United States Patent

[11] 3,624,823

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[21] Appl. No. **20,217**
[22] Filed **Mar. 17, 1970**
[45] Patented **Nov. 30, 1971**

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[32] Priority **Mar. 18, 1969**
[33] **Germany**
[31] **P 19 13 520.7**

[54] **MULTICYLINDER FUEL INJECTION PUMP FOR INTERNAL COMBUSTION ENGINES**
2 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **417/454,** 417/499, 417/539
[51] **Int. Cl.** **F04b 7/04,** F04b 27/00
[50] **Field of Search** 417/454, 490–500, 539; 92/169, 171

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Attorney—Edwin E. Greigg

ABSTRACT: For providing a sturdy, simplified and easily adjustable and disassemblable multicylinder fuel injection pump, the sidewalls and base walls of the pump housing are uninterrupted by openings for servicing; the pump pistons operate in cylinder sleeves each of which is directly insertable in an associated housing bore and supported therein by a collar integral with said cylinder sleeve and engaging said pump housing; said cylinder sleeves are held and secured in said housing bores by means of clamping yokes.

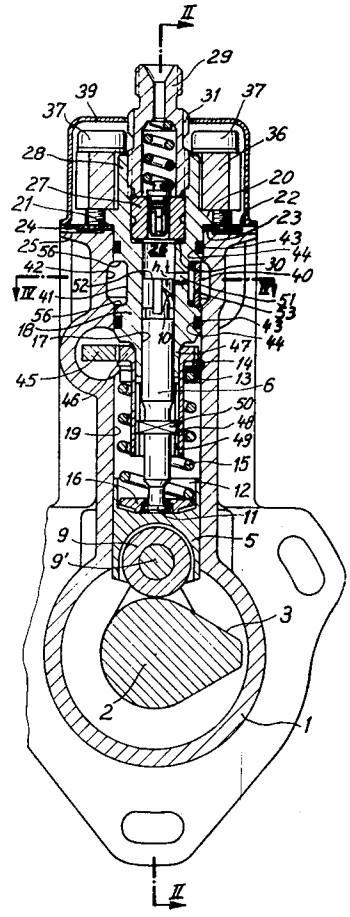

Fig. 1

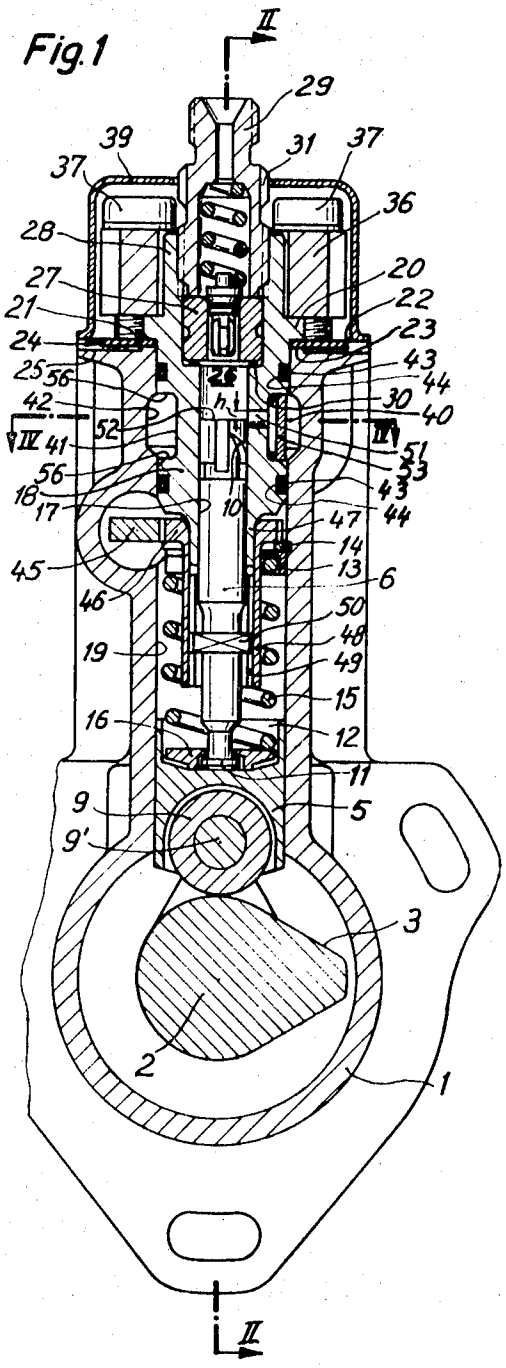
II
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Fig. 4

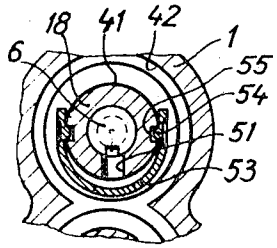
18
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Fig.2

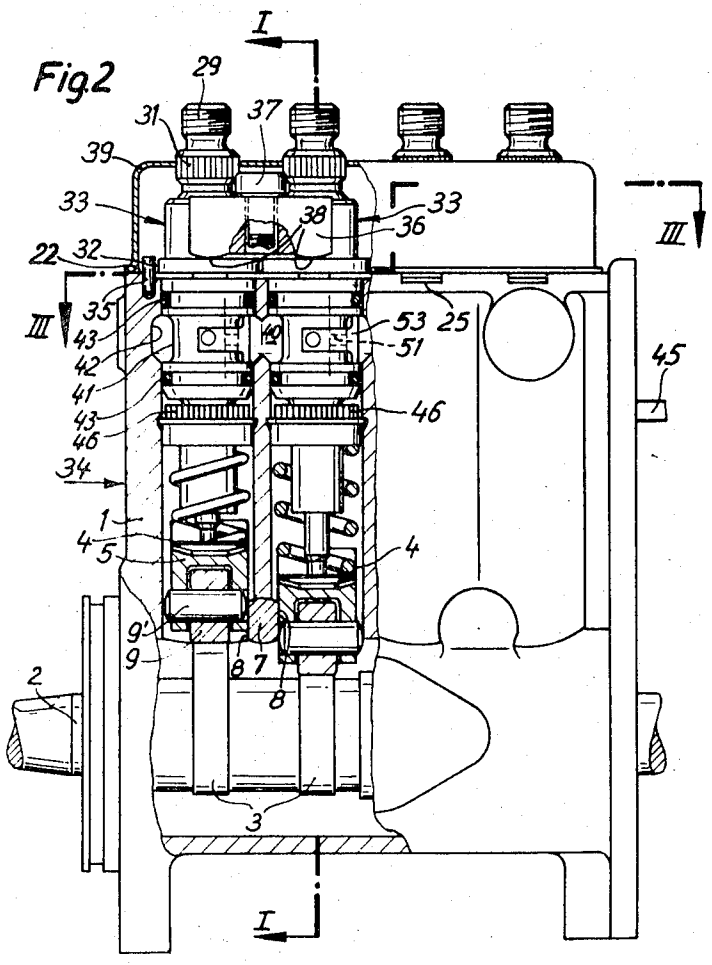
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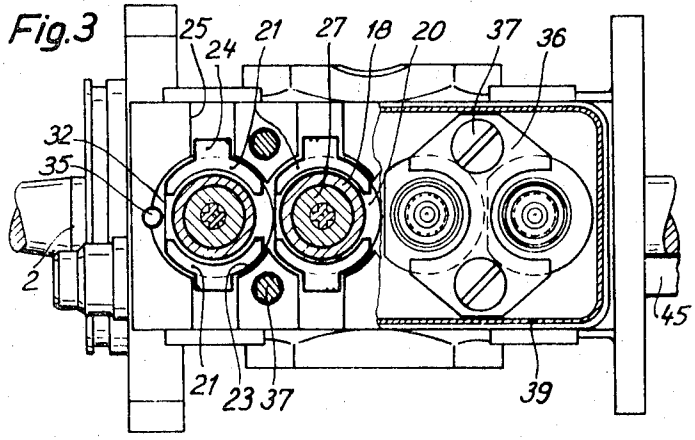
Fig.3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MULTICYLINDER FUEL INJECTION PUMP FOR INTERNAL COMBUSTION ENGINES

BACKGROUND OF THE INVENTION

This invention relates to a multicylinder fuel injection pump for internal combustion engines and is of the type that is provided with a unitary pump housing in which each pump piston is driven by a tappet which is urged against a driving cam of a pump drive shaft by a tappet spring supported on a spring seat disc. The said fuel injection pump is further of the type that is provided with a control device for varying the delivered fuel quantities; said control device preferably comprises pinion sleeves and a fuel quantity control member formed as a toothed rack. The pump pistons, which are provided with slanted control edges, are rotatable by associated turning means. The pump elements (formed of the cylinders and the pump pistons), as well as the spring seat discs, the tappet springs and tappets, may be dismantled by removing them from the pump in an upward direction.

In known pump structures of the afore-described type (such as disclosed in U.S. Pat. Nos. 2,185,444 and 2,185,146), the pump housing is, in the range of the tappets, interrupted by openings for assembly and inspection. Each cylinder sleeve is inserted into a flanged sleeve which, in turn, is disposed in a bore of the housing. The flanged sleeves, cylinder sleeves, pump pistons and tappet springs are secured together to form a unitary assembly which is upwardly removable from the pump. In order to remove the tappets, however, the fuel quantity control rod has to be taken out also.

The synchronization of the fuel quantity delivery is effected by turning a pinion with respect to the aforenoted pinion sleeve subsequent to the removal of the said unitary assembly or, in case of one particular pump structure of this type, by turning the said flanged sleeve while the unitary assembly remains in place.

For adjusting the prestroke, the unitary assembly has to be removed and the lower spring seat disc replaced or complemented with additional washers.

In another known pump structure of the aforenoted type (such as disclosed in U.S. Pat. No. 2,188,859), through lateral assembly bores compensating elements are inserted between the foot of the pump piston and the base of the tappet bore.

It is a desideratum that fuel injection pumps, particularly those used in diesel engines associated with automotive vehicles, require little or no maintenance, be inexpensive, have a high work capacity, small external dimensions and small weight and their adjustment be effected rapidly without the necessity of removing essential components of the pump or providing additional openings in its housing.

OBJECTS, SUMMARY AND ADVANTAGES OF THE INVENTION

It is an object of the invention to provide an improved fuel injection pump of the aforenoted type which meets the precedingly enumerated requirements and eliminates the disadvantages of known pump structures.

It is a further object of the invention to provide an improved fuel injection pump of the aforenoted note wherein, forgoing the above-mentioned removable unitary assembly in favor of mass production and low manufacturing costs, the components are simplified and reduced in number and further, substantial savings in the costs of testing and adjustment are obtained.

Briefly stated, according to the invention the sidewalls and the base of the pump housing are entirely closed and thus void of openings, with the exception of the necessary inlet and outlet ports for the fuel and lubricant. Further, the cylinder sleeves, provided with a narrow cylindrical support collar, are directly inserted into a bore of the pump housing. For the synchronization of the delivered fuel quantities, the cylinder sleeves are rotatable through a limited angle range and may be immobilized in their adjusted position. Said cylinder sleeves are held in the housing by means of clamping yokes.

The cylinder sleeve held in the associated pump housing bore and rotatable therein to a limited extent permits, without interfering with the control device, a rapid and simple synchronization of the fuel quantities to be delivered. The completely closed housing has a substantially improved sturdiness and superior sealing properties. Further, such a housing may be manufactured by die casting which is of a significant advantage in the mass production of fuel injection pumps. Further, a pump structure designed according to the invention permits, for a given pump length, the provision of a pump piston of larger diameter, resulting in an increase of the pump capacity. Or, for a given capacity, the pump length may be reduced.

The invention will be better understood, as well as further objects and advantages will become more apparent, from the ensuing detailed specification of a preferred, although exemplary, embodiment of the invention taken in conjunction with the drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an axial longitudinal sectional view of the preferred embodiment along line I—I of FIG. 2;

FIG. 2 is a partially sectional view of a reduced scale along line II—II of FIG. 1;

FIG. 3 is a partially sectional view along line III—III of FIG. 2; and

FIG. 4 is a fragmentary sectional view along line IV—IV of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to FIGS. 1 and 2, in the housing 1 of a fuel injection pump there is rotatably held a cam shaft 2, carrying a plurality of axially spaced cams 3. Each cam 3 drives a pump piston 6 through a roller tappet 5 provided with lateral guide faces 4. Between adjacent roller tappets 5 there is force fitted into housing 1 a guide pin 7 which, by virtue of its planar face portions 8, prevents a rotation of the tappets 5 and an axial displacement or roller pins 9' securing a roller 9 to each tappet 5. Each pump piston 6 has a slanted control edge 10 and, with the frontal terminal face of foot 11, engages the base of a cavity 12 provided in the roller tappet 5. The piston 6 is held in this position with a small clearance by means of a tappet spring 15 engaging a lower spring seat disc 16 which, in turn, surrounds the piston foot 11 and is urged into contact with the base of cavity 12. The tappet spring 15, with its other end, engages the housing 1 through an upper spring seat disc 13 and an associated snap ring 14. Each pump piston 6 is guided in a cylinder bore 17 of a cylinder sleeve 18 which, in turn, is turnably inserted in the housing bore 19. Each cylinder sleeve 18 has an integral collar 20 engaging an upper frontal edge face 22 of the pump housing 1 through two annular disc or washer segments 21, best seen in FIG. 3. Each of the latter is disposed in a depression 23 and is provided with an outwardly extending locking nose 24 which is accommodated by a complemental opening 25 of the pump housing 1. The openings 25 are deeper than the depressions 23 and longer than the noses 24 to facilitate the removal of the annular disc segments 21.

The pump work chamber 26 is bounded on the top by a pressure valve 27 which is inserted in a tubular extension 28 of the cylinder sleeve 18 and is securely clamped against an inner shoulder 30 of the cylinder sleeve 18 by a nipple 29. The latter is provided with a knurled peripheral portion 31 for engagement by an inserting and adjusting tool.

The support collar 20 of each cylinder sleeve 18 is cut off along a chord and thus has a flattened portion 32 for ensuring uniform orientation of the cylinder sleeves 18 and for reducing the distance therebetween. The cylinder sleeves 18 may be positioned in the pump housing 1 only in such a manner that the flattened portion 32 of each cylinder sleeve 18 in the same row is oriented in the same direction. To this end, preferably in front of a first pump element 33 formed of a pump piston 6 and a cylinder sleeve 18 (as viewed from the driving side 34),

there is force fitted into the pump housing 1 a pin 35, the distance of which from the adjacent cylinder sleeve 18 is so dimensioned that the latter may be inserted into the housing bore 19 only if its flattened portion 32 is oriented towards the pin 35. Said distance, however, is large enough to permit a limited rotation of about 15° of the cylinder sleeve 18 of the first element 33. The distances between any two adjacent cylinder sleeves 18 of the other pump elements 33 are again so dimensioned that they may be inserted and turned similarly to the cylinder sleeve 18 of the first element 33.

The cylinder sleeves 18 are clamped to the housing 1 in pairs by a double T-shaped clamping yoke 36 tightened to the housing 1 by two screws 37. In this manner, two of four pressure faces 38 of the clamping yoke 36 are pressed on opposite parts of the support collar 20 of one of the two cylinder sleeves 18. The clamping yokes 36 and screws 37 of the entire element row are protected from accidental contact or undesired access by means of a locked hood 39.

The suction chamber 40 of the fuel injection pump is formed by aligned complemental depressions 41 and 42 provided, respectively, in the lateral face of the cylinder sleeves 18 and in the housing bores 19. The diameter of each depression 42 is larger than the distance between the axes of two adjacent housing bores 19. Thus, adjacent depressions 42 intersect, forming a common suction chamber 40, eliminating the necessity of providing an additional longitudinal bore for this purpose. The suction chamber 40 is sealed from the housing bores 19 by means of packing rings 43 disposed in two annular grooves 44 provided in each cylinder sleeve 18 and located on either side of depression 41.

The control device for varying the fuel quantities to be delivered by the fuel injection pump comprises a flat control member 45 formed as a toothed rack with which there meshes with a plurality of pinions 46, one associated with each pump piston 6. Each pinion 46 is integral with a sleeve 48 and is rotatably held at a lower portion 47 of the cylinder sleeve 18. The sleeve 48 is provided along its inner wall with longitudinal grooves 49 which serve for guiding a lug 50 integral with the pump piston 6. When the fuel quantity control rod 45 is longitudinally displaced, each pinion sleeve 46 is rotated, imparting to the associated pump piston 6 a rotary motion by virtue of the engagement between the lug 50 and grooves 49. As a result, the position of the inclined control edge 10 changes with respect to a control bore 51 provided in the wall of the cylinder bore 17 (the bore 51 is shown in FIG. 1 in a position shifted 90° ; it is positioned preferably diametrically opposite the flattened portion 32 of support collar 20). In this manner, the quantity of the delivered fuel is conventionally increased or decreased.

For the purpose of cancelling the high impact energy of the fuel jet exiting from the bore 51 upon termination of the fuel delivery, each cylinder sleeve 18 is provided with a baffle plate 53 disposed in front of bore 51 and preferably made of hardened spring steel. The baffle plate 53 is of a semicircular configuration and, with two pins 54, as best shown in FIG. 4, engages two diametrically opposed notches 55 provided in the cylinder sleeve 18 within the area of the depression 41. The baffle plate 53 fits into the depression 41 and is thus prevented by its sidewalls 56 from axial displacement. The baffle plate 53 is the widest at its middle that faces the control bore 51 and is, at its ends provided with the pins 54, sufficiently narrow to allow the space between the baffle plate 53 and the control bore 51 to be in communication with the suction chamber 40. The aforedescribed baffle plates provided according to the invention have several advantages over the known means for cancelling said impact energy (for example, the provision of individual steel rings as disclosed in German Pat. No. 1,172,897). In the first place, the baffle plates 53 have no additional securing means; secondly, they do not interfere with the dismantling of the associated cylinder sleeve, since they do not project beyond the minimum diameter necessary for insertion and removal of said cylinder sleeve and thirdly, they are fixedly secured to the associated cylinder sleeve so that despite a rotary adjustment of the latter for synchronizing the fuel quantities to be delivered (to be described hereinafter), they absorb the fuel jet exiting from the bore 51 always in the same manner.

For removing any pump element 6, 18, as well as the associated tappet spring 15 and roller tappet 5, first the hood 39 is taken off. Thereupon the screws 37 are loosened, the clamping yoke 36 is removed and the cylinder sleeve 18, together with the pinion 46, is pulled out of the housing bore 19. Thereafter the snap ring 14 and the spring seat disc 13 are removed upwardly. The last-named two components are at one side flattened so that the teeth on fuel quantity control rod 45 extending into the housing bore 19, do not interfere with the dismantling operation. The tappet spring 15 and the lower spring seat disc 16 are of such diameter that by laterally shifting these components in the housing bore 19, their removal is possible without the necessity of taking out the fuel quantity control rod 45. Then the pump piston 6 is pulled out which carries with it the lower spring seat disc 16. Finally, the roller tappet 5 is taken out. During the upward removal of the latter, it is rotated 90° so that its guide faces 4 are oriented towards the fuel quantity control rod 45.

For setting the beginning of the injection during each pressure stroke, as well as the delivered fuel quantities of each pump element 33 formed of a component 6 and 18, a prestroke adjustment and a synchronization of each individual pump element has to be performed.

For adjusting the prestroke, the piston stroke "h " (FIG. 1) representing the distance which the upper edge 52 of the pump piston 6 travels prior to closing the control bore 51 (i.e., prior to the start fuel delivery during each pressure stroke of piston 6), is adjusted in such a manner that it is of identical magnitude in each element 33. This adjustment is, according to a feature of the invention, substantially simplified by the use of annular disc segments 21 arranged in complemental pairs (FIG. 3). It is well seen, particularly from FIG. 1, that the fixed axial position of cylinder sleeve 18 and thus the height of the bore 51 and the value "h" depends on the thickness of disc segments 21 inserted between the support collar 20 of the cylinder sleeve 18 and the edge face 23 of the pump housing 1. Thus, for effecting an adjustment of stroke "h," the screws 37 are loosened, the cylinder sleeve 18 is slightly lifted from the depression 23 and the discs 21 may be laterally removed and replaced with those of appropriate thickness. The annular disc segments 21 are available in a series of thicknesses differing by 0.05 mm., so that the magnitude "h" may be set in a sufficiently accurate manner. The discs of different thicknesses may be recognized by appropriate marker notches or other means provided on the noses 24. The use of two-part annular segments instead of single-part setting discs (as disclosed, for example, in German Pat. no. 1,050,604), is advantageous over the prior art in that a replacement of these segments does not necessitate the removal of the associated cylinder sleeve.

The synchronization of the fuel quantities to be delivered is performed subsequent to the aforedescribed adjusting step for setting the prestroke. The fuel quantity control rod 45 is preferably held fixedly in its position for full load fuel delivery. Then, by rotating each cylinder sleeve 18, the control bore 51 is, with respect to the control edge 10, brought into a position in which each pump element 33 delivers identical fuel quantities within the permitted tolerances. For this operation, the screws 37 are loosened only to such an extent that the cylinder sleeve 18 may not rise even when the pump is operating, but may be rotated to a desired extent by means of a tool engaging the serrations 31 of the nipple 39. Upon completion of this adjustment, the screws 37 are tightened, and the hood 39 is placed in position and locked.

What is claimed is:

1. In a multicylinder fuel injection pump, the improvement comprising,

A. a one-part pump housing having closed sidewalls and a closed base, said pump housing openable solely at its top to provide the only access to the inside of said housing for introducing and withdrawing pump components,

B. a plurality of serially arranged, parallel extending bores provided in said housing,

C. a cylinder sleeve inserted directly into each said bore, said cylinder sleeve being provided with a radial control bore and being rotatable through a limited angle for synchronizing the fuel quantities delivered through each cylinder,

D. a pump piston slidably held in each cylinder sleeve and provided with an oblique control edge,

E. a radially outwardly projecting collar of circular outline integral with each cylinder sleeve and having a flattened portion along a chord, said cylinder sleeves being so positioned with respect to one another that a flattened portion of one collar being immediately adjacent an arcuate portion of an adjoining collar to ensure identical orientation of each cylinder sleeve in its associated housing bore and permit rotation of each cylinder sleeve to a limited extent,

F. means clamping said collar against an edge face surrounding said bore to secure said cylinder sleeve therein,

G. clamping yokes tightenable to said housing to engage each cylinder sleeve for immobilizing it in its associate bore and

H. a pin fixedly held in said pump housing immediately adjacent the flattened portion of the collar of the first cylinder sleeve in a series thereof to determine the orientation of said first cylinder sleeve with respect to said pump housing, said pin permits rotation of said first cylinder sleeve to limited extent.

2. In a multicylinder fuel injection pump, the improvement comprising,

A. a one-part pump housing having closed sidewalls and a closed base, said pump housing openable solely at its top to provide the only access to the inside of said housing for introducing and withdrawing pump components,

B. a plurality of serially arranged, parallel extending bores provided in said housing,

C. a cylinder sleeve inserted directly into each said bore and provided with a radial control bore and diametrically opposed depressions,

D. an arcuate baffle plate secured to each sleeve and spaced outwardly from said control bore, said baffle plate having a face portion in registry with said control bore,

E. inwardly directed pin means integral with each baffle plate and nesting in said opposed depressions,

F. a pump piston slidably held in each cylinder sleeve,

G. a radially outwardly projecting collar integral with each cylinder sleeve,

H. means clamping said collar against an edge face surrounding said bore to secure said cylinder sleeve therein and

I. clamping yokes tightenable to said housing to engage each cylinder sleeve for immobilizing it in its associated bore.

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