May 9, 1944. K. R. HAGEN 2,348,538

FUEL PUMP

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Fig. 1.

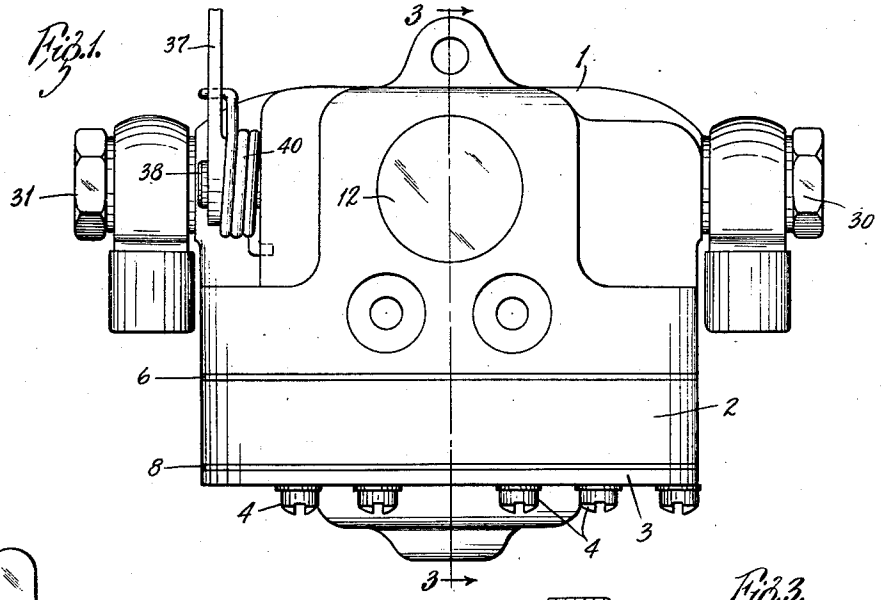

Fig. 3.

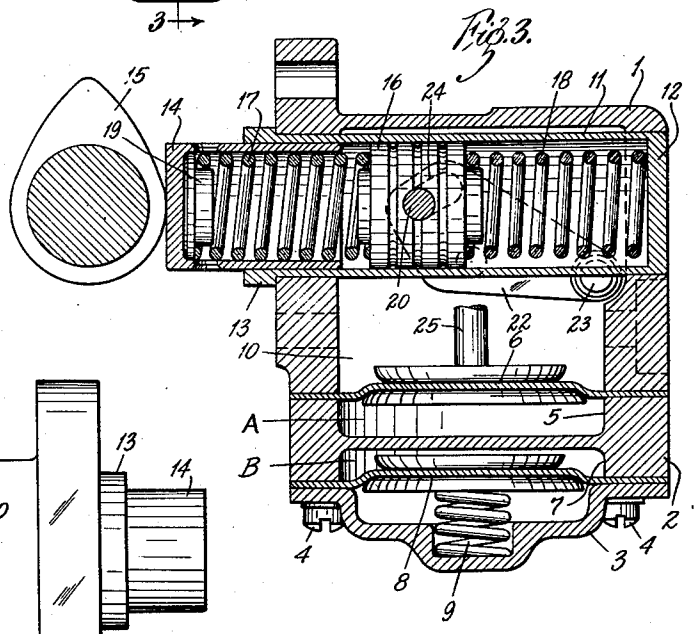

Fig. 2.

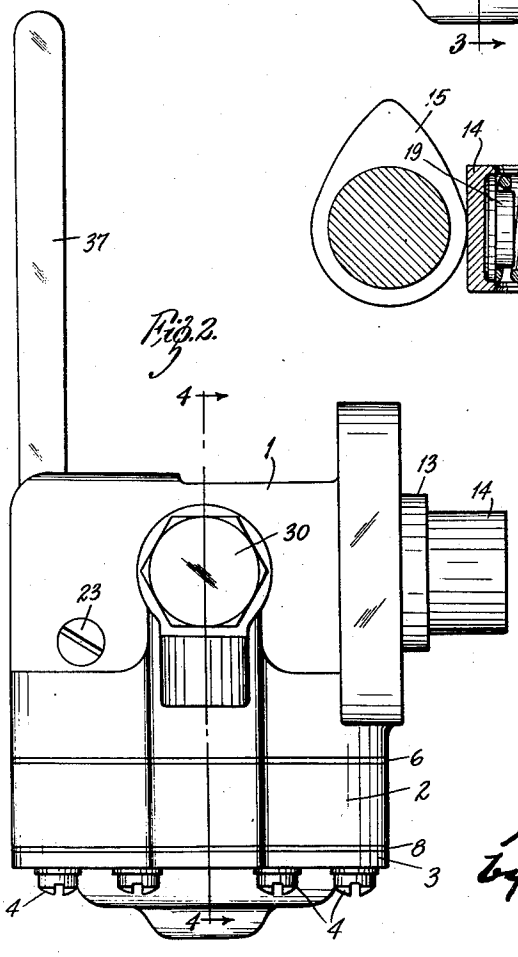

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Fig. 4.

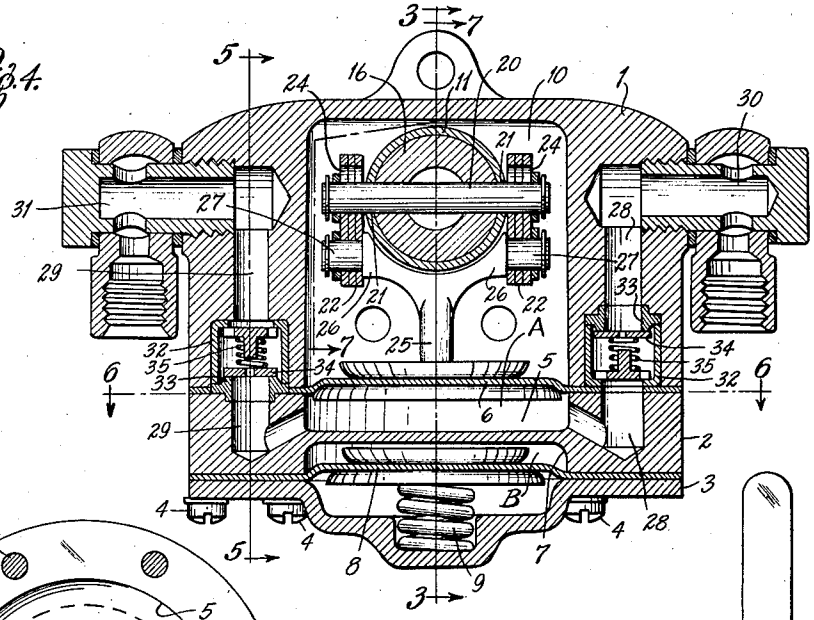


Fig. 6.

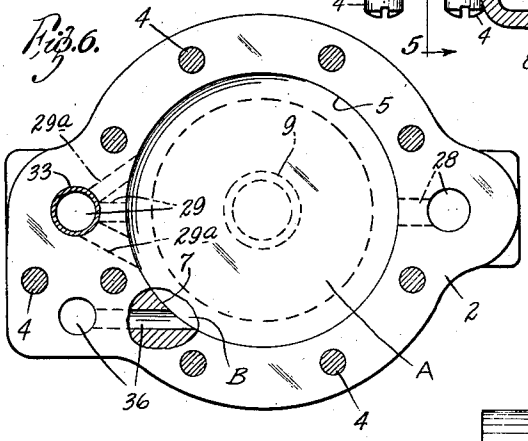


Fig. 5.

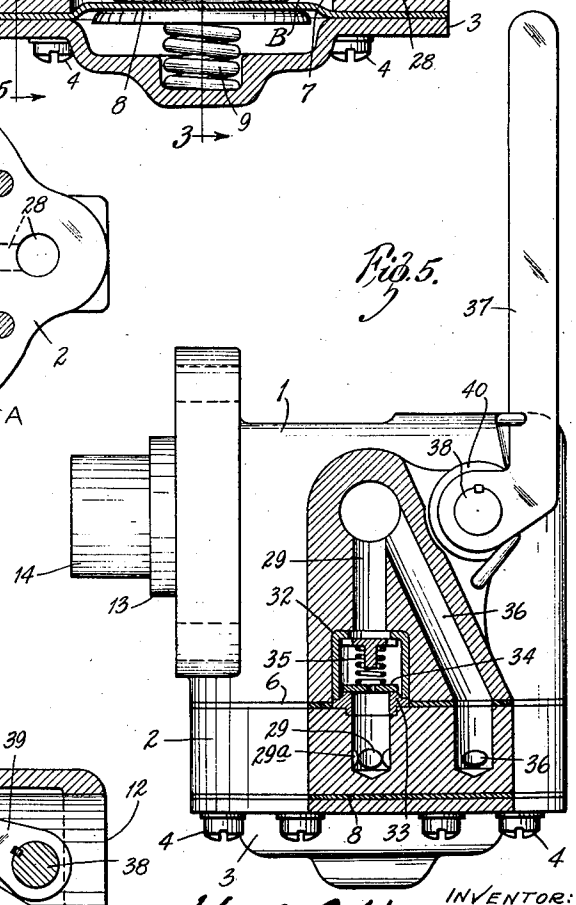
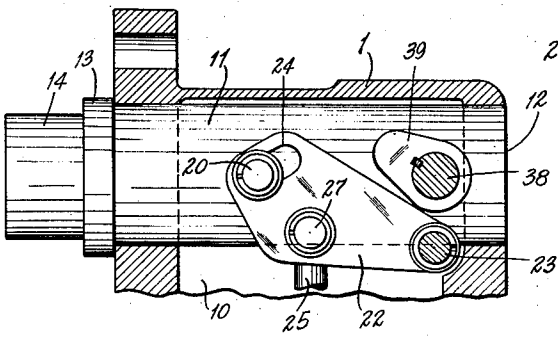


Fig. 7.



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FUEL PUMP

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10 Claims. (Cl. 103—207)

This invention relates to pumps, particularly diaphragm pumps for supplying fuel to the charge forming device of an internal combustion engine. The invention has for its principal objects to provide a strong, compact and durable diaphragm pump of simple and economical construction, to facilitate assembly and disassembly of the parts, to increase the discharge capacity of the pump, to provide a continuous discharge of fuel, and to provide readily accessible manually operable means for priming and flushing the pump. The invention consists in the pump and in the construction, combinations and arrangements hereinafter described and claimed.

In the accompanying drawings, which form part of this specification and wherein like symbols refer to like parts wherever they occur,

Fig. 1 is a side elevational view of a pump embodying my invention,

Fig. 2 is an end elevational view of said pump,

Fig. 3 is a central vertical longitudinal section through said pump on the line 3—3 in Fig. 1,

Fig. 4 is a central vertical transverse section through said pump on the line 4—4 in Fig. 2,

Fig. 5 is a vertical section on the line 5—5 in Fig. 4,

Fig. 6 is a horizontal section on the line 6—6 in Fig. 4; and

Fig. 7 is a vertical section on the line 7—7 in Fig. 4.

My fuel pump comprises a casing including a main housing or body member 1 and horizontal intermediate and bottom plates 2 and 3, respectively, that are clamped flatwise together and to the underside of said housing by screws 4. The intermediate plate 2 has a central circular recess 5 in the top thereof that is covered by a horizontal diaphragm 6, which is clamped between said plate and the underside of the housing 1 and constitutes the movable wall of an expansible upper or main pump chamber A formed by said diaphragm and recess. An accumulator or cushioning chamber B is formed below the pump chamber A by a central circular recess 7 in the bottom of the intermediate plate 2 and a diaphragm 8 that covers said recess and is clamped between said intermediate plate and the bottom plate 3. As shown in the drawings, the diaphragm or deformable wall 8 of the lower pulsation chamber B is pressed upwardy by a coil compression spring 9 so as to reduce the capacity or volumetric content of said chamber and deliver fuel therefrom.

The housing or casing 1 has a central circular cylindrical downwardly opening chamber 10 therein; and a hollow cylindrical horizontal sleeve 11 extends from end to end of said housing along a diameter of said chamber with its end portions pressfitted in axially alined cylindrical openings provided therefor in opposite ends of said housing. The sleeve 11 has a closed end 12 disposed flush with the corresponding end of the housing 1; and the opposite end of said sleeve is left open and has an exterior collar or shoulder 13 disposed in endwise abutting relation to the corresponding end of said housing.

Reciprocable in the open end of the sleeve 11 is an inwardly opening tappet cup 14 whose closed outer end is engaged by a power operated rotary edge cam or tappet 15, which preferably forms part of the fuel injection pump (not shown) that is to be supplied with fuel by the fuel supply pump. Reciprocable in the sleeve 11, between the closed end 12 thereof and the tappet cup 14 in the open end thereof, is a cylindrical crosshead 16; and located in said sleeve, one on each side of said crosshead, are two coil compression springs 17 and 18 of substantially the same size, rate, and capacity. The spring 17 bears at one end against the crosshead 16 and has its other end seated on a button 19 that is located in the tappet cup 14 and has a convex spherical head that seats against the closed cam engaging end of said cup. The other spring 18 seats at one end against the other end of the crosshead 16 and at its other end against the closed end 12 of the spring and crosshead supporting sleeve 11.

A horizontal pin 20 fits in a diametrical bore provided therefore in the crosshead 16 and extends on opposite sides of said crosshead through diametrically opposed longitudinal guide slots 21 provided therefore in the sleeve 11. Duplicate rock levers 22, preferably of laminated construction, are located in the chamber 10 of the housing 1, one on each side of the crosshead supporting sleeve 11, and are pivotally supported at one end for vertical swinging movement in said chamber on axially alined pivots 23 that project into said chamber from opposite sides thereof. The horizontal cross pin 20 carried by the crosshead 16 extends on opposite sides of the sleeve 11 into arcuate slots 24 provided therefor in the free ends of the rock levers 22. The diaphragm or movable wall 6 of the upper pump chamber A has an upright stem 25 fixed thereto which extends upwardy into the chamber 10 centrally thereof and has oppositely extending arms 26 at its upper end that terminate at their outer ends in trunnions 27 that are pivotally supported in openings provided therefor in the respective rock levers 22 between the pivots 23 therefor and the

arcutae slots 24 in the free ends thereof, said slots curving upwardly about said trunnions and centers.

The housing 1 has a valved inlet passageway 28 and a valved outlet passageway or conduit 29 formed therein, one on each side of the chamber 10. The inlet end of the intake or inlet passageway or conduit 28 has a suitable inlet fitting 30 therein; and an outlet fitting 31, similar to the inlet fitting 30, is threaded into the outlet end of the outlet or discharge passageway 29. The inlet passageway 28 leads downwardly from the inlet fitting 30 through the housing 1 into the intermediate plate 2, where it opens laterally into the main or upper pump chamber A. The outlet passageway 29 leads from the opposite side of the main pumping chamber A upwardly through the intermediate plate 2 and housing 1 to the outlet fitting 31.

Mounted respectively in the inlet and outlet passageways forming bores of the housing 1 are the inlet and outlet valve assemblies of identical construction, each valve assembly comprising a cage 32 and a valve seat member 33 fitting in said bore, and a disk valve 34 mounted in said casing and yieldably held against said seat by a coil compression spring 35. As shown in the drawings, the two valve assemblies are mounted in reverse positions in their respective passageways, so that the valve in the inlet passageway functions as an inwardly opening check valve and the valve in the outlet passageway functions as an outwardly opening check valve. The outlet passageway 29 communicates at its lower or inner end through branch passageways 29a with the lower or accumulator or cushioning chamber B; and said lower chamber is in continuous communication with said outlet passageway, outwardly of the outlet valve therein, through an auxiliary outlet or discharge passageway 36 that leads horizontally from said chamber and thence upwardly at an oblique angle to the main outlet passageway.

The operation of the hereinbefore described fuel supply pump is as follows: When the drop or base circle of the cam or tappet 15 moves into position opposite the closed outer end of the tappet cup 14, said tappet cup is pressed against said cam by the spring 17, and the crosshead 16 is slid outwardly in the same direction in the sleeve 11 by the expansive action of the pumping spring 18, whereby the slot-and-pin connections 20, 24 between said crosshead and the rock levers 22 cause the latter to swing upwardly on their supporting pivots 23 and raise the diaphragm or movable wall 6 of the main pump chamber A and thus draw fuel into said chamber through the valve inlet passageway 28. When the nose or rise of the edge cam 15 engages the tappet cup 14, the crosshead 16 is slid inwardly in the sleeve 11 against the pressure of the springs 17 and 18 and the slot-and-pin connections 20, 24 between said crosshead and the rock levers 22 cause the latter to swing downwardly on their supporting pivots 23 and depress the diaphragm 6 of the main pumping chamber A, thereby forcing the fuel from said chamber through the valved outlet passageway 29.

As the rates of the springs 17 and 18 are the same, the maximum stroke of the crosshead 16 is equal to one-half the stroke of the cam or tappet 15, and the position of said crosshead in its supporting sleeve 11 depends on the balance of the forces of the two springs in the different positions of the tappet cup 14. Thus, the length of stroke of the crosshead 16 and the quantity of fuel drawn into and discharged from the main pumping chamber A vary according to the back pressure of the fuel in the fuel discharge line, the quantity of fuel discharged depending on the fuel consumption of the engine regardless of the length of stroke of the cam 15.

As each stroke of the diaphragm 6 of the main pump chamber A produces a pressure pulsation, there is an intermittent delivery of fuel from said chamber. With a minimum pressure, the springs 17 and 18 will impart a full stroke to the crosshead 16; and, as the pressure builds up, the stroke of the crosshead will be diminished until a maximum pressure is reached at which the crosshead remains stationary and no movement is imparted thereby to the diaphragm 6. When the fuel injection pump is not able to use the full discharge of the supply pump, the surplus fuel is forced into the auxiliary or accumulator chamber B, thus forcing the diaphragm or movable wall 8 thereof downwardly against the resistance of the loading spring 9 and increasing the capacity or volumetric content of said chamber; and, as this auxiliary chamber is always in communication with the outlet passageway 29 outwardly of the outwardly opening check valve therein, the spring 9 will operate to force the fuel from the auxiliary chamber into the discharge line when the pressure decreases between discharge strokes of the main pumping diaphragm 6 and thus maintain a constant discharge of fuel from the supply pump. This lower or auxiliary chamber B also increases the discharge capacity of the pump due to the fuel stored in said chamber during the intermittent peak pressures produced by the diaphragm 6 of the main pump chamber B.

The above fuel supply pump is also provided with a separate or auxiliary manually operable priming or flushing means. Said means preferably comprises a hand lever 37 fixed to the exposed outer end of a horizontal rock shaft 38 that is journaled in the housing 1 and extends into the chamber 10 therein, where it is provided with a cam 39 adapted to swing downwardly into engagement with the inclined upper edge of one of the rock levers 22, to thereby force said lever and the diaphragm 6 connected therewith downwardly. The hand lever 37 is normally held in inoperative position with the cam 29 clear of the rock lever 22 by means of a coil torsion spring 40 having one end anchored to the housing and the other end hooked around said lever. This hand lever may be operated to impart a pumping stroke to the diaphragm 6 regardless of the position of the pump actuating cam 15.

Obviously, the hereinbefore described pump admits of considerable modification without departing from the invention. Therefore, I do not wish to be limited to the precise pump construction shown and described.

What I claim is:

1. A pump comprising a casing having an expansible chamber and inlet and outlet passageways communicating with said chamber, a diaphragm forming a movable wall for said chamber, and means for reciprocating said diaphragm to successively increase and decrease the volumetric content of said chamber, said means including a member operatively connected to said diaphragm and reciprocable in said casing in a direction transverse to the direction of recipro-

cation of said diaphragm, a spring for moving said member in one direction, and a rotary cam for moving said member in the other direction against the pressure of said spring, and manually operable means for moving said member in said other direction against the pressure of said spring in all positions of said rotary cam.

2. A pump comprising a casing having an expansible chamber and inlet and outlet passageways communicating with said chamber, a diaphragm forming a movable wall for said chamber, and means for reciprocating said diaphragm to successively increase and decrease the volumetric content of said chamber, said means including a member operatively connected to said diaphragm and reciprocable in said casing in a direction transverse to the direction of reciprocation of said diaphragm, a spring for moving said member in one direction, and mechanically operable means for moving said member in the other direction against the pressure of said spring, said mechanically operable means comprising a tappet cup reciprocable in said casing in the direction of reciprocation of said member, a cam for moving said tappet cup in the direction of said member, and a spring interposed between said member and said tappet cup for yieldably transmitting to said member the movement imparted to said tappet cup by said cam.

3. A pump comprising a casing having an expansible chamber and inlet and outlet passageways communicating with said chamber, a diaphragm forming a movable wall for said chamber, and means for reciprocating said diaphragm to successively increase and decrease the volumetric content of said chamber, said means including a member reciprocable in said casing and operatively connected to said diaphragm, a spring for displacing said member in one direction, and means for displacing said member in the other direction including a power operated member and a spring between said member and said power operated member, the two springs being of substantially equal strength, whereby the position of said member is determined by the balance of forces of the two springs in the different positions of the power operated member and the length of stroke of said member and the diaphragm actuated thereby varies according to the back pressure in said outlet passageway.

4. A pump comprising a casing having an expansible chamber and inlet and outlet passageways communicating with said chamber, a diaphragm forming a movable wall of said chamber, and means for reciprocating said diaphragm to successively increase and decrease the volumetric content of said chamber, said means including a crosshead operatively connected to said diaphragm and reciprocable in said casing transversely of the direction of reciprocation of said diaphragm, a spring interposed between said casing and one end of said crosshead for displacing the latter in one direction, and means for displacing said crosshead in the other direction including a power-operated member and a spring between said member and the other end of said crosshead.

5. A pump comprising a casing having an expansible chamber and inlet and outlet passageways communicating with said chamber, a diaphragm forming a movable wall of said chamber, and means for reciprocating said diaphragm to successively increase and decrease the volumetric content of said chamber, said means including a crosshead operatively connected to said diaphragm and reciprocable in said casing transversely of the direction of reciprocation of said diaphragm, a spring interposed between said casing and one end of said crosshead for displacing the latter in one direction, and means for displacing said crosshead in the other direction including a power-operated member and a spring between said member and the other end of said crosshead, and means for manually operating said diaphragm against the pressure of said first mentioned spring.

6. A pump comprising a casing having an expansible chamber and inlet and outlet passageways communicating with said chamber, a diaphragm forming a movable wall of said chamber, and means for reciprocating said diaphragm to successively increase and decrease the volumetric content of said chamber, said means including a crosshead operatively connected to said diaphragm and reciprocable in said casing transversely of the direction of reciprocation of said diaphragm, a spring interposed between said casing and one end of said crosshead for displacing the latter in one direction, and means for displacing said crosshead in the other direction including a power operated member and a spring between said member and the other end of said crosshead, the connection between said crosshead and diaphragm including a rock lever pivotally supported in said casing for swinging movement alongside of said crosshead in the direction of reciprocation of said diaphragm, a slot in said lever, a cross-pin fixed to said crosshead and extending into said slot, and a spindle connected to said diaphragm and pivotally connected to said lever between the pivot therefor and the slot therein.

7. A pump comprising a casing having an expansible chamber and inlet and outlet passageways communicating with said chamber, a diaphragm forming a movable wall of said chamber, and means for reciprocating said diaphragm to successively increase and decrease the volumetric content of said chamber, said means comprising a crosshead operatively connected to said diaphragm and reciprocable in said casing transversely of the direction of reciprocating movement of said diaphragm, a spring interposed between said casing and one end of said crosshead for displacing the latter in one direction, and means for displacing said crosshead in the other direction including a power operated member and a spring between said member and the other end of said crosshead, said connection between said crosshead and diaphragm including a rock lever pivotally supported in said casing for swinging movement alongside of said crosshead in the direction of reciprocation of said diaphragm, a slot in said lever and disposed at an oblique angle to the direction of reciprocation of said crosshead, a cross-pin fixed to said crosshead and extending into said slot, and a spindle connected to said diaphragm and pivotally connected to said lever between the pivot therefor and the slot therein, and means for manually operating said lever against the resistance offered by said first mentioned spring.

8. A pump comprising a casing having an expansible chamber and inlet and outlet passageways communicating with said chamber, a diaphragm forming a movable wall of said chamber, and means for reciprocating said diaphragm to successively increase and decrease the volumetric content of said chamber, said means comprising a crosshead operatively connected to said dia-

phragm and reciprocable in said casing transversely of the direction of reciprocation of said diaphragm, a spring interposed between said casing and one end of said crosshead for displacing the latter in one direction, and means for displacing said crosshead in the other direction including a power operated edge cam, a tappet cup and a spring between said tappet cup and the other end of said crosshead, said connection between said crosshead and diaphragm including a pair of rock levers pivotally supported in said casing for swinging movement on opposite sides of said crosshead in the direction of reciprocation of said diaphragm, slots in said levers, a cross-pin fixed to said crosshead and extending on opposite sides thereof into said slots, and a spindle fixed to said diaphragm and pivotally connected to said levers between the pivots therefor and the slots therein.

9. A pump comprising a casing having an expansible chamber and inlet and outlet passageways communicating with said chamber, a diaphragm forming a movable wall of said chamber, and means for reciprocating said diaphragm to successively increase and decrease the volumetric content of said chamber, said means comprising a sleeve mounted in said casing transversely of the direction of reciprocation of said diaphragm, a crosshead reciprocable in said sleeve, a spring mounted in said sleeve between one end thereof and the corresponding end of said crosshead for displacing the latter in one direction, and means for displacing said crosshead in the other direction including a power operated edge cam, a tappet cup reciprocable in said sleeve and a spring mounted in said sleeve between said tappet cup and the other end of said crosshead, said connection between said crosshead and diaphragm including a pair of rock levers pivotally supported in said casing for swinging movement on opposite sides of said sleeve in the direction of reciprocation of said diaphragm, slots in said levers, a cross-pin fixed to said crosshead and extending on opposite sides thereof through longitudinal slots in said sleeve into said slots in said levers and a spindle fixed to said diaphragm and pivotally connected to said levers between the pivots therefor and the slots therein and a manually operable cam mounted in said casing and movable into engagement with one of said levers for operating the same in one direction of its swinging movement.

10. A pump comprising a casing having an expansible chamber and inlet and outlet passageways communicating with said chamber, a diaphragm forming a movable wall for said chamber, and means for reciprocating said diaphragm to successively increase and decrease the volumetric content of said chamber, said means comprising a member operatively connected to said diaphragm and reciprocable in said casing in a direction transverse to the direction of reciprocation of said diaphragm, a spring in engagement with one end of said member for moving the same in one direction, and means for moving said member in the other direction against the pressure of said spring, said means comprising a second spring having one end in engagement with the other end of said member, a tappet cup engaging the other end of said second spring, and a rotary edge cam engaging said tappet cup for moving the same against the pressure of said second spring.

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