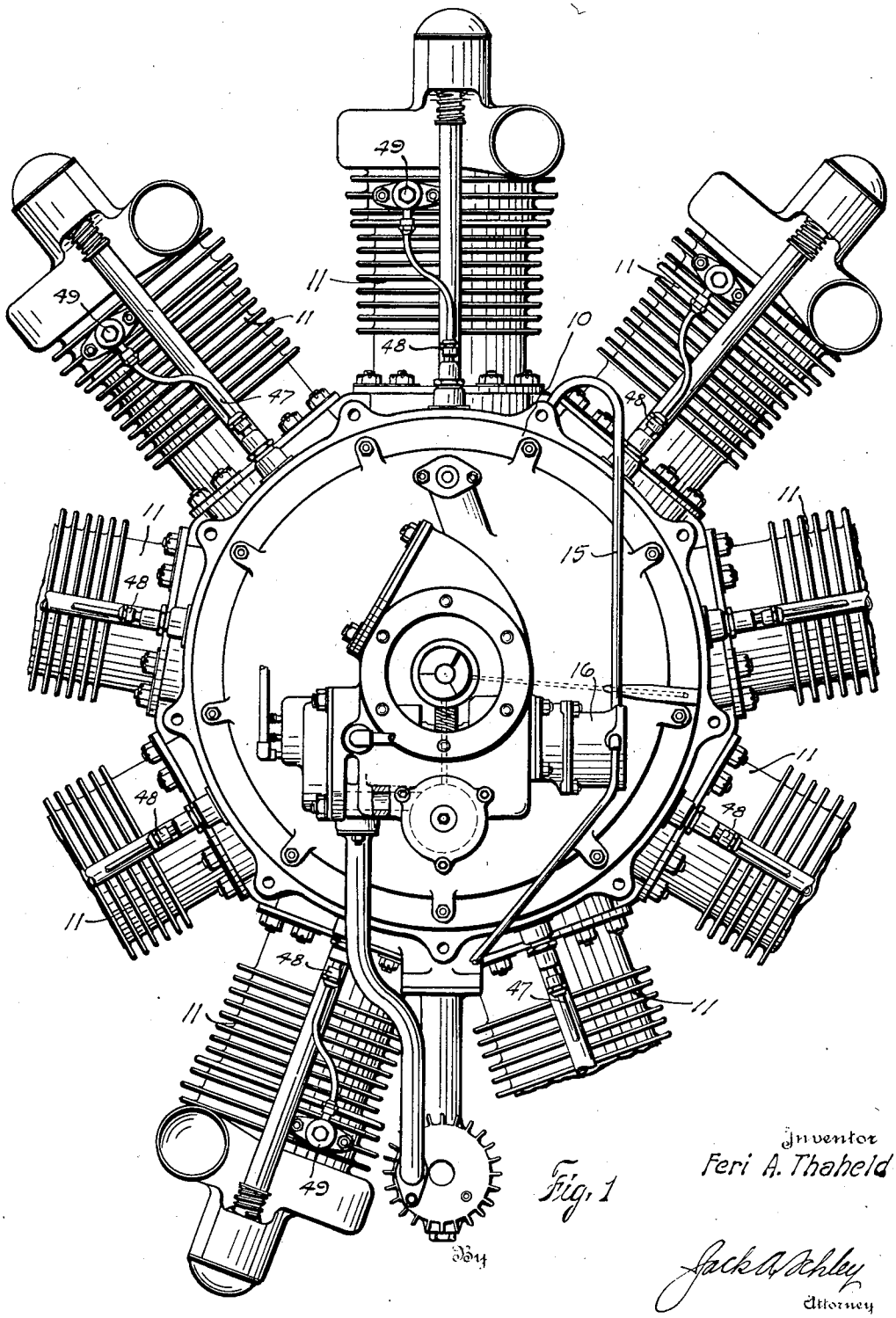



Fig. 1

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Original Filed Nov. 26, 1930 4 Sheets-Sheet 2

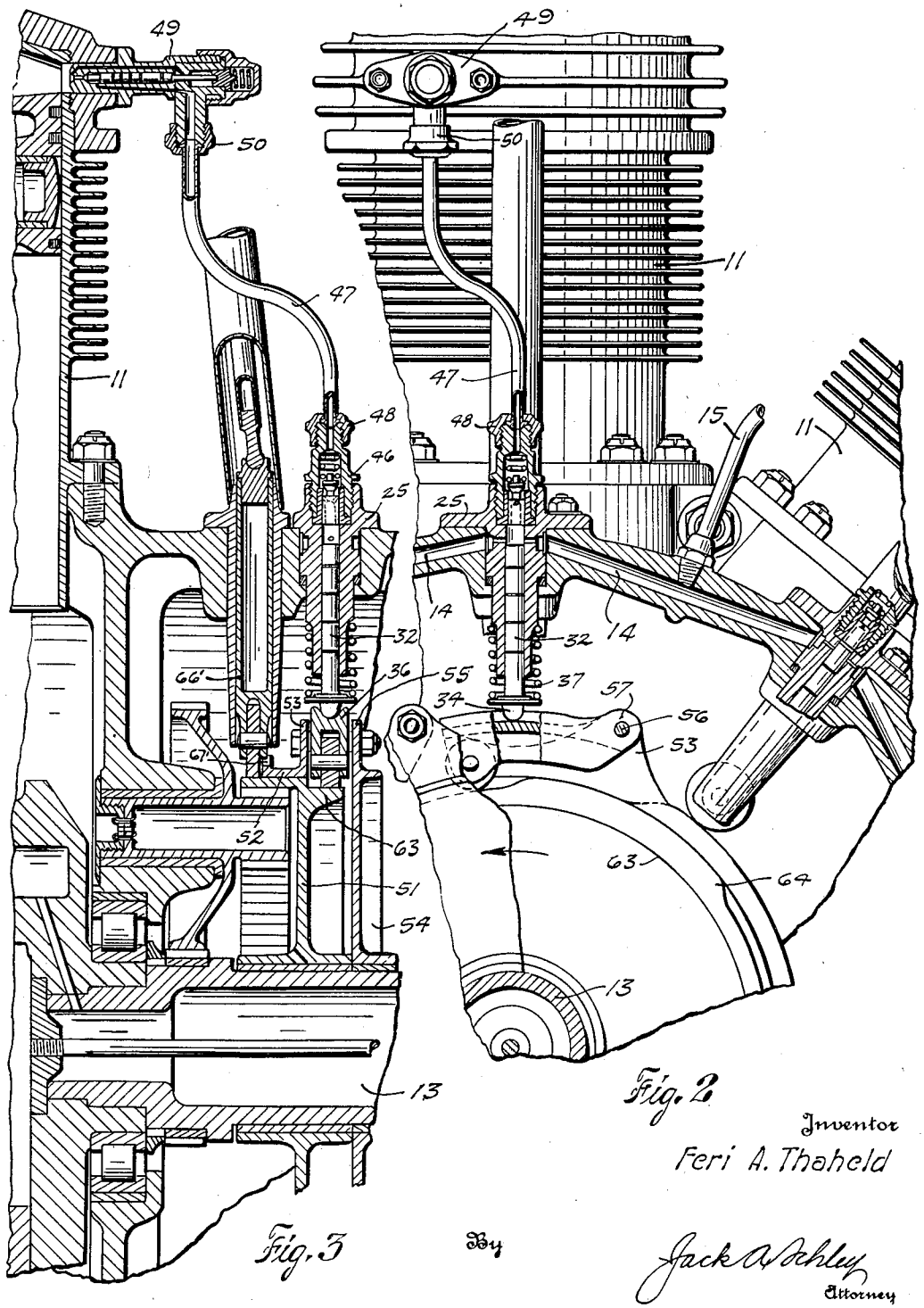



Fig. 3

Fig. 2

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FUEL PUMPING MECHANISM FOR INTERNAL COMBUSTION ENGINES

Original Filed Nov. 26, 1930 4 Sheets-Sheet 3

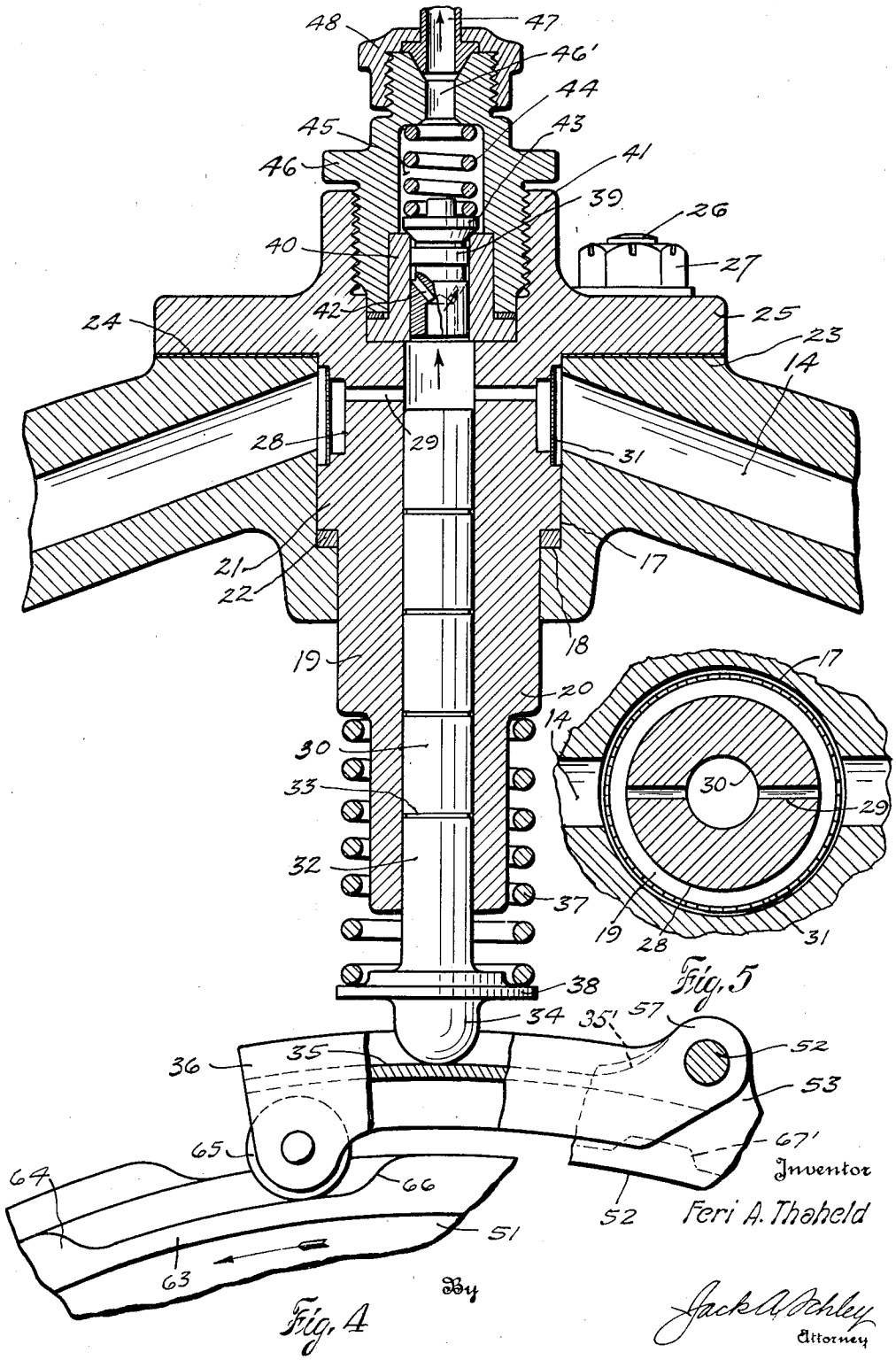



Fig. 4




Fig. 5

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FUEL PUMPING MECHANISM FOR INTERNAL COMBUSTION ENGINES

Original Filed Nov. 26, 1930 4 Sheets-Sheet 4

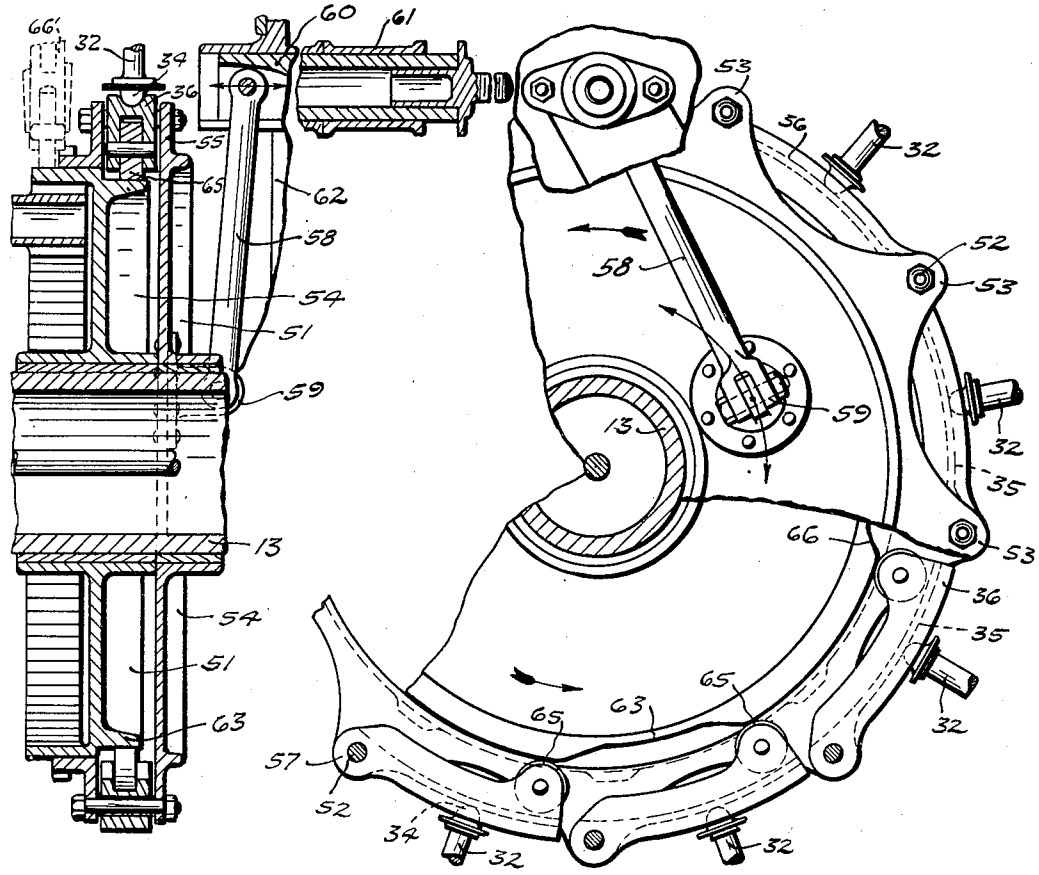



Fig. 7

Fig. 6

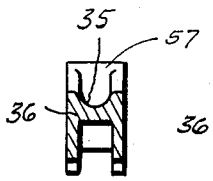



Fig. 9

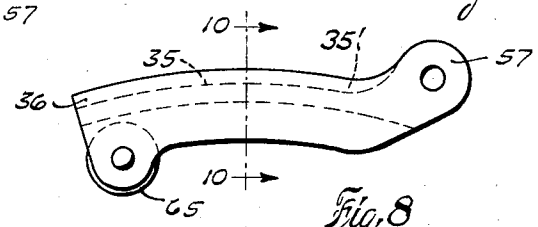



Fig. 8

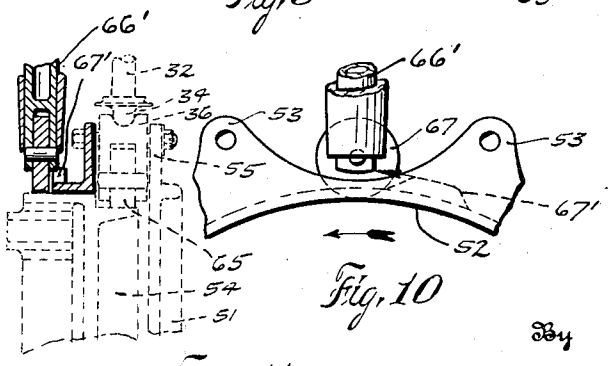



Fig. 10

Fig. 11

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Patented Apr. 16, 1935 1,997,985

# UNITED STATES PATENT OFFICE

1,997,985

## FUEL PUMPING MECHANISM FOR INTERNAL COMBUSTION ENGINES

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Original application November 26, 1930, Serial No. 498,351. Divided and this application September 4, 1931, Serial No. 561,194

2 Claims. (Cl. 103—38)

This invention relates to new and useful improvements in fuel pumping mechanisms for internal combustion engines.

This application is filed as a division of my copending application Serial No. 498,351, filed November 26, 1930, now Patent No. 1,966,771, issued July 17, 1934.

One object of the invention is to provide an improved fuel pump and fuel supply structure.

A further object of the invention is to provide an improved form of fuel conducting line and removable pumps connected in that line in a new and novel manner.

Another object of the invention is to provide a pump barrel having inlet ports, an outlet, and a plunger, together with means for forcing the plunger outwardly beyond the ports and for holding the plunger outwardly beyond said ports during the injection period, thereby preventing back pressure air entering said ports and getting into the fuel supply lines.

A further object of the invention is to provide an improved pump mounting including a seat for the pump and an overhanging flange, whereby the pump may be securely fastened and communication had with the fuel supply lines without the use of exterior connections.

Still another object of the invention is to provide an actuating lever for each pump having a grooved surface for receiving the boss on the plunger, whereby a more efficient working structure is formed and displacement of the parts is eliminated.

A construction designed to carry out the invention will be hereinafter described together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings in which an example of the invention is shown, and wherein:

Figure 1 is a rear elevation of an engine constructed in accordance with the invention,

Figure 2 is a partial vertical sectional view taken through the pump structure and at right angles to Figure 1,

Figure 3 is a vertical sectional view of a portion of the engine and including the parts shown in Figure 2,

Figure 4 is an enlarged sectional view of one of the fuel pumps and associated parts,

Figure 5 is a horizontal cross-sectional view through the fuel pump of Figure 4, on the line of its inlet ports,

Figure 6 is a partial rear elevation of the pump and valve operating means,

Figure 7 is a vertical sectional view of the same,

Figure 8 is a side elevation of one of the actuating levers,

Figure 9 is a vertical sectional view taken on the line 10—10 of Figure 8,

Figure 10 is a detail of one of the tappets and its operating means, and

Figure 11 is a detail of the decompressing means.

In the drawings the numeral 10 designates a cylindrical crank case having a plurality of radial cylinders 11 mounted thereon. A crank shaft 12 is suitably mounted in the crank case and provided with a rear trunnion or extension 13, as is best shown in Figures 2 and 4. A fuel passage or line 14 is formed within the wall of the crank case and liquid fuel is supplied thereto by a pipe 15 from a booster pump 16 (Figure 1), which receives fuel from a suitable source of storage.

Adjacent each cylinder 11 the crank case is provided with a cylindrical socket 17 having an annular seat 18 at its bottom. A pump 19 is provided for each socket and each pump includes a cylindrical barrel 20 seated in the socket and extending through the bottom thereof into the crank case. The barrel has a shouldered head 21 fitting in the socket and resting upon a packing gasket 22. The outer end of the socket is surrounded by a boss 23 having a flat surface for receiving a packing gasket 24, which is interposed between the boss and an outwardly directed flange 25 preferably made integral with the pump barrel. Stud bolts 26 fastened in the boss extend upwardly through the gasket and the flange and receive nuts 27, whereby the pump is fastened in place.

It will be noted that the passages 14 connect with the socket 17 between the packings 22 and 24. By this arrangement leaking of the fuel oil is reduced to a minimum and the use of exterior connections between the fuel line and the pump is avoided. The pump is conveniently and securely fastened in place and is readily removable when necessary.

An annular groove 28 formed in the head 21 of the pump provides a circular passage for the fuel fluid, whereby such fluid may pass around the pump, which removes any obstruction to the free flowing of the fluid through the fuel line 14. The head is provided with fuel ports 29 extending from the groove to the bore 30. A strainer

31 encircles the groove and prevents foreign particles entering the pump from the fuel line.

A fuel plunger 32 having a close sliding fit in the bore 30 is provided throughout its length with a plurality of spaced annular grooves 33. Any fuel liquid which may seep between the plunger and the surface of the bore will collect in these grooves and serve both as a lubricant and as seal rings for said plunger. The outer end of the plunger is normally slightly inward of or substantially flush with the ports 29, as is best shown in Figure 4. The inner end of the plunger has a convex boss 34, which rides in a complementary groove 35 extending longitudinally on the upper side of an actuating lever 36. The boss is held in engagement with the lever by a coiled spring 37 confined on the inner end of the barrel and engaging a flange 38 surrounding said boss.

When the lever 36 is lifted the plunger 32 will be displaced outwardly beyond the ports 29 and these ports will be closed at their inner ends until the plunger is returned. This will prevent back pressure air entering the ports 29 and finding its way into the fuel line 14 so long as said ports are covered. The charge of liquid is displaced outwardly by the plunger through a sleeve 39, which is mounted in a bushing 40 disposed in a box 41 integral with the flange 25. The sleeve has ports 42 for diffusing the fuel charge. A check valve 43 is seated on the outer end of the bushing under the tension of a spring 44. The spring 44 is mounted in the chamber 45 in a nipple 46 which is screwed into the box and holds the bushing in place.

As is shown in Figure 4, the chamber 45 communicates through a port 46' with a fuel tube 47. The fuel tube is fastened to the nipple by a cap 48. The upper end of this tube is connected with an injector 49 by means of a cap 50. As the injector forms no particular part of the invention, and may be of any suitable type, it is not considered necessary to describe the same. It is pointed out that the sizes and areas of the fuel supply elements are such that a single stroke of the pump plunger 32 will displace sufficient fuel liquid from the pump to provide the desired fuel charge which will be distributed into the cylinder from the injector.

The spring 44 is under sufficient tension to resist the static pressure of the liquid fuel in the line 14. Upon operation of the plunger 32, the fuel pressure in the pump will be built up between the end of the plunger and the valve 43, until sufficient pressure is had to overcome the tension of the spring 44 and thus displace said valve, thereby opening a channel to the injector. It is not believed necessary to go into the injection of the fuel as this has nothing to do with the elements of the invention involved in the pump and its mechanism.

A cam disk 51 (Figure 3) is mounted on the crank shaft 12. A decompression ring 52 is rotatably confined on the outer periphery of the cam disk and is provided with spaced ears 53, one being provided for each lever 36. A control disk 54 is rotatably confined on the crank shaft and carries a plurality of ears 55. The ears 53 and 55 are arranged in pairs and each pair carries a pivot bolt 56. Each lever 36 has a lug 57 at its rear end journaled on one of the bolts 56.

The decompression ring 52 and the control disk 54 being free to rotate, and the levers being attached thereto by the bolts 56, it is obvious that by adjusting the disk 54, the said levers 36 are moved circumferentially either in a clockwise or a counter-clockwise direction, according to the direction said disk 54 is rotated. Any means for rotating the disk 54 may be provided and I have shown a very simple device consisting of a link 58 (Figures 6 and 7) pivoted to a clevis 59 journaled in the disk 54. The upper end of the link is pivoted in the end of a plunger 60 telescoping a barrel 61 mounted in the rear cover plate 62 (Figures 1 and 7) of the crank case. By sliding the plunger inwardly the link is moved downwardly, thus rotating the disk 54 in a clockwise direction. By pulling the plunger outwardly the link 58 is lifted, thus rotating the disk in a counter-clockwise direction.

On the side of the cam disk 51 I form a cam ring 63 (Figures 2, 3, 4, 6 and 7). Lugs 64 are mounted on the periphery of this ring in the path of rollers 65 carried by the outer ends of the levers 36 and traveling on said periphery. Each lug, as is best shown in Figure 4, has an inclined approach 66. As the roller 65 rides up this approach its lever is lifted and the plunger 32 is thus displaced. When the roller reaches the upper surface of the lug it travels therealong, thus holding the plunger outwardly beyond the ports 28 during such travel. The upper surface of each lug 64 is long enough to hold the plunger outwardly until the injection of fuel has been completed.

It will be seen that by adjusting the control disk 54 in a clockwise direction each lever 36 will be moved under the boss 34 of the plunger 32 of each pump, so as to bring said boss nearer the outer end of the lever and thereby increase the travel of the pump plunger. This also advances the roller 65 in the orbit of the cam 64, thus advancing the timing in proportion to the increase in the charge of fuel. By a reverse adjustment of the disk 54 the stroke of the plunger is reduced and the timing is retarded. The automatic timing and fuel charging features form the subject matter of my co-pending application Serial No. 442,316, filed April 7, 1930, and a detailed description of the same is considered unnecessary.

The tappet plungers 66' have rollers 67 traveling on the face of the cam disk 51. The decompression ring 52 carries lugs 67' (Figures 3, 7, 10 and 11) adjacent the ears 53. When the control disk 54 is moved in a counter-clockwise direction these lugs engage under the tappet plungers and lift them, whereby the engine valves are opened. At the same time the levers 36 are advanced so that the bosses 34 ride up the inclined ends 35' (Figures 4 and 8) of the grooves 35, whereby the plungers are forced outwardly and the ports 28 thus closed. This prevents air seeping back into the fuel line 14 when the decompressing means is operated.

Various changes in the size and shape of the different parts, as well as modifications and alterations, may be made within the scope of the appended claims.

Having illustrated and described a preferred form of the invention, what I claim, is:

1. Fuel injecting means for internal combustion engines comprising, a fuel pump for each engine cylinder, operators for the pumps, revolving means periodically engaging the operators, a support to which the operators are attached, means for adjusting said support to vary the actuation of said operators, and means on the operators for sustaining the pump plungers at the ends of their injection strokes, whereby fuel is excluded from entering the pumps and back pressure air is excluded from the fuel supply.

2. Fuel injecting means for internal combustion engines comprising, a fuel pump for each engine cylinder, operators for the pumps, revolving means periodically engaging the operators, a rotatable support to which the operators are attached, means for adjusting said support to vary the actuation of said operators, means on the operators for sustaining the pump plungers at the ends of their injection strokes, whereby fuel is excluded from entering the pumps and back pressure is excluded from the fuel supply, a hand operator, and a link connecting said operator with the rotatably adjustable support for adjusting said support upon actuation of said hand operator.

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