Oct. 28, 1930. W. C. CARTER 1,779,420

ELECTRICALLY OPERATED FUEL PUMP

Filed July 10, 1925

Fig. 1.

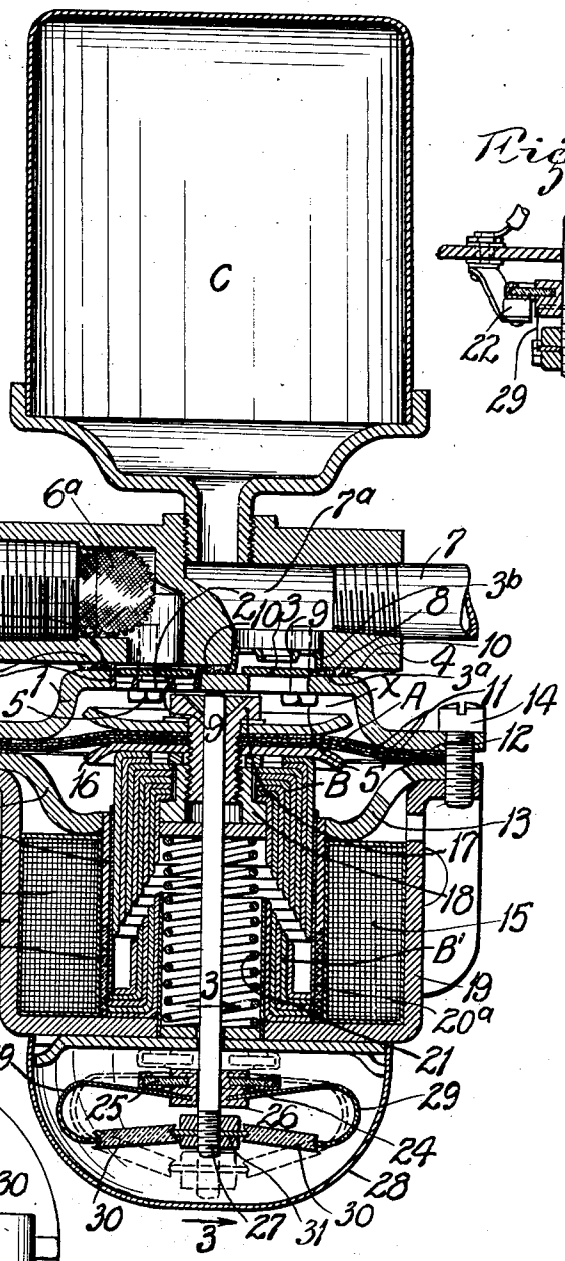


Fig. 3.

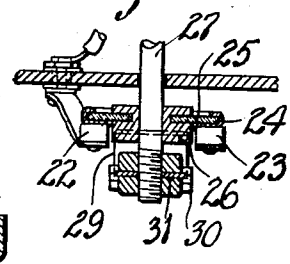
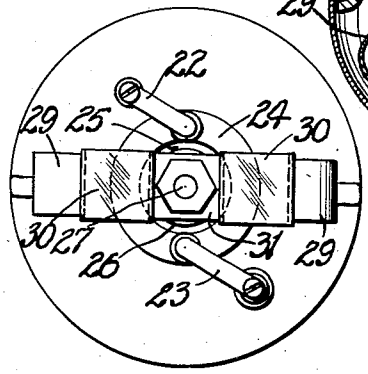


Fig. 2.



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ELECTRICALLY-OPERATED FUEL PUMP

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This invention relates to fuel pumps of the type in which the pumping element consists of a diaphragm that is operated by a solenoid.

One object of my invention is to provide a fuel pump of the general type mentioned, which is of such construction that the valves can be inspected and repaired easily.

Another object is to provide an electrically-operated fuel pump that is equipped with a solenoid whose core is inexpensive to construct and of such design that the diaphragm will be operated at a speed slow enough to provide ample time for the fuel to enter the pumping chamber of the pump on the suction stroke of the diaphragm.

And still another object of my invention is to provide an electrically-operated fuel pump in which the energizing circuit is opened and closed intermittently by a quick throw switch which is so designed that the movement of a solenoid core, that constitutes the actuating means for the pumping element, is utilized to gradually increase the pressure of the switch contacts on each other during the stroke of said core. Other objects and desirable features of my invention will be hereinafter pointed out.

Figure 1 of the drawings is a vertical sectional view of an electrically-operated diaphragm pump constructed in accordance with my invention.

Figure 2 is a bottom plan view of the quick throw switch; and

Figure 3 is a vertical sectional view of said switch, illustrating the co-operating contacts of same.

Referring to the drawings which illustrate the preferred form of my invention, A designates a diaphragm that is combined with a dished member 1 so as to form a diaphragm chamber x into which liquid fuel is drawn and discharged intermittently by the movement of said diaphragm, the admission of the fuel to the pumping element x being governed by an automatic inlet valve 2, and the discharge of the fuel from said chamber being governed by an automatic discharge valve 3. Each of said valves consists of a light weight disk that is combined with a cage which serves as a stop to limit the movement of the valve away from its seat, and in the form of my invention herein illustrated said valves and cages are so arranged that they can be inspected and renewed simply by removing a member 4 that is detachably connected to the pump chamber member 1 by fastening devices 5, or in any other suitable manner. The pump chamber member 1 and the diaphragm A that co-operates with same are arranged horizontally and the member 4 is superimposed upon the member 1, as shown in Figure 1 of the drawings. The supply pipe 6 and discharge pipe 7 of the pump are connected to inlet and discharge passageways 6^a and 7^a in the member 4, and a gasket 8 is interposed between the members 1 and 4 so as to provide liquid tight joints between the same. The intake valve 2 seats against a flat face 2^a on the underside of the member 4 and is surrounded by a cage 2^b that is confined between the members 1 and 4, and the discharge valve 3 seats against a flat face 3^a on the top side of the member 1 and is surrounded by a cage 3^b that is confined between the members 1 and 4. The particular design of said valve cages is immaterial, so long as they are constructed in such a manner that they can be removed easily after the member 4 has been separated from the member 1. I have herein illustrated each of said valve cages as consisting of a sheet metal stamping, of tubular form in general outline, provided with a stop 9 that limits the movement of the valve away from its seat and provided with a flange 10 that is interposed between the meeting faces of the members 1 and 4.

The diaphragm A is of such design that in the operation of manufacturing the pump it is easy to combine said diaphragm with a pump chamber member 1 and it is a simple matter to make diaphragms that are absolutely uniform both as to size and degree of buckle. Preferably, the diaphragm A is constructed in the form of a complete unit and is composed of a plurality of disks 11 of fabric treated to render them impervious to gasoline, and a metal member 12 that embraces the edge portions of said disks and clamps them together. The member 12, which is of annular form in outline and sub-

stantially channel-shaped in cross section, is of slightly less internal diameter than the disks 11. Consequently, in the operation of combining the disks 11 with the member 12 said disks become slightly buckled, as shown in Figure 1, so that the diaphragm will be free to move back and forth with a quick movement, and thus create suction and pressure intermittently in the pumping chamber x that causes charges of liquid fuel to be drawn into said chamber, through the supply pipe 6 and discharged therefrom through the outlet pipe 7. The peripheral edge portion of the diaphragm A is clamped against the underside of the pump chamber member 1 by a clamping device 13 of magnetic material that is detachably connected to the member 1 by screws 14, said clamping member 13 forming part of the housing of the core of the solenoid that is used to actuate the diaphragm.

The solenoid just referred to is of novel construction and comprises a coil 15 and a two-piece core composed of a movable member B and a stationary member B′, said movable member being connected to the diaphragm A preferably by clamping plates 16 that embrace the central portion of the diaphragm, as shown in Figure 1. The clamping plates 16 are connected to the movable member B of the solenoid core by a bolt 17 projecting downwardly through the clamping members 16 and a nut 18 inside of the movable member B of the core that receives the lower end of said bolt. The coil of the solenoid is disposed horizontally so that the movable member B of the core will slide vertically in same and remain centered with respect to the coil, and the housing 19 of the coil, which is formed of magnetic material, is connected with the diaphragm clamping member 13, previously referred to, by the fastening devices 14. The spool or tubular member on which the coil of the solenoid is wound preferably comprises a top portion 20 of magnetic material which surrounds the movable member B of the core, and a bottom portion 20^a of non-magnetic material that surrounds the stationary member B′ of the core, said top portion 20 being connected to the top piece 13 of the coil housing.

When the solenoid circuit is closed the movable core member B moves downwardly, due to magnetic attraction, and when said movable core member reaches the end of its downward stroke, the solenoid circuit opens automatically, whereupon said core member moves upwardly under the influence of an expansion spring 21 whose tension is increased by the downward movement of the core member B. Instead of constructing the core members from solid pieces of magnetic material, I prefer to form said members from magnetic sheet metal stampings arranged in nested relation, thereby enabling the core members of the solenoid to be formed accurately and at a low cost by a punch press operation. I also prefer to form said core members in such a way that the diaphragm A of the pump will be operated at a speed slow enough to provide ample time for a full charge of fuel to enter the pumping chamber x, at each suction stroke of the diaphragm. To this end I propose to form the movable member B of the core from a plurality of cup-shaped stampings of magnetic material, arranged one within the other, as shown in Figure 1, with the top portions of said stampings disposed upwardly, and form the stationary member B′ of the core from a number of tubular stampings arranged one within the other and provided at their lower ends with laterally-projecting flanges arranged in superimposed relation. Core members of the kind referred to can be made on a punch press by unskilled labor at a lower cost than it is possible to construct solid core members that require machining, and moreover, they are accurate and uniform.

The stationary core member B′ is provided at its upper end with a projection or substantially cone-shaped portion that is arranged in opposed relation to the walls of a tapered or substantially cone-shaped socket in the lower end of the movable core member B, but instead of forming said tapered surfaces of equal length, the tapered surface on one of said members is made of slightly greater length than the tapered surface on the other member. In the form of my invention herein illustrated the tapered surface of greatest length just referred to is formed on the movable member B of the core, and is disposed in such relation with the tapered surface on the stationary core member B′ that the lower edge portion of the tapered surface on the core member will telescope over and be disposed in concentric relation with the cylindrical side of the core member B′ before the member B reaches the end of its downward stroke.

Various means can be used for controlling the solenoid circuit, but I prefer to control said circuit by a manually-operable switch that is closed when the pump is in operation, and an intermittently-operating, quick throw switch which is of such construction that the movement of the movable member B of the core is utilized to mechanically move the contact carrier of the switch so as to progressively increase the pressure of the contacts on each other during the suction stroke of the diaphragm, thereby insuring free passage of the electric current through the contacts of said switch. In the present form of my invention the intermittently operating, quick-throw switch that governs the solenoid circuit comprises two stationary contacts 22 and 23 and a movable contact 24 that is adapted to

bridge the space between the contacts 22 and 23 and connect them together, the contact 22 being grounded and the contact 23 connected to the coil 15 of the solenoid. The movable contact 24 is constructed so that it is capable of revolving so as to bring different portions of same into engagement with the contacts 22 and 23 and is herein illustrated as being carried by an insulator or contact carrier 25, which is revolubly mounted on a block 26 that is loosely mounted on a rod 27 connected to the movable core member B, said rod 27 projecting downwardly through the bottom of the coil housing of the solenoid into a switch housing 28 arranged under said coil housing. The switch housing 28 is detachably connected to the coil housing in any suitable manner. The movable contact 24 is arranged underneath the stationary contacts 22 and 23 and is normally held pressed against said stationary contacts by the expansive force of two springs 29 arranged so that the pressure of same builds up or increases progressively during the downward stroke of the movable member B of the core. In the form of my invention herein illustrated the springs 29 are U-shaped leaf springs arranged horizontally with their upper end portions connected to the block 26, previously referred to, and with their lower end portions connected to two toggle links 30, which, in turn, are pivotally connected or rockably mounted on a collar 31 that is secured to the lower end of the rod 27 at a point below the block 26 through which said rod passes freely. When the solenoid circuit is open the movable member B of the core is held in its elevated position, as shown in Figure 1, by the spring 21 and the movable contact 24 of the intermittent switch is held in engagement with the contacts 22 and 23 by the upward force which the springs 29 exert on the block 26 on which the contact carrier 25 is mounted. As soon as the solenoid circuit is closed by closing the manually-operable switch previously referred to, the movable member B of the core moves downwardly, due to magnetic attraction, and this downward movement of said core member causes the toggle links 30 to exert pressure on the springs 29 in a direction tending to force the block 26 upwardly, thereby exerting an upward thrust on the contact carrier 25, with the result that the pressure of the contact 24 on the contacts 22 and 23 is increased. This pressure increases progressively until the collar 31 on the rod 27 reaches such a point that the toggle links 30 swing past dead center, whereupon the springs 29 will flex in a direction to move the block 26 and contact carrier 25 downwardly, thus moving the contact 24 away from the contacts 22 and 23, and causing the solenoid circuit to be opened. As soon as the solenoid circuit is interrupted the movable member B of the core moves upwardly under the influence of the spring 21, and by the time said core member reaches the end of its upward stroke, the contact 24 engages the contacts 22 and 23, and thus closes the circuit, after which the movable member B of the core will move downwardly, as above described.

If desired, the pump can be equipped with an air-tight chamber C connected with the discharge-passageway 7^a so as to maintain a pressure on the carburetor or other device to which the fuel is being supplied by the pump.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a fuel pump, a solenoid provided with a core composed of a stationary member and a movable member, said members having opposed, cone-shaped surfaces of different lengths arranged in concentric relation and disposed so that one end portion of the cone-shaped surface of greatest length will telescope over the side of the core member that carries the other cone-shaped surface, near the end of the stroke of the movable core member.

2. In a fuel pump, a solenoid composed of a stationary core member and a movable core member, said stationary core member having a cone-shaped portion and the movable core member having a cone-shaped recess of greater length than said cone-shaped portion arranged so that the lower edge portion of same will telescope over the side of the stationary member of the core near the end of the stroke.

3. In a fuel pump, a solenoid provided with a core composed of a stationary member and a movable member having opposed tapered surfaces of different length, each of said core members being constructed from a plurality of sheet metal stampings arranged in nested relation.

4. In a fuel pump, a solenoid provided with a movable core for actuating an external member, an intermittently operating, quick throw switch for governing the solenoid circuit, comprising a shiftable contact carrier that is adapted to be moved towards and away from a stationary contact, and a means rendered operative by the bodily movement of the core during the stroke of said external member for increasing the pressure of the contacts of the switch on each other in a direction to maintain the circuit closed and for separating said contacts with a quick break near the termination of said stroke.

5. In a fuel pump, a diaphragm, a solenoid provided with a movable core, an intermittently operating quick throw switch in the solenoid circuit provided with co-operating contacts, a resilient means that normally holds said contacts in engagement with each other, and a means rendered operative by the bodily movement of the core in one direction

for increasing the pressure which said resilient means exerts on said contacts in a direction to maintain the circuit in its closed condition and for causing said resilient means to separate said contacts with a quick break near the termination of the stroke of said core.

6. In a fuel pump, a solenoid provided with a movable core, an intermittently operating quick throw switch in the solenoid circuit comprising a shiftable contact carrier, a resilient means that normally exerts pressure on said contact carrier in a direction to hold the contacts of the switch in engagement with each other, and a positively operated means rendered operative by the bodily movement of the core in one direction for increasing the pressure which said resilient means exerts on the contacts in a direction to maintain the circuit in its closed condition and for causing said resilient means to separate the contacts with a quick break when the core reaches the end of its stroke.

WILLIAM C. CARTER.