Oct. 3, 1939. P. L. SCOTT 2,174,898

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Fig. 1

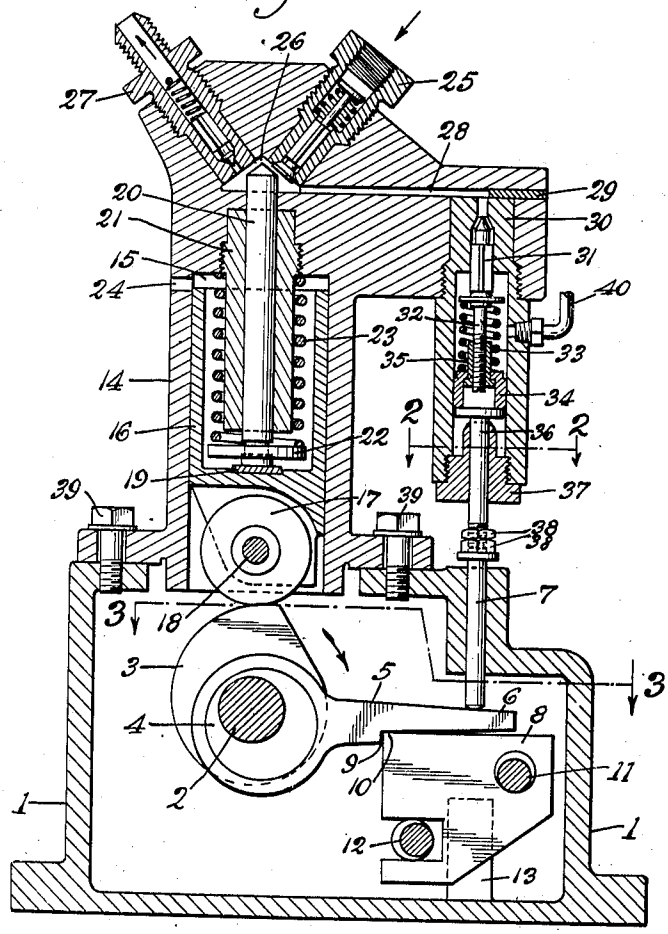
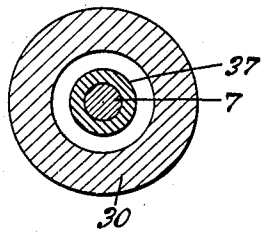


Fig. 2



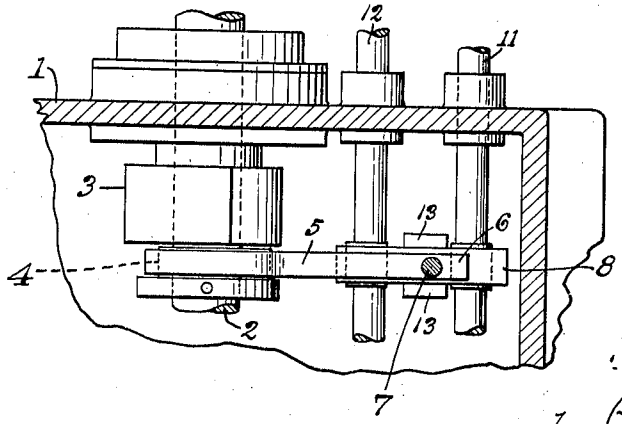


Fig. 3

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Fig. 4

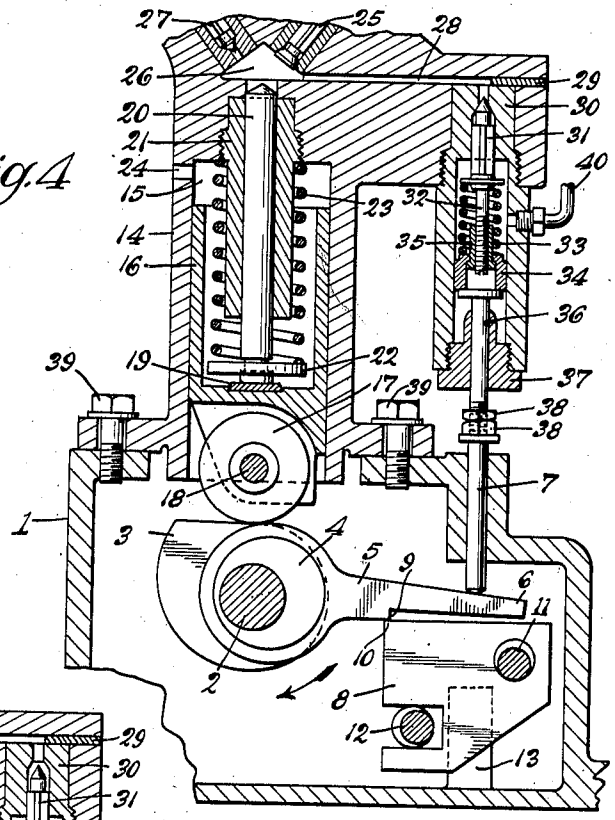
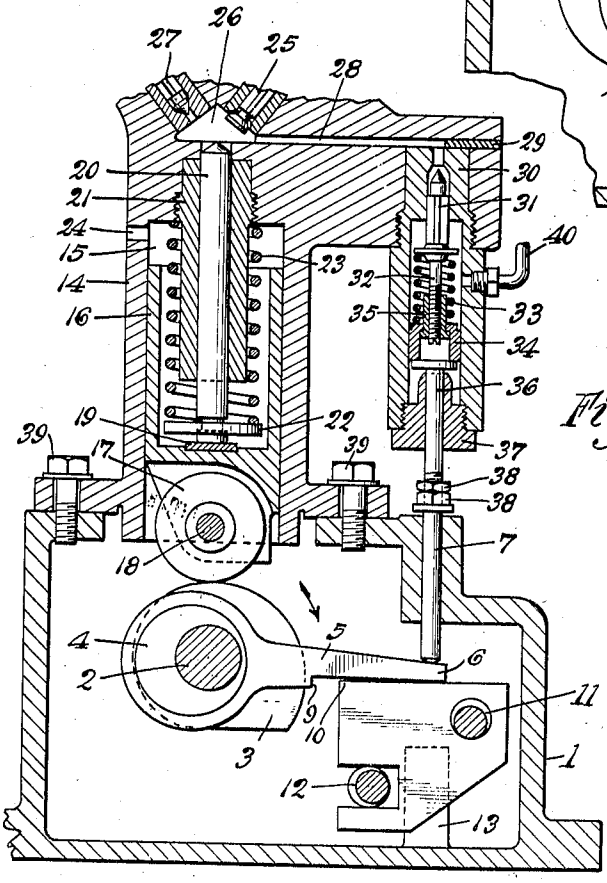


Fig. 5



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UNITED STATES PATENT OFFICE

2,174,898

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Application August 7, 1935, Serial No. 35,110

6 Claims. (Cl. 123—139)

This invention relates to fluid pumps and more particularly to high pressure liquid pumps of the type used to deliver fuel to an atomizing valve in an internal combustion engine. One object is to provide a pump in which the quantity delivered may be easily, fully, and accurately controlled by a light mechanism. Another object is to provide a fuel pump in which the time of initiation of delivery may be readily and easily changed while the pump is in operation and by a structure which is an integral part of the pump itself. Another object is to provide a unitary mechanism for accomplishing both these controls. Another object is to provide a safety device integral with this control mechanism. Other objects will appear from time to time.

The invention is illustrated, more or less, diagrammatically in the accompanying drawings, wherein:

Figure 1 is a cross section of such a fuel pump;

Figure 2 is a section taken along the line 2—2 of Figure 1;

Figure 3 is a plan view of the control mechanism, with parts in section, taken at line 3—3 of Figure 1.

Figure 4 is a sectional view showing the control mechanism with the control valve closed.

Figure 5 is a section, similar to Figure 4, and showing the control mechanism as it is prior to valve closure.

Like numerals are applied with like parts throughout.

In Figure 1, 1 is a pump base supporting a combined cam and eccentric shaft 2. 3 is a cam mounted upon the shaft and 4 is an eccentric mounted adjacent to the cam upon the same shaft. 5 is a trip lever mounted on the eccentric. The nose 6 of this lever bears against the tappet rod 7 and against the fulcrum block 8. The trip lever has a trip point 9 which may slide across face of the block 8 and drop off the nose 10 of this block. The block 8 is supported by two eccentric shafts 11 and 12 which are arranged to provide both vertical and horizontal movement of the block 8 for purposes to be described later. The block 8 is positioned against transverse motion by the guide members 13, 13. Mounted upon the base 1 is a pump body 14, having a bore 15 in which a slider 16 is arranged to reciprocate. The slider 16 carries at one end a roller 17, adapted to cooperate with the face of the cam 3. The roller is mounted on a pin 18 and this structure constitutes the cam follower. Inserted in the cam follower is a hardened button 19 which bears against the end of a plunger 20, which is mounted for reciprocation within a barrel 21 which in turn is screw-threaded into the body 14. 22 is a spring retainer washer which is fitted around the head of the plunger 20. A spring 23 bears against this washer and serves to withdraw the plunger 20 and to return the cam follower 16 against the receding face of the cam 3. 24 is a vent hole leading to the bore 15. 25 is a suction valve assembly screwthreaded into the body 14 and providing an admission means for fluid into the pumping chamber 26. 27 is a discharge valve assembly screwthreaded into the body 14. 28 is a liquid passage leading from the pumping chamber 26 and closed by a plug 29. 30 is a control valve cage screwthreaded into the body 14 and connecting with the fluid passageway 28. 31 is a valve mounted in the cage 30. It is held upon its seat by means of the stem 32, the spring 33 and the washer 34. The tension on the spring is adjusted by means of the nut 35. The washer 34 is contacted by a push rod 36 which is arranged to slide in a bushing 37 which is screwthreaded into the cage 30. The push rod 36 may be adjusted in length by means of the nuts 38, 38. The lower end of the push rod 36 is contacted by the tappet rod 7 which reciprocates in a bore in the base 1. The pump body 14 is attached to the base by means of the cap screws 39, 39. 40 is an outlet discharging from the valve 31 to any convenient point, for example to a sump or to some other suitable point on the suction side of the pump.

Heretofore, in the construction of liquid pumps of the particular type shown, namely, high pressure liquid fuel pumps intended to deliver liquid fuel to an atomizing valve in an engine, the two essential controls have been considered and made as separate elements. It is of course necessary in all internal combustion engines employing injection of fuel to be able to regulate the quantity of fuel from stroke to stroke. In many engines it is also essential to be able to change the time of introduction of fuel with respect to piston position or to the angular position of the crank shaft while the engine is in operation. In all constructions so far employed a separate and independent mechanism has been used to accomplish this change in timing. Such mechanisms have proved both expensive and cumbersome and have been in the form of a separate device or attachment outside the pump proper. One of the purposes of this invention is to provide for both these controls in a unitary mechanism built into the pump proper, and further to provide a light and simple mechanism to accomplish this dual purpose. As

will be seen from the drawing, the mechanism consists in a trip lever 5 which is carried on an eccentric 4 which is mounted on the same shaft that carries the driving cam. As this eccentric rotates it imparts an oscillatory motion to the trip lever 5, which during part of the time rides upon the trip block 8 at its nose portion 6, and part of the time rides upon another part of the same block 8 upon its trip point 9. When the point 9 is in contact with block 8, the lever will fulcrum about this point, as shown in Figure 4, causing the nose 6 to rise as the eccentric rotates. The nose 6 presses against the tappet rod 7, and moves it upward. This upward motion is transmitted to the push rod 36 and to the pre-loaded spring and stem assembly 32, 33, 34, and ultimately to the valve 31, causing this valve to seat. When the point 9 drops off the trip nose 10 of the block 8, as shown in Figure 1, it obviously drops the nose 6 of the lever 5 and permits the entire train of mechanism just described, to drop, finally permitting the valve 31 to be unseated by pressure existing in the passage 28 and ultimately in the pumping chamber 26. The block 8 is mounted upon two eccentric shafts which are arranged to move this block both vertically and horizontally. The eccentric shaft 11, upon rotation, will cause the block 8 to move horizontally backward and forward. Only a small amount of rotation of this eccentric shaft is employed. Hence only negligible vertical motion occurs for considerable horizontal motion. As the block 8 is moved horizontally the trip point 9 will drop off the nose 10 sooner or later in the cycle. As the block 8 is moved away from the shaft 2 the tripping occurs earlier in the cycle. As it is moved toward the shaft 2 the tripping will occur later in the cycle.

The eccentric shaft 12 is arranged to move the nose 10 of the block 8 and the adjacent face of the block upon which the trip point 9 fulcrums prior to tripping, in a vertical direction. As this nose and face are moved upward and as the lever 5 fulcrums on the point 9 the nose 6 of this lever will contact the tappet rod 7 earlier in the cycle. As the nose 10 and adjacent face is moved downward by the eccentric shaft the nose 6 will obviously contact the tappet rod later in the cycle. The eccentric shaft 12 has small angular motion and is arranged to give the maximum amount of lift or vertical motion with a minimum horizontal motion. It will be seen, then, that a movement of either one of these shafts has no appreciable effect upon the functioning of the other shaft, with respect to its particular control of the cycle of operations. The train of mechanism which transmits the functioning of the lever 5 to the valve 3 is shown in the form of Figure 1 as merely one convenient mechanism consisting of two rods and an adjustment, with the exception of the important pre-loaded spring assembly.

It is of course evident that any attempt to make a rigid train in this particular place would require what would probably be unreasonable accuracies in commercial manufacture. The pre-loaded spring assembly not only permits overrun due to inaccuracies in manufacture and assembly without damage to the parts but also compensates for the varying strokes of the nose 6 depending upon the position of the block 8. This pre-loaded spring assembly serves a further important service, namely, it provides a safety valve which will open when any predetermined pressure in the pumping chamber 26 is exceeded and thereby prevent damage to the atomizing valve, the high pressure piping, or to the pump itself which easily result from stoppage in the atomizing valve. This preloaded spring assembly consists in a stem 32, bearing against the end of the valve 31. This stem carries the spring 33 which abuts against an enlargement upon the stem at one end. At the other end the spring 33 abuts against the cup-shaped washer 34, which is drilled and arranged to slide upon the stem 32. The spring is put under initial load by means of the nut 35. This load is determined by the maximum permissible pressures in the pumping chamber 26. Sufficient compression is put upon this spring to hold the valve shut against the desired pressure under the condition of support of the washer 34 by the push rod 36 and the tappet rod 7, and in turn the lever and block mechanism already described. When the pusher rod 36 bears against the washer 34 its upward force is transmitted by the washer to the spring and thence to the stem 32. The spring is therefore a yielding member interposed in an otherwise rigid linkage.

The use and operation of my invention are as follows:

The operation of the general mechanism of the pump such as the inlet and outlet valves, cam and cam follower, and so forth are too well known to need detailed description. The inlet assembly 25 is connected to a liquid supply and the outlet assembly 27 is connected to an atomizing nozzle. As the cam shaft rotates the cam follower is caused alternately to rise as the flat driving face of the cam acts upon the roller, and to drop as the roller follows the receding face of the cam. The first movement obviously causes a discharge stroke of the pump plunger and the second movement causes a suction stroke.

The novel features of the invention reside largely in the linkage from the eccentric 4 through to the valve 31, which is the control valve of the pump. This valve controls both the timing and the quantity. This valve is open just before and at the instant the plunger begins to move upward on a discharge stroke. Its being open is due of course to the relative positions of the lever 5 and the block 8 together with the position of the eccentric 4 at that instant. Since the pumping chamber 26 is connected by means of the passage 28 to this valve 31, when this valve is open discharge will evidently take place through this valve and not through the discharge valve 27 to the atomizer, since the latter circuit presents a far higher resistance. When such discharge takes place through the valve 31 it may be by-passed back to the fuel tank or in any part of the suction circuit, such piping not being shown in detail since it forms no essential part of the invention and is merely a matter of design convenience. As the eccentric 4 rotates and the lever 5 begins to fulcrum about the point 9, the nose 6 rises, and takes up the train of mechanism 7, 36 and 32, 33, 34. The valve 31 is thus lifted until it seats firmly and is held seated against predetermined pressure, which are regulated by the adjustment on the spring 33. If these pressures are accidentally exceeded the valve 31 will unseat against the spring 33, permitting discharge through this valve and preventing damage. However, assuming conditions to be normal when this valve closes it will stop all flow through passage 28 and compel the entire discharge of the pump to take place through the discharge assembly 27 and to the atomizing valve. It is the instant at which this valve closes with respect to the

angular position of the cam shaft and ultimately of course to the crank shaft of the engine to which the pump shaft is permanently connected by gearing or other suitable drive which determines the timing of injection. As this valve 31 closes earlier with respect to the cam shaft, injection into the engine will occur earlier and as this valve closes later the injection into the engine will occur later. To cause the valve 31 to close earlier the eccentric shaft 12 is rotated, to raise the nose 10 of the block 8 and the face of the block adjacent to the nose. This causes the nose 6 of the lever 5 to contact the tappet rod 7 earlier and this in turn causes the train of mechanism up to the valve 31 to operate and to close the valve earlier. To obtain later timing the eccentric shaft 12 is moved so as to cause the nose 6 to contact the tappet rod later, thereby causing the valve to close later. As already described, the motion of the eccentric shaft 12 has negligible effect upon the second function of control, quantity, since it does not move the block 8 appreciably to the right or left.

The control of quantity is accomplished by changing the length of time, or the number of degrees with respect to the cam shaft that this valve is held closed. Assuming that a proper timing has been obtained, then as the load on the engine changes and it is necessary to vary the quantity of fuel delivered, the block 8 is moved to the right or the left by means of the eccentric shaft 11, the block sliding upon the eccentric shaft 12. As the block 8 is moved to the right the trip point 9 of the lever 5 will reach the nose 10 of the block 8, and drop off earlier in the cycle. The earlier it drops off the earlier is the valve 31 released since it responds to the train of mechanism lying between it and the lever 5. This means that discharge through this valve will be permitted earlier in the cycle, at an earlier point in the travel of the plunger on its discharge stroke, and obviously at an earlier point in the engine cycle. If this valve is allowed to open when the pump plunger has travelled but half its stroke it is clear that but half the quantity of oil will be delivered as compared to the condition when the valve is held shut for the entire discharge stroke of the pump plunger. To hold this valve closed during longer periods of pump plunger travel and thereby obtain larger and larger quantities of oil the block 8 is moved to the left toward the cam shaft. The trip point 9 will then drop off the nose 10 at a later and later time. As described, the horizontol movement to obtain quantity control has negligible effect on the time adjustment.

Either or both of these controls may be manually operated and either or both the controls may be governor operated.

It is evident that while I have shown one particular form of such a device in a complete and operative structure, the principles involved may be employed in a wide variety of structures, and the invention is therefore not limited to the particular type shown but may be used in many other types of pumps.

I claim:

1. In a fuel pump for internal combustion engines, a pump body having a pumping chamber, a suction valve and a separate control valve in communication with the pumping chamber, means for operating said control valve, a pump plunger mounted for reciprocation in the body to perform suction and discharge strokes, a drive for said plunger and a separate drive for said control valve, and means for varying both the time of closing and independently the time of opening of said control valve during the discharge stroke, said varying means comprising a fulcrum block and lever fulcrumed thereon, and parts for raising said fulcrum block and for independently moving it laterally, while the pump is running, said lever forming part of the drive for the control valve.

2. In a liquid pump, suction and discharge valves, a separate control valve for accommodating discharge from the pump during desired portions of the discharge cycle of the pump, means for closing the control valve against pressure within the pump, said closing means including a stem engageable with said control valve to close it, a push rod, a yielding member interposed between the push rod and said stem to yieldingly transmit to the control valve force applied to the push rod whereby to permit the control valve to open in response to predetermined pressure in the pump, and means for applying driving force to the push rod during the discharge stroke of the pump, said means including a lever engageable with the push rod and movable in opposite directions to transmit a driving force thereto and to discontinue the application of force thereto, respectively, and means cooperable with said lever for varying the time of application of said force to said push rod and for varying the time of release of force therefrom independently whereby the control valve is alternately closed and opened to permit discharge therethrough at varying times in the discharge cycle of the pump.

3. In a liquid pump, suction and discharge valves, a separate control valve, means for closing said control valve at various times in the discharge cycle of the pump, said valve closing means comprising a stem, a push rod, means for reciprocating the push rod, a yieldable member intermediate said push rod and said stem, said push rod moving means including a fulcrum part and a fulcrum lever arranged to slide and to fulcrum upon said fulcrum part, said adjusting means for said fulcrum part comprising a pair of eccentric shafts mounted for rotation and in contact with said fulcrum part, one of said shafts rotatable for raising the fulcrum part generally vertically and the other of said shafts rotatable for moving said fulcrum part generally laterally for varying the time of opening and the time of closing of said control valve.

4. In a liquid pump having a pumping barrel, independent suction and discharge valves positioned to control the entrance and exit of liquid to said barrel, a separate control valve and a mechanical linkage for said control valve, said linkage including the following elements arranged each to act upon the succeeding element: a fulcrum member, a lever fulcrumed thereon, a push rod, a yieldable member, a valve operating stem and said control valve, and means including adjustable parts for adjusting said fulcrum member, said lever operating the push rod towards and away from the valve operating stem for alternately causing closing and opening movements of the valve, said adjustable means being effective for independently adjusting the times at which the push rod moves towards the control valve operating stem for closing actuation of the linkage, and the times at which the push rod moves away from the valve operating stem for valve opening actuation of the linkage.

5. In a liquid pump having a pumping barrel, suction and discharge valves positioned to control

the entrance and exit of liquid to said barrel, a separate control valve and an independent mechanical linkage for effecting opening and closing of said control valve, said linkage including the following elements arranged each to act upon the succeeding element: a fulcrum member, a lever fulcrumed thereon, a push rod, a resilient member and a valve operating stem, said resilient member being positioned between said valve operating stem and said push rod, means for rocking the lever to move the push rod towards and away from the valve operating stem, and means including separate adjustable parts for adjusting said fulcrum member, said adjustable parts being effective for independently adjusting the times at which the linkage is moved to cause closing movement of the control valve and the times at which the linkage is moved for effecting opening movement of the control valve.

6. In a fuel pump for internal combustion engines, a pump body having a pump chamber therein, inlet and outlet passages to said chamber, suction and discharge valves positioned in said passages to admit and discharge liquid, a third passage communicating with said chamber and an independent quantity control valve positioned to control flow through said passage, said valve being normally open to permit flow but adapted to be closed to prevent flow at desired times in the pump cycle, a plunger in said pump and means for driving it, a drive for said control valve to move it into a closed position and to release it for movement to its normally open position, resilient means in said control valve drive, said resilient means being preloaded to transmit the driving force of said drive and support the valve in closed position against predetermined pressure existing in said third passage when said valve is in closed position, said drive including means for independently varying the times at which said control valve is moved into closed position and the times of releasing it for movement to its normally open position.

PHILIP LANE SCOTT.