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PUMPING MECHANISM

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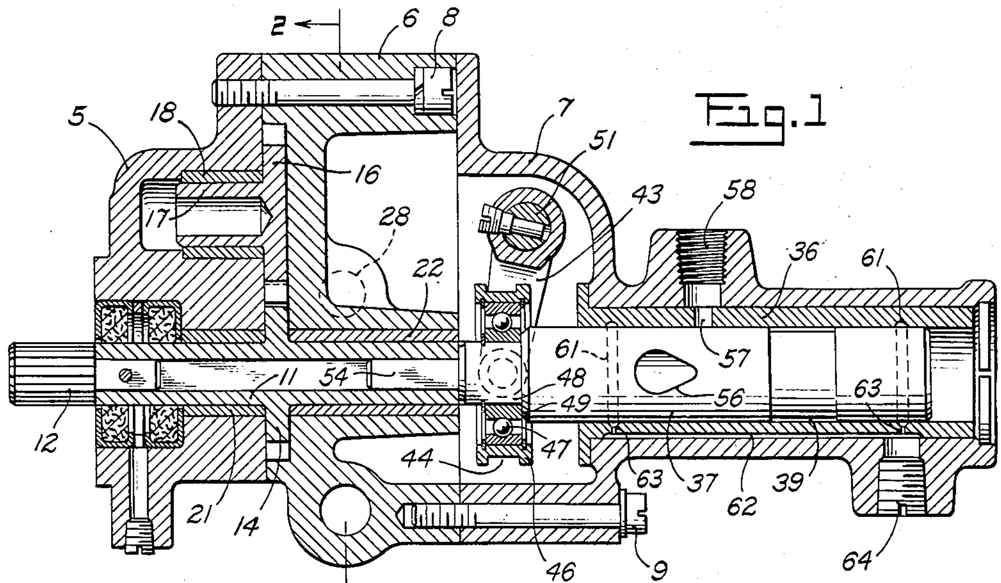


Fig. 1

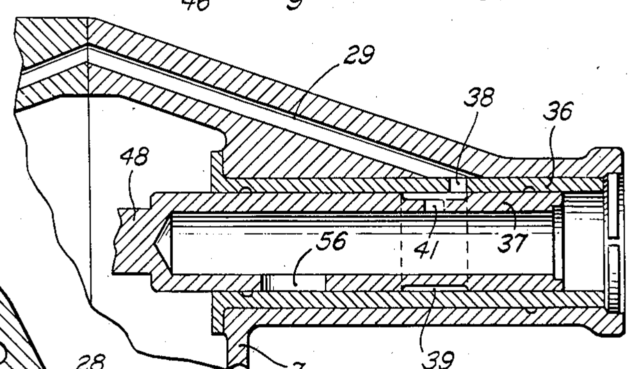


Fig. 3

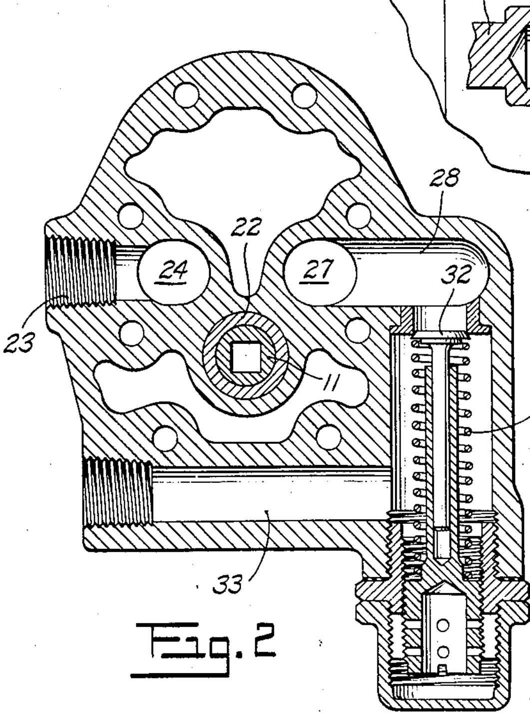


Fig. 2

Fig. 4

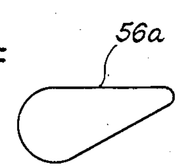
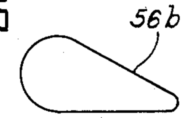


Fig. 5



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PUMPING MECHANISM

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9 Claims. (Cl 103—37)

This invention relates to pumps, and particularly to pumps appropriate for developing moderate pressures for injecting fuel into an internal combustion engine, either in advance of the intake ports or directly into the combustion chambers of the several engine cylinders.

In the operation of internal combustion engines, it is desirable to vary the amount of fuel supplied to the engine in accordance wtih variations in the power output, or otherwise expressed, in relationship to the weight of air used by the engine in a unit of time, so as to keep the air/fuel ratio of the mixture within certain limits, as previously determined to be most desirable.

An object of this invention is to provide a constant pressure pump of variable output, in which the output can be varied at will without interfering with the continuous operation thereof, or of the engine supplied thereby.

Another object of the invention is to provide, in a pump of the character indicated, unitary means for varying both the quantity impulse of the pump's output, as well as the duration of each injection and the timing as measured by the rotation of the crankshaft, and in a predetermined relationship which will assure maintenance of most efficient combustion conditions throughout the whole speed and power range of the engine.

These and other objects of the invention will become apparent from inspection of the following specification when read with reference to the accompanying drawing wherein is illustrated the preferred embodiment of the invention. It is to be expressly understood, however, that the drawing is for the purpose of illustration only, and is not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawing,

Fig. 1 is a longitudinal sectional view of a device embodying the invention;

Fig. 2 is a transverse sectional view along the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary longitudinal sectional view of the device of Figs. 1 and 2, as viewed at a right angle to the viewpoint of Fig. 1; and

Figs. 4 and 5 show possible variations in the contour of one element of the device.

The pump shown includes two sections 5 and 6, held in abutting relationship by screws 8, and a third section 7 abutting the section 6 and held thereto by screws 9. A hollow drive shaft 11 has a splined member 12 keyed thereto, and a flange 14 on said hollow shaft 11 is formed into a spur gear to mesh with, and drive, a similar spur gear 16 with a hub 17 that is rotatably received in a bearing sleeve 18 carried by the housing section 5; additional bearing sleeves 21 and 22 being provided to facilitate rotation of the hollow drive shaft 11. The gears 14 and 16 constitute the pumping elements and receive the fuel by way of inlet passage 23 and port 24, the latter registering with the pump chamber at the region of tangency of the two pitch circles of the gears as does also the outlet port 27 which discharges the pumped fuel to the chamber 28, from which the fuel emerges by way of outlet passage 29. In the event of excessive pressure development a second path of fuel discharge is automatically made operative by the yielding of the spring 31 which normally holds valve 32 against its seat and thus normally blocks emergence of fuel by way of relief passage 33, leading back to the fuel source (by connections not shown).

Now will be described the novel means for controlling the quantity and timing of the fuel discharge from passage 29. As shown, said means is embodied in a sleeve 36 and a hollow rotary valve 37, the former being secured fixedly in the extending portion of the housing section 7, and the latter being rotatable and slidable within the former. A single port 38 in the cylinder 36 registers with the pump discharge passage 29, as indicated in Fig. 3, and also registers with the circumferential recess 39 in the cylinder 37; the said recess 39 being of sufficient extent, longitudinally, to maintain such condition of registry with port 38 throughout the range of longitudinal movement of said cylinder 37. One or more ports 41 extend through the wall of cylinder 37 and thereby serve to direct the pumped fuel into the hollow interior of said cylinder 37, from which it subsequently emerges in successive pulsations, the duration of each pulsation (and hence the quantity of fuel delivered to the engine cylinders) being variable by operation of the manual control shown at 43. In the illustrated embodiment the control 43 is in the form of a bifurcated lever, or yoke, having end pins adapted to ride in the circumferential recess 44 of a collar 46 secured to the outer race of a ball bearing assembly 47 whose inner race is secured about the reduced section 48 of the cylinder 37 and abuts the shoulder 49 of the latter, wherefore manual shifting of the yoke 43 about the axis of its supporting shaft 51 (journaled in the housing section 7) will produce a proportional longitudinal movement of the cylinder 37 within the stationary sleeve 36. The cylinder 37 is continuously rotated in synchronism with pump shaft 11 by reason of the keyed connection between the square inner surface (see Fig. 2) of the hollow shaft 11, and the corresponding square end 54 of the cylinder 37.

The means by which the longitudinal relationship between sleeve 36 and valve 37 controls the pump's output further includes a number (preferably equal to the number of combustion chambers to be supplied with fuel) of ports 57 through the wall of sleeve 36 in exact traverse alignment and evenly spaced on the circumference of sleeve 36; the port 56 in valve 37 registering in rotation with each of the ports 57 and the outlets 58 to which are connected the pipes (not shown) leading to the fuel injection nozzles, installed on the intake manifold ahead of the engine cylinder intake port, or installed directly in the cylinder heads of the engine. It will be apparent that the longitudinal shifting of the valve 37 will produce a variation in the size of the arc of registry between the opposite edges of opening 56, on the one hand, and the opposite edges of fixed port 57 on the other. Thus is provided a control of the length of time, during each cycle of rotation, when flow of fuel can take place by way of said intermittently registering openings.

To lubricate the surface of cylinder 37 which has rotating relationship to sleeve 36, I provide two or more circular grooves 61 along the inner surface of cylinder 36, to receive lubricant from a chamber formed by a longitudinally extending recess 62 in the outer surface of cylinder 36, from which the lubricant reaches the grooves 61 by way of radial passages 63. Port 64 is preferably connected permanently to the pressure lubricating system of the engine.

The position of valve 37 shown in Fig. 1 corresponds to the "no output" adjustment, as the point of port 56 is in position to move past port 57 in sleeve 36 without allowing any fuel to flow therethrough.

With the shape of port 56 as shown, when the valve 37 is moved outwardly, while the injection becomes longer, it starts sooner and ends later with respect to the position of the crankshaft. Other shapes could be used for port 56 in order to provide a different method of timing the injection. Figs. 4 and 5 show two such other shapes. The shape of Fig. 4 would provide fixed timing of the begining of the injection and the timing of the ending of the injection would vary with the length of the injection. With the port shaped as in Fig. 5, one would obtain the opposite result, namely, variable timing for the beginning and fixed timing for the ending of the injection.

Port 56 need not necessarily be cut through the wall of distributing valve 37 as shown in Figs. 2 and 3, but could be milled out to form a depression whose outer rim would have the same shape and outline, and would communicate with the bore of the distributing valve by means of a drilled hole in the widest part of the port.

What is claimed is:

1. In a pump, a drive shaft, a pair of concentric cylinders in alignment with said drive shaft, means responsive to rotation of said drive shaft to deliver fluid to the interior of the inner cylinder, means including a passage through the outer cylinder for discharging said fluid from said inner cylinder, means for controlling the rate of discharge through said passages, said means comprising surfaces on said inner cylinder to interrupt the delivery of fluid to said discharge passage at regular intervals in each cycle of rotation of said drive shaft, and means for regulating the duration of each such interruption.

2. In a pump, a drive shaft, a pair of concentric cylinders in alignment with said drive shaft, means responsive to rotation of said drive shaft to deliver fluid to the interior of the inner cylinder, means including a passage through the outer cylinder for discharging said fluid from said inner cylinder, means for controlling the rate of discharge through said passages, said means comprising surfaces on said inner cylinder to interrupt the delivery of fluid to said discharge passage at regular intervals in each cycle of rotation of said drive shaft, means for regulating the duration of each such interruption, said last named means comprising a member engageable with said inner cylinder to cause axial movement thereof in relation to said outer cylinder, when said member is shifted from one predetermined position to another, and means for shifting said member.

3. In a pump, a drive shaft, a valve mechanism comprising a pair of cylinders one of which is rotatable within and slidable longitudinally of the other, means for drivably connecting said rotatable cylinder with said drive shaft, means comprising registerable passages in said cylinders for causing flow of fluid from the pump during a portion of each revolution of the drive shaft, and means for changing the degree of registry between said openings, to vary the amount of fluid discharge of the pump, said means being operable during the continued operation of the pump.

4. In a pump, a drive shaft, a valve mechanism comprising a pair of cylinders one of which is rotatable within and slidable longitudinally of the other, means for drivably connecting said rotatable cylinder with said drive shaft, means comprising registerable passages in said cylinders for causing flow of fluid from the pump during a portion of each revolution of the drive shaft, means for changing the degree of registry between said openings, to vary the amount of fluid discharge of the pump, said means being operable during the continued operation of the pump, said last named means comprising a thrust member surrounding said shiftable cylinder, and means for changing the position of said thrust member.

5. In a pump, a drive shaft, a pair of concentric cylinders in alignment with said drive shaft, means for drivably connecting one of said cylinders with said drive shaft to cause relative rotation between said cylinders, means comprising registerable openings in said cylinders for producing periodic discharge of fluid from the pump during operation thereof, and means for maintaining a continuous film of lubricating oil between the relatively moving cylinders.

6. In a pump, a drive shaft, a pair of concentric cylinders in alignment with said drive shaft, means for drivably connecting one of said cylinders with said drive shaft to cause relative rotation between said cylinders, means comprising registerable openings in said cylinders for producing periodic discharge of fluid from the pump during operation thereof, means for maintaining a continuous film of lubricating oil between the relatively moving cylinders, said last named means comprising a groove extending longitudinally along the outer surface of the

outer cylinder, and means for maintaining communication between said groove and the engaging surfaces of both cylinders.

7. In a pump, a drive shaft, a pair of interengaging pumping elements, one of which is integral with said drive shaft, inlet and discharge passages converging adjacent the area of interengagement of said pumping elements, and means for regulating the amount of flow through said discharge passage, said means comprising a pair of concentric cylinders, registerable openings through which the fluid flows from said discharge passages to the interior of the inner cylinder, and additional registerable openings through which the fluid within the inner cylinder is delivered therefrom while the drive shaft is rotating through a predetermined portion of its arc of revolution.

8. In a pump, a drive shaft, a pair of interengaging pumping elements, one of which is integral with said drive shaft, inlet and discharge passages converging adjacent the area of interengagement of said pumping elements, means for regulating the amount of flow through said discharge passage, said means comprising a pair of concentric cylinders, registerable openings through which the fluid flows from said discharge passages to the interior of the inner cylinder, and additional registerable openings through which the fluid within the inner cylinder is delivered therefrom while the drive shaft is rotating through a predetermined portion of its arc of revolution, and means operable during continued rotation of the drive shaft to vary the duration of each delivery interval.

9. In a pump, a drive shaft, a pair of interengaging pumping elements, one of which is integral with said drive shaft, inlet and discharge passages converging adjacent the area of interengagement of said pumping elements, means for regulating the amount of flow through said discharge passage, said means comprising a pair of concentric cylinders, registerable openings through which the fluid flows from said discharge passages to the interior of the inner cylinder, and additional registerable openings through which the fluid within the inner cylinder is delivered therefrom while the drive shaft is rotating through a predetermined portion of its arc of revolution, and means operable during continued rotation of the drive shaft to vary the duration of each delivery interval, said last named means comprising a member operable to vary the degree of registry between said last named registerable openings.

DESIRE J. DESCHAMPS.