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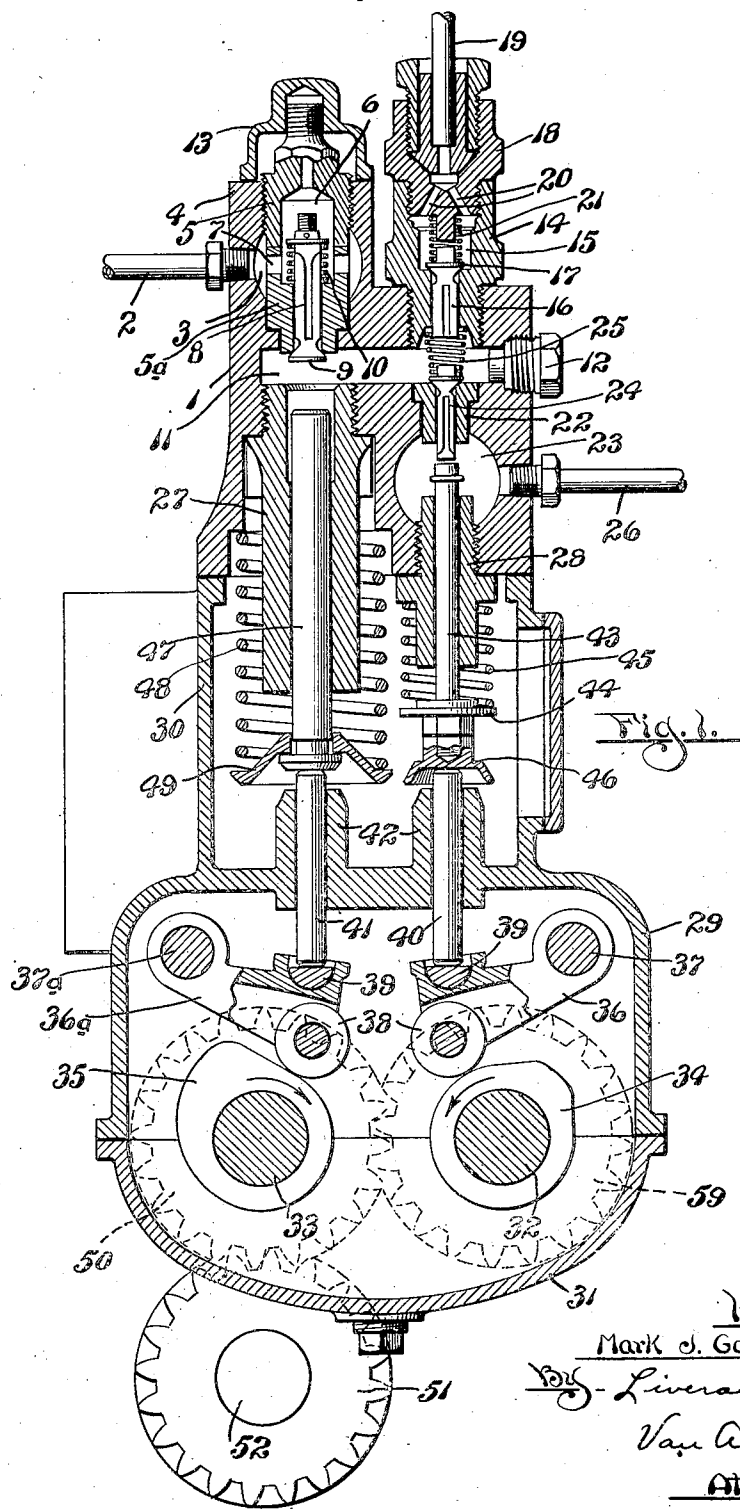
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FUEL PUMP FOR OIL ENGINES

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## UNITED STATES PATENT OFFICE

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## FUEL PUMP FOR OIL ENGINES

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3 Claims. (Cl. 123—139)

This invention relates to a fuel pump for oil engines, particularly those of the type in which fuel is injected under heavy pressure into compressed air above a piston in an internal combustion engine substantially at the limit of the compression stroke of the piston, the fuel being ignited due to the high temperature generated through the heavy compression of the air.

In the injection of fuel into the compressed air in an engine cylinder it is apparent that for different speeds and loads of the engine the amount of fuel should be varied, increasing or diminishing in accordance with the work which has to be performed. It is also apparent that it is very desirable, and from a practical standpoint necessary, that the time at which the fuel may be injected into compressed air should be subject to variation within proper limits in analogy to the advancing or retarding the spark in internal combustion engines in which the charges are electrically ignited from spark plugs.

The pump which I have devised is one particularly applicable to engines of a small, compact and high speed design such as are required particularly for automotive engines, and also for marine engines, in both of which the speed and load is widely variable and the engine is of a relatively small and compact size and design.

My invention consists of many novel details of construction and combination and arrangements of parts for the effective production of an oil fuel pump for internal combustion engines available for use as stated, and in which the fuel injected into the cylinders of the engine may be varied either by manual control or automatically by governor control, and in which the time of injection of the fuel may be controlled and varied by manual control. Understanding of the invention may be had from the following description taken in conjunction with the accompanying drawings, in which,

Fig. 1 is a vertical section through the pump of my invention, it being understood that one of these pumps would be used for each of the cylinders in multiple cylinder engines, the parts thereof of all of the pumps being actuated by the same cam shafts, and

Fig. 2 is a fragmentary horizontal section and plan view showing the driving and controlling mechanisms used for varying the quantities of fuels for different speed and load conditions and for varying the time of fuel injections.

Like reference characters refer to like parts in the figures of the drawings.

In the construction of the pumping unit for a

cylinder of an engine, a body 1 of metal is provided into a side of which the inlet fuel pipe 2 leads to a cavity 3 within the body which is made in an upwardly projecting portion 4 thereof. Said part 4 is vertically positioned and bored and threaded at its upper portion for the reception of a plug formed of two parts, an upper part 5 and a lower part 5a, the upper part being threaded into the upper end of the projection 4 and forcing the lower part 5a downwardly against a suitable seat therefor, as shown. The two parts 5 and 5a of the plug are interiorly recessed making a chamber 6 to which openings or passages 7 lead from the cavity 3 as shown. The lower part 5a of the plug has a central longitudinal opening therein in which a valve stem 8 is mounted, there being a valve 9 at the lower end of the valve stem which, when in the upper position of the valve, as shown in Fig. 1, closes the passage. Normally the valve 9 and stem 8 are yieldingly held in upper position by a coiled spring 10 located within chamber 6. The body 1 has a longitudinal chamber 11 therein made from one side of the body nearly through to the other side with which the lower end of the passage through the part 5a communicates and is normally cut off by the valve 9. The outer end of the chamber 11 is closed by a screw 12. A cap 13 threads onto the upper end of the upper part 5 of the plug first described covering the same as shown.

Alongside the upwardly extending projection 4 of the body 1, a valve housing 14 is located provided at its lower portion with a reduced exteriorly threaded neck which threads through an opening made in the upper side of the body 1 to the chamber 11. The housing 14 has a chamber 15 in its upper portion, and a passage therefrom downwardly to communicate with the chamber 11. In this passage a valve stem 16 is slidably mounted provided with a valve 17 at its upper end which in its lower position closes the passage from the chamber 15.

An outlet member 18 threads into the upper end of the housing 14 and from the same an outlet pipe 19 for the fuel leads away, being connected to the outlet member 18 by a suitable coupling; and passages 20 lead from the chamber 15 through the outlet member 18 so as to carry fuel therefrom to the pipe 19. In practice the pipe 19 leads to the injection valve which carries the fuel to and injects it into the compressed air in a cylinder, which air is compressed on the compression stroke of the piston, as fully shown in a co-pending application, Serial No. 447,917, filed April 28, 1930, relating to the structure of the injection

valve. A coiled spring 21 is located in the chamber 15 and acts upon the valve 17 to yieldingly hold it normally in lower closed position as shown in Fig. 1.

- 5 Below the chamber 11 and in direct axial alignment with the housing 14 is a bushing 22 having a passage therethrough which leads to a chamber 23 in the body 1. A spill valve 24 passes through the bushing 22 and is acted upon by a spring 25 in the chamber 11, as shown, to normally hold the valve in a position to close the passage from the chamber 11 to chamber 23.

- A drainage pipe 26 leads from the chamber 23 and is designed to go to the main supply of liquid fuel, serving as a by-pass for such fuel as is not required in the engine operation as will later be described.

- Directly below and in axial alignment with the plug members 5 and 5a is a relatively long cylindrical guide 27 which serves as the barrel of the force pump and which threads upwardly through openings made in the body 1 to the underside of the chamber 11. A guide sleeve 28 threads upwardly through another opening in the underside of the body 1 to the chamber 23 and the second sleeve 28 is in axial alignment with the bushing 22 and the housing 14.

- A cam shaft casing 29 is formed integrally at its upper side with an upwardly extending housing having vertical walls 30, the housing being open at its upper side. The body 1, with the attached parts described, is located upon the upper ends of the sides 30 and with the sleeves 27 and 28 extending into said housing. The cam shaft casing is closed at its lower side by a cover 31 in a manner analogous to the cover of a crank case in internal combustion engines.

- Two cam shafts 32 and 33, parallel to each other, are spaced apart short distances, extending lengthwise of the cam shaft casing and are rotatably mounted therein. On the cam shaft 32 a plurality of spaced apart cams 34 are secured or integrally formed and, similarly, other cams 35 are fixed on the shaft 33. While the disclosure with reference to Fig. 1 is of a pump in which the parts are actuated by one cam 35 and one cam 34, it is to be understood that with a multiple cylinder engine each cylinder requires the operative action of a cam 34 and a cam 35 and that all of the pumps for a multiple cylinder engine are actuated by the cams on the two cam shafts 32 and 33.

- Levers 36 and 36a, respectively, are located over the cams 34 and 35 and extend outwardly and upwardly having pivotal mountings at their upper ends at 37 and 37a, respectively. Each of the levers at its inner end and underside carries a roller 38 riding against the cams 34 and 35 respectively. Each of the levers at its inner end and upper side is recessed and in each recess a rocker 39, in a segment of a sphere, or cylinder, is mounted. The lower ends of two vertically positioned rods 40 and 41 bear against the upper sides of the rockers 39. Said rods 40 and 41 pass upwardly through guide sleeves 42 at the upper side of the cam shaft case; and the vertical axes of the rods 40 and 41 are coincident with the axes of the sleeves 28 and 27 respectively.

- A tappet rod 43 passes slidably through the sleeve 28 and at its lower end portion has a disc 44 thereon between which and an outwardly extending flange on the sleeve 28 a coiled compression spring 45 is located which tends to move the rod 43 downwardly and bring the lower end portion 46 connected with said rod 43 snugly

against the upper end of the rod 40. A piston 47, in the form of a cylindrical rod, is slidably mounted through the sleeve or barrel 27 and its lower end is held against the upper end of the rod 41 through the force of a coiled compression spring 48 which bears against a dished member 49 connected at the lower end of the piston 47, the upper end of the spring 48 bearing against the body 1.

At an end of the cam shaft 33, as shown in Fig. 2, a spiral gear 50, having a relatively wide face, is secured, which is driven from a second narrower spiral gear 51 splined on the end of a drive shaft 52 which may be operated from the engine. The shaft 52 has mountings in any suitable part 53 of the engine block or base. An arm 54 is fixed to the support 53 on which a lever 55 is pivotally mounted between its ends. A rod 56 is connected to the outer end of the lever and may lead to any suitable place for manual control, it being evident that the lever 55 may be swung to different positions by a longitudinal movement of the rod 56. The inner end of the lever 55 is formed as a yoke to engage with a collar 57 connected to or formed integral with the driving gear 51.

It is evident that with the driving gear 51 located at different positions in the width of the face of the gear 50, the cam shaft 33 is turned to a different angular position with respect to the driving shaft 52 and therefore that the cams 34 will operate to effect its results (later appearing), of altering or varying the time of injection of fuel.

The cam shaft 32 has a splined projecting end 58 on which a combined gear 59 and collar 60 is mounted meshing with and being driven by the gear 50. A second arm 61 is carried by the support 53 on which a lever 62 is mounted, the outer end of the lever having a rod 63 secured thereto which leads to any suitable place for manual control. The pivot 64 at the inner end of the lever 62 is permanently connected therewith and an eccentric 65 is permanently secured on the pivot 64, it being apparent that on angular movement of the lever 62 the eccentric swings about the axis of the pivot 64. A lever 66 is mounted around the eccentric and has its inner end formed as a yoke to connect with the collar 60 while the outer end has a rod 67 leading therefrom to any suitable governor control for shifting gear 59 to different positions in the width of the face of the gear 50. And, as will now be described, such shifting of the gear 59 either manually through actuating the rod 63 or automatically through the governor control rod 67 has the effect of changing the quantity of fuel injected into the engine cylinders, inasmuch as a shifting of the spiral gear 59 along the inclined spiral teeth and grooves of the gear 50 alters the relative position of the cams 34 and 35.

In the operation of the device the cam shafts 32 and 33 rotate in opposite directions and lift the levers 36 and 36a. The fuel from the main fuel supply either under gravity or under light pressure flows from the pipe 2 into the chamber or cavity at 3 and thence into the chamber 6. The down stroke of the piston 47 of the pump caused by the spring 48 when the lever 36a moves downwardly to the lower parts of the cam 35 causes suction whereby the pressure of air overcomes the spring 10, opening the valve at 9 and thereby drawing fuel into the chamber 11. The upstroke of the piston 47 forces the liquid in the chamber 11, the chamber being filled with liquid, to

the valve at 17 which is lifted and the liquid thereupon pumped outward through the pipe 19 leading to the cylinder injection valve. Such flow of liquid will occur only so long as the valve at 24 remains in its closed position. The valve 24, however, is lifted when the cam 34 raises the rod 43 against the valve 24, whereupon the valve 17 closes and the liquid is pumped into the chamber 23 and thence through the by-pass pipe 26 back to the main fuel supply.

It is evident that the quantity of liquid injected is dependent upon the length of time that the piston 47 is moving upwardly on its pumping stroke before the valve 24 is lifted, and that a greater quantity of liquid will be pumped through the pump 19 and injected into a cylinder the later the cam 34 is in operating the rod 43 upwardly. Therefore, a shifting of the gear 59 across the face of the gear 50 either retards or accelerates the time of engagement of the cam 34 with the lever 36 which serves to actuate the rod 43, and the quantities of fuel for different speed and load both manually or by governor.

The time at which the injection will take place into an engine cylinder is dependent upon how soon or how late the upward pumping stroke of the pump piston 47 takes place relative to the piston compression stroke and this is regulated and controlled by the cam 35 coming to a position to operate the piston 47 at an earlier or later period. It is evident that shifting the gear 51 to different positions in the length of the spiral gear 50 will either move the cams 35 forward or back of an intermediate position such as illustrated in Fig. 2 and the fuel be injected either slightly before or slightly after or directly at the time the piston is at its uppermost position in the cylinder and on dead center to the crank shaft, being in several respects analogous to retarding and advancing the spark in internal combustion engines fires by spark plugs.

The construction described is of a very practical, simple and compact design, and particularly available for use with the small compact high power internal combustion engines used in automotive or marine work where there is necessarily a wide variation of speed of operation and of resistance encountered and great flexibility of operation is absolutely necessary. The use of the two cam shafts, one for timing and the other for controlling fuel quantities, is very practical and the necessary feature of the present

invention. Various changes in detail of structure may be resorted to without departing from the invention which is defined in the appended claims and which is to be considered comprehensive of all forms of structure coming within the scope of the claims.

I claim:

1. In a fuel pump having a plunger and a spill valve and cams on cam shafts for respectively operating said plunger and valve, the combination of a spiral gear of relatively wide face on one of said cam shafts, a drive shaft, a spiral gear splined thereon in mesh with the first spiral gear and having a narrower face than the first spiral gear, means for adjusting the second spiral gear lengthwise of the shaft on which it is splined, a third spiral gear splined on the other cam shaft also having a narrower face than the first gear, and means for adjusting the third spiral gear lengthwise of its shaft, substantially as and for the purposes described.

2. In a mechanism of the class described having a body with a chamber therein, a plunger operable in a portion of chamber and a spill valve associated with said chamber whereby release of pressure therein may be had, the combination of revoluble means for operating said plunger, a second means for operating said spill valve, means for synchronously adjusting the first and second means relative to each other, a third common driving means engaging the first means, said first means being connected to said second means to drive the same in timed relationship therewith and means for adjusting said third means whereby said first means is driven in timed relationship from the third means.

3. In a mechanism of the class described having a body with a chamber therein, a plunger operable in a portion of chamber and a spill valve associated with said chamber whereby release of pressure therein may be had, the combination of revoluble means for operating said plunger, a second means for operating said spill valve, a third common driving means, said first means being connected to said second means to drive the same, adjustable means between the common driving means and the first means including two intermeshing axially movable helical gears, and two independently operable sets of regulating means therefor.

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