

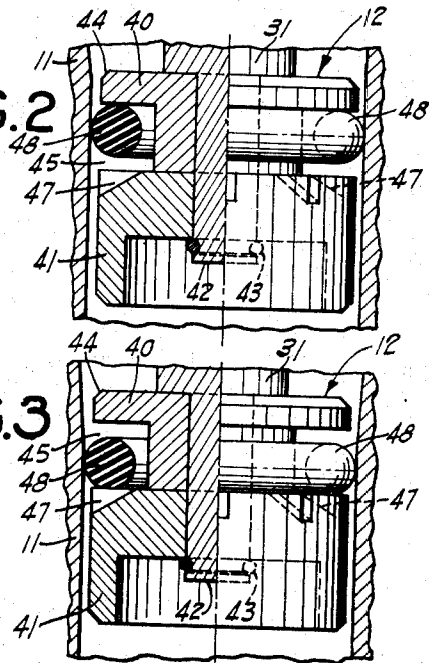
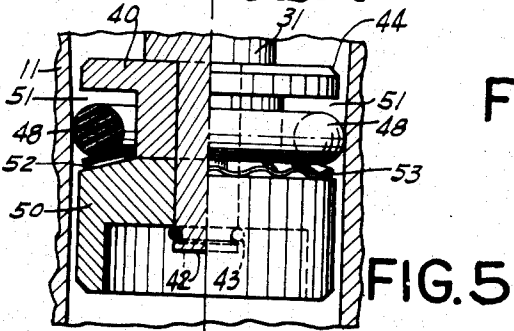
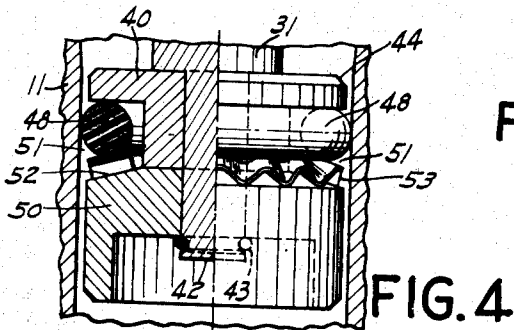
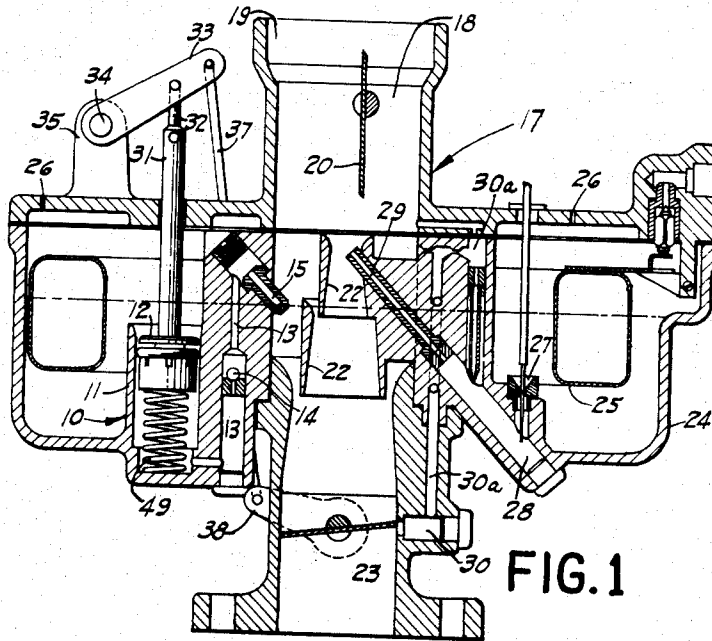
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LIQUID PUMP

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## LIQUID PUMP

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6 Claims. (Cl. 103-178)

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This invention relates to liquid pumps, particularly to pumps of the reciprocating piston expansible chamber type.

An object of this invention is to provide a pump of the expansible chamber type in which the need for separate inlet valve is eliminated, by combining the functions of piston sealing and admission of liquid to the pumping chamber.

Another object is to provide a pump of this type in which liquid is admitted to the expansible chamber through the annular space between the piston and the cylinder wall.

An additional object is to provide a pump of this type having automatic yet simple and inexpensive means for opening the annular passage between the piston and cylinder wall during the intake movements of the pump and for sealingly closing this passage during discharge movements.

A further object is to provide in a pump of this type sealing means for the purpose indicated above which will conform to the most minute irregularities in the cylinder wall so as to form a liquid tight seal, and which will be freely movable with respect to the cylinder wall.

Further objects and advantages will appear from the specification and accompanying drawings, in which:

Fig. 1 is a sectional view of a pump applied to a carburetor;

Fig. 2 is a fragmentary side view of the pump, partially sectionalized, showing the piston as it appears during the discharge stroke;

Fig. 3 is a fragmentary side view of the pump, partially sectionalized showing the piston as it appears during the intake stroke;

Fig. 4 is a fragmentary side view of a modified form of my pump, partially sectionalized, showing the piston as it appears during the discharge stroke; and

Fig. 5 is a fragmentary side view of the modification, partially sectionalized, showing the piston as it appears during the intake stroke.

Referring now to the drawing, the numeral 10 generally indicates a reciprocating pump comprising a cylinder 11, piston 12, outlet passages 13, having outlet check valve 14, therein, and discharge nozzle 15. In the embodiment shown, cylinder 11 is slightly flared at its upper open end and forms part of the wall structure of a carburetor, generally indicated at 17. Carburetor 17 comprises a mixture conduit 18 flanged at its lower end or outlet for attachment to the intake manifold of an internal combustion engine and having an air inlet 19 at its upper end, a choke valve 20 therein for regulating the admis-

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sion of air, stacked venturis 22, and a throttle valve 23 for regulating the discharge therefrom. Carburetor 17 is also provided with a conventional constant level fuel chamber 24 in which the fuel level is controlled by float 25. Air at atmospheric pressure is admitted to chamber 24 through air vents 26. Fuel is supplied to the mixture conduit from chamber 24 by metering valve 27, passage 28, and discharge nozzle 29, and by idle port 30 and associated passageways 30a. Additional fuel for acceleration is provided by pump 10, located within the constant level fuel chamber 24; cylinder 11 of pump 10 is open at its upper end, its upper edge being somewhat below the level of fuel in chamber 24, so as to be at all times submerged. Piston 12 is provided with a stem 31 connected at its upper end by link 32 with lever 33 which is fulcrumed at one end as at 34, in boss 35 on the fuel chamber cover. A link 37 connects the free ends of lever 33 and crank 38 mounted on the throttle shaft, so that opening and closing movements of the throttle cause respectively downward and upward movements of piston 12.

Piston 12, as best shown in Figs. 2 and 3, consists of collar 40 and head element 41, mounted on narrowed lower end portion 42 of stem 31, and secured in abutting relation to each other by a snap ring 43 in the grooved extremity of stem end portion 42. Collar 40 is of substantially less diameter than cylinder 11 and is formed with an upper annular shoulder 44 of just slightly less diameter than the cylinder, so that it forms with head element 41 a substantially solid undersized piston having a relatively deep annular groove 45 in its peripheral surface. Piston head 41 is in form an inverted cup and has formed in its upper surface a plurality of equally spaced radial outwardly sloping slots 47, the purpose of which will be seen below. An annulus 48, of circular cross-section, is mounted in annular groove 45. The outer diameter of annulus 48 is slightly greater than the inner diameter of pump cylinder 11, so as to be at all times in sealing engagement with the latter. The cross-section diameter of the annulus is slightly less than the height and depth of groove 45 in order to permit vertical movement of the annulus between the upper and lower edges of groove 45. This also permits liquid to flow from above collar 40, through the annular space between the periphery of shoulder 44 and the cylinder wall, and around the inner surface of annulus 48, when annulus 48 is in its lowermost position relative to piston 12, as shown in Fig. 3. It should be noted that, although an annulus of circular cross-section is shown in the

drawings and described above, the annulus 48 may be of square, rectangular, or other cross-section. A coil spring 49 seated in the lower end of cylinder 11 normally urges piston 12 upwardly so that as throttle valve 23 closes, piston 12 is moved upwardly in submerged cylinder 11, outlet check valve 14 seats, and a partial vacuum is created in that portion of cylinder 11 below piston 12; due to the pressure differential on opposite sides of piston 12 and to frictional resistance between annulus 48 and the cylinder wall, annulus 48 seats on the lower edge of groove 45, and as the liquid above piston 12 is displaced by the piston, it flows around the periphery of shoulder 44, above and inside of annulus 48, through slots 47, around the periphery of head 41 and into the portion of pump cylinder 11 below piston 12.

As throttle valve 23 is moved toward open position, piston 12 is moved downwardly. The difference in fluid pressures on the upper and lower surfaces of annulus 48, and the slight frictional resistance between annulus 48 and the wall of cylinder 11 causes annulus 48 to sealingly seat against shoulder 44, thus obstructing the passage of fuel past piston 12. Thus, during downward movement, the escape of fluid past piston 12 is prevented and pump piston 12 forces the fuel below it through passage 13, outlet check valve 14, and discharge nozzle 15 into mixture conduit 18.

In order that it may accommodate itself readily to irregularities in the cylinder wall, and at the same time be easily slidable therein, annulus 48 is preferably made of a tough yet deformable gasoline resistant material having a low coefficient of friction such as "Teflon," a tetrafluoroethylene resin made by E. I. du Pont de Nemours & Company. "Teflon" is deformable under pressure, but is of low resiliency, so that when forced through the slightly flared open end of pump cylinder 11, a "Teflon" annulus readily conforms to the contour of the cylinder wall, to provide a sealing fit. Relatively free movement of the annulus with respect to the cylinder wall is facilitated by the low friction coefficient of "Teflon" (.09-.12 on polished steel) and by the fact that due to its low resiliency, "Teflon" once conformed to surface irregularities of the cylinder tends to retain its conformation between successive movements of the piston.

Annulus 48 may also be formed of gasoline-resistant synthetic rubber.

A modified form of my invention is shown in Figs. 4 and 5 in which the piston comprises shouldered collar 40 and head 50 mounted on the narrowed lower end portion 42 of stem 31, and secured in abutting relation to each other and to the shouldered portion of stem 31 by a split ring or other securing means. The upper portion of head 50 is of frustro-conical shape sloping downwardly and outwardly so that it cooperates with collar 40 to form a substantially solid piston with an annular groove 51 in its peripheral wall. Groove 51 thus has a horizontal upper surface, a vertical inner surface and a downwardly and outwardly sloping lower surface 52. An annulus 48, as described above, is mounted in groove 51. To retain annulus 48 in sealing engagement with shoulder 44 and to permit the passage of fuel between annulus 48 and lower surface 52 of groove 51, an annular frustro-conical wave spring 53, having substantially the same slope as surface 52 is interposed between annulus 48 and lower surface 52 of groove 51. Frustro-conical wave springs are particularly suitable

because, in cooperation with frustro-conical surface 52, they are self centering; their force has horizontal as well as vertical components so that they not only urge annulus 48 into sealing engagement with shoulder 44, but they also urge the annulus into sealing engagement with cylinder wall 11; even when compressed, wave spring 53 acts as a spacer between annulus 48 and sloping surface 52 to permit the flow of fluid therebetween, thus eliminating the need for slots in head element 50. During upward, or intake movements of the piston due to frictional resistance between annulus 48 and cylinder wall 11 and to the pressure differential applied to the upper surface of annulus 48, spring 53 is compressed as shown in Fig. 5. Thus, the fuel displaced by the upward movement of the piston is permitted to flow around the periphery of shoulder 44 between annulus 48 and the upper and vertical wall portion of groove 51, between the corrugated surfaces of wave spring 53 and respectively, annulus 48 and sloping surface 52 and through the annular space between head 50 and cylinder wall 11 into the portion of cylinder 11 below the piston. On the downward, or discharge stroke, spring 53 expands, urging annulus 48 upwardly into sealing engagement with shoulder 44 and, if a resilient, flexible annulus is used, outwardly into more positive sealing engagement with the wall surface of cylinder 11.

It is to be understood that pumps constructed according to this disclosure are adapted to a wide range of uses and are not limited to the embodiment disclosed herein; consequently, the exclusive use of all modifications of the invention as come within the scope of the appended claims is contemplated.

What is claimed is:

1. In a pump, a cylinder having an inlet end communicating with a supply of liquid and an outlet port in its opposite end, an undersize piston in said cylinder having an annular groove in its periphery, an imperforate annulus mounted for axial movement in said groove, said annulus being of larger internal diameter than the external diameter of any portion of the inner wall at the bottom of said groove in sealing engagement with the wall of said cylinder, fluid passage means connecting the inner portion of said groove and the space formed between the periphery of said piston and said cylinder wall, said fluid passage means being adjacent the portion of said annulus nearest the outlet end of said cylinder, and means for imparting reciprocating motion to said piston to engage said annulus with the edge of said groove adjacent the inlet end of said cylinder to close said fluid passage on the working stroke of said pump and to disengage said annulus on reverse movement to open said passage.

2. In a pump, a cylinder having an inlet end communicating with a supply of liquid and an outlet port in its opposite end, an undersize piston in said cylinder having an annular groove in its periphery, an imperforate annulus mounted for axial movement in said groove, said annulus being of larger internal diameter than the external diameter of any portion of the inner wall at the bottom of said groove in sealing engagement with the wall of said cylinder, a plurality of radial slots in the edge of said groove nearest the outlet end of said cylinder to permit the emission of liquid from said groove, and means for imparting reciprocating motion to said piston to engage said annulus with the edge of said groove adjacent the inlet end of said cylinder to close said fluid

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passage on the working stroke of said pump and to disengage said annulus on reverse movement to open said passage.

3. In a pump, a cylinder having an inlet end communicating with a supply of liquid and an outlet port in its opposite end, an undersize piston in said cylinder having an annular groove in its periphery, an imperforate annulus mounted for axial movement in said groove, said annulus being of larger internal diameter than the external diameter of any portion of the inner wall at the bottom of said groove in sealing engagement with the wall of said cylinder, a frusto-conical wave spring means on said piston lightly urging said annulus outwardly of said annular groove and into sealing engagement with the edge of said groove nearest the inlet end of said cylinder, fluid passage means connecting the inner portion of said groove and the space formed between the periphery of said piston and said cylinder wall, said means connecting the inner portion and piston periphery being adjacent the edge of said groove nearest the outlet end of said cylinder, and means for imparting reciprocating motion to said piston to engage said annulus with the edge of said groove adjacent the inlet end of said cylinder to close said fluid passage on the working stroke of said pump and to disengage said annulus on reverse movement to open said passage.

4. In a pump, a cylinder having an inlet end communicating with a supply of liquid and an outlet port in its opposite end, an undersize piston in said cylinder having an annular groove in its periphery, an annulus of tough, deformable material of low resiliency and with a low coefficient of friction on smooth metal surfaces being loosely mounted in said groove and slidable in said cylinder, said annulus being force-fitted into said cylinder to sealingly conform to irregularities in the wall structure thereof, a frusto-conical wave spring means on said piston lightly urging said annulus outwardly of said annular groove and into sealing engagement with the edge of said groove nearest the inlet end of said cylinder, means formed by said spring adjacent the edge of said groove nearest the outlet end of said cylinder for permitting the passage of liquid from the inner portion of said groove to the periphery of said piston, and means for imparting reciprocating motion to said piston to engage said annulus with the edge of said groove adjacent the inlet end of said cylinder to close said fluid passage on the working stroke of said pump and to disengage said annulus on reverse movement to open said passage.

5. In a pump, a cylinder having an inlet end communicating with a supply of liquid and an outlet port in its opposite end, an undersize piston in said cylinder having an annular groove in its periphery, an annulus loosely mounted in

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said groove, said annulus being constantly in sealing engagement with the wall of said cylinder, an annular frusto-conical radially corrugated wave spring interposed between said annulus and the edge of said groove nearest the outlet end of said cylinder to urge said annulus outwardly of said annular groove and into sealing engagement with the opposite edge of said groove, the spaces between the corrugations of said spring being adapted to permit the passage of liquid from the inner portion of said groove to the periphery of said piston, and means for imparting reciprocating motion to said piston to engage said annulus with the edge of said groove adjacent the inlet end of said cylinder to close said fluid passage on the working stroke of said pump and to disengage said annulus on reverse movement to open said passage.

6. In a pump, a cylinder having an inlet end communicating with a supply of liquid and an outlet port in its opposite end, an undersize piston in said cylinder having an annular groove in its periphery, an annulus of tough, deformable material of low resiliency and with a low coefficient of friction on smooth metal surfaces being loosely mounted in said groove and slidable in said cylinder, said annulus being force-fitted into said cylinder to sealingly conform to irregularities in the wall structure thereof, an annular frusto-conical radially corrugated wave spring interposed between said annulus and the edge of said groove nearest the outlet end of said cylinder to urge said annulus outwardly of said annular groove and into sealing engagement with the opposite edge of said groove, the spaces between the corrugations of said spring being adapted to permit the passage of liquid from the inner portion of said groove to the periphery of said piston, and means for imparting reciprocating motion to said piston to engage said annulus with the edge of said groove adjacent the inlet end of said cylinder to close said fluid passage on the working stroke of said pump and to disengage said annulus on reverse movement to open said passage.

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