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FUEL INJECTION PUMPS COMPRISING A DISTRIBUTING VALVE FOR
USE WITH FIVE CYLINDERS INTERNAL COMBUSTION ENGINES
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Fig. 1.

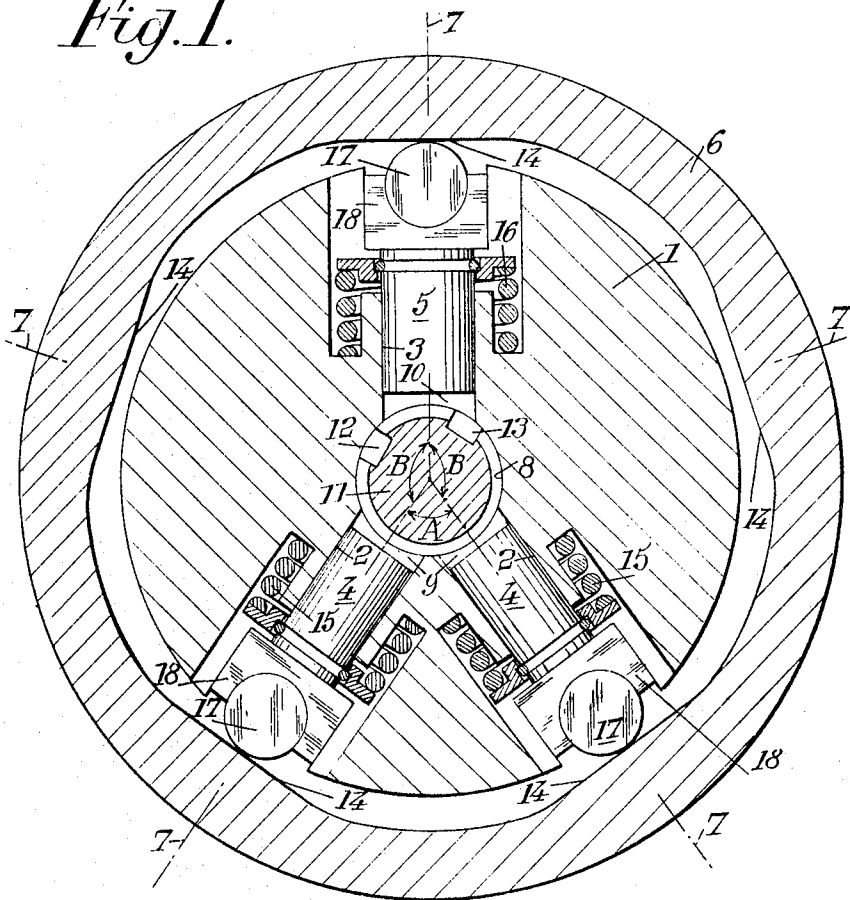


Fig. 2.

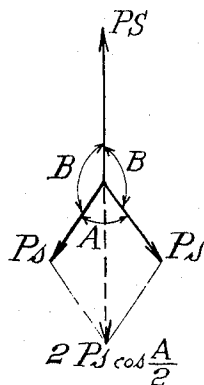
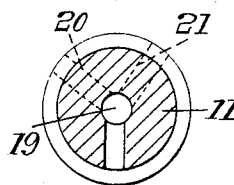


Fig. 3.



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FUEL INJECTION PUMPS COMPRISING A DISTRIBUTING VALVE FOR USE WITH FIVE CYLINDERS INTERNAL COMBUSTION ENGINES

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954,602, Patent 354,986

2 Claims. (Cl. 103—2)

The present invention relates to fuel injection pumps of the kind disclosed in the U.S. Patent No. 3,091,231 to J. R. Giraudon for "Fuel Injection Pumps," which pumps comprise a body provided with radial bores in which are slidably mounted pistons, an annular cam disposed about said body to cooperate with each of the pistons, means for rotating the body and the cam with respect to each other, in such manner as to actuate said pistons and a distributing valve capable of connecting to each of the cylinders of an engine a central passage communicating with the whole of the pump chambers limited by said pistons in their respective bores, said means and said distributing valve being driven in synchronism with said engine.

The chief object of the present invention is to provide a pump of this kind with a reduced number of pistons while balancing the reactions on the cam at the time of injection.

The invention consists, chiefly, in a pump of this kind for use with a five cylinder internal combustion engine, in making use of an annular cam having five lobes and cooperating with only three pistons, to wit two pistons of equal cross sections making an angle of about 72° with each other and a piston of larger cross section the axis of which makes equal angles with the two other pistons respectively, the cross section of this last mentioned piston being substantially 1.6 times the cross section of each of the two other pistons.

A preferred embodiment of the present invention will be hereinafter described with reference to the appended drawings, given merely by way of example, and in which:

FIG. 1 is a diagrammatical cross section of a pump made according to the present invention;

FIG. 2 is a diagram illustrating the essential advantage of the pump of FIG. 1;

FIG. 3 is a cross section, in a plane different from that of FIG. 1, of the slide valve shown by said FIG. 1.

The present invention relates to a fuel injection pump for a five cylinder internal combustion engine.

The pump comprises:

A body 1 provided with radial cylindrical bores 2 and 3 where pistons 4 and 5 are slidably mounted;

An annular cam 6 coaxially surrounding body 1 and adapted to cooperate with pistons 4 and 5;

Means for rotating body 1 and cam 6 with respect to each other about their common axis in order to actuate pistons 4 and 5 (body 1 may be fixed and cam 5 rotating or inversely) and

A distributing valve capable of successively connecting with each of the five cylinders of the internal combustion engine (not shown), through connections 7, a central passage 8 communicating with all the pump chambers 9 and 10 limited by pistons 4 and 5 in their respective bores 2 and 3;

Said means and said distributing valve being driven in synchronism with said internal combustion engine.

The distributing valve in question may comprise a rotary cylindrical member 11 housed in passage 8 and driven at the same speed as cam 6 or body 1, according

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as the case may be. Valve member 11 comprises a groove 12 adapted to connect chambers 9 and 10 successively to connections 7, during the delivery strokes of pistons 4 and 5. This groove 12 may also serve to feed chambers 9 and 10 with the fuel that is sucked in, but it seems more advantageous to provide at least one other groove 13 for this purpose. To this effect a radial hole 20 may connect a longitudinal hole 19 successively with connections 7, during the delivery of the pump, a second radial hole 21 serving to the feed during the suction periods.

Now, according to the present invention, use is made of a cam 6 with five lobes 14 cooperating with the only three pistons, to wit two pistons 4 of equal respective cross sections *s* disposed along respective lines making between them an angle *A* equal to about 72° (one fifth of a circumference) and a piston 5 of greater cross section *S* making with the two other pistons, respectively, two equal angles *B*

$$\left(180^\circ - \frac{A}{2}\right)$$

the cross section *S* of this piston 5 being substantially 1.6 times the cross section of the two other pistons 4. When the three pistons have a circular cross section, the diameter *D* of piston 5 is equal to about 1.27 *d*, *d* being the diameter of each of the pistons 4.

As shown by FIG. 1, pistons 4 and 5 may be urged outwardly against cam 6 by springs 15 and 16 (or, when body 1 is a rotary body, merely by the centrifugal force). Rollers 17 are carried by shoes 18 rigid with the pistons so that the contact between the pistons and the cam is a rolling contact.

This pump works as follows:

When the internal combustion engine fed by the pump is running, pistons 4 and 5 are simultaneously acted upon by three of the five lobes 14 of cam 6 and this five times per cycle of the engine, with a maximum output identical every time. Therefore it will be understood that the pump delivers, five times per revolutions of body 1 or cam 6, an identical volume of fuel at identical times interval.

If *P* is the instantaneous delivery pressure of the pump, the reactions exerted on cam 6 by pistons 4 are each equal to *P_s* and the reaction exerted on said cam 6 by piston 5 is equal to *P_S* and these three reactions are directed along the axes of bores 2 and 3, respectively, as shown by FIG. 2. The two reactions equal to *P_s* have a component equal to

$$2P_s \cos \frac{A}{2}$$

that is to say for *A*=72° equal to 1.618.*P_s*, that is to say approximately 1.6 *P_s*. Constructionally this component is opposed to the reaction *P_S* exerted by piston 5. As, constructions also, *S*=1.6 *s*, said component 1.6 *P_s* is opposed to, and has the same value as, the reaction exerted by piston 5, so that the three reactions have a resultant equal to zero. Thus cam 6 is subjected to no effort tending to excenter it.

In a general manner, while the above description discloses what we deem to be a practical and efficient embodiment of our invention, it should be well understood that we do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of our invention as comprehended within the scope of the appended claims.

What we claim is:

1. A fuel injection pump of use with an internal combustion engine having five cylinders, which pump comprises, in combination, a body provided with three radial cylindrical bores, three pistons fitting slidably in said bores so as to form therewith three pump chambers respectively,

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an annular cam having five lobes coaxially surrounding said body and adapted to cooperate with said pistons, said body and said cam being adapted to rotate with respect to each other in synchronism with said internal combustion engine to actuate said pistons in said bores respectively, and a distributing valve operative in response to the relative rotation of said body and said cam and provided with a central passage communicating with the whole of said pump chambers, two of said bores being of equal respective cross sections and having their respective axis disposed at an angle of about 72° and the third bore being of a larger cross section equal to approximately 1.6 times the cross section of each of the two first mentioned bores, the axis of said third mentioned bore being disposed along the bisectrix of the angle made by the respective axes of the two first mentioned bores.

2. A fuel injection pump according to claim 1 wherein

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said three bores are of circular cross section, the diameter of the bore of larger cross section being equal to approximately 1.27 times the diameter of each of the two first mentioned bores.

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