July 9, 1940. R. L'ORANGE 2,207,324

FUEL INJECTION PUMP

Filed July 13, 1938

Fig.1.

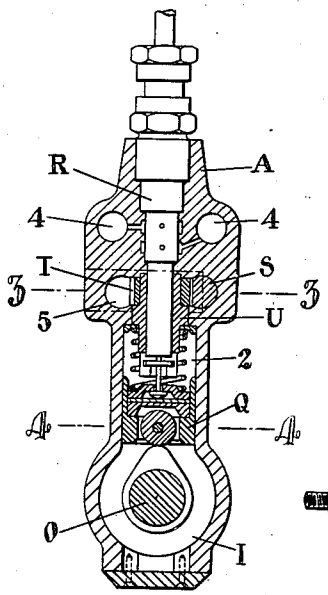


Fig.2.

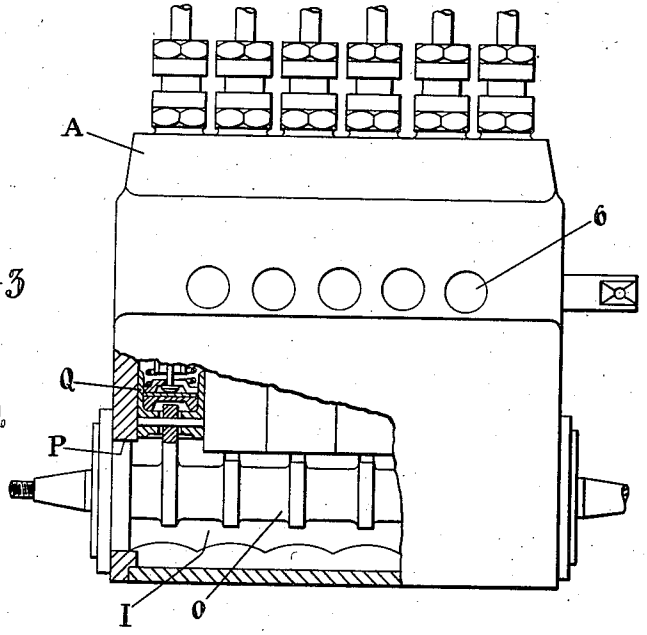


Fig.3.

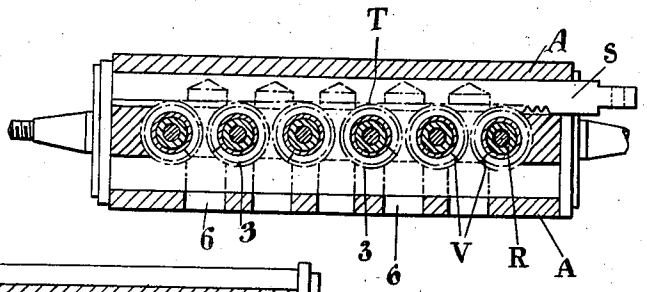
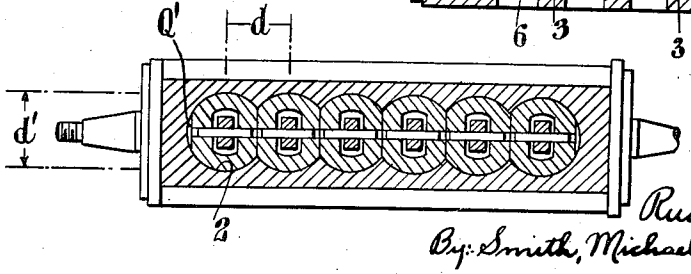


Fig.4.



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FUEL INJECTION PUMP

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8 Claims. (Cl. 103—154)

This invention is for improvements in or relating to fuel injection pumps for internal combustion engines, and the main object of the invention is to provide an improved, efficient and compact construction of such fuel pumps.

Usually the bodies of fuel injection pumps are constructed integrally with the cam casing in order to save space and material. When such pumps are made on an extremely small scale, it is difficult to produce suitable cores for the casing.

Preferably the pump body according to the present invention comprises a cylinder block, tappet casing, and shaft casing made integrally from a single block, and in which all the spaces within the body, for example those which form the housing for the cam shaft, the tappet guides, the pump cylinders, fuel conduits and the like are formed by machining the integral block, and preferably by being bored from a solid block. However, although the said spaces may be formed by being bored out of a solid block, their preliminary formation may be effected by fitting simple cores, normally of circular cross-section, in a casting. In order to effect the final formation of the spaces all the inner walls of the casting are then machined or bored out so that nothing remains of the skin or shell of the casting, which usually contains sand. The thicknesses of the various walls are not, in any way limited in the same way as they are owing to difficulties which arise in casting, and may be made as thin as possible commensurate with the strength of the body not being brought below permissible limits.

Furthermore, when pump bodies are produced from the solid they may be cut from bars which have been drawn, cast or pressed to a definite profile and thereafter bored, so that the external form of the bodies is also very simply and accurately produced.

According to one feature of the present invention, the tappet guide surfaces are arranged to merge one into another to form a continuous longitudinally extending tappet chamber. Thus, the tappet guides may be bored to a diameter which is greater than the distance between the tappet centres so as to obtain, inter alia, a pump body of greater compactness and simplicity than hitherto.

The dimensions of known pump bodies may, by this feature of the invention, be considerably reduced, for example by about 30% which results in a corresponding considerable reduction in the length of the entire pump.

In forming the tappet guides in the manner indicated above, tappets can be employed upon the sides of which flats can be formed which not only ensure compactness but at the same time provide very simple means whereby the tappets can be prevented from rotating in their guides. Usually it is necessary to provide pins and slots to achieve the same object which require rather complicated milling.

A modified form of pump may be obtained by the radius of the sides of the tappets being increased, for example to infinity, so that the point from which the radius of a tappet is struck is not the centre of the tappet and in the limiting case the cross sectional shape of the tappet becomes rectangular.

The invention is more particularly described with reference to the accompanying drawings, in which:—

Figure 1 illustrates a sectional elevation of a pump constructed in accordance with the present invention, the pump illustrated being of the six-cylinder type constructed upon the unidirectional flow principle.

Figure 2 illustrates in side elevation the pump illustrated in Figure 1, with a portion of the cam casing cut away.

Figure 3 is a cross sectional plan view taken on the line 3—3 of Figure 1, and

Figure 4 is a similar view to Figure 3, but taken on the line 4—4 of Figure 1.

The invention is illustrated as applied to a pump having a rotary piston control and in which the cylinders are absolutely central in the pump body, but it will be appreciated that it can be applied to a pump in which the control is effected by increasing and decreasing the length of the tappet, in which case also the pump could be built with the cylinders absolutely central.

Referring to the drawing the pump body A is made from a single piece of metal into which the following bores have been made:

(a) A bore I arranged to house a cam shaft O and form a bearing P.

(b) Six bores 2 shaped to form the guides for tappets Q in a manner hereinafter set forth.

(c) Six bores 3 co-axial with the bores 2 shaped and arranged to receive liners R for the pistons.

(d) Two corresponding longitudinal bores 4 so arranged that one constitutes the feed and the other the return conduit for fuel.

(e) Two symmetrically arranged bores 5, the right hand one of which is arranged to house and form the guide for a regulating rack S, whilst the other forms a means whereby access to regulating toothed rings T may be readily obtained for adjustment purposes.

(*f*) Five transverse bores 6, one formed between each pair of bores 3 in such a manner that the material between adjacent bores 3 is removed to provide access to the toothed rings T.

The toothed rings T are formed as split rings by being split at V and are sprung upon a sleeve U so as to constitute a solid drive therewith. In such a construction the mounting means for each toothed ring does not extend beyond the pitch circle thereof. Such a construction is necessary with the tappet and tappet guide structure according to the invention, since the pump cylinders are very close to one another.

When it is desired to adjust the position of a ring T upon a sleeve U, the ring is sprung open, (for example by inserting a screwdriver into the slit V), and the ring is thereupon turned upon the sleeve U. When the position of the ring is adjusted, the screwdriver is withdrawn from the split V whereupon the ring T snaps back upon the sleeve U, thereby re-establishing the rigid connection between the ring T and the sleeve U.

By this simple form of adjustment, the space required for a toothed ring T is reduced to a minimum.

It will be observed from the section illustrated in Figure 4 that the guides which house the tappets Q are formed in side by side relationship by boring holes such that the distance *d* between the centres of the individual tappets is less than the diameter *d'* of a single bore made to form a tappet guide. Such a construction permits tappets Q to be employed which have flat faces Q' arranged so that the adjacent faces of neighboring tappets engage with one another and prevent the tappets rotating in their respective guides.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

1. In a multi-cylinder fuel injection pump, a body comprising a one-piece block having a plurality of uniformly closely spaced parallel bores for the cylinders, a plurality of bores constituting tappet guides coaxial with the said cylinder bores and each of greater diameter than the distance between the centres of adjacent cylinder bores, and a bore constituting a casing for a driving shaft extending longitudinally of the block and transversely of the tappet guide bores and communicating therewith, and tappets fitting said guide bores, each tappet having two oppositely disposed flat faces and the tappets being slidably arranged one in each tappet guide with the flat faces of adjacent tappets in contact.

2. In a multi-cylinder fuel injection pump, a body comprising a one-piece block having a plurality of uniformly closely spaced parallel bores for the cylinders, liners in said bores, a plurality of bores constituting tappet guides coaxial with the said cylinder bores and each of greater diameter than the distance between the centres of adjacent cylinder bores, and a bore constituting a casing for a driving shaft extending longitudinally of the block and transversely of the tappet guide bores and communicating therewith, tappets fitting said guide bores, each tappet having two oppositely disposed flat faces and the tappets being slidably arranged one in each tappet guide with the flat faces of adjacent tappets in contact, sleeves mounted one on each of the liners constituting the cylinders containing the pistons of the pump, regulating means whereby rotation of said sleeves causes the regulation of the output of the cylinders, separate toothed rings, means for mounting the said toothed rings one upon each sleeve, the said mounting means not extending beyond the pitch circle of each toothed ring, and a rack co-operating with the toothed rings for the regulation of the output of all of the cylinders of the pump.

3. In a multi-cylinder fuel injection pump, a body comprising a one-piece block having a plurality of uniformly closely spaced parallel bores for the cylinders, liners in said bores, a plurality of bores constituting tappet guides coaxial with the said cylinder bores and each of greater diameter than the distance between the centres of adjacent cylinder bores, and a bore constituting a casing for a driving shaft extending longitudinally of the block and transversely of the tappet guide bores and communicating therewith, tappets fitting said guides bores, each tappet having two oppositely disposed flat faces and the tappets being slidably arranged one in each tappet guide with the flat faces of adjacent tappets in contact, sleeves mounted one on each of the liners constituting the cylinders containing the pistons of the pump, regulating means whereby rotation of said sleeves causes the regulation of the output of the cylinders, toothed rings mounted one upon each sleeve, the said toothed rings being split and sprung upon their sleeves, and a rack co-operating with the toothed rings for the regulation of the output of all of the cylinders of the pump.

4. In a multi-cylinder fuel injection pump, a body comprising a one-piece block having a row of uniformly closely spaced parallel bores for the cylinders, a pair of bores extending symmetrically one on one side and the other on the other side along the row of cylinder bores and intersecting the surfaces thereof, a plurality of bores each of which extends transversely between an adjacent pair of cylinder bores and intersects the surfaces thereof at the level of the said pair of bores extending along the row of cylinder bores, a plurality of bores constituting tappet guides coaxial with the said cylinder bores and each of greater diameter than the distance between the centres of adjacent cylinder bores, and a bore constituting a casing for a driving shaft extending longitudinally of the block and transversely of the tappet guide bores and communicating therewith, tappets fitting said guide bores, each having two oppositely disposed flat faces, slidably arranged in the said tappet guides with the flat faces of adjacent tappets in contact, liners constituting cylinders mounted one in each cylinder bore, pistons mounted one in each cylinder and arranged to be actuated by a tappet corresponding thereto and to be rotated about the axis of the cylinder to regulate the output thereof, sleeves mounted one on a portion of the outer surface of each liner and arranged to rotate the piston in the said liner, toothed rings mounted one upon each sleeve, the said toothed rings being split and sprung upon their sleeves and being adjustable relatively thereto, and a rack co-operating with the toothed rings for the regulation of the output of all of the cylinders of the pump, the said toothed rings and the rack being disposed in the spaces constituted by the said transverse bores and the said pair of bores extending along the row of cylinder bores.

5. In a multi-cylinder fuel injection pump, a body comprising a one-piece symmetrically formed block having a plurality of uniformly closely spaced parallel bores for the cylinders, liners in said bores, a plurality of bores constituting tappet guides coaxial with the said cylinder bores and each of greater diameter than the

distance between the centres of adjacent cylinder bores, and a bore constituting a casing for a driving shaft extending longitudinally of the block and transversely of the tappet guide bores and communicating therewith, tappets fitting said guide bores, each having two oppositely disposed flat faces, the tappets being slidably arranged one in each tappet guide with the flat faces of adjacent tappets in contact and the bores for the cylinders, tappets and driving shaft being symmetrical about the median plane of the block.

6. In a multi-cylinder fuel injection pump, a body comprising a one-piece symmetrically formed block having a plurality of uniformly closely spaced parallel bores for the cylinders, liners constituting cylinders in said bores, a plurality of bores constituting tappet guides coaxial with the said cylinder bores and each of greater diameter than the distance between the centres of adjacent cylinder bores, and a bore constituting a casing for a driving shaft extending longitudinally of the block and transversely of the tappet guide bores and communicating therewith, tappets fitting said guide bores, each tappet having two oppositely disposed flat faces, the tappets being slidably arranged one in each tappet guide with the flat faces of adjacent tappets in contact and the bores for the cylinders, tappets and driving shaft being symmetrical about the median plane of the block, sleeves mounted one on each of the liners, regulating means whereby rotation of said sleeves causes the regulation of the output of the cylinders, separate toothed rings, means for mounting the said toothed rings one upon each sleeve, the said mounting means not extending beyond the pitch circle of each toothed ring, and a rack co-operating with the toothed rings for the regulation of the output of all of the cylinders of the pump.

7. In a multi-cylinder fuel injection pump, a body comprising a one-piece symmetrically formed block having a plurality of uniformly closely spaced parallel bores for the cylinders, liners constituting cylinders mounted in said bores, a plurality of bores constituting tappet guides coaxial with the said cylinder bores and each of greater diameter than the distance between the centres of adjacent cylinder bores, and a bore constituting a casing for a driving shaft extending longitudinally of the block and transversely of the tappet guide bores and communicating therewith, tappets fitting said guide bores, each tappet having two oppositely disposed flat faces, the tappets being slidably arranged one in each tappet guide with the flat faces of adjacent tappets in contact and the bores for the cylinders, tappets and driving shaft being symmetrical about the median plane of the block, sleeves mounted one on each of the liners, regulating means whereby rotation of said sleeves causes the regulation of the output of the cylinders, toothed rings mounted one upon each sleeve, the said toothed rings being split and sprung upon their sleeves, and a rack co-operating with the toothed rings for the regulation of the output of all of the cylinders of the pump.

8. In a multi-cylinder fuel injection pump, a body comprising a one-piece symmetrically formed block having a row of uniformly closely spaced parallel bores for the cylinders, a pair of bores extending symmetrically one on one side and the other on the other side along the row of cylinder bores and intersecting the surfaces thereof, a plurality of bores each of which extends transversely between an adjacent pair of cylinder bores and intersects the surfaces thereof at the level of the said pair of bores extending along the row of cylinder bores, a plurality of bores constituting tappet guides coaxial with the said cylinder bores and each of greater diameter than the distance between the centres of adjacent cylinder bores, and a bore constituting a casing for a driving shaft extending longitudinally of the block and transversely of the tappet guide bores and communicating therewith, the bores for the cylinders, tappets and driving shaft being symmetrical about the median plane of the block, tappets fitting said guide bores, each having two oppositely disposed flat faces, slidably arranged in the said tappet guides with the flat faces of adjacent tappets in contact, liners constituting cylinders mounted one in each cylinder bore, pistons mounted one in each cylinder and arranged to be actuated by a tappet corresponding thereto and to be rotated about the axis of the cylinder to regulate the output thereof, sleeves mounted one on a portion of the outer surface of each liner and arranged to rotate the piston in the said liner, toothed rings mounted one upon each sleeve, the said toothed rings being split and sprung upon their sleeves and being adjustable relatively thereto and a rack co-operating with the toothed rings for the regulation of the output of all of the cylinders of the pump, the said toothed rings and the rack being disposed in the spaces constituted by the said transverse bores and the said pair of bores extending along the row of cylinder bores.

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