

April 13, 1948.

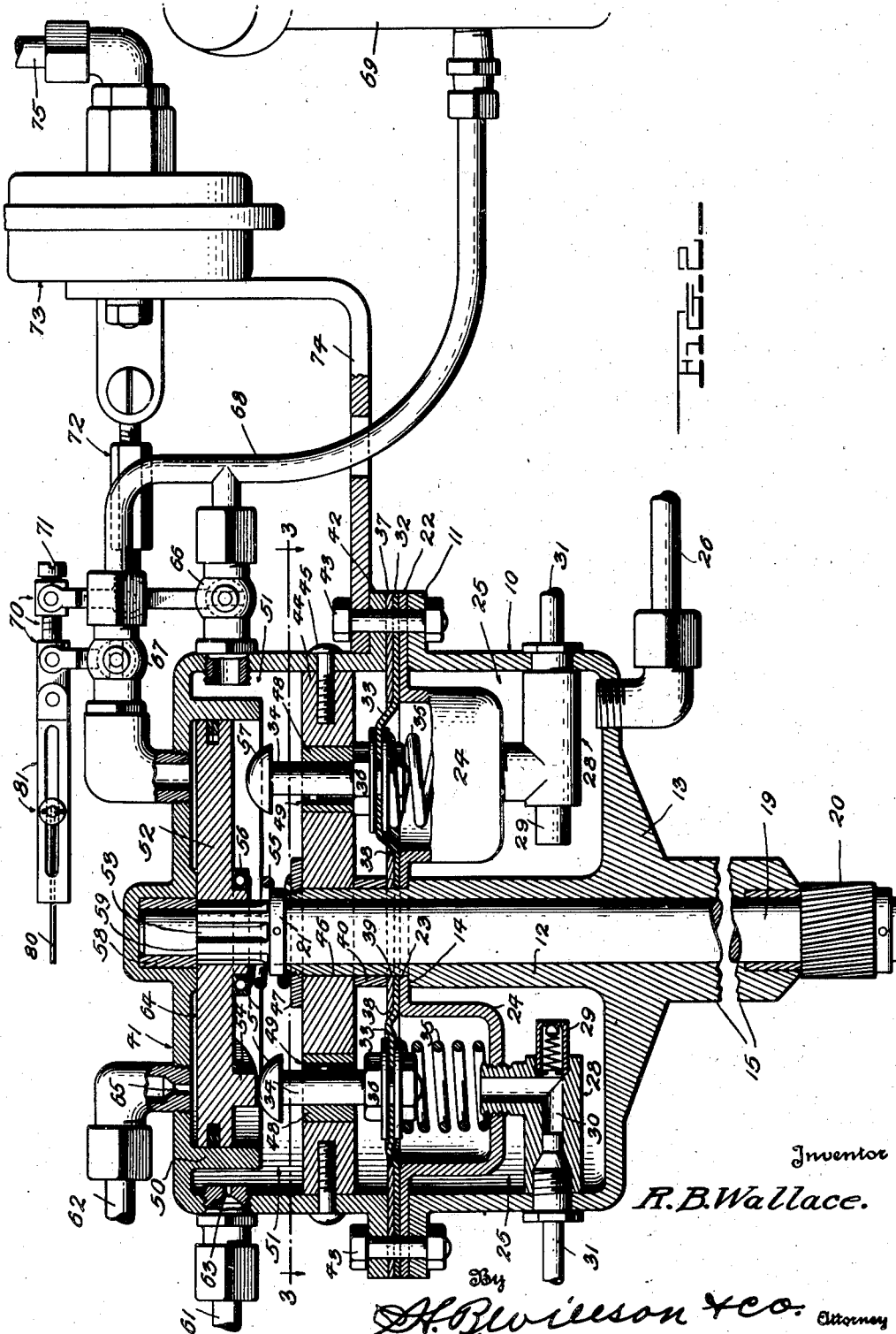
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FUEL INJECTING PUMP

Filed April 26, 1944

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FIG. 4-

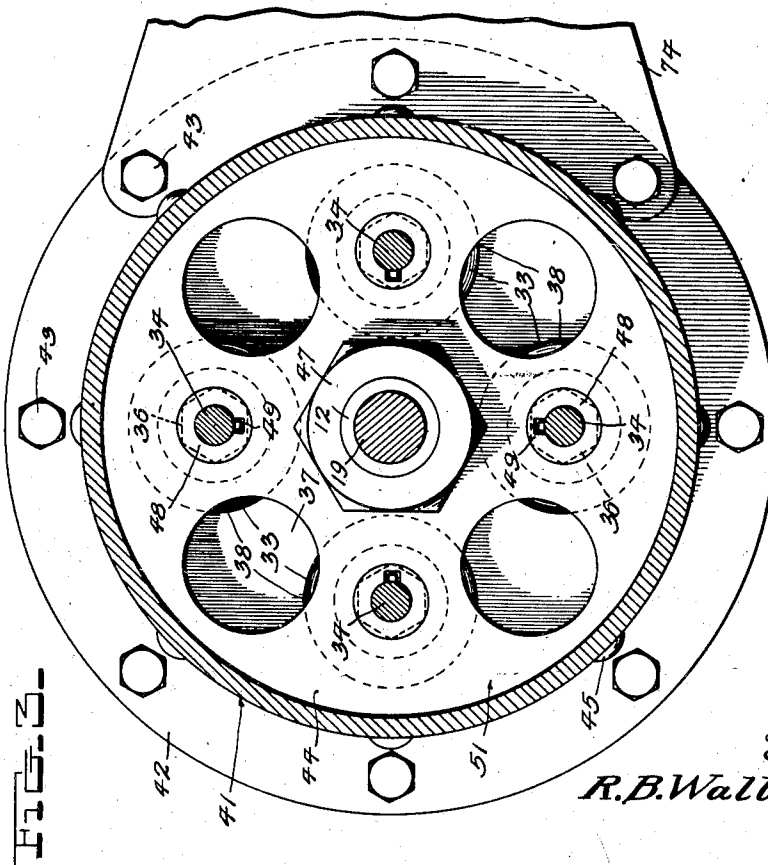
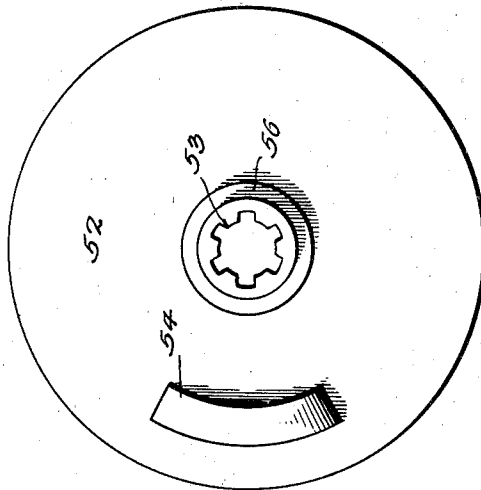


FIG. 3-

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2,439,498

FUEL INJECTING PUMP

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Application April 26, 1944, Serial No. 532,830

12 Claims. (Cl. 103—38)

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The invention relates to pumps and the embodiment herein disclosed is designed for injecting fuel into the cylinders of an internal combustion engine.

One object of the invention is to provide an efficient and reliable pump which may be easily and inexpensively manufactured without extremely accurate machining of parts.

Another object is to provide a construction which will not be injured by sand or other gritty substances in the liquid being pumped.

A still further object is to provide a single rotatable cam disk for successively operating a plurality of pump units, said cam disk being shiftable axially toward and from actuating elements of said pump units to vary the strokes of the same and thus vary the pump output.

Yet another object is to make novel provision for utilizing fluid under pressure, preferably the lubricating oil of an engine, for controlling the shifting of the aforesaid cam disk as required.

A further object is to provide a novel diaphragm type pump in which both sides of each diaphragm will be subjected to pressure, to minimize the stresses thereon.

Still another object is to provide for automatic control of the pump output, when the pump is used for fuel injecting purposes, by means actuated by pressure variances in the air intake of the engine.

With the foregoing and minor objects in view, the invention resides in the novel subject matter hereinafter described and claimed, description being accomplished by reference to the accompanying drawings.

Figure 1 is a side elevation showing the pump and controlling means therefor operatively connected with an engine.

Fig. 2 is an enlarged vertical sectional view partly in elevation.

Fig. 3 is a horizontal sectional view on line 3-3 of Fig. 2.

Fig. 4 is a bottom plan view of the cam disk.

Fig. 5 is a sectional perspective view showing the connecting means between the two control valves, and portions of the automatic and manual operating means for said connecting means.

Fig. 6 is a horizontal sectional view on line 6-6 of Fig. 5.

A preferred construction has been illustrated and will be rather specifically described, with the understanding, however, that within the scope of the invention as claimed, variations may be made.

A lower cup-like casing section 10 is provided,

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said section having a continuous flange 11 at its open upper end. A central upstanding sleeve 12 is integral with or otherwise fluid-tightly secured to the bottom 13 of the casing section 10, said sleeve being provided with an external upwardly facing shoulder 14 preferably in the plane of the top surface of the flange 11. The bottom 13 is integral with or otherwise rigidly joined to the upper end of a sleeve-like stub 15 to be suitably secured in a boss or the like 16 on the crank case 17 of an internal combustion engine 18. In this stub 15, a vertical shaft 19 is rotatably mounted, said shaft being provided with a gear 20 in the present disclosure, to be driven by a coacting gear on the cam shaft or other suitable part of the engine 18. A collar 21 is shown secured to the shaft 19 and resting on the upper extremity of the sleeve 12 to prevent downward end play of said shaft, upward end play being prevented by means hereinafter described.

Resting upon the flange 11 is a partition disk 22 which also rests upon the shoulder 14, said disk 22 having a central opening 23 through which the upper portion of the sleeve 12 extends. The partition disk 22 carries a circular series of cups 24 which project downwardly into the chamber 25 below said disk, said cups being open at the upper side of this disk. A fuel line 26 extends to the chamber 25 from the conventional fuel pump 27 of the engine 18, and each of the cups 24 is provided with an appropriate connection 28 having a valved inlet 29 communicating with said chamber 25, each of said connections 28 also having an outlet 30. The outlets of the various couplings are suitably connected with lines 31 for supplying the fuel to the engine cylinders.

A diaphragm disk 32 rests on the partition disk 22, and portions 33 of said diaphragm disk extend across the open upper ends of the cups 24. Suitably secured to these diaphragm portions 33, are upwardly projecting actuating stems 34, said diaphragm portions 33 and stems 34 being biased upwardly by means of suitable springs 35 in the cups 24, upward movement, however, being limited by suitable stop means which may well be formed in part by some of the nuts 36 which secure the stems and diaphragms together.

A hold-down disk 37 rests upon the diaphragm disk 32 and is formed with openings 38 exposing the diaphragm portions 33, said disk 37 having a central opening 39 through which the portion of the sleeve 12 above the shoulder 14 extends. Surrounding this sleeve portion and resting on

the hold-down disk 37, there is a spacing collar 40.

An upper, inverted cup-like casing section 41 is provided, the lower end of this section having a continuous flange 42 which rests on the hold-down disk 37 over the flange 11, bolts 43 being passed through the two flanges and the intervening parts to clamp them tightly together. Within the casing section 41, there is a perforated guide disk 44 for the stems 34, said disk being secured to the wall of the casing section 41 by screws 45, resting on the collars 40, and having a central opening 46 through which the portion of the sleeve 12 above said collar, extends. A clamping nut 47 is threaded upon the upper extremity of the sleeve 12 and bears against the disk 44 to clamp it tightly against the collar 40 and to clamp the three disks 37, 32 and 22 between said collar and the shoulder 14. The disk 44 carries guide bushings 48 for the stems 34 and any suitable provision such as the stud and groove connections 49, may be employed to prevent rotation of said stems in said bushings.

The top of the casing section 41 is integral with or otherwise fluid-tightly joined to a cylinder 50 which projects downwardly therefrom, the lower end of said cylinder being in open communication with the chamber 51 within the casing section 41. Both rotatable and slidable in the cylinder 50 is a disk or piston 52 which is splined at 53 on the shaft 19 to be driven by the latter. The lower side of the disk 52 carries a single cam 54 which is successively cooperable with the stems 34 to depress them and thus expel fuel from the cups 24 through the lines 31 to the engine cylinders. The disk or piston 52 is upwardly biased by a spring 55 resting on the nut 47, a thrust bearing 56 being preferably interposed between said spring and said disk or piston. In the present disclosure, each stem 34 is formed with a rounded head 57 cooperable with the cam 54, but obviously a roller could be substituted for said head, if desired.

The shaft 19 is reduced above the spline 53 and is rotatably mounted in a bushing 58 which may well abut the shaft shoulder 59 to hold said shaft against upward end play.

An oil line 60 communicates with the lubricating system of the engine 18, said line having two branches 61 and 62. The branch 61 communicates through a restricted orifice 63 with the chamber 51 and thus the lower side of the disk or piston 52 is subjected to the oil pressure pumped to said chamber 51 by the usual engine oil pump. The other branch 62 of the line 60 communicates with the chamber 64 above the disk or piston 52 through a restricted orifice 65, and thus the upper side of said disk or piston is also subjected to the pressure of the oil pumped into the chamber 64. One outlet valve 66 is provided for the chamber 51, and another outlet valve 67 is employed for the chamber 64, these valves being connected with an oil return line 68 for returning the oil to the engine. In the present disclosure, the line 68 is connected with the usual oil filler pipe 69 of the engine. In the present disclosure, the valves 66 and 67 are of the rotary plug type and their plugs are connected with each other by appropriate connecting means 70 to cause one valve to gradually open and the other to gradually close, and vice versa, as said connecting means are operated. The connecting means 70 preferably includes an adjustment 71 for initially setting the two valves relatively.

The connecting means 70 is adjustably linked at 72 to a known diaphragm unit 73 which may well be mounted on a bracket 74 secured by some of the bolts 43 above described. A line 75 extends to the diaphragm unit 73 from the air intake 76 of the engine 18, said air intake having a throttle valve 77 operable by a foot pedal or the like 78.

A hand control is indicated at 79, for longitudinally moving a control wire 80, which wire is slidably connected by a suitable means 81 with the connecting means 70 of the two valves 66 and 67. Thus, these valves, while automatically operable under the influence of pressure variances in the air intake 76, may also be actuated by hand, whenever desired.

It will be seen that rotation of the shaft 19 drives the disk or piston 52 to cause its cam 54 to successively depress the actuating stems 34 of the circular series of pump units, stem-depression and ascent (under the influence of the spring 35) producing the required pumping action to take the pump-supplied fuel from the chamber 24 and supply it to the engine cylinders. It will be obvious that the extent to which the stems 34 are depressed, will be governed by the position of the piston or disk 52 and, therefore, the position of this latter element will control the output from the pump units. The disk or piston 52 is positionally controlled by the pressure differential or the lack of such, in the chambers 51 and 64, and said pressure differential or lack of same is caused by the positions of the valves 66 and 67. The valve positions are obtained, either manually through the control 79 or automatically through the diaphragm unit 73 which is actuated by and is thus under the influence of pressure in the air intake 76 of the engine. It will thus be seen that the fuel supplied to the engine cylinders may be readily controlled according to requirements.

Attention is invited to the fact that each diaphragm is subjected to fluid pressure on both of its sides (oil above and fuel below) and is thus relieved of the serious strains encountered in the common diaphragm-type pumps in which only one side of the diaphragm is subjected to pressure. Moreover, when the supply of oil to chamber 51 is furnished by the usual engine lubricating system and automatically controlled in accordance with pressure variances in the engine air intake, as in the present disclosure, the oil becomes an auxiliary regulating factor for the richness of the mixture, for at idling speeds, (low oil pressure) each diaphragm bows or flexes more under the influence of the fuel forced into the cup or chamber 24 at each intake stroke of the diaphragm, thus causing each pump to admit more fuel, and this fuel supplied to the engine gives the required richness for idling speeds.

As excellent results may be attained from the structure herein disclosed, it may be considered as preferred. However, attention is again invited to the possibility of making variations within the scope of the invention as claimed. While the pump has been described for fuel injection, it is obvious that it may be employed for other purposes, for example, to inject water into the cylinders of engines to aid in preventing overheating.

I claim:

1. A pump comprising a cylinder, a piston slidable axially in said cylinder and also rotatable therein, means whereby said piston may be rotated, a pump-actuating element at one side of said piston and biased toward the latter, means

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for limiting the movement of said pump-actuating element toward said piston, means on said one side of said piston and cooperable with said pump-actuating element for forcing it away from said piston during part of each revolution of said piston, and means for admitting a controlling fluid to and exhausting it from said cylinder to axially shift said piston and vary the stroke imparted to said pump-actuating element.

2. A pump comprising a cylinder, a piston slidable axially in said cylinder and also rotatable therein, means whereby said piston may be rotated, a pump-actuating element at one side of said piston and biased toward the latter, means for limiting the movement of said pump-actuating element toward said piston, means on said one side of said piston and cooperable with said pump-actuating element for forcing it away from said piston during part of each revolution of said piston, and means connected with said cylinder at opposite sides of said piston for admitting and exhausting a controlling fluid to axially shift said piston and vary the stroke imparted to said pump-actuating element.

3. A pump comprising a casing, a partition dividing said casing into two chambers, a liquid inlet into one of said chambers, a circular series of pumps carried by said partition and including inlets communicating with said one of said chambers, said pumps having actuating elements biased away from said one of said chambers and exposed in the other of said chambers, means for limiting the movement of said actuating elements away from said one of said chambers, a rotatable and slidable piston in said other of said chambers and having its axis aligned with the center of said circular series of pumps, means whereby said piston may be rotated, means on said piston for successively forcing said actuating elements toward said one of said chambers as said piston rotates, said casing having a cylinder in which said piston is operable, and means for admitting a controlling fluid to and exhausting it from said cylinder to shift said piston axially to vary the stroke of said actuating elements.

4. A pump comprising a casing, a partition dividing said casing into two chambers, one of which is provided with a liquid inlet, said partition having a circular series of cups projecting into said one of said chambers, said cups having their open ends disposed toward the other of said chambers, said cups each having liquid admission and discharge means, the former of which is in valved communication with said one chamber to conduct liquid from this chamber to said cups, diaphragms secured across the open ends of said cups, operating means for said diaphragms including stems projecting from said diaphragms into said other of said chambers and a rotary cam in this chamber cooperable with said stems, and fixed guides for said stems.

5. A pump comprising a lower cup-like liquid-receiving casing section having a continuous flange at its upper end, said casing section having a liquid inlet, a central sleeve secured to the bottom of said casing section and projecting above the plane of said flange, said sleeve having an external upwardly facing shoulder near its upper end, a partition resting on said flange and said shoulder and having a central opening through which said sleeve extends, said partition having a circular series of upwardly open downwardly projecting cups, said cups each having liquid admission and discharge means, the former of which is in valved communication with said casing sec-

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tion, a diaphragm disk resting on said partition and extending across the open ends of said cups, a hold-down disk resting on said diaphragm disk and having a central opening through which said sleeve extends, said hold-down disk having apertures exposing the portions of said diaphragm disk which extend across the open ends of said cups, upwardly projecting stems secured to said exposed portions of said diaphragm disk, an upper inverted cup-like casing section having a continuous flange lying upon said hold-down disk over the aforesaid flange, fasteners securing said flanges together and clamping the two disks and partition between them, a stem-guiding disk within said upper casing section and having a central opening through which said sleeve extends, said stem-guiding disk being provided with guides through which the aforesaid stems extend, spacing means on said sleeve between said hold-down disk and said stem-guiding disk, a clamping nut threaded on the upper end of said sleeve and lying upon said stem-guiding disk, an operating shaft rotatable in said sleeve and having a disk within said upper casing section, and means on said disk for successively depressing said stems as said disk is rotated.

6. A pump comprising a cup-like liquid-receiving casing having a liquid inlet, a disk secured to said casing and closing the open side thereof, said disk having a circular series of cups projecting into said casing, the bottoms of said cups being disposed toward the bottom of said casing, each of said cups having liquid admission and discharge means, the former of which is in valved communication with said casing to conduct liquid from said casing to said cups, diaphragms secured to said disk and extending across the open ends of said cups, and means for operating said diaphragms.

7. A pump comprising a cup-like liquid-receiving casing having a liquid inlet, a disk secured to said casing and closing the open side thereof, said disk having a circular series of cups projecting into said casing, the bottoms of said cups being disposed toward the bottom of said casing, each of said cups having liquid admission and discharge means, the former of which is in valved communication with said casing to conduct liquid from said casing to said cups, diaphragms secured to said disk and extending across the open ends of said cups, a sleeve extending from the bottom of said casing through said disk, a rotary shaft extending through said sleeve, a cam disk on said shaft in outwardly spaced relation with the aforesaid disk, actuating stems secured to said diaphragms and cooperable with said cam disk, and fixed guides for said stems.

8. In a pump of the type in which a rotary disk actuates a pumping means, and in which the output of said pumping means is variable by axially shifting said rotary disk; a cylinder containing said rotary disk and disposed in fluid-tight contact with the peripheral edge thereof to permit said disk to also constitute a piston, and means for conducting fluid to and from said cylinder to effect required axial shifting of the combined rotary disk and piston.

9. In a pump of the type in which a rotary disk actuates a pumping means, and in which the output of said pumping means is variable by axially shifting said rotary disk; a cylinder containing said rotary disk and disposed in fluid-tight contact with the peripheral edge thereof to permit said disk to also constitute a piston,

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fluid supply means for supplying fluid under pressure to said cylinder at opposite sides of the combined rotary disk and piston, fluid exhaust means for conducting fluid from said cylinder at opposite sides of said combined rotary disk and piston, and valve means for controlling the flow of fluid from said supply means to said exhaust means to relatively regulate the fluid pressure at opposite sides of said combined rotary disk and piston, to effect required axial shifting of said combined rotary disk and piston.

10. A pump comprising a lower cup-like casing section having a liquid inlet, a central sleeve secured to the bottom of said casing section and projecting above the upper end of said casing section, said sleeve having an external upwardly facing shoulder near its upper end, a partition resting on said upper end of said casing section and said shoulder and having a central opening through which said sleeve extends, said partition having a circular series of upwardly open downwardly projecting cups, said cups each having liquid admission and discharge means, the former of which is in valved communication with said casing section, a diaphragm disk resting on said partition and extending across the open ends of said cups, a hold-down disk resting on said diaphragm disk and having a central opening through which said sleeve extends, said hold-down disk having apertures exposing the portions of said diaphragm disk which extend across the open ends of said cups, upwardly projecting stems secured to said exposed portions of said diaphragm disk, an upper inverted cup-like casing section resting upon the portion of said hold-down disk which overlies the side wall of said lower casing section, fastening means securing the two casing sections together and clamping the two disks and partition between them, a stem-guiding disk within said upper casing section and having a central opening through which said sleeve extends, said stem-guiding disk being provided with guides through which the aforesaid stems extend, spacing means on said sleeve between said hold-down disk and said stem-guiding disk, a clamping nut threaded on the upper end of said sleeve and lying upon said stem-guiding disk, an operating shaft rotatable in said sleeve and having a disk within said upper casing section, and means on said disk for suc-

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cessively depressing said stems as said disk is rotated.

11. In a fuel feeding means for an internal combustion engine, a diaphragm and means driven by said engine for operating said diaphragm, means providing a fuel chamber at one side of said diaphragm, means providing an oil chamber at the other side of said diaphragm, a fuel pump driven by said engine, fuel-conducting means extending from said fuel-pump to said fuel chamber, fuel-discharge means from said fuel chamber to said engine, and oil-conducting means extending from the lubricating system of said engine to said oil chamber to conduct lubricating oil under pressure to said oil chamber, whereby the oil pressure within said oil chamber will minimize the pumping stresses on said diaphragm.

12. A structure as specified in claim 11; together with means for controlling the oil pressure in said oil chamber.

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