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FUEL PUMP FOR INTERNAL COMBUSTION ENGINES

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2 Sheets-Sheet 2

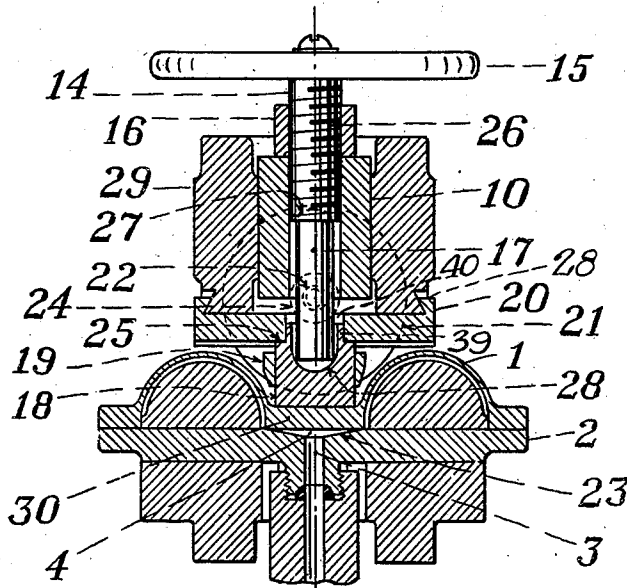


Fig. 2

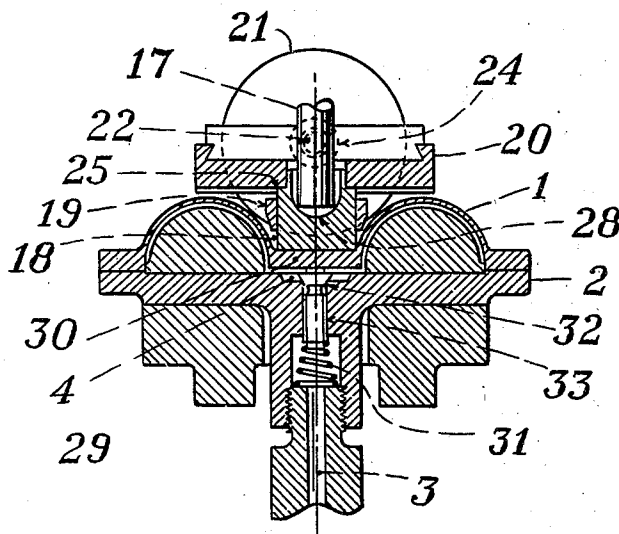


Fig. 3

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FUEL PUMP FOR INTERNAL COMBUSTION
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18 Claims. (Cl. 103—150)

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amended April 30, 1928; 370 O. G. 757)

Our invention relates broadly to a fuel pump of the diaphragm type for internal combustion engines and more particularly to a means for pumping non-lubricant and low viscosity fluids as required in solid injection systems for internal combustion engines.

An object of the invention is the provision of a simple means for injecting fuel in which there are no rubbing surfaces in contact with the pumped fuel, eliminating the wearing away of such parts with consequent leakage of fuel or the necessity for frequent replacement of worn parts. Also initial leakage of fuel due to mechanical clearance is entirely eliminated.

Another object of the invention is the provision of a pump incorporating means for a positive control and a uniform metering of the discharge occurring in each cycle of the pumping operation.

A further object of the invention is the provision of a means to provide for obtaining a sharp cut-off which is essential for efficient operation of solid injection engines.

With the above and other objects in view the invention consists in the construction, combination and arrangement of parts as will be described more fully hereinafter.

Reference is to be had to the accompanying drawings forming a part of this specification in which like reference characters indicate corresponding parts throughout the several views, and in which—

Fig. 1 is a sectional view of the preferred embodiment of our invention,

Fig. 2 is a section on the line A—A of Fig. 1, and

Fig. 3 is a similar view of a slightly modified form of the diaphragm actuating mechanism of our invention.

Referring to the drawings and more particularly to Fig. 1, 29 is a housing secured to a suitable support by fastening elements 35, and has a base member 2 rigidly mounted thereon in any suitable manner, we having shown bolts 37 for the purpose. A diaphragm 1, preferably consisting of a thin flexible plate formed to permit considerable latitude of flexure at its central portion, is secured at its edges to the base member 2 by a suitable means 27 in a manner to prevent leakage at this point. The diaphragm is thickened somewhat at its circumference and its central portion, the latter being depressed to form a central protuberance 30, there being sufficient clearance between the protuberance and the base member to form a chamber 4. The

portion of the diaphragm between the protuberance and the thickened edges is concave to fit over convex member 36 forming a part of the base member 2. The base member is provided with a suitably sized passageway 3 to permit adequate flow into or out of the chamber 4. The entrance to the passageway is chamfered, as at 23, to provide a seat for the protuberance of the diaphragm.

Inlet passage 7 communicates with the main passageway 3 and is provided with a check valve 6 that permits fluid to flow only into the main passageway. Discharge passage 8 also communicates with the main passageway 3 and is likewise provided with a check valve 5 that permits fluid to flow only out of the main passageway. It will be understood that, if desired, spring-loaded valves may be employed in our invention instead of the check valve.

Limiting the volume of chamber 4 to closely approximate the volume of fuel to be pumped per cycle provides uniform metering of the fuel discharged in each cycle of operation. The volume of the chamber is regulated by the permissible movement or outward flexure of the diaphragm. Such flexure is governed by the position of a wedge-shaped stop 20 which is slidably mounted in the housing and which is provided with a threaded opening to receive a threaded shaft 22 having a thrust collar 24 permitting rotary but not axial movement in the housing. A suitably calibrated hand wheel 21 provides easy manipulation of the shaft. The wedge shaped stop is mounted in the housing to slide in a guideway 38 and to move in a plane at right angles to its support 29, as shown in Fig. 2. A guide 19, serving as a support for a sliding cross-head 18, is fixed to the base. The cross-head is adapted to abut on the diaphragm and the surface 25 of the stop 20, and it is provided with a concave recess 28 to receive one end of a floating link 17. Projections 39 on the cross-head engage in a slot 40 in the wedge-shaped stop 20, more clearly shown in Fig. 2, assuring proper engagement between the cross-head and stop. It will be understood that the abutting faces of the cross-head and stop are suitably beveled to provide a firm contact therebetween. By proper adjustment of the stop 20 the cross-head is so positioned with respect to the diaphragm that the outward flexure thereof is limited to the desired amount, and hence the desired maximum chamber volume is obtained, thus controlling the quantity of fuel drawn in per cycle of operation.

As a means to control the ejection of fuel we employ a rocker arm 10 pivoted on a stub shaft 11. One end of the rocker arm carries a roller 12 which rides over the surface of a cam 9 mounted on a shaft 34 driven by a suitable element of the engine. The other end of the rocker arm is provided with a threaded transverse bore 26 to receive a threaded adjustable tappet 14 which is adjusted in the bore by a hand wheel 15. One end of the tappet is spherically concave to receive an end of the floating link 17. This floating link is the means of inwardly flexing the diaphragm to eject the charge of fuel drawn in by the previous outward flexure of the diaphragm. The link 17, owing to its floating characteristic, is free to move with the cross-head when the diaphragm flexes outwardly. By this arrangement a metered amount of fuel is ejected from the pump each time the roller rides over the top of the cam because the link will have the same distance of movement each time due to the locking of the tappet in its adjusted position by the lock lever 16.

For adjusting the pump prior to operation, cam 9 is rotated so that roller 12 is at the extended portion of the cam, which condition represents the position of the cam for maximum diaphragm deflection. Handwheel 15 is then rotated so as to deflect the diaphragm until the protuberance 30 seats against chamfered surface 23, after which the tappet is locked by the lever 16.

With the cam in the position shown in Figure 1, the chamber volume is reduced to its minimum value. As the cam is rotated in the direction indicated by the arrow, spring 13 moves the rocker arm 10 drawing tappet 14 away from the diaphragm. Due to its own resilience and aided by a primary pressure kept in the intake passage 7, the protuberance 30 of the diaphragm is deflected away from its seat allowing fuel to enter the chamber 4. The motion of the diaphragm away from its seat is stopped when the cross-head comes into contact with the wedge-shape stop 20. The tappet 14 being moved away from the diaphragm by the action of the rocker arm allows the floating link to be moved by the cross-head. Further rotation of the cam brings the tappet again in the direction of the diaphragm depressing it through the cross-head and forcing the fuel in the chamber 4 out through passageway 3, past check valve 5 into the discharge passage 8. The depression of the diaphragm continues until the protuberance 30 abuts the chamfered seat 23 thus sealing the passageway 3 against further fuel flow. This is co-incidental with the arrival of the roller 12 at the top of the cam. The action of closing passageway 3 at the end of the pumping stroke is one of the factors accounting for the sharp cut-off which is a feature of the pump. This cycle of operation is repeated for each revolution of the cam.

In Figure 3 we have shown a modified form in which the main passageway is closed by a valve 32 having a spline shaft 33 normally held open by a spring 31. When the diaphragm is depressed, as previously explained, it abuts the valve, closing it on its seat.

It will be understood that the above description and accompanying drawings comprehend only the general and preferred embodiment of our invention and that various changes in construction, proportion and arrangement of parts may be made within the scope of the appended claims without sacrificing any of the advantages of our invention.

The invention described herein may be manu-

factured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What we claim is:

1. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, an intake passage and an outlet passage leading to a common port in the housing in communication with the chamber, check valves in the respective passages, an adjustable actuating means for deflecting the diaphragm to close the port, and means for regulating the initial volume of the chamber.

2. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, an intake passage and an outlet passage leading to a common port in communication with the chamber, check valves in the respective passages, mechanical actuating means for periodically deflecting said diaphragm in one direction only, and a floating link controlled by said actuating means for regulating the amount of deflection of said diaphragm.

3. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, an intake port in the housing in communication with said chamber, a check valve in said intake port, an outlet port in the housing in communication with said chamber, a check valve in said outlet port, a shaft mounted for rotation in the housing, a cam on said shaft, a rocker arm pivotally mounted in the housing, an adjustable lug mounted on said rocker arm and disposed to abut the diaphragm, said rocker arm being provided with a roller disposed to ride on the periphery of said cam, and resilient means for holding said roller in constant contact with said cam.

4. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, a common inlet and outlet port communicating with the chamber, a cross-head within the housing against which the diaphragm is adapted to abut, and a tapered member by which the position of the cross-head is adjusted for regulating the initial chamber volume whereby the volume of fluid pumped during each cycle of operation is regulated.

5. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, a tapered member for regulating the initial chamber volume, a floating link for depressing the diaphragm in a pumping operation, a common inlet and outlet port communicating with the chamber, and means for actuating the link.

6. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, a common inlet and outlet port communicating with the chamber, a tapered member for regulating the initial chamber volume and a floating link for depressing the diaphragm into abutment with said housing in a pumping operation.

7. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, a common inlet and outlet port com-

communicating with the chamber, a floating link for deflecting the diaphragm to its initially deflected position into abutment with the housing, and means for limiting the return deflection of the diaphragm.

8. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, a common inlet and outlet port communicating with the chamber, and a floating link for periodically deflecting the diaphragm from the initially deflected position into abutment with the housing, and means for limiting the return deflection of the diaphragm.

9. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, a port in the housing in communication with the chamber, a floating link for depressing the diaphragm into abutment with the housing causing the diaphragm to cover said port and means for actuating the floating link.

10. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, said diaphragm having a protruding portion, a common inlet and outlet port in the housing in communication with said chamber, and a floating link for depressing the diaphragm into abutment with the housing causing said protruding portion to cover and close said port.

11. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, said diaphragm having a protruding portion, a port in the housing in communication with said chamber, and a chamfered seat surrounding said port so located that when the diaphragm is sufficiently deflected said protruding portion abuts with the chamfered seat covering and closing said port.

12. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, said diaphragm having a protruding portion, means for regulating the initial clearance between the diaphragm and the housing, a port located in the housing in communication with the chamber and having a chamfered seat at the inlet of the chamber, and means for deflecting the diaphragm until said protruding portion abuts said chamfered seat.

13. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, said diaphragm having a protruding portion, means for initially deflecting the diaphragm, a port located in the housing in communication with said chamber having a chamfered seat, and means for deflecting the diaphragm until said protruding portion abuts said chamfered seat.

14. A pump of the class described comprising a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, said diaphragm having a protruding portion, means for regulating the initial clearance be-

tween the diaphragm and the housing, a main port located in the housing in communication with said chamber, having a chamfered seat, means for deflecting the diaphragm, pressing said protruding portion periodically into abutment with said chamfered seat, an intake port in communication with said main port, a check valve in said intake port, an outlet port in communication with said main port, and a check valve in said outlet port.

15. A pump of the class described comprising a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, said diaphragm having a protruding portion, means for initially deflecting said diaphragm, a main port located in the housing in communication with the chamber, an intake port in communication with said main port, a check valve in said intake port, an outlet port in communication with said main port, a check valve in said outlet port, and a floating link for periodically deflecting the diaphragm from the initially deflected position to a position in which the protruding portion abuts and covers said main port.

16. A pump of the class described comprising a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, said diaphragm having a protruding portion, means for initially deflecting the diaphragm, a main port located in the housing in communication with the chamber and having a chamfered seat, an intake port in communication with said main port, a check valve in said intake port, an outlet port in communication with said main port, a check valve in said outlet port, and a floating link for periodically deflecting the diaphragm from the initially deflected position to a position in which the protruding portion abuts said chamfered seat, thereby closing the main port.

17. A pump of the class described comprising a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, a common port in the housing in communication with said chamber, an intake port in communication with said common port, a check valve in said intake port, an outlet port in communication with said common port, a check valve in said outlet port, and a floating link for periodically deflecting said diaphragm into abutment with the housing causing the diaphragm to cover and seal said common port.

18. In a pump of the class described, in combination, a housing, a diaphragm secured to the housing forming a chamber jointly with the housing, means for initially deflecting the diaphragm, a port located in the housing in communication with the chamber, the port being provided with a valve having a resilient means for keeping said valve normally unseated, and means for periodically depressing the diaphragm from its initially deflected position into abutment with the valve causing said valve to seat and close said port.

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