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2,160,978

FUEL PUMP

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Fig. 2

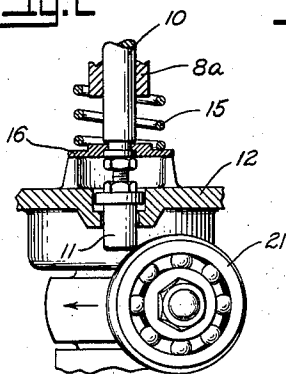


Fig. 1

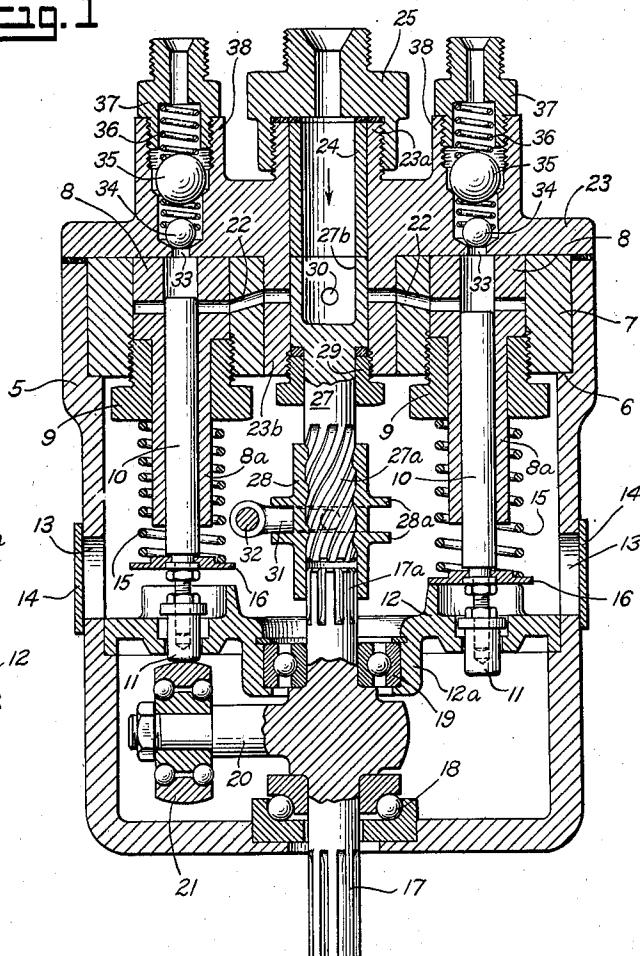


Fig. 3

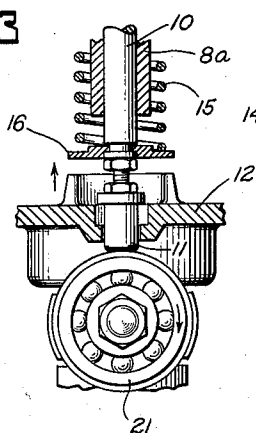
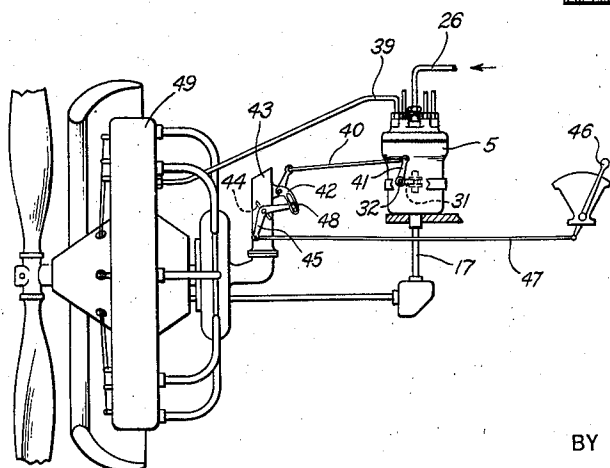


Fig. 4

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FUEL PUMP

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2 Claims. (Cl. 103—37)

This invention relates to pumps, and more particularly to a multi-cylinder pump of the reciprocating piston type.

It has heretofore been proposed to provide a multi-cylinder pump wherein the cylinders have the longitudinal axes thereof disposed parallel and spaced about a common central axis which coincides with the axis of rotation of a distributor adapted to control the discharge from each pump cylinder. Such a pump has been used to supply fuel to the cylinders of internal combustion engines and is frequently referred to as a solid fuel injection pump. In the prior construction referred to, it has been considered necessary to provide means for bypassing a portion of the fuel discharged from each pump cylinder in order to control the quantity of fuel delivered to the engine cylinders.

An object of the present invention is to provide a novel pump of the above type of simplified construction and one which does not require the use of a variable or adjustable by-pass discharge opening in order to regulate the rate of discharge from the pump.

Another object of the invention is to provide a multi-cylinder pump embodying novel means for regulating the discharge from each pump cylinder, said means constituting a distributor adapted to close the intake to each cylinder and to open said intakes at selected times.

A further object is to provide novel pumping apparatus of the above type for supplying fuel to an internal combustion engine, said apparatus being so constructed that each pump cylinder will have a constant angular time of intake port opening for any given control setting, the time in seconds of intake opening varying inversely as the engine speed.

Another object is to provide a novel method for controlling the output of a pump.

A further object is to provide a novel pump of the type wherein the piston (or pistons) is of fixed stroke and is adapted to control the inlet to the pump cylinder, the time of inlet opening being variable relative to the position of said piston with respect to the inlet, whereby the output of the pump is controlled.

A still further object is to provide a novel pump for supplying fuel to the cylinders of an internal combustion engine, said pump being so constructed that the throttle lever or accelerator of the engine may be employed to simultaneously control the engine air supply valve and to regulate the fuel discharge from said pump to secure the de-

sired mixture of fuel and air supplied to the engine cylinders.

The above and other objects and advantages of the invention will appear more fully hereinafter in the detailed description which is to be read with the accompanying drawing illustrating the preferred embodiment. 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 primarily had for this purpose to the appended claims.

In the drawing, wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is a longitudinal sectional view illustrating a multi-cylinder pump constructed in accordance with the invention;

Fig. 2 is a detail, partly in section and with parts broken away, illustrating suitable means for moving a pump piston to fuel discharge position in accordance with the present invention;

Fig. 3 is a detail, similar to Fig. 2, showing the piston and actuating means therefor in discharge position; and

Fig. 4 is a diagrammatic view illustrating operating connections between the pump shown in Fig. 1 and a multi-cylinder engine.

In the form shown in Fig. 1, the pump comprises a cup-shaped housing or casing 5 provided in the inner wall thereof, adjacent the top, with an annular shoulder 6 which constitutes a support for a mounting ring 7 for a plurality of pump cylinders 8. Thimbles 9 threaded into ring 7 secure said cylinders in operative position, the inner end of each thimble having engagement with a shoulder formed on the outer wall of the cylinder. A piston 10 of fixed stroke, for each cylinder, is provided at its lower end with an adjustable tappet 11 slidably guided in a plate 12 rigidly mounted in any suitable manner, as by an annular shoulder, in the lower portion of casing 5. Preferably, windows 13 are provided in the casing to facilitate adjustment of tappets 11, and said windows may be provided with a suitable closure or closures 14. A coil compression spring 15 is interposed between thimble 9 and a follower 16 rigidly attached in any suitable manner to the lower end of the piston, said spring surrounding an extension or sleeve 8a, formed integrally with the wall of cylinder 8, which projects through thimble 9 to provide the desired bearing surface for the piston and to prevent engagement between the piston and spring. The latter tends to maintain the piston at the end of its suction stroke,

with follower 16 in engagement with the upper surface of plate 12.

Novel means are provided for moving pistons 10 to discharge position. As shown, said means is constituted by a power or drive shaft 17 adapted to be operatively connected in any suitable manner to a power shaft of the engine. Shaft 17 is rotatably mounted in casing 5 by means of a bearing 18 carried in the lower wall of the casing and a bearing 19 mounted in the central cup-shaped portion 12a of member 12. The upper splined end 17a of the power shaft projects above the plane of the upper surface of member 12. A radial arm 20 is rigidly attached to, or formed integrally with, shaft 17, intermediate the ends thereof, so that said arm projects laterally between bearings 18 and 19. Mounted on the outer end of arm 20 is a ball bearing cam roller 21 adapted to engage in succession the various piston tappets 11 whereby the pistons are moved to discharge position, said pistons being returned on the suction stroke by means of springs 15. It will be noted that the longitudinal axis of shaft 17 coincides with the longitudinal axis of casing 5 and that the axes of the cylinders 8 are parallel thereto, the radial distance of each cylinder axis from the shaft axis being the same.

Novel means are provided for distributing or supplying fuel to the various cylinders 8 through suitable cylinder intake passages 22, said distributor means being so constructed that the rate of fuel flow from each cylinder may be regulated by controlling said means. To this end casing 5 is provided with a cover 23 having a centrally disposed passage in which is mounted a spacing sleeve 24. A threaded boss 23a surrounds the upper end of said passage to receive a nipple 25 for a fuel supply pipe 26 (Fig. 4). Cover 23 is provided on its lower face with a central and inwardly extending sleeve 23b constituting a housing for a rotatable distributor 27 adapted to be rotated by shaft 17 but angularly adjustable relative to said shaft.

In the form illustrated, the lower end of distributor 27 is provided with spiral splines 27a which are engaged by a longitudinally movable sleeve 28, the lower end of said sleeve being slidably and drivably secured to the upper end 17a of the power or drive shaft by means of straight splines. Preferably, the lower portion of distributor 27 is of reduced diameter to provide a shoulder adapted to be engaged by suitable packing and a gland 29 for retaining said distributor in operative position within sleeve 23b. The upper portion or head of the distributor, which has a working clearance with the inner surface of the sleeve of approximately .002", is recessed to a diameter substantially equal to the inside diameter of spacing sleeve 24, the fuel supplied to the pump flowing through nipple 25, sleeve 24, and into said recess 27b. A radial passage 30 is provided in the wall of the recessed portion or head of the distributor, said passage having a periphery substantially identical to that of a cross-section of each of the passages 22 and being located longitudinally of distributor 27 so that there will be full registry between opening 30 and the adjacent ends of each of the passages 22 during rotation of the distributor.

It is desirable to provide for angular adjustment of distributor 27 relative to intake passages 22 or cylinders 8, and for this purpose sleeve 28 is provided with suitable collars 28a to receive a shifting fork 31 adapted to be actuated by a rock shaft 32 which extends through the wall of casing

5. Movement of fork 31 in a counter-clockwise direction, for example, moves sleeve 28 upwardly, whereby the angular position of distributor 27 may be adjusted relative to the intake passages 22 of the cylinders, and this adjustment is made without disturbing the driving relation between said distributor and said shaft, and without longitudinal movement of the distributor.

Cover 23 is provided with discharge openings or passages 33 adapted to be closed by one or more valves 34, 35. As illustrated, valve 34 is a spring pressed ball valve of less diameter than the spring pressed ball valve 35. Seating spring 36 for ball valve 35 is positioned by the walls of a recess formed in a nipple 37, threaded into a boss 38 on the cover, each of the nipples 37 receiving pipes, one of which is shown at 39 in Fig. 4, for connecting each pump cylinder to the respective engine cylinder.

In operation, shaft 17 is rotated, whereby cam roller 21 engages follower levers 11 in succession to actuate pistons 10 of fixed stroke to discharge fuel from cylinders 8 past valves 34, 35, pipes 39, to the corresponding cylinders of the engine. After each piston or plunger 10 is moved by roller 21 to discharge its fuel load, said piston is forced downwardly or inwardly by spring 15, whereupon a partial vacuum is created in the cylinder above the piston. If the piston be moved by spring 15 to a position such that the upper end of the piston is below intake passage or side port 22, fuel will flow from the distributor into the cylinder when distributor passage 30 registers with intake passage 22. The amount of fuel drawn into the cylinder by the partial vacuum and hence the amount of fuel discharged from each cylinder may be regulated by controlling the angular time said port 30 opens relative to the upward movement of piston 10, it being noted that in its upward movement the piston is effective to seal the inner end of passage 22. The angular adjustment of distributor 27, and hence passage 30, is controlled by longitudinal movement of sleeve 28.

It will be noted that the construction illustrated and described gives a constant angular time of intake port opening, which results in an increasing time in seconds of port opening as the engine speed decreases. Consequently, an angular adjustment of distributor 27 is required which is similar to the angular adjustment required for the usual air intake or throttle valve of an internal combustion engine, and accordingly the desired mixture ratio for the engine may be obtained by mechanically connecting the adjusting mechanism for the distributor to the control lever for the engine air throttle.

As shown more clearly in Fig. 4, the above connection may be effected by means of a link 40 pivotally connected at one end to an arm 41 secured to the rock shaft 32 for fork 31. The opposite end of link 40 is pivotally connected to a bell crank lever 42 which is operatively mounted on a fixed pivot that may be carried by the air intake 43. A throttle or air valve 44 in said intake is adapted to be operated by a bell crank lever 45 connected to throttle lever 46 by means of a link 47. Bell crank 45 is operatively connected to bell crank 42 by means of a pin and slot connection 48, said pin and slot connection constituting a cam whereby desired relative movement between throttle valve 44 and distributor 27 may be obtained to secure variations in the mixture ratio throughout the full range of operation of the engine 49.

There is thus provided a novel multi-cylinder

pump which is simple in construction and which is adapted for a wide variety of uses. The pistons 10 coact with the angularly adjustable distributor 27 to control the output of the pump. For example, if the distributor is adjusted to such an angular position that port 30 does not begin to register with an inlet passage 22 until the piston for said passage reaches a position, in its upward movement, such that the inner end of passage 22 is almost closed, it will be seen that only a small amount of fuel will be drawn into the cylinder, and hence a small amount will be delivered to the engine cylinder. The time, in seconds, of intake opening varies inversely as the engine speed and accordingly the adjusting means for the distributor may be mechanically connected to the means for controlling the engine air intake valve.

Various changes may be made in details of construction and the arrangement of the parts, and, as will be understood by those skilled in the art, the apparatus and the novel method disclosed are not limited to use in connection with fuel injection, nor to multi-cylinder pumps. It will be understood that the term distributor as used here is sufficiently broad to include means for controlling one or more inlets. Reference will accordingly be had, primarily, to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. In a fluid pump, a body, a plurality of parallel cylinders therein arranged about a central drive shaft, a piston in each of said cylinders, a cam on said drive shaft arranged to actuate said pistons in sequence, said cylinders having discharge ports and inwardly extending inlet ports, said pistons being movable to close said intake ports after a predetermined movement, a hollow sleeve valve coaxial with the drive shaft having

a portion forming a shaft, said valve shaft and said driving shaft being aligned, one of said shafts having helical threads on its outer surface and the other shaft having straight splines, a slidable sleeve encircling the adjacent ends of both shafts and cooperating with the threads and splines for changing the angular relation between the shafts, means for preventing axial movement of each of said shafts, said sleeve valve having a port in its side wall adapted to align with each intake port in sequence, and means for introducing fluid to the interior of said valve whereby the fluid is distributed to the cylinders.

2. In an apparatus of the class described, a casing, a fluid receiving distributor rotatably mounted in said casing, means for preventing axial movement of said distributor, a plurality of pump cylinders positioned in said casing at substantially equal radial distances from said distributor, said cylinders having intake passages adapted to receive fluid from said distributor, said distributor being in the form of a shaft having an axial recess closed at its driven end and open at the other end for receiving a supply of fluid, and said distributor having a radial port extending through its side wall into said recess to periodically align with the cylinder intake passages and to permit fluid to flow from the recess into the cylinders, pistons in said cylinders arranged to close the cylinder intake passages during reciprocation of the pistons, means including a shaft for actuating said pistons, said shaft being axially aligned with said distributor shaft, means including an axially movable sleeve encircling the adjacent ends of both shafts for angularly adjusting said distributor relative to said piston actuating shaft and for driving the distributor.

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