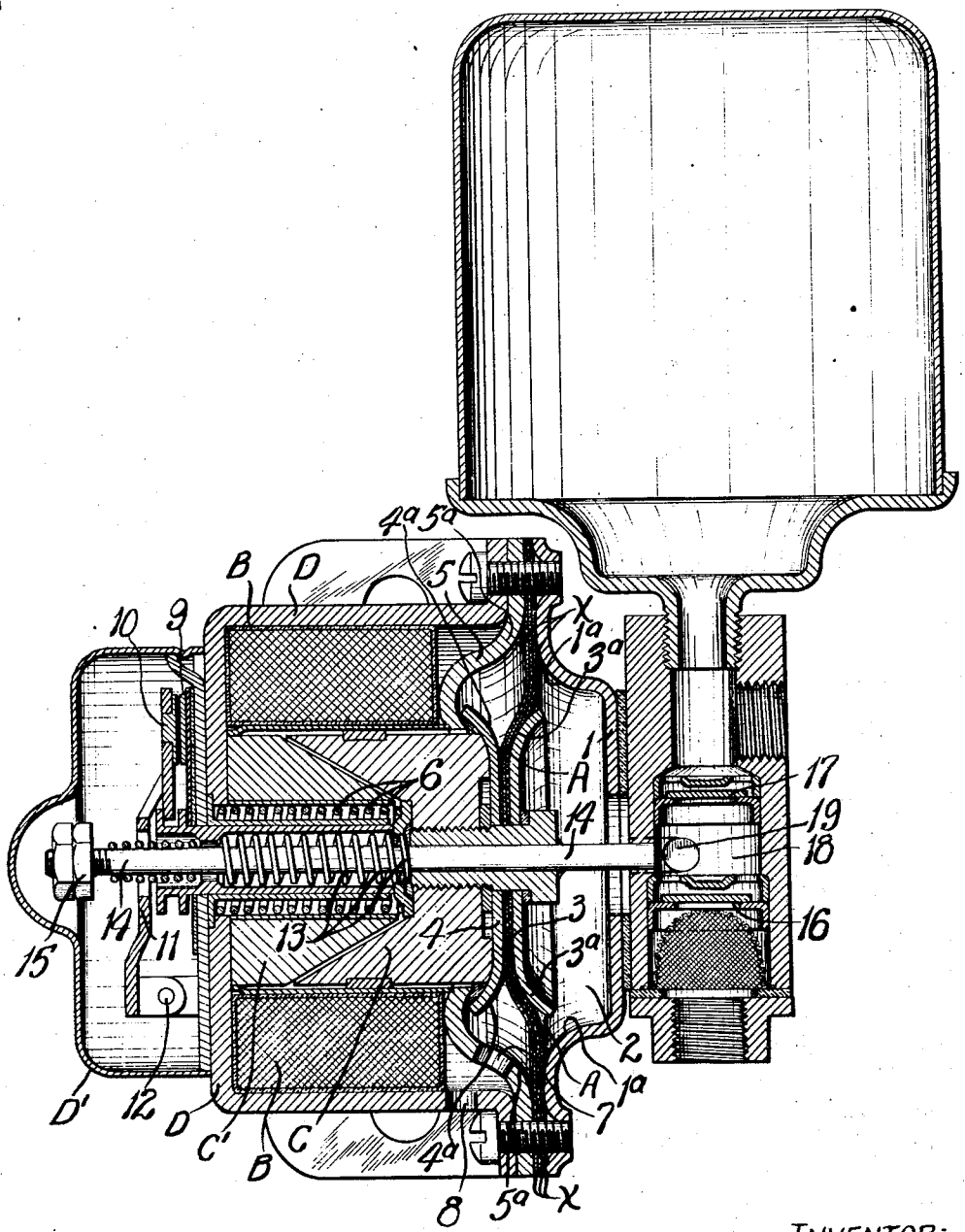
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PUMP DIAPHRAGM

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PUMP DIAPHRAGM.

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This invention relates to diaphragm pumps, and has for its main object to provide a diaphragm pump that can be operated continuously for a long period without liability of the diaphragm fatiguing or breaking down.

Another object is to provide a diaphragm pump that can be used successfully in a fuel supply system for internal combustion engines for drawing gasoline from a source of supply and feeding it to the engine or to a device associated with the engine.

To this end I have devised a pump whose pumping element consists of a diaphragm composed of a plurality of layers of fabric treated to render it impervious to the liquid being handled by the pump without making it stiff, brittle or inflexible, and members arranged at opposite sides of said diaphragm for preventing it from being subjected to sharp bends or strains which tend to weaken or disrupt it when it flexes back and forth. It is immaterial, so far as my broad idea is concerned, what means is used to operate the diaphragm, and the particular purpose for which the pump is used is also immaterial. The pump is particularly well adapted for use, however, in liquid fuel supply systems for internal combustion engines on account of the fact that the diaphragm is of such a character that gasoline has no objectionable effect on same, and moreover, is of such a nature that it will not fatigue or break down when it is operated continuously for long periods, as is necessary in a fuel supply pump for internal combustion engines. Accordingly, I have herein illustrated my invention embodied in an electrically-operated pump designed for use on an automobile or other power-operated vehicle, for drawing gasoline or other liquid fuel from a source of supply and feeding it to the engine or to the carburetor of the engine.

The figure of the drawing is a sectional view of an electrically-operated diaphragm pump constructed in accordance with my invention.

Referring to the drawings, which illustrate one form of the invention, A designates the diaphragm of the pump which is composed of a plurality of layers x of fabric, preferably sea island cotton, sail cloth or aeroplane cloth, that is treated so as to make it impervious to gasoline or water, without making it stiff, brittle or inflexible. One process that I have found to be very successful for treating the fabric from which the diaphragm is made contemplates impregnating the fabric with a linseed oil solution that contains lamp black and a drier, and then drying the treated fabric in an oven. Any other treating process may be used, however, that will make the fabric impervious to liquids of the kind intended to be handled by the pump, without interfering with or destroying the inherent flexibility of the fabric. The diaphragm A is arranged in opposed relation to a rigid member 1 that forms one wall of a pumping chamber 2 and which may consist of a substantially cup-shaped casting or sheet metal stamping. The peripheral edge of the diaphragm A is combined with the member 1 in such a manner that the diaphragm is taut and normally disposed in such a position that pressure exerted on the central portion of the diaphragm in one direction causes it to flex away from the stationary wall 1 of the pumping chamber, thereby creating a suction in said chamber which causes the liquid being pumped to be drawn into said chamber, and pressure exerted on the central portion of the diaphragm in the opposite direction causes it to flex towards the stationary wall 1, thereby causing the liquid in the pumping chamber 2 to be expelled from same. As previously stated, the diaphragm is a laminated structure composed of a plurality of layers of treated fabric, and in order to impart long life to the diaphragm, the layers of fabric of which it is constructed are clamped together only at the center and at the peripheral edge of the diaphragm, thereby permitting the intermediate portions of said layers to move relatively to each other when the diaphragm flexes back and forth.

In order to eliminate sharp bends in the diaphragm A and prevent said diaphragm from being subjected to strains or pressures that tend to disrupt it, I confine the central portion of the diaphragm between two disk-shaped members 3 and 4 whose edge portions are flared in opposite directions so as to form convexed surfaces 3^a and 4^a, respectively, and I confine the peripheral edge portion of the diaphragm between the member 1, previously referred to, and an opposed clamping member 5, which members 1 and 5 are provided with convexed surfaces 1^a and 5^a, respectively, that flare in opposite directions from the point where the peripheral edge portion of the diaphragm is gripped by the members 1 and 5. The means that is used to actuate the diaphragm is connected to the members 3 and

4, which embrace the center portion of the diaphragm, and when the pump is in operation, the movement of said members 3 and 4 away from and towards the stationary wall 1 of the pumping chamber causes the diaphragm to be brought into engagement, first with the convexed surfaces 3^a and 1^a at the right hand side of the diaphragm and then into engagement with the convexed surfaces 4^a and 5^a at the left hand side of the diaphragm. In this way the diaphragm is prevented from being subjected to sharp bends or strains which tend to injure or disrupt it, owing to the fact that the opposed convexed surfaces 3^a and 4^a on the members 3 and 4, respectively, constitute supporting surfaces for the diaphragm that eliminate strains on the diaphragm at the point where it is gripped by said members, and the convexed surfaces 1^a and 5^a on the members 1 and 5, respectively, constitute supporting surfaces for the diaphragm that eliminate strains on same adjacent the point where the diaphragm is gripped by the members 1 and 5. The area and curvature of the supporting surfaces just referred to can be varied, so long as said supporting surfaces are of such design and arrangement that they tend to impart a slight curvature to the diaphragm as it flexes back and forth and also support the diaphragm in such a way, when it is in its two extreme positions, that the strains to which the diaphragm is subjected at such times are not concentrated on the portions of the diaphragm in immediate proximity to the members 3 and 4 that grip the center portion of the diaphragm and the members 1 and 5 that grip the peripheral edge portion of the diaphragm. I am aware of the fact that laminated pump diaphragms have heretofore been constructed from sheets of leather and rubber and from thin sheets of metal, but such laminated diaphragms cannot be used successfully in a pump employed for handling gasoline that forms part of a liquid fuel supply system for an internal combustion engine, because gasoline has an injurious effect on rubber and leather and the continuous flexing of the diaphragm for long periods causes the diaphragm to fatigue and break down if it is constructed of materials of the kind mentioned. My improved pump has neither of the objectionable characteristics above referred to and in numerous tests that have been made to determine the commercial practicability of my pump the diaphragm has shown no defects, even in destructive tests in which the diaphragm was operated continuously for periods far in excess of the normal life of a power-operated vehicle.

As previously stated, my broad idea contemplates the use of any suitable means for actuating the diaphragm of the pump, such as an electrically-operated mechanism, a spring, a mechanical device, or pressure produced by the expansion or compression of a medium. In the pump herein illustrated, which is designed for use on power-operated vehicles for drawing liquid fuel from a source of supply and feeding it to the engine or to a carburetor associated with the engine, the diaphragm A is actuated by an electrically-operated mechanism consisting of a solenoid that comprises a coil B, and a core composed of a movable core piece or member C and a stationary core piece or member C'. The members C and C' are forced apart by an expansion spring 6, and the movable core piece C is rigidly connected to the members 3 and 4 that embrace the central portion of the diaphragm. The coil B of the solenoid is surrounded by a metal housing D that encases the diaphragm clamping member 5, previously referred to, and said housing and diaphragm clamping member are provided with ventilating openings 7 and 8, respectively, so as to establish atmospheric pressure on the outside of the diaphragm A. The electric circuit that is used to energize said solenoid is provided with two switches, one a manually-operated switch (not shown) that is adapted to be closed when it is desired to set the pump in operation, and the other an automatically-operating, intermittent switch that opens and closes said circuit intermittently so as to cause the movable core piece C to reciprocate, and thus actuate the diaphragm A. The intermittent switch just referred to is arranged inside of a removable cover or cap piece D' on the end wall of the housing D and comprises a stationary contact 9 and a movable contact 10. The stationary contact 9 is carried by an insulated member on the end wall of the housing D that is electrically connected with one end of the coil B of the solenoid. The movable contact 10 is carried by a member 11, herein illustrated as a lever, pivotally connected at 12 to a supporting device on the end wall of the housing and adapted to be rocked on its pivot so as to open and close the circuit in which the coil B is arranged. The contacts 9 and 10 are separated to break the coil circuit by means of a hammer or circuit interrupter E arranged so that it will impart a sharp blow to the lever 11 which carries the movable contact 10 at or about the time the movable core piece C reaches the end of its inward stroke, namely, the end of its stroke to the left. During the inward stroke of said movable core piece energy is stored up in a spring 13 that is combined with the hammer E, and when the polarity of the magnetic force changes, due to the movable core piece C coming in contact with the stationary core piece C', the hammer E moves under the influence of the spring 13 and strikes the lever 11 a blow in a direction to separate the contacts 9 and 10 with a quick break. The means used to move the lever 11 in a direction to close the circuit

in which the contacts 9 and 10 are arranged consists of a rod 14 attached to the movable core piece C and having its outer end projecting through a hole in the lever 11 and threaded so as to receive an adjustable stop 15 that is arranged on the outside of the lever 11, said stop being adapted to bear against said lever and move it towards the stationary contact 9 when the movable core piece C nears the end of its outward stroke, namely, the end of its stroke to the right. After the circuit of the solenoid has been closed, the movable core piece C will move inwardly towards the stationary core piece C′ and the hammer E will be held in an inactive position, due to the magnetic force produced by the current flowing through the core B of the solenoid. As soon as the movable core piece C comes into engagement with the stationary core piece C′, the polarity of the magnetic force changes and immediately thereafter the hammer E will move outwardly under the influence of the spring 13 and strike the lever 11 a blow that separates the contacts 9 and 10, thereby opening the coil circuit. As soon as the circuit is opened or interrupted by the blow imparted to the lever 11 by the hammer E, the movable core piece C moves outwardly under the influence of the spring 6 which was placed under tension by the inward stroke of said movable core piece, and at about the time said core piece C reaches the end of its outward stroke the stop 15 on the rod 14 causes the lever 11 to move into a position to close the coil circuit, whereupon the operations above described will be repeated. Accordingly, so long as the manually-operated switch of the coil circuit is maintained in its closed position, the diaphragm A will flex back and forth and thus cause liquid fuel to be drawn into the pumping chamber 2, past the intake valve 16, and thereafter discharged from said chamber past the discharge valve 17, said valves being arranged in a valve passageway 18 that is connected by ports or ducts 19 with the pumping chamber 2.

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

1. A laminated diaphragm composed of a plurality of layers of fabric treated with a linseed oil solution so as to render said layers impervious to liquids without making them stiff, brittle or inflexible.

2. A laminated diaphragm composed of a plurality of layers of fabric treated to render it impervious to liquids without making the fabric inflexible, and means for clamping said layers together only at the center and at the peripheral portion of the diaphragm, thus leaving the intermediate portions of said layers free to move relatively to each other.

WILLIAM C. CARTER.