United States Patent [19]

Vuaille

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[54] **CONTROL RODS FOR THE FLOW PER STROKE OF PISTON MACHINES, ESPECIALLY INJECTION PUMPS, AND IN THESE MACHINES THEMSELVES**

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Related U.S. Application Data

[63] Continuation of Ser. No. 197,688, Nov. 11, 1971, abandoned.

[52] **U.S. Cl.**..... **417/494;** 417/499; 123/139 AA; 123/139 AB

[51] **Int. Cl.**..... **F04b 7/04;** F04s 39/10

[58] **Field of Search**..... 417/499, 494, 500; 123/139 AB, 139 AA, 139 AG, 139 B

[56] **References Cited**

UNITED STATES PATENTS

2,127,211 8/1938 Edwards ..... 417/494 X

FOREIGN PATENTS OR APPLICATIONS

1,136,329 12/1956 France 417/494
221,314 5/1962 Austria

Primary Examiner—C. J. Husar
Assistant Examiner—Richard E. Gluck

[57] **ABSTRACT**

The rod is constituted by a profiled element, with a transverse section of L-shape, on which are fixed separating members comprising walls at right angles to the direction of the length of the element. The adjacent walls of two neighboring members, define a recess adapted to receive the end of a finger. The position of the finger controls the relative angular position of the piston and the cylinder. The device is useful for "in line" fuel pumps.

7 Claims, 6 Drawing Figures

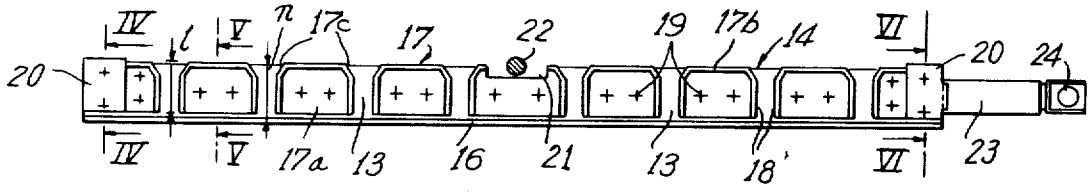

FIG. 1

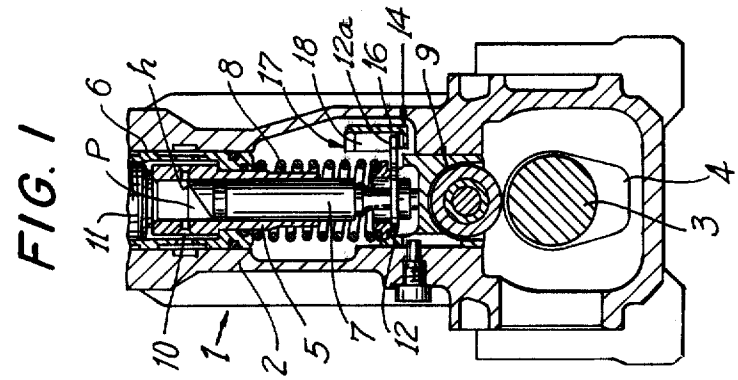

FIG. 2

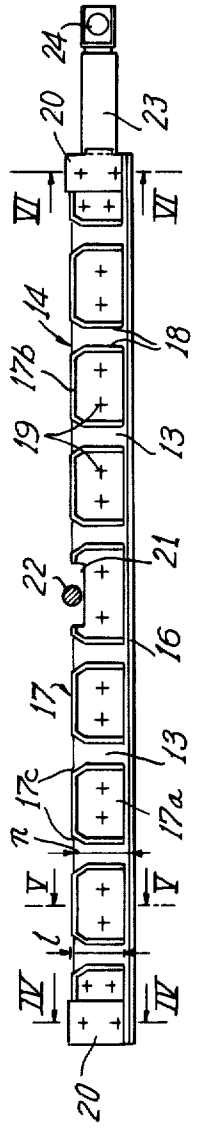

FIG. 3

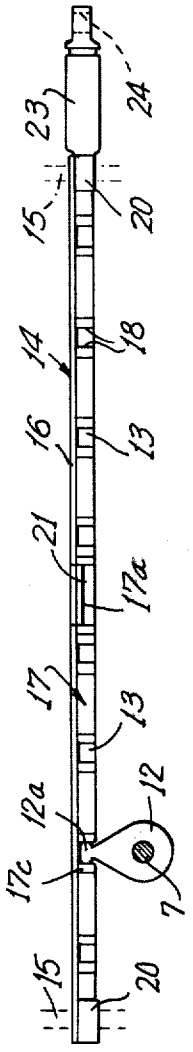

FIG. 4

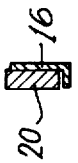

FIG. 5

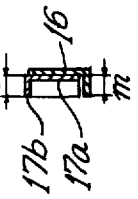

FIG. 6

CONTROL RODS FOR THE FLOW PER STROKE OF PISTON MACHINES, ESPECIALLY INJECTION PUMPS, AND IN THESE MACHINES THEMSELVES

This application is a continuation application of Ser. No. 197,688, filed NoV. 11, 1971, now abandoned.

The invention relates to a control rod for the flow per revolution of a machine with at least one piston and cylinder, of which piston and cylinder the flow per revolution depends on the relative angular position of the said piston and cylinder, which rod is adapted to slide in two slides arranged at each of its ends and to cooperate, in the portion comprised between the slides, with at least one finger controlling the relative angular position of the said piston and cylinder, the said rod being constituted by a profiled element and being equipped with means adapted to define as many housings or recesses as there are fingers, each housing being adapted to receive the end of a finger.

The invention relates more particularly, because it is in this case that its application seems to have the most advantage, but not exclusively, among these control rods to those for fuel injection pumps.

It is a particular object of the invention, to render the abovesaid rods such that they respond to the various exigencies of practice better than hitherto and especially such that they are of simple and economic manufacture by reason particularly of a reduced number of machining operations, and of small transverse bulk.

According to the invention, a control rod for the flow per revolution, of the type defined above, is characterised by the fact that the abovesaid means adapted to define the housings, comprise separating members fixed on the profiled element and spaced from one another, in the direction of the length of the said element, these separating members being bounded by walls at right angles to the direction of the profiled element, the abovesaid housings or recesses being constituted by spaces comprised between adjacent said walls, of neighboring members.

Advantageously, the transverse section of the profiled element in the shape of an L, with unequal wings, and the separating members are arranged in the concavity of the L, the width of the separating members being substantially equal to that of the wing of large width of the profiled element so that the abovesaid housings extend along the whole width of the wing of large width.

Preferably, the separating members are hollow and comprise a base plate, of substantially rectangular form, arranged against the inner face of the wing of large width of the profiled element, the said plate being bounded partially, on its periphery, by a wall at right angles to the plane of this plate.

Also preferably, the separating members are fixed on the profiled element by spot welding.

The invention also relates to machines with at least one piston and cylinder, especially for fuel injection pumps, equipped with a control rod for the flow per revolution such as previously defined.

The invention consists, apart from the features mentioned 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 in no way limiting.

FIG. 1 of this drawing, is a partial transverse section of a piston injection pump equipped with a control rod for the flow per revolution constructed according to the invention.

FIG. 2 shows, in elevation, the control rod of the flow per revolution.

FIG. 3 is a view from above of the rod of FIG. 2, a control finger for the rotation of a piston being shown in addition.

FIG. 4 is a section along the line IV—IV of FIG. 2.

FIG. 5 is a section along the line V—V of FIG. 2.

FIG. 6 lastly, is a section along the line VI—VI of FIG. 2.

Referring to FIG. 1, there will be seen an in line fuel injection pump 1 comprising a housing 2 traversed, in the direction of the length, by a shaft 3 bearing cams 4.

One or several cylinders 5 (eight in the case of the pump intended to be equipped with the rod shown in FIG. 2), are mounted in bushes 6 borne by the housing 2.

The axes of each cylinder are parallel between themselves, situated in the same plane and at right angles to the axis of the shaft 3.

A piston 7 is mounted in each cylinder 5 and axial alternating movements of these pistons are controlled by a cam 4, associated with its piston, and an opposing spring 8; a pushrod 9 is advantageously provided between the piston and the cam.

Fuel supply ports 10, diametrically opposite, opening into the bore of the cylinder 5 are provided in the wall of the latter. The opening and closing of these supply ports 10 of the cylinder are controlled by the piston 7 on its axial movements; a delivery connection 11 is provided at the upper portion of the cylinder 5 and is adapted to lead the fuel under pressure towards the combustion chambers of the engine.

The head of the piston 7 comprises a peripheral passage P bounded towards the bottom by a helicoidal wall *h*.

According to the relative angular position of the piston 7 of the cylinder 5, the helicoidal wall h will close or uncover the ports 10 on a rising or descending movement of the piston 7 sooner or later. There is as a result a variation in the volume of fuel injected per revolution of the shaft, in other words, a variation in the flow rate per revolution of the fuel pump, as a function of the relative angular position of the piston and of the cylinder.

The relative angular positions of the piston 7 and of the cylinder 5 are controlled, for each piston, by a finger 12 of flat shape, of which the contour appears in FIG. 3, mounted rigidly to the end of the piston 7 neighboring the pushrod 9, and hence connected in rotation to the said piston. The middle plane of this finger is at right angles to the axis of the piston. The end 12*a* of the finger is adapted to be engaged, accurately, in a recess 13 provided on a control rod 14 for the rotary movements of the piston 7. This control rod is adapted to slide, in a direction parallel to the axis of the shaft 3, in two slides 15, diagrammatically shown in FIG. 3, arranged at each end of the rod 14.

The recess 13 are situated in the portion of the rod 14 comprised between the two slides 15.

An injection pump of this type is described, for example in French Pat. No. 1,136,329 of applicant, filed 24 Aug., 1955 and in this Certificate of Addition No. 68,846 filed 21 Dec., 1955.

The control rod **14** for the flow per revolution of the injection pump **1** is constituted by a rectilinear profiled element **16**, with transverse section of which the bending moment is high. The rod **14** is equipped with means adapted to define as many recesses **13** as there are fingers **12**.

The means adapted to define the recesses **13** comprise separating members **17** fixed on the profiled element **16** and spaced from one another in the direction of the length of the said element.

The separating members **17** are bounded by walls **18** at right angles to the direction of the length of the element **16**. The recesses **13** are constituted by spaces comprised between the walls **18** turned towards one another, of two neighboring separating members **17**.

Advantageously, the section of the profiled element **16** is an L-section, that is to say a right angle, with unequal wings, the wing of largest width being oriented parallel to the axes of the cylinders **5** so that the bending moment of the element **16** to flexing forces in a plane parallel to the abovesaid axes is large. The concavity of the L is turned towards the fingers **12**, the narrow wing of the L being arranged below these fingers, between the latter and the camshaft **3**.

The separating members **17** are arranged in the concavity of the L and their maximum thickness *e* (FIG. **5**) is substantially equal to the width m (FIG. **5**) of the concavity of the L so that the total thickness of the control rod **14** is substantially equal to the inside width of the narrower wing of the element **16**.

The width **1** (FIG. **2**) of the separating member **17** is substantially equal to the width *n* (FIG. **2**) of the wider wing of the L-shaped profiled element **16**.

The separating members **17**, in the form of sockets, may be hollow. They then comprise a base plate **17***a* (FIG. **2** and **5**) partly bounded, on its periphery, by a wall **17***b* at right angles to the plane of the plate **17***a*. The contour of the latter is substantially rectangular, two of the upper corners **17***c* of this contour being inclined at 45°, as is seen clearly in FIG. **2**. The wall **17***b* does not extend along the side of the plate **17***a* neighboring the wing of smallest width of the L. Due to the abovesaid inclined corners **17***c* , the housings **13** have at their upper portion a flared aperture (see FIG. **2**) facilitating, on assembly, the introduction of the end **12***a* of a finger **12** into a housing.

The base plate **17***a* of the sockets is applied against the inner surface of the wing of largest width of the element **16**. Preferably, the profiled element is of steel and is obtained by drawing and the sockets **17**, also of steel, are obtained by stamping a metal sheet or by precision molding or by drawing. The fixing of the sockets on the profiled element **16** is then advantageously achieved by spot welding, the welding spots being diagrammatically represented by the crosses **19** on the base plates **17***a* of the sockets. At the two ends of the profiled element **16**, in the concavity of the latter, are arranged blocks **20**, in the form of a rectangular parallelopipede, welded on to the wider wing of the L-shaped profiled element **16**. These blocks **20** are intended to slide in the slideways **15** and to ensure the guidance of the element **16** in said slideways. A rectangular groove **21** is provided at the middle of the upper portion of the vertical wing of the profiled element **16** and in the socket **17** occurring at this place. The edges of this groove, at right angles to the longitudinal direction of the element **16**, are adapted to cooperate with a stop **22** (FIG. **2**), so as to limit the amplitude of displacements of the rod **14** on each side of a mean position.

The profiled element **16** is extended on one side, on the right in case of FIGS. **2** and **3**, by a cylindrical portion **23** provided at its longitudinal end with an ear **24** adapted to be connected, for example, by a lever controlled by a centrifugal regulator (not shown) driven by a motor supplied by the pump.

In a variation, the separating members **17** are solid and constituted by blocks with a solid cross section, substantially similar to the blocks **20**. The solid separating members are obtained, preferably, by drawing and their edges are chamfered.

The control rod **14** according to the invention has the following advantages.

The recesses **13** are formed without a machining operation, hence manufacture is simple and economical.

The resisting bending moment of the rod **14** is considerable and does not undergo substantial diminution at the level of the recesses **13**.

The total thickness of the rod **14** is small so that the push rod **9** can be given dimensions greater than those which were characteristic up to the present in conventional injection pumps.

The recesses **13**, of which the large dimension is oriented parallel to the axes of the pistons **7**, permit displacement of the fingers **12** along the said axes so that the fingers **12**, necessarily connected in rotation to the pistons **7** can, also, be ridigly fixed in translation to the latter.

I claim:

1. A control rod for a fuel injection pump adapted to control the quantity of fuel delivered per stroke of the pump, said pump having at least one coaxial piston and cylinder, fuel delivery control means associated with said piston regulated by the angular positioning of the piston relative to said cylinder with respect to their common axis, two slides arranged at each end of the rod, said rod being an elongate member adapted to longitudinally slide in said slides, at least one finger fixed to said piston so as to be rotatable therewith and having a free end controlling said relative angular position, said rod member including a profiled element of L-shaped cross-section having a wide wing and a narrow wing, said wide wing being parallel to the axis of the cylinder and said narrow wing extending towards said cylinder, a plurality of separating members which are approximately U-shaped fixed on said profiled element in the hollow of said L-shaped element the separating members being spaced from one another in the direction of the length of said element said separating members defining as many recesses therebetween as there are fingers, each recess receiving the free end of one finger, the free end of each said finger having a width substantially equal to the width of the recess in which it is positioned, said separating members being formed by walls at right angles to the longitudinal direction of said rod, each U-shaped member having its open end facing the narrow wing of the L-shaped element, the dimension of each U-shaped member perpendicular to the wide wing being substantially equal to the dimension of the narrow wing perpendicular to the wide wing.

2. Control rod according to claim **1**, wherein the separating members are hollow and comprise a base plate of substantially rectangular shape arranged against the surface of said wide wing of said L-shaped element facing the concavity thereof, each separating member

partly bounded, on its periphery by a wall at right angles to the plane of said plate, said wall comprising inclined corners defining flared openings to said recesses remote from said narrow wing.

3. Control rod according to claim 1, in which the axial sliding movements of the piston are controlled by a camshaft, the narrow wing of the L-shaped element being arranged between the camshaft and said finger.

4. Control rod according to claim 1, in which the profiled element and the separating members are of steel, including spot welds fixing the separating members on the profiled element.

5. Control rod according to claim 1, wherein the separating members are hollow and comprise a base plate of substantially rectangular shape arranged against the surface of the wider said wing of said L-shaped element facing the concavity thereof, partly bounded, on its periphery, by a wall at right angles to the plane of said plate, said wall comprising inclined corners defining flared openings to said recesses remote from the narrower said wing.

6. Control rod according to claim 1, comprising a block at each longitudinal end of the rod in the form of a rectangular parallelepiped, fixed in the hollow of said L-shaped element and serving for the guidance of the rod in said slides.

7. Control rod according to claim 1 in which the separating members have a size equal to that of the wide wing, along a direction parallel to the axis of the cylinder.

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