Jan. 18, 1927. 1,614,493

F. ROCHEFORT

APPARATUS FOR DISTRIBUTING FUEL

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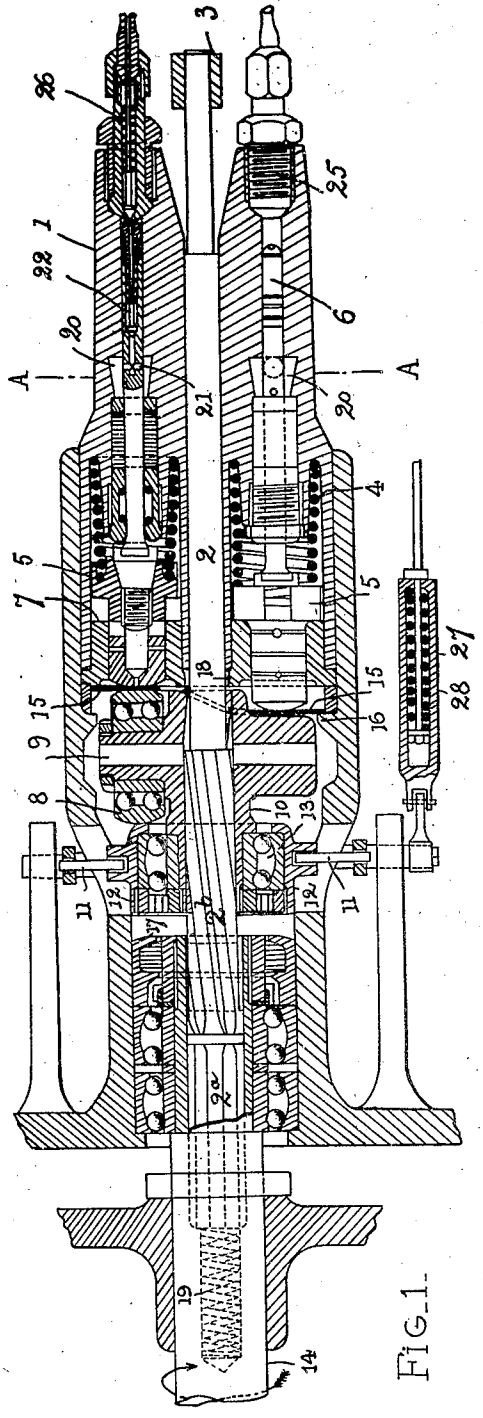


FIG. 1.

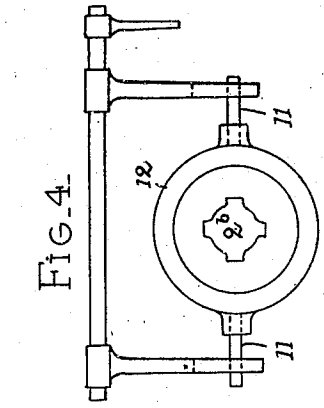


FIG. 4.

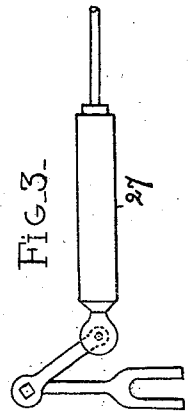


FIG. 3.

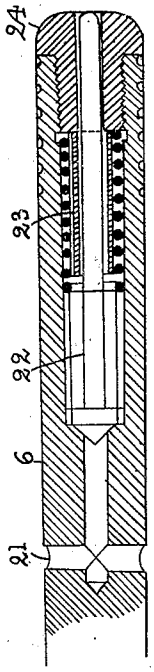


FIG. 5.

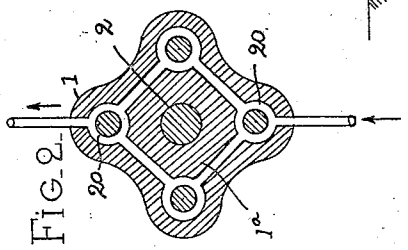


FIG. 2.

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR DISTRIBUTING FUEL.

Application filed March 28, 1923, Serial No. 628,236, and in France April 13, 1922.

My invention relates to a system of distribution of fuel under high pressure.

Its object is to effect an arrangement of the pump bodies symmetrical in relation to an axis, and a novel method of controlling plunger pistons by a single cam, enabling uniform deliveries to be obtained as regards all the pumps and great accuracy in regulating injection and delivery points.

This object I obtain by the uniform arrangement of the pump bodies parallel to and around the controlling shaft; and by the actuation of the plunger pistons, effected by a single cam which enables one and the same profile to be caused to act on all the plungers.

The precise regulations of the injection points are effected by means of a double shifting one of which is for automatic correction, the other for optional correction.

The invention concerns apparatus for distributing fuel under high pressure intended for the direct feeding of internal combustion engines, with one or more than one cylinder.

In the annexed drawing, by way of example, showing one of the methods of carrying out the invention,

Fig. 1 is a longitudinal section through the axis of the apparatus,

Fig. 2 a transverse section along line A—A in Fig. 1.

Figs. 3 to 5 are detail views, Fig. 5 being drawn to a larger scale than Figs. 1 to 4.

The apparatus shown by way of example is a multiple piston-pump distributor, in which the cylinders 1, or feed-pump bodies, are arranged parallel to and uniformly distributed around the controlling shaft. The shaft 2 rotates in the bearings 1^a (Fig. 2) formed in the cylinders casting and can move longitudinally under the action of a controlling device provided at 3. On shaft 2 both straight grooves 2^a and helical grooves 2^b are formed. Springs 4 move the actuating blocks 5 of the plungers 6 back against the stop 7 after the passage of the actuating cam which consists of a movable roller 8 rotating on a trunnion 9 firmly connected with a controlling sleeve 10 provided internally with helical grooves which correspond to the helical projections on the shaft 2. The sleeve 10 rotates under the action of the shaft 2 and can be moved longitudinally on it by means of any suitable device arranged on two trunnions 11 firmly connected with a casing 12 containing a double bearing 13; the controlling of the sleeve can be effected by hand or automatically by a regulator.

The shaft 2 is actuated by a hollow shaft 14 equipped internally with straight grooves corresponding to the straight projections on the shaft at 2^a. This hollow shaft 14 is controlled by the motor and rotates at a uniform ratio of speed, determined by the working cycle of the motor.

The rotation of the shaft 14 involves that of the shaft 2 which itself bears the cam carrying sleeve 10 and forces the point of action of the cam 8 to describe a circle perpendicular to the axis of the driving shaft 2 and parallel to the plane of rest of the actuating blocks 5 of the plungers 6; these blocks ending in a rounded off part.

An annular deformable disc 15 is interposed in order to establish a permanent contact between the cam 8 and the actuating blocks 5 when the pumps are in action, this being for the purpose of preventing shocks between these two parts.

The disc 15 undergoes a limited deformation when the pistons act. It is brought back against the annular stop or bearing 16 by the plunger return springs 4.

The movement of the cam-bearing sleeve 10 on the shaft 2 is limited by the stops 17 and 18; when it comes against 17 the cam 8 no longer touches the disc 15; the stop at 18 determines the maximum stroke of the plungers.

The position of sleeve 10 determines the delivery of the pumps.

The cam 8 in its circular movement runs on the deformable disc 15 which transmits the thrust which it receives to the actuating blocks 5 of the plungers 6 which move successively to an extent corresponding to the distance of the cam-bearing sleeve 10 in relation to the stop 17.

Because of the obliquity of the actuating grooves 2^b, the sleeve 10 in moving longitudinally is shifted angularly in relation to the driving shaft 2.

The direction and degree of this obliquity are so arranged as to keep appreciably uniform the point at which the beginning of the injection is fixed in relation to the motor whatever may be the variations of delivery obtained by variation of the course of the plunger pistons.

In order to obtain a variation of the point of injection without variation of the delivery of the pumps, it is only necessary to act on the controlling device provided at 3 which enables the driving shaft 2 to be moved longitudinally. During this movement the shaft 2 is not angularly shifted in relation to the motor as it slides in the straight grooves 2^a, formed in the hollow shaft 14 driven by the motor at a constant rate of speed; but it causes the cam-bearing sleeve 10 which is retained in the longitudinal direction by the double stop 13, to be angularly shifted in relation to it and this without variations of the course of the plungers.

In order to effect variations of the point at which the injection is arranged and simultaneous variations of delivery, all that is necessary is to actuate simultaneously the controlling devices provided at 3 and at 11. The driving shaft 2 is returned to its initial position by the action of a powerful spring 19 contained in the hollow shaft 14 and acting on the driving shaft through compression.

The controlling device provided at 11 may likewise be reversible according to the type of motor for which the apparatus is intended.

For this purpose annular chambers 20 in the form of truncated cones (the large bases of which are set in the same direction) are formed in the pump bodies and have a length greater than the length of the suction opening 21 formed in each plunger, and communicating with the suction valve casing formed in the plunger itself. All the annular chambers 20 are connected together by passages formed in the sides of the pump blocks. This constitutes a supply reservoir and has passing through it a stream of liquid under pressure, but of slight speed, the object of which is to drive out of the annular chambers the gas bubbles which might have been previously in the body of the liquid.

Obviously the form of the devices, the arrangements of the gearings, and the general mounting may be modified as far as the arrangements of the motor may require, without modifying the working of the system. In order to effect a very great uniformity of delivery of the pumps and a very precise closing of the suction valves 22 (Fig. 5) these are placed in the plungers, so as to cause their inertia to act for controlling their opening or closing; these valves have conical seats with very long guides and are furnished with a lift limiter, consisting of a small grooved absolutely free tubular sleeve 23, of a certain length and capable of sliding on the valve guide rod, between the stop screw 24 (bored inside with a square or hexagonal hole, allowing the liquid to pass around the guide rod during the suctional action of the plungers), and the valve body 22.

This small sleeve 23 not being in contact with the plunger, has a constant tendency through inertia to become stationary, and neutralizes the actuating effect of the suction action of the plunger on the valve; when the direction of movement of the plunger changes; and thus assists in increasing the opening and closing speed of the valve.

The socket 25 contains the compression valve and bears its seat; this valve has likewise a long guide, it is returned to its seat by a spring 26 and the pressure maintained in the compression tubes, by an identical back pressure valve, placed on the atomizer to which the liquid is conveyed.

In order to avoid the breaking of the controlling and distributing devices (shaft, cam, disc, plungers) in case of obstruction of an atomizer or atomizers, the device effecting the regulating of the plungers (serving for regulating the delivery of the pumps in action) carries a safety damping device 27 formed by a spring 28 or any other flexible contrivance, the tension of which is regulated so that the cam-bearing sleeve 10 recoils in order that the plungers may not have to support a strain greater than the normal maximum strain admitted by regulating well under their limit of resistance, as well as that of the devices mentioned above.

It is quite understood that other methods and other forms of execution may be resorted to without altering the nature of this invention.

It is likewise possible according to the circumstances and the purposes for which the apparatus is employed to modify the details of construction and mounting. On the other hand the various constituent devices of this invention might be replaced by others acting in the same way or producing the same result.

I claim:—

1. A fuel pump for internal combustion engines comprising an axially movable rotatable central shaft, bearings therefor, a plurality of pump casings disposed symmetrically around the said shaft, movable plungers in said pump casings, a sleeve mounted on the said shaft so as to move axially thereon, a trunnion provided on said sleeve, a single cam-roller rotatably carried by the said trunnion so as to act directly and successively on the heads of the said plungers, and a controlling device (11, 12) adapted to maintain the said sleeve at the desired point for the delivery of fuel by the said plungers.

2. A fuel pump for internal combustion engines comprising an axially movable ro-

tatable central shaft, bearings therefor, a plurality of pump casings disposed symmetrically around the said shaft, movable plungers in the said pump casings, the said shaft being formed with helical projections, a nut-like sleeve mounted on the said shaft and adapted to engage the said helical projections thereon, a trunnion provided on said sleeve, a single cam-roller rotatably carried by the said trunnion so as to act directly and successively on the heads of the said plungers, and a controlling device (11, 12) adapted to maintain the said sleeve at the desired point for the delivery of fuel by the said plungers.

3. A fuel pump as set forth in claim 1, in which the end of the said central shaft has straight projections, a hollow shaft being provided with corresponding grooves engaging said projections so as to maintain invariable the angular position of the said shaft in relation to the motor, the said grooves inducing the rotation and axial movement of the said shaft (2) resulting in an optional shifting of the points of injection without influencing the delivery of the pumps.

4. A fuel pump as set forth in claim 1, in combination with the controlling device (11, 12), a safety damping device (27) so arranged that the said sleeve is maintained in position recoiling only when the strain is greater than the normal maximum strain, thereby preventing the breaking of the parts in case of an obstruction.

In testimony whereof he has affixed his signature.

FRANÇOIS ROCHEFORT.