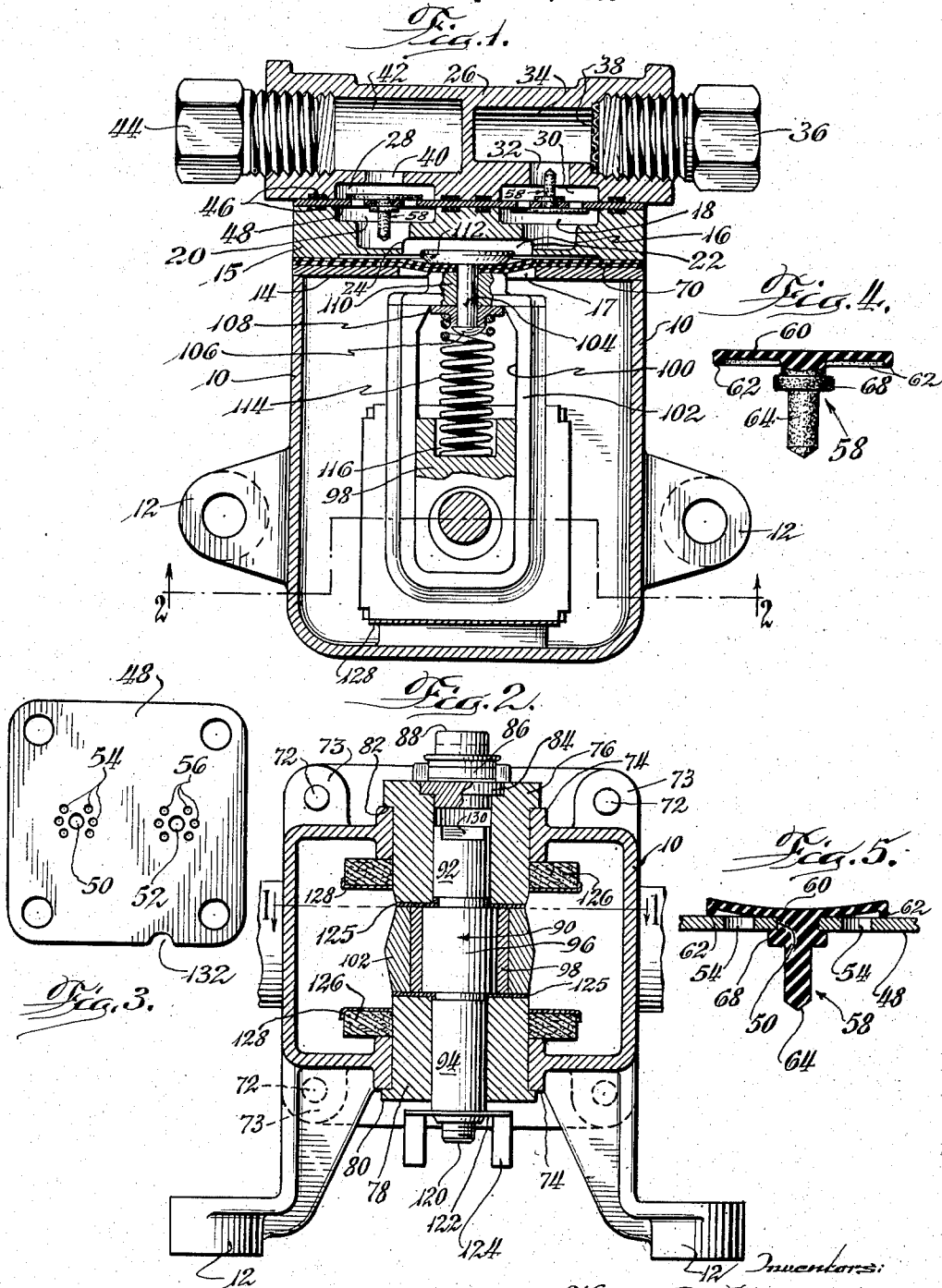


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CONSTANT PRESSURE LIQUID PUMP

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CONSTANT PRESSURE LIQUID PUMP

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1 Claim. (Cl. 103—150)

The present invention relates to constant pressure pumps, particularly to a small motor driven pump intended primarily for supplying fuel under pressure to the spray nozzle of a vehicle combustion heater.

One of the objects of the present invention is to provide an improved pump for delivering liquid fuel at substantially constant pressure to the spray nozzle of a combustion heater.

An additional object is to provide a pump of the above type which can be manufactured at relatively low cost and which, in spite of its low cost, will have a long and trouble-free service life and which can be assembled or disassembled readily.

An additional object is to provide a novel pump of the type described which will operate in either direction and is suitable for coupling directly to the shaft of a relatively high speed electric motor such as may be used for operating a heater combustion air blower in addition to the pump of the present invention for instance.

Other objects and advantages will become apparent from the following description of a preferred embodiment of our invention which is illustrated in the accompanying drawings.

In the drawings, in which similar characters of reference refer to similar parts throughout the several views:

Fig. 1 is an enlarged vertical sectional view through a pump embodying our invention. This view may be considered as being taken in the direction of the arrows substantially along the line 1—1 of Fig. 2;

Fig. 2 is a transverse sectional view which may be considered as taken substantially along the line 2—2 of Fig. 1 looking upwardly as indicated by the arrows;

Fig. 3 is a plan view of a valve plate forming a portion of the mechanism of the present invention;

Fig. 4 is a molded rubber element which forms a portion of the valve mechanism of the pump illustrated; and

Fig. 5 is a fractional vertical sectional view showing one of the assembled pump valves.

Although the pump of our invention has other applications, as will be apparent, it is particularly adapted for supplying fuel to the spray nozzle of a spray type burner adapted for use in a vehicle heater of the combustion type. This type service requires that the pump supply liquid fuel, usually gasoline, at a substantially constant pressure, which may suitably be of the order of twenty to twenty-five pounds per square inch when gasoline is used. Pumps of this duty, however, may be of quite low volumetric capacity, ordinarily less than one-half gallon per hour or so being adequate. They should be as small as is reasonably possible and operate upon a low power input. A pump of this type should preferably be operable at high rotational speed and in either direction so that the pump can be directly coupled to a high speed electric motor used primarily for driving a blower for instance. Furthermore, it is of course a great advantage to be able to manufacture pumps fulfilling the above conditions at low cost.

Referring primarily to Figs. 1 and 2 of the drawings,

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it will be seen that the pump includes a generally rectangular crankcase 10 suitably formed as a die casting, which has a pair of ears 12 at the front side for the purpose of attaching the pump to an electric motor or other suitable mounting and driving means. The crankcase has a closed bottom and is open at the top, the top being covered by a plate 14 with a hole 17 in the center thereof. Another plate 15 above plate 14 provides a pumping chamber 16 in its lower surface, and a pair of valve chambers 18 and 20 which are formed in the top surface thereof. Valve chambers 18 and 20 have downward extensions which intersect with the pumping chamber 16 at 22 and 24, respectively.

Directly above the plate 15 is a top member 26, the lower surface of which has a pair of reentrant chambers 28 and 30 formed therein in alignment with the chambers 18 and 20 and of substantially the same dimensions. The chamber 30 is connected by a cored passage 32 with an inlet chamber 34 which is threaded to receive a fitting 36 to be connected by tubing to a suitable source of fuel to be pumped. Preferably a screen 38 is provided at the outlet end of the fitting 36 to remove any solid matter that may be present in the fuel.

The chamber 28 is similarly connected through a port 40 with an outlet chamber 42 which is threaded to receive an outlet fitting 44. Fitting 44 is to be connected by a line to the heater burner nozzle.

The contiguous flat surfaces of the plate 15 and the top member 26 are machined to provide annular grooves surrounding the chambers 20, 18, 28 and 30, and these grooves receive resilient sealing gaskets 46 which extend slightly beyond the faces of the members 15 and 26 when in the uncompressed condition. A rectangular valve plate, formed of sheet steel for instance and indicated at 48 is interposed between the members 26 and 15 and this valve plate, as is best shown in Fig. 3, has two holes 50 and 52 extending therethrough in axial alignment with the valve chambers 20 and 28, and 18 and 30. Additional small openings 54 and 56 are formed through the valve plate around but near the openings 50 and 52, respectively.

A pair of identical resilient valve closure members 58 operate in conjunction with the valve plate 48. The valve members 58 are formed as molded soft rubber elements and one is shown enlarged in Fig. 4 in its as-molded condition. It comprises a circular disc-like portion 60 which is shown as being flat on top and comparatively thin. At its periphery the under surface of this disc is shaped to provide a circumferential ridge 62 which extends downwardly slightly. At its center, the underside of the disc portion 60 is connected to a downwardly extending stem 64 which has a diameter at its lower end slightly smaller than the diameter of the central holes 50 and 52. The upper portion of the stem, however, has an outwardly extending circumferential ridge 68 which is so positioned that its upper edge is spaced downwardly from the under surface of the disc 60 by an amount which is slightly less than the thickness of the valve plate 48. Above the ridge 68 the diameter of the stem 64 is such as to be slightly larger than the diameter of the holes 50 and 52.

The valves for the pump are assembled by taking one of the members 58 and pushing the lower end of its stem 64 through the hole 50 from the top and then grasping the lower end of the stem 64 which protrudes below the plate with a pair of pliers for instance and pulling downwardly so as to stretch the rubber stem sufficiently to pull the ridge 68 through the hole 50 into a position below the plate. The stem 64 is then released to complete the assembly. This assembly operation produces a structure as shown in Fig. 5 where it will be seen that the ridge 68 seats tightly against the bottom surface of the plate 48 while the portion of the stem thereabove tightly fits the

hole 50. Furthermore, the center of the disc portion 60 is drawn downwardly against the surface of the plate 48 so that the annular ridge 62 is resiliently pressed against the upper surface of the plate 48 in good contact therewith, thereby providing a line contact between the ridge 62 and the plate 48 on a circle which lies outside the area occupied by the holes 54.

As shown in Fig. 1 of the drawings, the valve just described constitutes the outlet valve for the pump. The inlet valve is assembled in exactly the same fashion excepting that the end of the stem 64 is pushed through the opening 52 from beneath the plate and pulled upwardly so as to produce an assembly substantially identical to that shown in Fig. 5, excepting in the inverted position. This may be seen from an inspection of Fig. 1.

A pair of flexible diaphragms (one could be used, but two give greater life and reliability) formed of rubberized cloth fabric for instance, are shown at 70. They are clamped between the top flat surface of the plate 14 and the lower surface of the plate 15.

Conveniently, the principal elements of the assembly so far described can be secured together by four cap screws 72 which extend downwardly in order through the four corners of the top member 26, the valve plate 48, the intermediate plate 15, the diaphragms 70, and the lower plate 14, and finally are threaded into ears 73 formed integrally with the die casting which supplies the crankcase 10. Conveniently, the members 14, 15 and 26 can be formed as die castings.

At the front and back the crankcase 10 is provided with holes surrounded by annular integrally formed rings 74 which are drilled in alignment to receive flanged sleeve bearing members 76 and 78. In the embodiment shown these bearings are formed of oil-treated sintered bronze and the member 78 is pressed securely into place with its flange 80 at the end thereof against the outer face of the crankcase ring 74. The opposite bearing member 76 is similarly pushed inwardly through the opening in the crankcase surrounded by the ring 74 until its end flange 82 is against the end of the ring 74. However, whereas the bearing 78 forms a press fit with the crankcase 10, the bearing 76 is a light push fit therein so that it may be easily inserted and removed.

The outer end of the opening through the loose bearing member 76 is closed by a headed plug 84 and this bearing member and the plug are retained in place in the crankcase by means of a spring metal clip 86 which has one end bearing against the external end of the plug 84 while the other end of the clip is secured to the back face of the crankcase by a screw 88. By loosening the screw 88, therefore, the metal clip 86 may be swung arcuately to one side so as to permit the bearing member 76 and plug 84 to be pulled out and separated from the crankcase 10. During assembly the bearing member 76 can be slid into its opening in the crankcase 10, and the spring metal clip 86 swung into position so as to overlie the end of the plug 76, after which the screw 88 is tightened.

An eccentric shaft indicated generally at 90 has two end portions 92 and 94 in alignment to fit the bearings 76 and 78, respectively. Between these sections the shaft is shaped to form a cylindrical eccentric portion 96. The eccentric portion is larger than the end portions and fits a cylindrical opening formed through a rectangular block 98 formed preferably of oil treated sintered bronze so as to have good bearing qualities. The side edges of this block are parallel and fit within a slot 100 formed in a yoke 102 suitably produced as a machined die casting. A rivet 104 having a large head 112 with a convex lower surface is passed downwardly through the center of the diaphragm 70, through the center of a generally cylindrical spacer 110 formed as a portion of the yoke which extends through the hole 17, through the yoke and through a stepped washer 108. The lower end of the rivet is headed at 106 against the washer 108 to complete the sub-assembly.

A coil compression spring 114 has its lower end seated within a recess 116 formed in the top of the block 98, while its upper end is seated against the flange of the stepped washer 108. The spring, therefore, acts to urge the yoke 102 and diaphragm 70 upwardly with respect to the block 98.

In Fig. 1 the eccentric shaft is shown as being rotated so as to bring the eccentric portion 96 to its lowermost position, thereby urging the block 98 downwardly as far as it will go. Under this condition the lower surface of the block 98 is brought into contact with the lower end inside surface of the yoke 102, thereby pulling the yoke and the center of the diaphragm 70 downwardly.

As the eccentric shaft rotates beyond this position, the block 98 will be wobbling to one side slightly and moved upwardly, the wobbling action being absorbed by the resiliency of the diaphragm. As the block 98 moves upwardly the spring 114 is progressively compressed, assuming that the diaphragm 70 at its center remains in the same position. When the block 98 reaches its uppermost position, the pressure developed within the spring 114 will be at a maximum, and if the pressure within the chamber 16 above the center of the diaphragm is insufficient to resist this spring pressure, the spring will move the diaphragm upwardly at the center so as to displace some of the liquid fuel within the pump chamber 16 out through the valve in the chamber 20 and thence to the outlet fitting 44. During the next 180 degrees of rotation of the eccentric shaft the pressure in the spring 114 will be relieved to some extent and eventually the lower end of the block 98 will be brought against the inside surface at the bottom of the yoke 102 thereby pulling the yoke and the center of the diaphragm downwardly with the result that liquid fuel is drawn inwardly through the fitting 36 and inlet valve into the valve chamber 16 and thence to the pump chamber 22, thereby refilling the pump chamber.

The pressure developed by the pump, therefore, is a function of the force developed by the spring 114 and the area of the portion of the diaphragm 70 exposed to the fuel within the pump chamber 116. The maximum stroke of the pump is relatively slight (of the order of .04 inch in the embodiment illustrated) and therefore the maximum change in the length of the spring 114 and the change in the pressure developed thereby is never very great. The result is that the pressure on the outlet side of the pump always remains substantially constant, excepting during the instant of refilling the pump chamber 16, since any tendency of the outlet pressure to drop below a predetermined level results in the spring displacing the diaphragm upwardly and passing more fuel to the pump outlet. Whenever fuel is not required at the nozzle (such as occurs when a valve in the fuel line is closed) the block 98 continues to move upwardly and downwardly so as to follow the eccentric shaft, but the yoke 102 will remain in substantially fixed position, excepting for the side to side wobbling, and the entire stroke of the block 98 will be absorbed in the spring 114.

The end 94 of the eccentric shaft is threaded as at 120 for connection to a driving motor or other suitable means for rotating the shaft 90. As shown, the end of the shaft 96 is simply threaded to a sheet metal nut 122 having a pair of outstanding wings 124 at its ends which can extend into grooves at the side edges of a rubber block. Another similar wing nut engages the same rubber block at right angles thereto and is connected to a motor shaft for instance, so that the drive is taken from the motor to the shaft 94 through the rubber block, thereby providing a universal joint between these elements. Such simple universal joints are well known and need no description here, particularly since the arrangement for connecting the end 94 of the shaft 90 to the driving mechanism for the pump forms no part of the present invention.

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Any side thrust of the yoke 102, or the block 98, or the eccentric shaft 90 is taken by a pair of thin, hard, thrust washers 125 which are positioned between the inner ends of the bearing members 76 and 78 and the substantially flush faces of the eccentric 96, the block 98, and the yoke 102.

A reservoir for additional lubricant is provided by a pair of rectangular felt pads 126 which have openings through the center thereof adapted to fit the outside surfaces of the bearing members 76 and 78 tightly, these pads being maintained in position outwardly against the inside surfaces of the crankcase by a U-shaped spring metal retainer 128 which has a pair of upstanding side members engaging against the inside surfaces of the pads 126 and an integrally formed cross-member at the lower end thereof which connects these two upstanding portions.

The pump described above is assembled in the following fashion: The rubber valve discs 58 are inserted and attached to the valve plate as previously described, and the sealing rings 46 are inserted in their respective depressions. Also preassembled is the mechanism made up of the yoke 102, the rivet 108, and the diaphragm 70. Thereafter, one of the oil retaining pads 126 is slid over the inner end of the bearing member 78 previously pressed into place in the crankcase, and the other pad 126 is approximately located and these two pads are retained in position by the spring metal member 128.

The yoke 102, the block 98, and the spring 114 are then preassembled and the lower end thereof is inserted into the open end of the crankcase 10. The eccentric shaft then has the end 94 inserted through the large opening at the back of the crankcase, through one of the thrust washers 125 through the opening in the block 98, through the other thrust washer 125, and finally through the bearing member 78. The other bearing 76 is then pushed into place. In so doing the inner end of the bearing 76 passes through the center hole in the felt pad 126. If alignment is not immediate, the assembler can insert a finger through the top opening in the crankcase 10 so as to push the pad 126 and the adjacent end of the retainer 128 into an appropriate location.

The rubber diaphragms 70 are then crumpled together and passed upwardly through the hole at the center of the plate 14 and the eccentric shaft 94 is turned so as to bring the eccentric portion to the bottom of its stroke. As an aid to the operator in performing this manipulation, the eccentric shaft may have a flat spot thereon as indicated at 130. It is shown as being in such a position that the block 98 and yoke 102 are at the end of the intake stroke when this flat spot is toward the bottom of the crankcase. After this operation has been accomplished, the diaphragm 70 will automatically spring out into its original position and the block 15 can then be placed thereover. This is followed by the valve plate 48 and the top member 26. The cap screws 72 are thereafter inserted and tightened and the plug 84 is located

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and retained by the spring clip 86 to complete the assembly.

As an aid in orienting the plate 14, the member 15, the valve plate 48 and the top member 26, properly with respect to each other and to the crankcase 10, it is convenient to notch each of these elements as indicated at 132 in Fig. 3 during their manufacture in such fashion that when the parts are appropriately oriented these notches line up and form a groove extending along a vertical line.

From the above description of a preferred embodiment of our invention it will be appreciated that all of the elements which form this pump are simple to fabricate and can readily be assembled into an operative device. Furthermore, the disassembly operation is extremely easy, since it is necessary merely to loosen the screw 88 and remove the cap screws 72 in order to separate the elements into the various individual parts and subassemblies of which the pump is composed. It will also be appreciated that variations and modifications may be made in the device illustrated without departing from the scope or spirit of the invention and that therefore the scope of this invention is to be measured by the scope of the following claim.

Having described our invention, what we claim is new and useful and desire to secure by Letters Patent of the United States is:

In a pump, a rotatable shaft having an eccentric in the central portion thereof which is larger than the ends of said shaft, a block having an opening therethrough fitted to said eccentric, a yoke including a central opening reciprocally receiving and guiding said block, the faces of said eccentric, said block and said yoke which are normal to the axis of said shaft at each end of said eccentric being substantially coplanar, a pair of thrust washers carried by said shaft in engagement with said faces, means restraining the thrust washers against axial movement away from the faces so that said single pair of washers act as thrust elements for said eccentric shaft and said block and said yoke, resilient means interposed between said block and one end of said yoke and tending to urge said one end of said yoke away from said block, said block impinging against the other end of said yoke to move said yoke in the opposite direction, a pump diaphragm connected to said one end of said yoke, means forming a pump chamber having inlet and outlet valves, said chamber being closed on one side by the face of said diaphragm which is away from said yoke.

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