

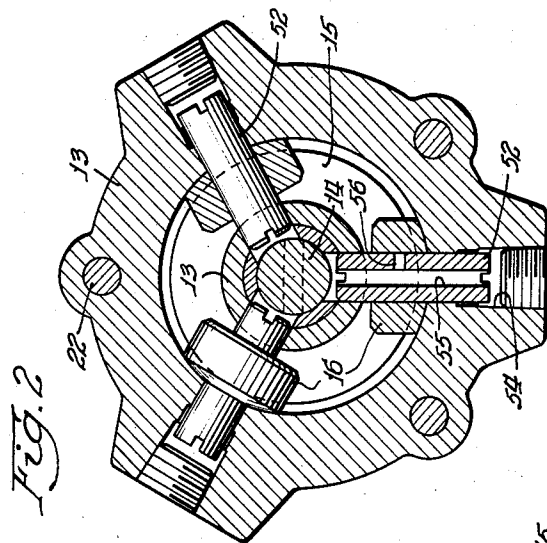
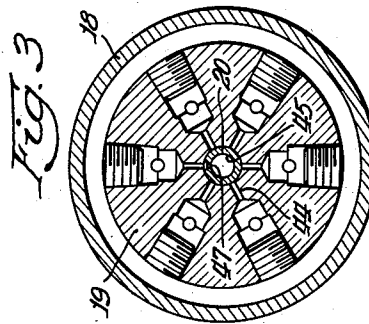
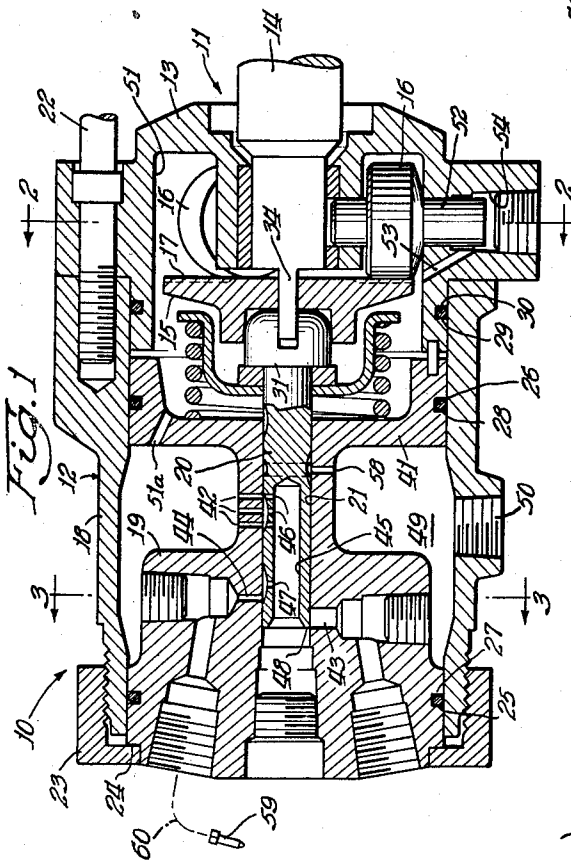
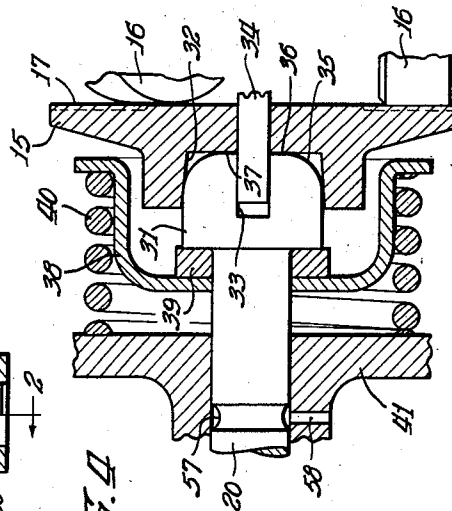
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FUEL INJECTION PUMP

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FUEL INJECTION PUMP

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2 Claims. (Cl. 103—2)

This invention relates to a pump for a fuel injection mechanism of an internal combustion engine.

The present invention constitutes an improvement of the fuel injection pump disclosed in pending application of Einar S. Dahl, Serial No. 702,389, filed December 12, 1957.

It is an object of the present invention to provide an improved fuel injection pump for direct cylinder injection, having an output that varies directly with the speed at which said pump is driven.

It is another object of the present invention to provide an improved fuel injection pump having a rotatable and reciprocating plunger connected to and driven by a rotatable cam for distributing fuel to respective cylinders of an internal combustion engine.

It is another object to provide a fuel injection pump in accordance with the preceding object, wherein the cam is in contact with a plurality of rollers and said plunger has a flexible connection with said cam for thereby allowing equal distribution of the driving load of the plunger upon the rollers.

It is an additional object to provide a fuel injection pump in accordance with the preceding objects having means for lubricating the rollers by the same liquid fuel as is delivered by the pump.

It is still another object to provide an improved cam and plunger for a fuel injection pump with the plunger having a partially rounded and partially flat end in contact with said cam.

The invention consists of the novel constructions, arrangements and devices to be hereinafter described and claimed for carrying out the above stated objects and such other objects as will appear from the following description of a preferred form of the invention, illustrated with reference to the accompanying drawings, wherein:

Fig. 1 is a longitudinal sectional view of the improved pump of the present invention;

Figs. 2 and 3 are views taken on lines 2—2 and 3—3 of Fig. 1; and

Fig. 4 is an enlarged fragmentary sectional view of a plunger and cam utilized in the pump of Fig. 1.

Referring now to Fig. 1, the improved pump of the present invention, designated by the numeral 10, comprises a driving section 11, and a pumping section 12. The driving section 11 comprises a casing 13, a drive shaft 14 journaled within the casing 13, and a cam 15. The drive shaft 14 is driven by a rotatable part of an internal combustion engine (not shown) and rotatably drives the cam 15. A plurality of rollers 16 are rotatably disposed within the casing 13 with their axes of rotation at right angles to the axis of the drive shaft 14 and are in contact with a cam surface 17 of the cam 15.

The pumping section 12 generally comprises an outer pump body 18, an inner pump body 19 slidably disposed within the outer body 18, and a plunger 20 reciprocatively and rotatably disposed within an axial central bore 21 formed in the inner body 19. The outer pump body 18 is attached to the casing 13 by a plurality of machine

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screws 22, and the inner pump body 19 is contained within the outer body 18 by means of a cap nut 23 which is threaded on the outer pump body 18 and which fits into an annular groove 24 formed on an end of the inner pump body 19. A fluid tight seal is provided between the inner pump body 19 and the outer pump body 18 by means of O-rings 25 and 26 which are contained in annular grooves 27 and 28, respectively, formed in the inner pump body 19. A fluid tight seal also is provided between the outer pump body 18 and the casing 13 by means of an O-ring 29 which is contained in an annular groove 30 formed in the casing 13.

The plunger 20 is formed with an enlarged cylindrical head 31 which extends into a cylindrical recess 32 formed in the cam 15. The cylindrical head 31 is formed with a slot 33, and a driving connection with the shaft 14 is provided by means of a tang 34 formed integrally with the shaft 14 which extends through the cam 15 and fits into the slot 33. The head 31 of the plunger 20 is formed with a partially rounded surface 35 and a partially flat surface 36 in contact with an annular surface 37 in the bottom of the recess 32.

A spring retaining collar 38 encircles the plunger 20 and abuts against a washer 39 which is disposed between the retaining collar 38 and the enlarged cylindrical head 31 of the plunger 20. A spring 40 is disposed under constant compression between the retaining cap 38 and an annular portion 41 of the inner pump body 19. The spring 40 tends to force the plunger 20 and cam 15 to the right as shown in Fig. 1 and press the cam surface 17 against the rollers 16.

The inner pump body 19 is formed with a plurality of fuel inlet ports 42, a fuel spill port 43 and a plurality of fuel delivery ports 44. The plunger 20 is formed with an axial central cavity 45 which extends throughout approximately one half of the length of the plunger 20. The plunger 20 also is formed with a plurality of fuel inlet ports 46 and a fuel delivery port 47. The ports 46 extend radially outward from the central cavity 45 and are adapted to be aligned with the fuel inlet ports 42 of the pump body 19 as the plunger 20 rotates. The fuel delivery port 47 also extends radially outward from the central cavity 45 and is adapted to be aligned with the fuel delivery ports 44 as the plunger 20 rotates. An end 48 of the plunger 20 is adjacent to the spill port 43 and restricts the port 43 as the plunger 20 reciprocates.

The pump 10 is adapted to be lubricated by a portion of the same liquid fuel as is pumped by the plunger 20. Fuel is supplied to an annular cavity 49 existing between the outer pump body 18 and the inner pump body 19 through a port 50. Fuel also is supplied to a cavity 51 formed in the casing 13 by means of a port 51a extending through the annular portion 41 of the inner pump body 19. Fuel within the cavity 51 provides lubrication between the rollers 16 and the cam 15. Each of the rollers 16 is rotatably mounted on a respective hollow shaft 52, and lubricating fuel is supplied to the interior thereof through channels 53 formed in the casing 13. Each channel 53 communicates with the cavity 51 and with a chamber 54 formed in the casing 13 at the radially outward end of each shaft 52. Fuel is allowed to pass from the chamber 54 through a central opening 55 in each shaft 52 to a radially extending port 56 also formed in the shaft 52. Fuel passing through the central opening 55 and the port 56 lubricates the interior of the roller 16.

Lubrication of the plunger 20 also is provided by means of an annular groove 57 formed on the plunger 20. A port 58 is in communication with the groove 57 and opens into the cavity 49 for allowing passage of fuel to the groove 57.

Fuel discharged by the pump 10 is distributed in timed relationship to a plurality of nozzles 59 extending into

the cylinders of an internal combustion engine (not shown). Each of the nozzles 59 is connected with a delivery port 44 through a fluid conduit 60.

In operation, the pump 10 functions as follows: the drive shaft 14 is driven by a rotatable part of the internal combustion engine (not shown), and rotatably drives the plunger 20 and cam 15. The cam surface 17 in contact with the rollers 16 imparts a reciprocating motion to the plunger 20 as it rotates. During the intake stroke of the plunger 20, that is, when the plunger is moving to the right as shown, the inlet ports 46 become aligned with the inlet ports 42 in the pump body 19. Fuel is drawn into the cavity 45, and as the plunger 20 rotates still further, communication with the inlet ports 42 is cut off. During the delivery stroke of the plunger 20, that is, to the left as shown in Fig. 1, the fuel within the cavity 45 and the central bore 21 is compressed by the plunger 20. A portion of the fuel within the bore 21 is discharged past the end 48 of the plunger 20 through the spill port 43. As the plunger 20 moves further to the left, the spill port 43 is cut off and the fuel delivery port 47 in the plunger 20 becomes aligned with one of the delivery ports 44. Fuel is discharged through the delivery ports 47 and 44, the conduit 60, and the nozzle 59 into a cylinder of the internal combustion engine. As the plunger rotates still further, communication between the ports 47 and 44 is cut off and the inlet ports 46 again become aligned with the inlet ports 42. The cycle just described is repeated for as many fuel delivery ports and as many cylinders as there are in the internal combustion engine.

The quantity of fuel delivered through each of the delivery ports 44 is determined by the proportion of fuel discharged through the spill port 43. The proportion of fuel delivered to that spilled can be varied by turning the cap nut 23. Turning of the cap nut causes the inner pump body 19 and the spill port 43 to be moved axially with respect to the end 48 of the plunger 20. The proportion delivered to the nozzles 59 thus can be increased or decreased depending upon the direction of rotation of the cap nut 23.

Fuel existing within the cavity 49 is allowed to pass through the port 51a and into the cavity 51. Fuel present within the cavity 51 acts as a lubricant between the rollers 16 and the cam surface 17. A portion of the fuel within the cavity 51 can pass through the channels 53, the chambers 54, the central openings 55 and the port 56 for lubricating the interior of each of the rollers 16.

The flexible connection provided between the cam 15 and the head 31 of the plunger 20 functions to equalize the driving load of the plunger 20 upon each of the rollers 16, as will now be described. It is virtually impossible to so locate the shafts 52 in the casing 13 that the cam 15 would maintain uniform contact with the rollers 16 if the cam 15 were formed integral with the plunger 20. The cam 15 should maintain equal contact at all times with all three of the rollers 16 shown. The driving force for reciprocating the plunger 20 is transmitted through the contacting surfaces 36 and 37. The partially rounded surface 35 formed on the head 31 allows the cam 15 to tilt slightly and still maintain a driving connection with the head 31 for reciprocating the plunger 20. Where provision is made, as in the present invention, for equalizing the load on the rollers 16, the lubrication requirements of each of the rollers 16 can be satisfied by the liquid fuel. The liquid fuel has sufficient lubricating qualities for this purpose. If the driving load were not equally distributed between the rollers 16, the roller or rollers carrying the greater load would require additional lubrication and it would be necessary to provide auxiliary lubricating means for the driving section 11 of the pump 10.

There has been provided by this invention an improved fuel injection pump having an output that varies directly with the speed at which the pump is driven. The pump has a rotating and reciprocating plunger driven by a rotating cam in contact with a plurality of rollers, and the driving load of the plunger is equally distributed over the various rollers, thereby permitting lubrication of the rollers by the same liquid fuel as is delivered by the pump.

It is to be understood that the invention is not to be limited to the specific constructions and arrangements shown and described, except only insofar as the claims may be so limited, as it will be apparent to those skilled in the art that changes may be made without departing from the principles of the invention.

We claim:

1. In a fuel injection pump for supplying liquid fuel to an internal combustion engine, the combination of a casing having a cylindrical bore therein, a plunger disposed within said bore, and drive means for rotating and reciprocating said plunger, said drive means including a drive shaft, a plurality of rollers rotatably mounted in said casing and a rotatable cam disposed axially between said rollers and said plunger for reciprocating said plunger as said cam and said plunger rotate, and spring means for forcing and maintaining said plunger in contact with said cam, said plunger being formed with a cylindrical head having a driving connection with said drive shaft including a slot for rotating said plunger and a partially round and partially flat end surface in contact with said cam for reciprocating said plunger, whereby said cam is allowed to tilt slightly with respect to said plunger and thereby maintain equal contact with each of said rollers.

2. In a fuel injection pump for supplying liquid fuel to an internal combustion engine, the combination of a casing having a cylindrical bore and a fuel supply chamber therein; a fuel delivery plunger having a cylindrical driving head and disposed within said bore; and drive means for rotating and reciprocating said plunger, said drive means including a drive shaft, a rotatable cam formed with a cylindrical recess for receiving and retaining the head of said plunger and having a driving connection therewith and a plurality of rollers rotatably mounted in said casing and in contact with said cam for imparting a reciprocating motion to said plunger as said cam rotates and spring means for maintaining the head in contact with said cam, said plunger head being formed with a slot forming a driving connection with said drive shaft for rotating said plunger and a partially flat end surface in contact with a flat surface on said cam and said plunger head also being formed with a partially round surface surrounding and adjacent to said flat surface for thereby providing a flexible driving connection with said cam for reciprocating said plunger, whereby said cam is allowed to tilt slightly with respect to said plunger as said cam rotates and thereby maintain equal contact with each of said rollers.

References Cited in the file of this patent

UNITED STATES PATENTS

2,478,528	Edwards	Aug. 9, 1949
2,567,367	Deschamps	Sept. 11, 1951
2,582,535	Drouot	Jan. 15, 1952
2,667,840	High	Feb. 2, 1954
2,759,422	Miller	Aug. 21, 1956
2,810,376	Aldinger	Oct. 22, 1957

FOREIGN PATENTS

1,070,407	France	Feb. 24, 1954
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