

[54] INJECTION PUMPS

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92/60.5; 123/139 B

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[57] ABSTRACT

A multicylinder fuel injection pump comprising a casing, hydraulic heads arranged in the housings of the casing and pistons adapted to slide in cylinders borne by the hydraulic heads. The hydraulic head comprises a delivery connector screwed into a bush and blocking the cylinder. The delivery connector comprises a collar adapted to serve as an axially stop for the hydraulic head against the casing. The invention is useful for automobile in-line fuel injection pumps.

7 Claims, 5 Drawing Figures

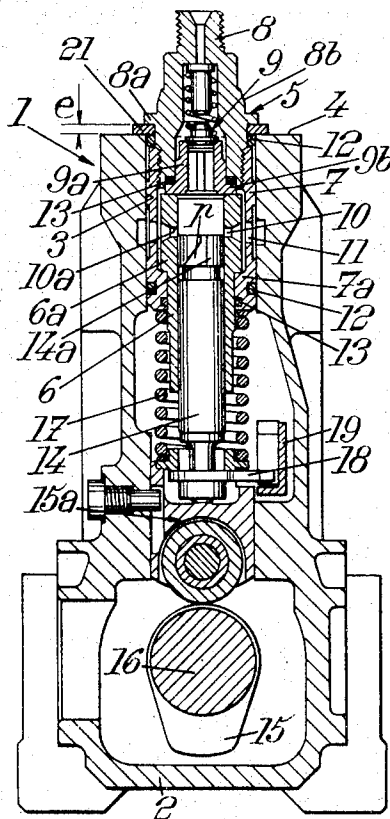


Fig. 1.

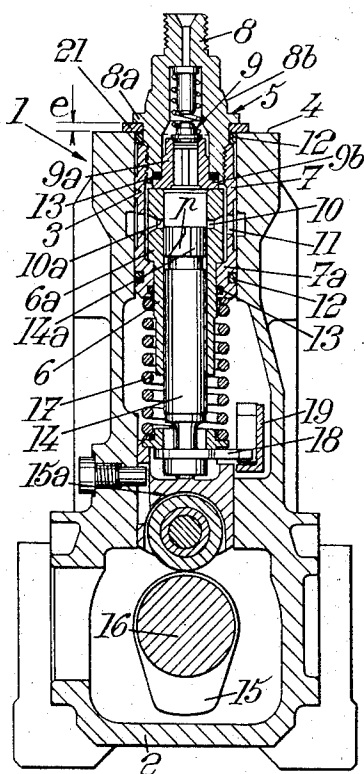


Fig. 2.

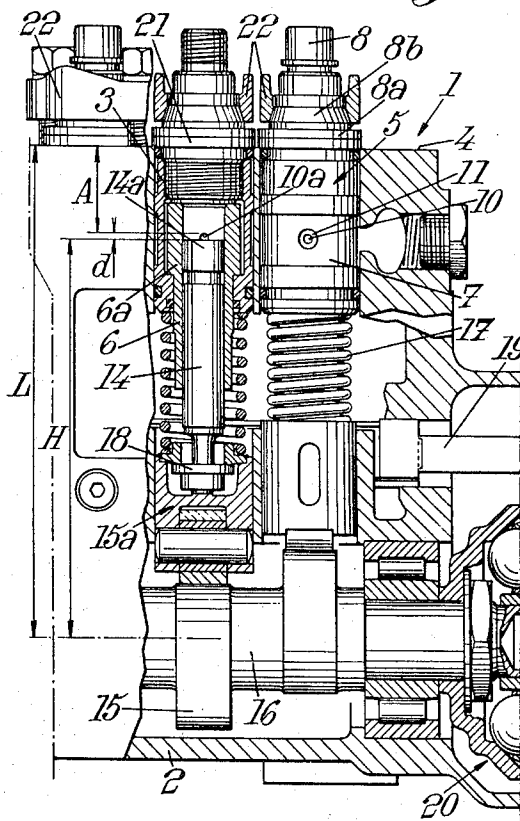
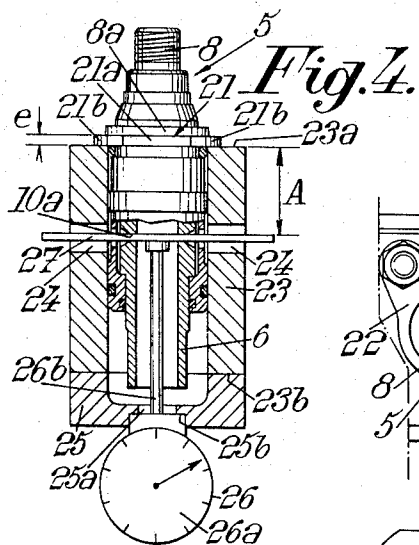
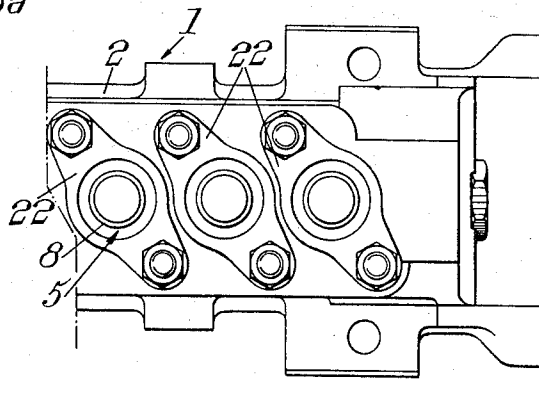
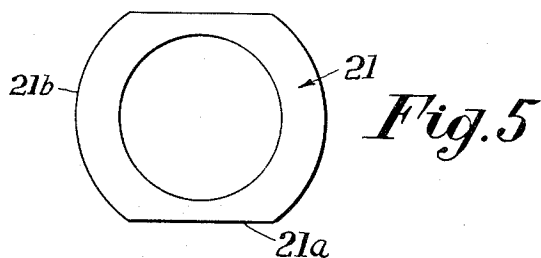


Fig. 4.



INJECTION PUMPS

The invention relates to multicylinder fuel injection pumps of the type which comprise:

- a casing provided with housings opening on one surface of said casing,
- hydraulic heads adapted to become engaged, each, in one of said housings, each head comprising a cylinder, an intermediate bush and a delivery connector screwed into the bush, the cylinder being blocked between said bush and the delivery connector, each cylinder comprising at least one supply orifice arranged in its cylindrical wall,
- pistons actuated by a camshaft, housed in the casing, each piston being adapted to slide in one cylinder and to actuate in the course of its alternating axial movements, the closing and the opening of said supply orifice.

The invention relates more particularly, and because it is in this case that this application seems to be most advantageous, but not exclusively, among these injection pumps, to fuel injection pumps called "in-line pumps".

It is a particular object of the invention, to render the abovesaid injection pumps such that they respond to the various exigencies of practice better than hitherto and especially so that each hydraulic head can constitute an easily interchangeable assembly and of which the adjustment is simple.

According to the invention, a multicylinder injection pump of the type previously defined is characterised by the fact that each delivery connector comprises a collar constituting a stop for the hydraulic head, against the casing of the pump, along the direction of the axis of the housing occupied by this hydraulic head.

Preferably, a stop member serving as a key, is associated with each hydraulic head and is arranged between the collar of the delivery connector and the surface of the casing on which the housings open, so as to be clamped between this collar and the surface of the casing, and the thickness of each stop member, associated with each hydraulic head, is such that said surface of the casing is separated from the upper edge of the supply orifice by an identical distance for all the hydraulic heads of the pump.

Advantageously, the stop member is blocked between the collar of the delivery connector and the bush, so that said member is connected to the hydraulic head when the delivery connector is screwed into the bush.

The stop member is advantageously constituted by a flat washer.

The invention also relates to a method for ensuring, in a multicylinder injection pump of the aforedefined type, suitable angular setting of the different cylinders, characterised by the fact that the distance is measured, when each hydraulic head is mounted, along the axis of the latter, between the surface of the collar of the delivery connector turned towards the cylinder and the upper edge of the delivery orifice of the latter, that the hydraulic head is dismantled and that a stop member is arranged between the said surface of the collar, the thickness of the stop member depending on the result of the previously effected measurement.

Advantageously, to effect the said measurement, there is used on one hand, a cylindrical sleeve, provided with openings in its cylindrical wall, into which

the mounted cylindrical head is introduced and, on the other hand, a calibrated cylindrical rod, serving as a gauge, adapted to be introduced through the said openings into the supply orifice of the cylinder.

- 5 The invention consists, apart from the features explained above, of certain other features which are preferably used at the same time and which will be more explicitly considered below with regard to a preferred embodiment of the invention which will now be described in more detailed manner with reference to the accompanying drawing, but which is not to be considered as other than exemplary and non-limiting.

FIG. 1 of this drawing shows, in transverse section, one embodiment of a multicylinder injection pump constructed according to the invention.

FIG. 2 is a partial view from the left, with respect to FIG. 1, with portions removed.

FIG. 3 is a partial view from above of the injection pump of FIGS. 1 and 2.

FIG. 4, illustrates the manner according to which the measurement of the distance between the upper edge of the supply orifice and the shoulder of the element connected to the cylinder of the hydraulic head

FIG. 5, lastly, is a plan view of an element of the embodiment of FIGS. 1 to 4.

Referring to FIGS. 1 and 2, there can be seen a multicylinder fuel injection pump 1, of which the different cylinders are arranged "in-line".

This pump comprises a casing 2 provided with housings 3 of which the axes are parallel and situated in a same plane. These housings 3 open on a same surface 4 of the casing 2, this surface being flat and at right angles to the axes of the housings 3.

A hydraulic head 5 is engaged in each of the housings 3. Each head 5 comprises a cylinder 6 of which the end 6a closest to the surface 4 has an outer diameter greater than that of the rest of the cylinder 6, so that at the junction of the end 6a of the rest of the cylinder, the portion of the outer wall of the cylinder is oriented radially and projects on the outer surface of the rest of the cylinder. The latter is mounted in a bush 7 open at its two ends and provide, at its end furthest from the surface 4, with a collar 7a projecting towards the inside of the bore of the said bush 7. The abovesaid radially oriented portion, situated at the junction of the end 6a of the cylinder 6 and of the rest of the latter, is adapted to come into cooperation with the collar 7a which constitutes a unilateral stop for the said cylinder.

Each hydraulic head 5 comprises also an element constituted by a delivery connector 8, connected to the cylinder 6, which element is provided with a collar or shoulder 8a adapted to constitute a stop for the hydraulic head 5 and the cylinder 6, in the direction of the axis of the housing 3, against the surface 4 of the casing 2.

The delivery connector 8 comprises, on the inside, a delivery valve 9 of which the body 9a is provided, at its upstream portion, with respect to the direction of flow of the fuel injected by the pump, with a collar 9b projecting towards the outside and adapted to be clamped between the delivery connector 8 and the end 6a of the cylinder 6. The delivery connector 8 and the bush 7 comprise respectively an outer threading and an inner threading, adapted to cooperate and to ensure the holding of the assembly of the hydraulic head 5. The cylinder 6 is held by the clamping of the end 6a between the collar 7a and the collar 9b of the delivery valve 9. The element constituted by the delivery con-

necter 8 is hence connected to the cylinder 6 through the bush 7.

Each cylinder 6 comprises at least one, preferably, two orifices 10, diammetrically opposite, for supplying fuel. These orifices are arranged in the cylindrical wall of the end 6a of the cylinder 6. Orifices 11 are also provided in the wall of the bush 7, to enable the fuel supplied, which arrives outside the bush 7, to penetrate inside the latter towards the orifices 10. Sealing rings 12 are provided between the bush 7 and the wall of the housing 3, in the neighborhood of the opposite ends of the said bush 7. Other sealing rings 13 are provided respectively between the cylinder 6 and the bore of the collar 7a, and between the bore of the valve 9a and the delivery connector 8.

In each cylinder 6 a piston 14, on one hand actuated by a cam 15, mounted on a camshaft 16 and by a push-rod 15a and, on the other hand, restored elastically by a spring 17 is adapted to slide and to actuate, in the course of its alternating axial movements, the closing and the opening of the supply orifices 10.

The head 14a of the piston 14 advantageously comprises a peripheral passage p, in the form of a helix, so that, according to the relative angular position of the piston 14 of the cylinder 6, the opening of the orifices 10 is produced after a larger or smaller movement of this piston, towards the delivery connector 8.

This angular position is actuated by a finger 18 mounted at the closest end of the piston 14 of the camshaft 16 and connected in rotation with this piston, and with an actuating rod 19 or "rack" adapted to slide in a direction parallel to the axis of the shaft 16 and to actuate the rotation of the finger 18. This rack 19 can be such as described in Applicant's copending U.S. patent application Ser. No. 197,088 filed Nov. 11, 1971, entitled "Improvements in control rods for the flow per revolution of piston machines, especially injection pumps, and in these machines themselves."

The camshaft 16 is driven by the internal combustion engine supplied by the injection pump 1, whilst the longitudinal movements of the actuating rod 19 are obtained from a centrifugal regulator 20 of which a portion is shown in FIG. 2.

A stop member 21 is associated with each hydraulic head 5 and arranged between said collar 8a and the surface 4 of the casing, so as to be clamped between this collar and this surface. Each stop member 21 is comprised between two flat surfaces and the thickness e of this member 21, that is to say the distance between the two flat surfaces respectively in contact with the collar 8a and the surface 4, is such that the said surface 4 is separated from the upper edge 10 of the intake orifice 10 by a distance A (FIG. 2), identical for all the hydraulic heads 5 of the pump 1. By upper edge 10a of the orifice 10 will be denoted the nearest edge of the surface 4.

The stop member 21 is constituted by a flat washer, engaged around the portion of the delivery connector 8 situated, with respect to the collar 8a, on the side of the piston 6. The outer contour of the washer forming the stop member 21 is not entirely circular and comprises two parallel rectilinear portions 21a (FIGS. 1 and 4) diametrically opposite, connected by two circular arcs 21b, diametrically opposite, turning their convexity outwardly.

The inner diameter of the whole provided in the stop member or washer 21 is just equal to the outer diame-

ter of the rear portion of the delivery connector 8 on which is provided the threading adapted to cooperate with the inner threading of the bush 7. Under these conditions, when the washer 21 is mounted on the connector 8 and when the bush 7 has been screwed on the threaded end of this connector, a sealing ring 12 having been arranged between the washer 21 and the end of the bush 7, it is not possible to disengage the washer 21. As a result there is an appreciable advantage due to the fact that this washer is connected to the hydraulic head 5 to which its thickness is suited. It is not possible, thus, to misplace this washer 21 as long as the hydraulic head has not been dismantled and in particular, the washer 7 is not separated from the delivery connector 8.

The portion of the delivery connector 8 situated outside the housing 3 comprises advantageously a frustroconic support surface 8b of which the diameter diminishes progressively as it recedes from the surface 4, so that the hydraulic head 5 is adapted to be held on the casing 2 by a flange 22 (FIG. 2) comprising an opening of which the inner wall is frustroconical and conjugated with the surface 8b. As seen in FIG. 3, the flange 22 comprises two diametrically opposite ears, in which are provided holes for the passage of fixing and clamping bolts for the flange 22 on the casing 2.

In a pump according to the invention, the distance A between the upper surface 4 of the casing 2 and the upper edge 10a of all the supply orifices of the pump cylinders will be constant and equal to a predetermined value.

Now, it has been noted that the variations in the distance between the upper edge 10a of the supply orifice 10 and the upper surface, adapted to recirculate the fuel, of the head 14a of the piston 14 (the latter being at the bottom dead center, that is to say occupying the position shown in FIG. 1) were due essentially, to the stacking of parts constituting the hydraulic head 5 and to the machining tolerances of these parts; on the other hand, the distance L (FIG. 2) between the axis of the shaft 16 and the surface 4 of the casing, and the distance H (FIG. 2) between the axis of the said shaft 16 and the upper surface of the head 14a of the piston 14, are always obtained with good precision. Since the distance d (FIG. 2) or "measurement", between the upper edge 10a of the supply orifices 10 and the upper surface of the head 14a, when the piston is at the bottom dead center, is equal to:

$$d = L - A - H,$$

(1)

it will immediately be seen that the inaccuracy on the side d is in absolute value, $\Delta d = \Delta L + \Delta A + \Delta H$. It will be recalled that the side d determines the angular position of the cam 16 through which the orifice is closed by the head 14a and injection commences.

As ΔL and ΔH are negligible, it will be seen clearly that due to the invention, ΔA being nil, or substantially nil, the inaccuracy Δd is substantially nil.

To determine the suitable thickness of the washer 21 on which thickness the good adjustment of the position of the edge 10a depends, there is provided a measuring tool comprising a cylindrical sleeve 23 (FIG. 4), of which the ends 23a, 23b are flat and parallel. The inner diameter of this sleeve 23 is equal to the diameter of the housing 3 provided in the casing 2 of the pump. The end 23a of the sleeve 23 plays the role of the surface

4 of the casing 2. Holes 24, of a diameter sufficient to compensate the possible variations in position of the orifices 10 due to manufacturing tolerances, are provided in a cylindrical wall of the sleeve 23, and are diametrically opposite.

A cover 25 is provided to be supported against the end 23b of the sleeve 23. This cover comprises a hole 25a and, on the opposite side of the sleeve 23, a counterbore 25b adapted to receive a support member for a micrometric comparator 26, the counterbore 25b serving as a reference surface. The comparator 26 comprises a reading dial 26a, with an indicating needle, and a mechanical feeler 26b adapted to project into the bore of the sleeve 23. The feeler 26b comprises, at its distant end from the dial 26a, a probe intended to come into contact with the part of which it is necessary to measure the position. A rod 27, cylindrical, calibrated, constituting a "measuring rod" of which the diameter is equal to that of the supply orifices 10, is provided to be introduced into these orifices and to extend at right angle to the axis of the cylinder 6 and to project on both sides of the sleeve 23 by passing through the holes 24.

To effect the measurement of the abovesaid thickness, the hydraulic head 5 is mounted, without a washer 21, and the said hydraulic head is introduced into the bore of the sleeve 23 so that the surface of the collar 8a, turned towards the cylinder 6, comes into contact with the ends 23a of the sleeve 23. The rod 27 is then introduced into the supply orifices 10, as shown in FIG. 4, then by placing the cover 25 and the comparator 26 also as shown in FIG. 4, therein, the position of the upper edge 10a with respect to the end 23a of the sleeve 23 is registered. For this it suffices, for example, to effect a displacement of the micrometric comparator 26 on the graduation 0 for a well-determined distance between the upper edge of the rod 27 and the end 23a of the sleeve 23. Preferably, the comparator 26 is keyed on the graduation 0 when the distance between the end 23a and the upper edge of the rod 27 is equal to the desired side A.

Under these conditions, on measurement, there will be read directly on the comparator 26 the value of the thickness e of the washer 21. It then suffices to dismount the hydraulic head 5, to introduce a washer 21 of which the thickness corresponds to the result of the measurement that has just been effected and to reassemble the hydraulic head 5.

After having mounted the washer 21, there may be effected a verification by introducing again the hydraulic head 5 into the sleeve, as shown in FIG. 4, the washer 21 then becoming supported against the end 23a of the sleeve 23.

By way of numerical example, it will be noted that the thicknesses of the washers 21 can vary by steps of 5/100 of a millimeter.

It is important to stress, that once the measurement and the adjustment of the hydraulic head 5 have been carried out, there is provided a preadjusted sub-assembly, interchangeable on the pump since, in effect, the sides L and H are practically constant for the various cylinders of one injection pump.

It must also be noted that, if it is desired to modify the side d for all the cylinders of a pump which have been adjusted under the abovestated conditions, it will suffice to modify, for all the hydraulic heads 5 the thick-

ness of the stop member 21, associated with each of these hydraulic heads, by the same amount.

In addition, due to the fact that the stop member 21 is blocked between two parts screwed against one another namely, on one hand, the delivery connector 8 provided with the collar 8a and, on the other hand, the bush 7, the variation in the thickness of the stop member 21 will not be troublesome from the point of view of blocking the said member since it will suffice to screw up a bit more, or a bit less, the connector 8 into the bush 7 to compensate the abovesaid variation in thickness of the stop member 21.

A further adjustment cylinder by cylinder will not have to be carried out.

As a result of which, there is obtained an injection pump of which the angular keying of all the piston-cylinder assemblies is correct, of which the hydraulic heads are interchangeable without having to recommence, after changing one head, the adjustment of the angular keying of the new piston-cylinder assembly, and of which the modification of the side d for all the cylinders only requires an identical variation of the thickness of the stop members 21 without having to recommence adjustment of the angular keying of each piston cylinder assembly.

I claim:

1. Multicylinder fuel injection pump comprising:

a casing provided with housings opening on one surface of said casing

hydraulic heads adapted to be engaged, each in one of said housings, each head having a cylinder, an intermediate bush and a delivery connector screwed into the bush, the cylinder being blocked between said bush and the delivery connector, each cylinder having at least one supply orifice arranged in its cylindrical wall,

pistons actuated by a camshaft, housed in the casing, each piston being adapted to slide in said cylinder and to actuate in the course of its alternating axial movements, the closing and the opening of said supply orifice,

each delivery connector comprising a collar constituting a stop for the hydraulic head, in preset spacial relationship to the casing of the pump, along the direction of the axis of the housing occupied by said hydraulic head.

2. Injection pump according to claim 1, wherein each said supply orifice comprises a top edge nearest the collar of the delivery connector and in which a stop member serving as a shim is associated with each hydraulic head, and wherein the stop member is arranged between the collar and the surface of the casing, on which the housings open, so as to be gripped between said collar and the surface of the casing, and the thickness of each said stop member is such that said surface of the casing is separated from the top edge of the supply orifice by a distance identical for all the hydraulic heads of the pump.

3. Injection pump according to claim 2, wherein the stop member is locked between the collar and the bush, with the interposition of a sealing ring between the stop member and the end of the bush.

4. Injection pump according to claim 3, wherein the stop member is constituted by a washer of which the contour comprises two diametrically opposite substantially rectilinear portions and two circular portions

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turning their convexity towards the outside and connecting said substantially rectilinear portions.

5. Injection pump according to claim 2, wherein the delivery connector comprises a frustroconic portion situated, with respect to the collar, on an opposite side axially to that of the casing, said portion having a diameter which diminishes in proportion as its distance to the casing increases, a flange element provided with a conjugate coaxial opening holding said hydraulic head on the casing by mating said frustroconic portion of the connector.

6. Injection pump according to claim 3, wherein the delivery connector comprising a frustroconic portion situated, with respect to the collar, on an opposite side axially to that of the casing, said portion having a diam-

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eter which diminishes in proportion as its distance to the casing increases, a flange element provided with a conjugate coaxial opening holding said hydraulic head on the casing by mating said frustroconic portion of the connector.

7. Injection pump according to claim 4, wherein the delivery connector comprises a frustroconic portion situated, with respect to the collar, on an opposite side axially to that of the casing, said portion having a diameter which diminishes in proportion as its distance to the casing increases, a flange element provided with a conjugate coaxial opening holding said hydraulic head on the casing by mating said frustroconic portion of the connector.

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