

Feb. 14, 1939.

P. L. VAUDET

2,147,390

FUEL FEED PUMP

Filed March 30, 1935

2 Sheets-Sheet 1

Fig. 1

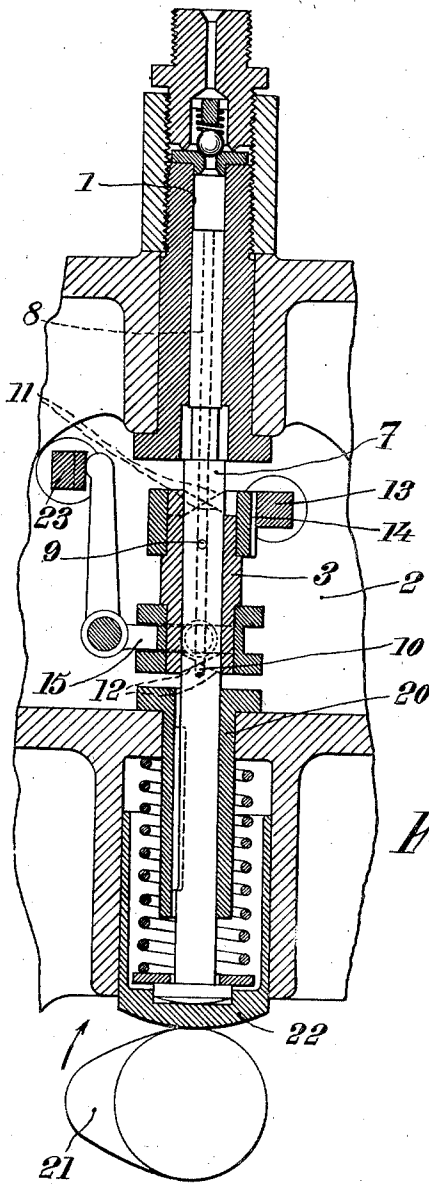


Fig. 2

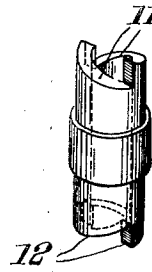


Fig. 3

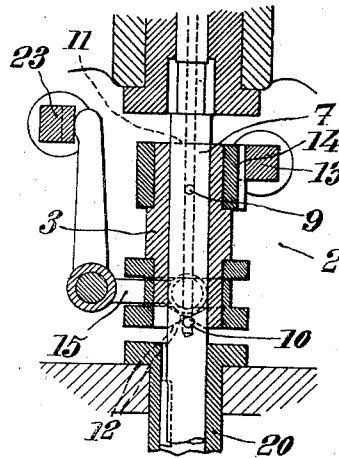
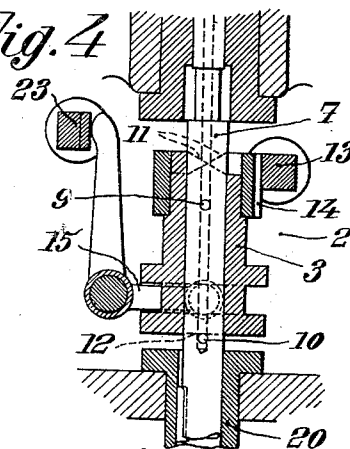


Fig. 4



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2 Sheets-Sheet 2

Fig. 5

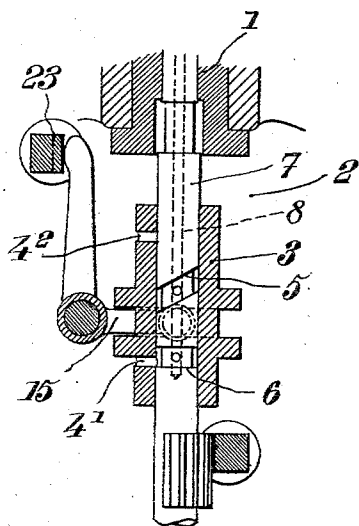


Fig. 6

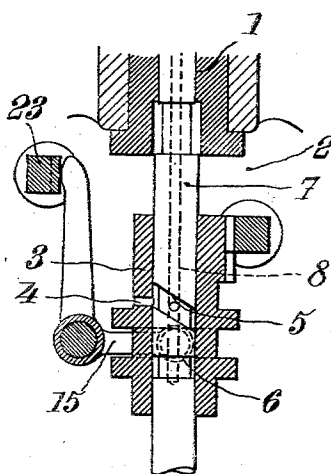
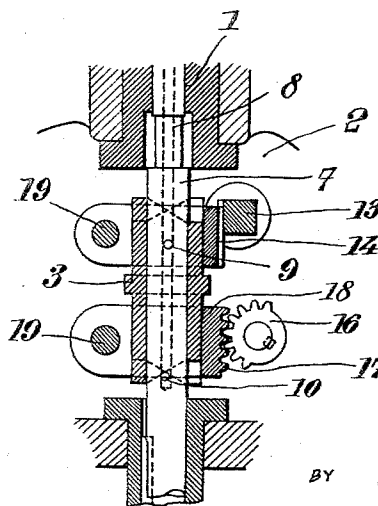


Fig. 7



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2,147,390

FUEL FEED PUMP

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12 Claims. (Cl. 123—139)

The present invention relates to fuel feed pumps for internal combustion engines.

The object of the present invention is to provide a pump of this kind which is better adapted to meet the requirements of actual practice than pumps of the same kind existing at the present time, and, especially, which permits a better adaptation to the conditions of working of the engine in connection with which it is used.

The essential feature of the present invention consists in providing means whereby it is possible, in accordance with the conditions of working of said engine, to vary on the one hand the amount of fuel fed to the engine for each stroke of the pump by varying the time elapsing between the beginning and the end of the feed, that is to say the duration of injection, and, on the other hand, the time at which said injection takes place, in particular for obtaining always a correct lead of the injection.

Said means include a piston and a sleeve surrounding said piston angularly movable with respect to each other, one of these elements being provided with orifices for the flow of fuel adapted to be stopped, at predetermined points of the relative reciprocating movement of said elements, by oblique surfaces carried by the other element, it being further possible to vary the position of said sleeve in the axial direction. With such an arrangement an angular movement of said two elements makes it possible to vary the duration of injection, while a displacement of said sleeve in the axial direction modifies the time of injection.

Other features of the present invention will result from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawings, given merely by way of example, and in which:

Fig. 1 is an axial sectional view, some parts being cut away of a fuel feed pump for internal combustion engines made according to a first embodiment of the present invention;

Fig. 2 is a perspective view of one of the parts of said pump;

Figs. 3 and 4 are partial axial sectional views showing modifications of the embodiment of Fig. 1;

Figs. 5, 6 and 7 are sectional views of three other embodiments, respectively.

There exist fuel feed pumps in which it is possible to vary the amount of fuel injected at each stroke in accordance with the power that is to be

developed by the engine. In most cases, this result is obtained by means of a piston having oblique faces or provided with grooves which are also oblique with respect to the axis of said piston, these faces or these grooves being adapted to cover or uncover inlet and discharge ports provided in the cylinder wall. Under these conditions, if the piston is mounted in such manner as to be able to pivot about its axis with respect to its cylinder, it is possible to vary, in accordance with the relative positions of said faces or grooves with respect to said ports, the length of the stroke for which the piston discharges fuel, and therefore the amount of fuel fed at each stroke of the pump.

Now experience has taught that it may be necessary to vary the lead of injection independently of the amount of fuel injected because it may happen, for instance, that, for high consumptions of fuel, the speed of revolution of the engine has very different values. Thus the engine of an automobile vehicle may, while developing the same power, either turn relatively slowly when the vehicle is climbing a hill, or, on the contrary turn at a very high speed when the vehicle is running along a level road.

Therefore the pump according to the present invention is so devised that it is possible to vary, simultaneously and independently, according to the conditions of working of the engine, on the one hand the amount of fuel fed to the engine, and, on the other hand, the time, with reference to the engine cycle, at which said fuel is fed.

This result may be obtained in different manners according to the present invention. For instance, in the case of a usual feed pump of the type above referred to, the orifice or orifices for the flow of the fuel that coact with the oblique faces or grooves of the piston are no longer carried by the pump cylinder but by a sleeve or jacket adapted to slide axially in said cylinder.

This sleeve may also be wholly independent of the pump cylinder. For instance, in the embodiment of Fig. 5, the pump cylinder is shown at 1. Piston 7, which reciprocates in said cylinder, cooperates with sleeve 3, which is independent of cylinder 1 and is mounted inside a chamber or reservoir 2 filled with fuel. The oblique groove above referred to is shown at 5. In the embodiment of Fig. 5, this oblique groove cooperates with a discharge port 4², while another groove 6 (which in this specific example is at right angles to the axis of the piston, but which might eventually be oblique like groove 5) cooperates with inlet port 4¹. Piston 7 is provided with an axial

conduit 8 communicating at one end with both of said grooves 5 and 6 and opening at the other end into the working face of said piston. Therefore when groove 6 is located opposite port 4¹ fuel can pass through said conduit 8 from reservoir 2 into the compression chamber of the pump. In the course of the upward stroke of the piston, when groove 6 has moved past port 4¹, fuel injection takes place. As soon as groove 5 comes opposite port 4², fuel injection ceases because the fuel under pressure in the compression chamber of the pump can flow back to chamber 2 through said groove 5 and discharge port 4². It will be readily understood that by rotating piston 7 about its axis in sleeve 3 (for instance by means of a rack 13a meshing with a pinion 14a keyed on the piston) the length of the portion of the piston stroke corresponding to fuel injection can be varied, while by moving said sleeve 3 axially (for instance by means of fork 15) the time at which injection takes place can be varied independently.

Instead of turning the piston, as in this embodiment it is much more advantageous to vary the amount of fuel fed by the pump by rotating the sleeve, which is also adapted to be given an axial displacement for varying the time of injection.

In this case illustrated by Figs. 1 to 4 inclusive, 6 and 7 both adjustments, that is to say the adjustment of the amount of fuel to be fed and the adjustment of the time of injection, are obtained through displacements of the same organ, to wit the sleeve.

Referring to Figs. 1 to 4 and 7, the piston 7 is provided with at least two distinct orifices 9 and 10, connected together by axial conduit 8 and adapted to coact with the opposite edges 11 and 12 of sleeve 3.

Both of these edges may be oblique, as shown in Figs. 1 and 2, or one of them is oblique and the other is at right angles to the axis of the sleeve, as shown by Figs. 3 and 4. For instance in Fig. 3, edge 12 is oblique so as to permit of varying the beginning of the period of injection, while in Fig. 4 edge 11 is oblique so as to permit of varying the end of the period of injection.

Advantageously, these oblique edges are made of two portions, symmetrical with respect to the axis of the sleeve and each corresponding to an arc of 180°, and adapted to coact with two diametrically opposed orifices 9 (for surfaces 11) and 10 (for surfaces 12). With such an arrangement (Fig. 2) any lateral reaction is eliminated.

The rotation of sleeve 3 with respect to piston 7 about the axis of said piston may be obtained through any suitable means, for instance a rack 13 meshing with a pinion 14 permitting an axial displacement of said piston while leaving said rack in mesh with said pinion. Said rack may be operated either manually or through any other means.

The axial sliding displacement of sleeve 3 may be obtained through any suitable means, for instance through a forked lever 15 rigid with an arm cooperating with an inclined surface of a member 23 which may be given a translatory displacement either manually or automatically, for instance in response to variations of the speed. This control of the axial displacement of sleeve 3 is shown in Figs. 1 and 3 to 6 inclusive.

In the modification shown by Fig. 7, the axial displacement of sleeve 3 is obtained through a pinion 16 meshing with teeth 17 provided in said sleeve, or rather in a piece 18 rigidly fixed to said sleeve.

Means may be provided for adjusting the position of the sleeve with respect to the organs controlling its rotation and its translation. In the case of a multi-cylinder engine provided with a plurality of pumps, this will permit of adjusting differently the respective positions of the pistons of said pumps. For instance, as shown in Fig. 7, element 14 may be adjusted angularly with respect to sleeve 3, and element 18 axially, said elements being fixed in the desired respective positions by means of screws 19.

Referring now to Fig. 6, the sleeve 3 is rotatable and axially movable by means of a rack 13 and a forked lever 15 respectively similar to the embodiments shown in Figs. 1-4 inclusive. The opposite edges 11 and 12 of the sleeve 3 are, however, at right angles to the axis of the sleeve and do not serve to control the fuel. The sleeve 3 is provided with a single part 4, which cooperates alternately with the grooves 5 and 6 arranged in the piston 7, to control the amount of the fuel to be fed and the time of injection. The edges of the groove 6 are at right angles to the axis of the sleeve, but they may be oblique to the axis like the edges of the groove 5.

The other parts of the pump may be made in any suitable conventional manner. Piston 7, which slides at one end, for instance at its upper end if it is vertical, in the cylinder proper 1, and at the other end in a sleeve 20 or the like, will be controlled for instance by a cam 21 and a push piece 22. As for chamber 2 surrounding sleeve 3, it will be made fluidtight so as to contain the liquid to be injected fed from a reservoir unless said chamber 2 constitutes the reservoir itself.

In view of the preceding explanations it is believed unnecessary to further describe the operation of the pump according to the present invention.

It is again pointed out that the embodiments of Figs. 1 to 4 inclusive, 6 and 7 are particularly advantageous because they are very simple since both adjustments are obtained by acting only on the sleeve and it is unnecessary to turn the piston in its cylinder.

While I have, in the preceding description, disclosed what I deem to be practical and efficient embodiments of the present invention, it should be well understood that I 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 the present invention as comprehended within the scope of the appended claims.

What I claim is:

1. In an injection pump for internal combustion engines, the combination of a cylinder, a plunger forming a working chamber within said cylinder and being movable in the latter, said plunger having a part projecting from said cylinder, a casing forming a supply chamber surrounding said projecting part of the plunger, said plunger having a longitudinal bore parallel to the axis thereof, one end of said bore communicating with said working chamber, the other end communicating with at least one conduit leading to the plunger surface projecting from said cylinder, means adapted to reciprocate said plunger in said cylinder, an adjustable sleeve loosely positioned on the projecting part of the plunger and adapted to control said conduit, said sleeve being rotatable as well as axially slidable with respect to said plunger, adjusting means adapted to cause a purely rotating motion of said sleeve about its axis, without axial motion thereof and additional

adjusting means adapted to displace said sleeve in an axial direction independently of the presence of the first mentioned adjusting means.

2. In an injection pump for internal combustion engines, the combination of a cylinder, a plunger forming a working chamber within said cylinder and being movable in the latter, said plunger having a part projecting from said cylinder, a casing forming a supply chamber surrounding said projecting part of the plunger, said plunger having a longitudinal bore parallel to the axis thereof, one end of said bore communicating with said working chamber, the other end communicating with two conduits leading at spaced points to the plunger surface projecting from said cylinder, means adapted to reciprocate said plunger in said cylinder, an adjustable sleeve loosely positioned on the projecting part of the plunger and provided with opposite edges controlling said conduits, at least one of said edges being inclined with respect to the axis of the sleeve, said sleeve being rotatable as well as axially slidable with respect to said plunger, adjusting means adapted to rotate said sleeve about its axis, and additional adjusting means adapted to displace said sleeve in an axial direction independently of the presence of the first mentioned adjusting means.

3. In an injection pump for internal combustion engines, the combination of a cylinder, a plunger forming a working chamber within said cylinder and being movable in the latter, said plunger having a part projecting from said cylinder, a casing forming a supply chamber surrounding said projecting part of the plunger, said plunger having a longitudinal bore parallel to the axis thereof, one end of said bore communicating with said working chamber, the other end communicating with two diametrically arranged conduits leading to the projecting plunger surface at points spaced from each other along said surface, means adapted to reciprocate said plunger in said cylinder, an adjustable sleeve loosely positioned on the projecting part of the plunger and provided with opposite edges controlling said conduits, at least one of said edges being provided with two inclined surfaces, each of said surfaces corresponding to an arc of 180° , said sleeve being rotatable as well as axially slidable with respect to said plunger, adjusting means adapted to rotate said sleeve about its axis, and additional adjusting means adapted to displace said sleeve in an axial direction independently of the presence of the first mentioned adjusting means.

4. In an injection pump for internal combustion engines, the combination of a cylinder, a plunger forming a working chamber within said cylinder and being movable in the latter, said plunger having a part projecting from said cylinder, a casing forming a supply chamber surrounding said projecting part of the plunger, said plunger having an axial bore one end of which communicating with said working chamber, the other end communicating with two conduits leading at spaced points to the plunger surface projecting from said cylinder, means adapted to reciprocate said plunger in said cylinder, an adjustable sleeve loosely positioned on the projecting part of the plunger and provided with opposite edges controlling said conduits, at least one of said edges being inclined with respect to the axis of the sleeve, said sleeve being rotatable as well as axially slidable with respect to said plunger and having at least one groove in a plane normal to its axis, adjusting means adapted to rotate

said sleeve about its axis, and adjusting means engaging with said groove of the sleeve and being adapted to displace said sleeve in an axial direction independently of the presence of the first mentioned adjusting means.

5. In an injection pump for internal combustion engines, the combination of a cylinder, a plunger forming a working chamber within said cylinder and being movable in the latter, said plunger having a part projecting from said cylinder, a casing forming a supply chamber surrounding said projecting part of the plunger, said plunger having an axial bore one end of which communicating with said working chamber, the other end communicating with two conduits leading at spaced points to the plunger surface projecting from said cylinder, means adapted to reciprocate said plunger in said cylinder, an adjustable sleeve loosely positioned on the projecting part of the plunger and provided with opposite edges controlling said conduits, at least one of said edges being inclined with respect to the axis of the sleeve, said sleeve being rotatable as well as axially slidable with respect to said plunger and having at least one groove in a plane normal to its axis, a pinion rigidly mounted on said sleeve, the teeth of said pinion being parallel to the axis of said sleeve, an adjusting rack meshing with said pinion and being adapted to rotate said sleeve about its axis, and adjusting means engaging with said groove of the sleeve and being adapted to displace said sleeve in an axial direction independently of the presence of said adjusting rack.

6. In an injection pump for internal combustion engines, the combination of a cylinder, a plunger forming a working chamber within said cylinder and being movable in the latter, said plunger having a part projecting from said cylinder, a casing forming a supply chamber surrounding said projecting part of the plunger, said plunger having an axial bore one end of which communicating with said working chamber, the other end communicating with two conduits leading at spaced points to the plunger surface projecting from said cylinder, means adapted to reciprocate said plunger in said cylinder, an adjustable sleeve loosely positioned on the projecting part of the plunger and provided with opposite edges controlling said conduits, at least one of said edges being inclined with respect to the axis of the sleeve, said sleeve being rotatable as well as axially slidable with respect to said plunger and having at least one groove in a plane normal to its axis, a pinion rigidly mounted on said sleeve, the teeth of said pinion being parallel to the axis of said sleeve, an adjusting rack meshing with said pinion and being adapted to rotate said sleeve about its axis, and a fork-like pivoted adjusting lever engaging with said groove of the sleeve and being adapted to displace said sleeve in an axial direction independently of the presence of said adjusting rack.

7. In an injection pump for internal combustion engines, the combination of a cylinder, a plunger forming a working chamber within said cylinder and being movable in the latter, said plunger having a part projecting from said cylinder, a casing forming a supply chamber surrounding said projecting part of the plunger, said plunger having a longitudinal bore parallel to the axis thereof one end of said bore communicating with said working chamber, the other end communicating with two conduits leading at spaced points to the plunger surface projecting

from said cylinder, means adapted to reciprocate said plunger in said cylinder, an adjustable sleeve loosely positioned on the projecting part of the plunger and provided with opposite edges controlling said conduits, at least one of said edges being inclined with respect to the axis of the sleeve, said sleeve being rotatable as well as axially slidable with respect to said plunger, adjusting means adapted to rotate said sleeve about its axis, a member provided with circumferential teeth normal to the axis of the sleeve and rigidly mounted on said sleeve, an adjusting rod journaled in said casing, and a pinion rigidly mounted on said rod and meshing with the teeth of said member, said adjusting rod being adapted to displace said sleeve in an axial direction independently of the presence of the first mentioned adjusting means.

8. In an injection pump for internal combustion engines, the combination of a cylinder, a plunger forming a working chamber within said cylinder and being movable in the latter, said plunger having a part projecting from said cylinder, a casing forming a supply chamber surrounding said projecting part of the plunger, said plunger having a longitudinal bore parallel to the axis thereof, one end of said bore communicating with said working chamber, the other end communicating with two conduits leading at spaced points to the plunger surface projecting from said cylinder, means adapted to reciprocate said plunger in said cylinder, an adjustable sleeve loosely positioned on the projecting part of the plunger and provided with opposite edges controlling said conduits, at least one of said edges being inclined with respect to the axis of the sleeve, said sleeve being rotatable as well as axially slidable with respect to said plunger, a pinion-like member rigidly mounted on said sleeve the teeth of said pinion being parallel to the axis of said sleeve, an adjusting rack meshing with said pinion-like member and being adapted to rotate said sleeve about its axis, a member provided with circumferential teeth normal to the axis of the sleeve and rigidly mounted on said sleeve, an adjusting rod journaled in said casing, and a pinion rigidly mounted on said rod and meshing with the teeth of said member, said adjusting rod being adapted to displace said sleeve in an axial direction independently of the presence of the first mentioned adjusting rack.

9. In an injection pump for internal combustion engines, the combination of a cylinder, a plunger forming a working chamber within said cylinder and being movable in the latter, said plunger having a part projecting from said cylinder, a casing forming a supply chamber surrounding said projecting part of the plunger, said plunger having a longitudinal bore parallel to the axis thereof, one end of said bore communicating with said working chamber, the other end communicating with at least one conduit leading to

the plunger surface projecting from said cylinder, means adapted to reciprocate said plunger in said cylinder, an adjustable sleeve loosely positioned on the projecting part of the plunger and adapted to control said conduit, said sleeve being rotatable as well as axially slidable with respect to said plunger and having at least one groove in a plane normal to its axis, adjusting means adapted to cause a purely rotating motion of said sleeve about its axis without axial motion thereof, and adjusting means engaging with said groove of the sleeve and being adapted to displace said sleeve in an axial direction independently of the presence of the first mentioned adjusting means.

10. In an injection pump for internal combustion engines, a fuel feed control comprising a plunger of which part thereof is directly exposed to and passes freely through the fuel chamber, a fuel control sleeve on said plunger, said sleeve having at least one of its edges inclined to the axis of said sleeve and said sleeve being movable on said plunger within the limits of the exposed part thereof, fuel passages in said plunger, said fuel passages terminating at the exposed surface of said plunger, said sleeve being adapted for permitting the fuel to pass into and out of said plunger, and means adapted to operate said sleeve in a purely axial direction and in a purely rotary direction for controlling the flow of the fuel into and out of said plunger.

11. In an injection pump for internal combustion engines, a fuel feed control comprising a plunger of which part thereof is directly exposed to and passes freely through the fuel chamber, a fuel control sleeve on said plunger and movable thereon within the limits of said exposed part, fuel passages in said plunger, said fuel passages terminating at the exposed surface of said plunger, said sleeve being adapted for permitting the fuel to pass into and out of said plunger and said sleeve having at least one of its edges inclined to the axis of said sleeve whereby a rotary motion of said sleeve varies the duration of fuel injection and a vertical movement thereof varies the time of injection.

12. In an injection pump for internal combustion engines, a fuel feed control comprising a plunger of which part thereof is directly exposed to and passes freely through the fuel chamber, a fuel control sleeve on said plunger and movable thereon within the limits of said exposed part, fuel passages in said plunger, said fuel passages terminating at the exposed surface of said plunger, said sleeve being adapted for permitting the fuel to pass, into and out of said plunger, said sleeve having at least one of its edges inclined to the axis of said sleeve, means adapted to longitudinally move said sleeve and means adapted to rotate said sleeve independent of said longitudinal movement.

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