Jan. 3, 1956 K. ZIESCHE ET AL 2,729,168

FUEL INJECTION PUMP

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Fig. 1

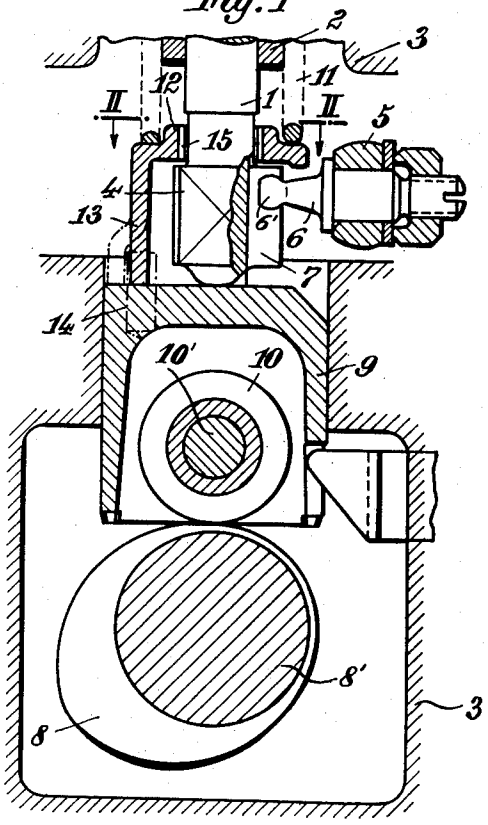


Fig. 3

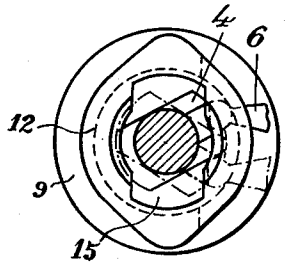


Fig. 2

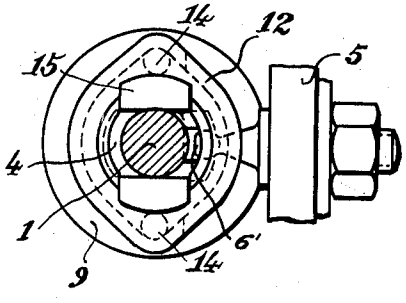
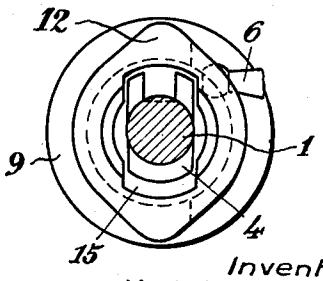


Fig. 4



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FUEL INJECTION PUMP

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5 Claims. (Cl. 103—41)

Our invention relates to fuel injection pumps and, more particularly, to injection pumps in which a reciprocating piston is angularly displaceable in the pump cylinder for controlling or regulating the quantity of fuel to be injected per stroke.

It is an object of the invention to provide a fuel injection pump in which a large angular movement of the pump piston is produced by an only short displacement of the regulator rod or control member that transmits the fuel adjusting movement to the pump, thus obtaining a wide-range fuel-quantity adjustment with a control device or regulator of small output movement and hence correspondingly small dimensions.

Another object of the invention is to devise a pump of the above-mentioned kind so that the component parts that must be removed when the pump piston and cylinder are to be disassembled from the pump housing are reduced to a minimum. More specifically, and with reference to injection pumps whose cylinder is cam operated during the compression stroke and spring returned during the suction stroke, the invention aims at providing a pump whose return spring and appertaining mounting elements remain unaffected when the piston and cylinder are being removed from the housing so that a disassembly and reassembly of the pump is facilitated.

In accordance with a feature of the invention, we provide the piston head in a pump of the above-mentioned type, with an axial groove and have this groove slidably engaged by a pin projecting from the regulator transmission rod so that movement of the regulator rod tangentially to the piston causes the piston head to be turned in accordance with the desired fuel quantity adjustment.

According to another feature of the invention, the piston head is hammer-head shaped and fits through a similarly shaped hole in an abutment plate for the piston return spring so that the piston can be removed from the pump housing and spring assembly when the piston is turned from its normal position into registry of its head with the hole of the abutment plate.

These and more specific objects and features of the invention will be apparent from the following description of the embodiment shown on the drawing, in which

Figure 1 shows a vertical axial section of the essential part of a fuel injection pump according to the invention,

Fig. 2 is a horizontal cross section of the same pump, the section being taken in the plane denoted in Fig. 1 by line II—II, while

Figs. 3 and 4 are sectional views corresponding to Fig. 2 but showing the piston in different angular positions.

The illustrated injection pump for an internal combustion engine is of the above-mentioned type in which a reciprocating piston is revolvably adjustable for regulation of the fuel quantity per stroke. Such pumps being well known as such, only the lower portions of the pump piston 1 and of the appertaining pump cylinder 2 are shown in Fig. 1. Also as known, the piston and cylinder can be removed from the pump housing 3 by lifting them upwardly out of the housing. For that reason, and as shown in Fig. 1, the horizontal dimensions of the piston head 4 are smaller than the smallest outside diameter of the cylinder 2 so that the piston head can freely pass through the cylinder-centering bore of the pump housing 3 when assembling or disassembling the pump. The angular position of the piston is controlled by a horizontally displaceable regulator rod 5 which carries a coupling pin 6. Pin 6 has a rounded or ball-shaped end 6' engaging a vertical groove 7 of the piston. The length of the groove in the axial piston direction is as large as, or larger than the stroke length so that the piston head can vertically reciprocate along the pin 6.

The drive means for actuating the piston comprises a cam 8 on a cam shaft 8' driven from the engine, and an intermediate guide member 9 whose top face abuts against the piston head. Member 9 is slidable in the pump housing structure in the axial direction of the piston and has a cam roller 10 journalled on a pin 10' and engaged by the cam 8. The cam drive is active only during the compression stroke, while a return spring 11 is effective during the suction stroke. Spring 11 is a compression spring and abuts against an abutment plate 12 which has a downwardly extending projection 13 seated on the guide member 9. Plate 12 is centered and secured against rotation relative to the guide member 9 by two pins 14 (Fig. 2) which engage respective holes of member 9. Fig. 1 shows by dot-and-dash lines one of the pins 14 turned 90° out of the actual position apparent from Fig. 2. In order to make the piston head 4 freely revolvable, a slight axial clearance is provided between the piston head and the abutment plate 12.

The piston head 4 is approximately hammer-head shaped as is best apparent from Figs. 2 to 4. The hole 15 of abutment plate 12 has a corresponding shape and offers enough clearance to let the head 4 pass through when the pump is being assembled or disassembled. However, the angular position of the hole 15 is such that the piston head 4 must be turned from its range of normal positions into registry with the hole before it can be passed through the hole. This is apparent from Figs. 3 and 4. In Fig. 3 the pin 6 of the regulator rod is shown in the two limit positions of its range of control movement and the corresponding two limit positions of the piston head are also indicated, one position of pin 6 and head 4 being shown in dot-and-dash illustration. It will be recognized that a short translatory displacement of pin 6 suffices to turn the piston head 4 over its entire range of regulatory adjustment during which the head remains out of registry with the hole 15 of the abutment plate 12. If the regulator rod is released and displaced a further amount, as shown in Fig. 4, the piston head 4 can be placed in registry with hole 15 and can be pulled out of the abutment plate 12.

The short regulator movement required for turning the piston through a large angular range makes pumps according to the invention especially favorable for applications where small dimensions are essential. For instance, in designs where the regulator has its motion transmitting sleeve immediately acting upon the regulator rod, the regulator, by virtue of the invention, can be given a shorter overall length. It will also be recognized that a pump according to the invention, as exemplified by the above-described example, facilitates inserting or removing the cylinder and piston without disassembling the piston return spring and the associated elements from their operative locations. Various changes and modifications in detail, design and arrangement can, of course, be made without departing from the essential features of our invention and within the scope of the claims annexed hereto.

We claim as our invention:

1. In a fuel injection pump, the combination of a cylinder, a piston axially reciprocable in said cylinder and angularly displaceable for regulating the amount of fuel per stroke, a piston head integral with said piston outside said cylinder, said head having an axially extending groove of a length at least equal to that of the piston stroke, and a member linearly displaceable in a direction tangential to said piston and having a pin directed toward said piston head, said pin having a ball-shaped end in sliding engagement with said groove to impart angular displacement to said piston head.

2. In a fuel injection pump, the combination of a pump housing structure having a bore, a cylinder seated in said bore, a piston axially reciprocable in said cylinder and angularly displaceable for regulating the amount of fuel per stroke, a piston head integral with said piston outside said cylinder, said head having a maximum diameter smaller than the outer diameter of said cylinder and having an axially extending groove, and a member displaceable in a direction tangential to said piston and having a pin in sliding engagement with said groove to impart angular displacement to said piston.

3. In a fuel injection pump, the combination of a pump housing structure having a bore, a cylinder removably seated in said bore, a piston axially reciprocable in said cylinder and angularly displaceable for regulating the amount of fuel per stroke, a piston head integral with said piston outside said cylinder, said head having a maximum diameter smaller than the outer diameter of said cylinder so as to be removable through said bore together with said cylinder, said piston head having an axially extending elongated groove, and a member linearly displaceable in a direction tangential to said piston and having a projection in slidable engagement with said groove to impart angular displacement to said piston.

4. In a fuel injection pump according to claim 3, said piston head being approximately hammer-head shaped, piston-actuating means comprising a guide member reciprocable relative to said housing structure in the axial direction of said piston and disposed adjacent to said head on the side away from said cylinder, said guide member being in engagement with said head for imparting stroke movement thereto in the direction toward said cylinder, an abutment plate having a hole traversed by said piston and being disposed between said head and said cylinder, rigid structural means connecting said plate with said guide member, said plate having due to said means a fixed axial spacing from said guide member and being reciprocable together with said guide member, spring means engaging said plate and being disposed between said plate and said housing structure for biasing said piston head away from said cylinder, said hole having a shape matching that of said head and being normally out of registry with said head to require turning of said head into registry for passing said head through said hole when assembling and disassembling the pump.

5. In a fuel injection pump, the combination of a housing structure having a bore, a cylinder removably seated in said bore, a piston axially reciprocable in said piston and angularly displaceable relative to said cylinder, said piston having outside of said cylinder a piston head, said head having a portion projecting radially from said piston, said portion having a diameter smaller than the outer diameter of said cylinder and having a groove extending parallel to the piston axis, a control member displaceable tangentially to said piston and in sliding engagement with said groove for imparting angular displacement to said piston, piston-actuating means comprising a guide member reciprocable relative to said housing structure in the axial direction of said piston and disposed adjacent to said head on the side away from said cylinder, said guide member being in engagement with said head for imparting stroke movement thereto in the direction toward said cylinder, an abutment structure seated against said guide member on the side of said guide member facing said piston head and having a plate extending transverse to the piston axis between said head and said cylinder, said plate having a hole traversed by said piston and of a shape similar to that of said piston head but normally out of registry therewith to permit said head to pass through said hole only when said piston head is turned into registry with said hole, and a compression spring disposed between said housing structure and said plate and abutting against said plate on the cylinder side of said plate for imparting stroke movement to said piston in the direction away from said cylinder.

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