June 17, 1930. W. A. BRACKETT ET AL 1,764,712

PUMP

Filed Oct. 24, 1927 2 Sheets-Sheet 1

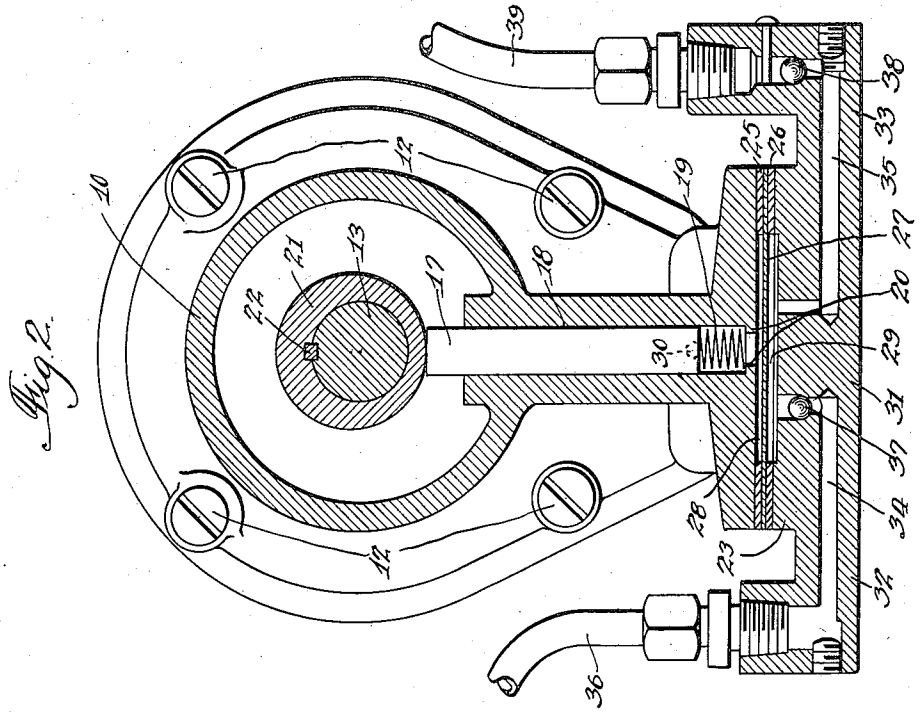

Fig. 2.

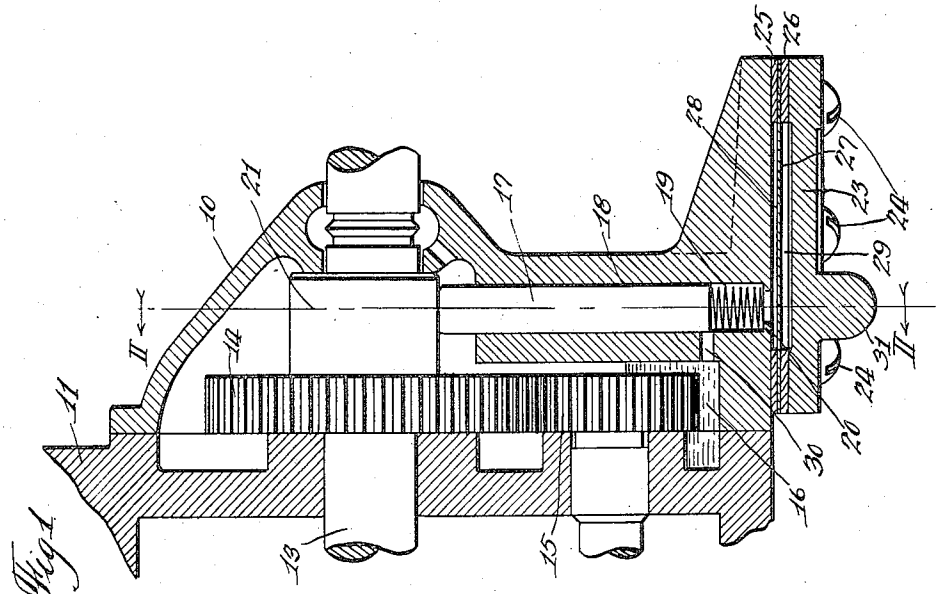

Fig. 1.

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Fig. 4.

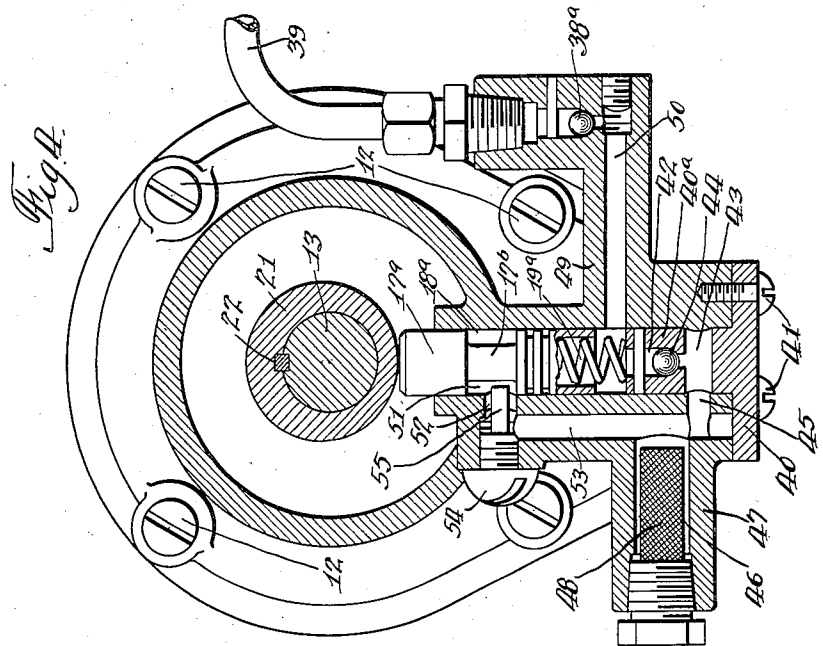
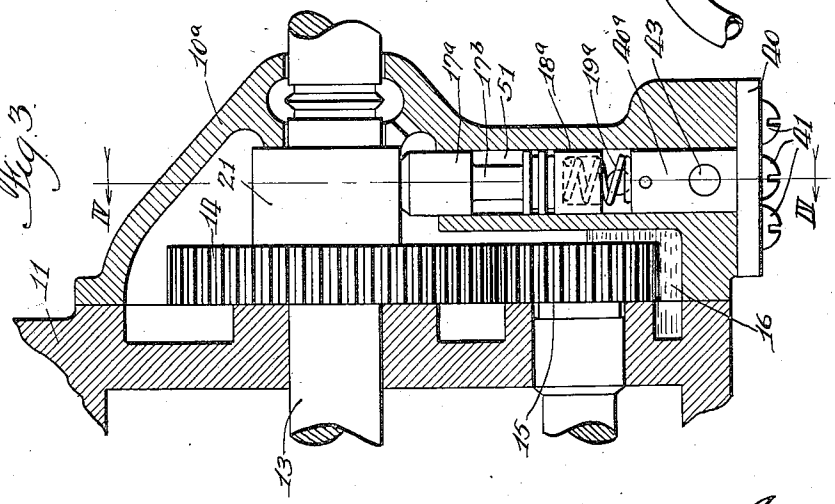


Fig. 3.



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Patented June 17, 1930 1,764,712

UNITED STATES PATENT OFFICE

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PUMP

Application filed October 24, 1927. Serial No. 228,141.

Our invention relates to pumps and has particular relation to reciprocating fluid pumps.

One object of our invention is to provide a reciprocating fluid pump that is adapted to be integrally associated with an internal combustion engine, or other prime mover, and that shall be so constructed that the leakage of the fluid to be pumped is precluded.

One application to which a pump embodying our invention is peculiarly adapted is that of an auxiliary pump associated with an internal combustion engine for the purpose of supplying liquid fuel to the engine. In such installations, it is important for the pump to be so constructed that there will be no leakage of the liquid fuel either outside the engine or into the crank-case of the engine to dilute the lubricating fluid therein. Our invention is adapted to numerous other applications, such, for example, as refrigerating machines and the like. Accordingly, we cite this particular application merely by way of example, and do not wish our invention to be limited in this respect.

Further objects and advantages of our invention will appear from a consideration of the following detailed description in connection with the accompanying drawings, in which:

Figure 1 is a vertical sectional view showing our invention as applied to an internal combustion engine or other machine;

Fig. 2 is a sectional view taken at right angles to the section of Fig. 1, along the line II—II of that figure;

Fig. 3 is a sectional view corresponding to the view of Fig. 1 and showing a modified form of our invention; and

Fig. 4 is a sectional view taken at right angles to the section of Fig. 3, along the line IV—IV of that figure.

Referring to the drawings, in which like reference characters indicate like parts, and first to Figs. 1 and 2, a pump embodying our invention is included within a housing 10 that is adapted to be secured to the main body portion 11 of an internal combustion engine, or other machine, by means of screws 12. The housing 10 also encloses an actuating mechanism such as a portion of a cam-shaft 13 and driving gears 14 and 15 therefor. The housing 10 co-operates with the main portion 11 of the machine to form a chamber 16 to which lubricating fluid may be supplied in any suitable and well known manner for the purpose of lubricating the gears 14 and 15.

A piston 17 is disposed within a cylinder bore 18 in the lower portion of the housing 10 and is biased upwardly by a compression spring 19 which co-acts between the lower extremity of the piston 17 and an annular shoulder portion 20 that is disposed at the lower extremity of the cylinder bore 18. A cam member 21, which is shown as a cylindrical member, is eccentrically mounted on the cam-shaft 13 and is fixed in position with respect thereto by a key 22. The cam 21 is disposed directly above the piston 17 and is adapted to engage the upper extremity thereof to reciprocate the piston 17 within the cylinder bore 18 in accordance with the rotation of the cam-shaft 13.

A base member 23 is secured to the lower surface of the housing 10 by cap-screws 24 and is spaced therefrom by gaskets 25 and 26 and a diaphragm 27. The gaskets 25 and 26 are of pliable material, such as rubber or the like. The diaphragm 27 is of any suitable flexible material and is disposed between the gaskets 25 and 26 to provide a chamber 28 between said diaphragm and the bottom surface of the housing 10 and a chamber 29 between said diaphragm and the base member 23. The chamber 28 is in direct communication with the lower end of the cylinder bore 18 and is adapted to be filled with lubricating fluid from the chamber 16. The lubricating fluid from the chamber 16 is permitted to flow into the lower portion of the cylinder bore 18 and thence into the chamber 28 through a port 30 extending through the wall of the cylinder bore 18 near the lower extremity thereof. The position of the port 30 is such that it will be partially or wholly uncovered by the piston 17 when the latter is in its upper-

most position, but will be wholly closed by the piston when the latter is actuated downwardly a short distance from its uppermost position.

The base member 23 comprises a downwardly projecting portion 31 having outwardly extending portions 32 and 33 at either side thereof. The portions 32 and 33 include passageways 34 and 35, respectively, which extend to the chamber 29. A conduit 36 is suitably connected to the outer extremity of the extended portion 32 in operative relation to the passageway 34 for the purpose of supplying fluid to be pumped to the chamber 29. A ball check-valve 37 is disposed in the passageway 34 to permit the fluid to be pumped to flow into the chamber 29 from the conduit 36, but to prevent a reversal of such flow. The passageway 35 includes a similar check-valve 38, that is adapted to permit fluid to be pumped from the chamber 29 through the passageway 35 to a conduit 39 that is operatively connected therewith at the outer extremity of the extended portion 33.

In the operation of the device shown in Figs. 1 and 2, the piston 17 is reciprocated in accordance with the rotation of the camshaft 13, the compression spring 19 always maintaining the piston 17 in operative engagement with the cam 21. As the piston 17 is so reciprocated, a predetermined amount of lubricating fluid is maintained in the chamber 28 and the lower portion of the cylinder bore 18 by reason of the fact that the port 30 is uncovered each time that the piston 17 attains its uppermost position. When the piston 17 is actuated downwardly from this position, the port 30 is closed thereby and pressure is exerted upon the predetermined quantity of lubricating fluid in the chamber 28 and the lower portion of the cylinder bore 18 in response to the further downward actuation of the piston 17. This pressure is transmitted uniformly to the upper surface of the flexible diaphragm 27 to flex the same downwardly. Assuming that the chamber 29 is filled with the fluid to be pumped, by reason of previous actuation of the pump or suitable priming, the downward flexing of the diaphragm 27 will exert pressure upon this body of fluid to cause a portion thereof to be forced out of the chamber 29 through the passageway 35, the check-valve 38 and the conduit 39 to a suitable reservoir or container (not shown) to which the fluid is to be supplied.

As the piston 17 is actuated upwardly by the force of the spring 19, after being actuated to its lowermost position by the cam 21, the diaphragm 27 returns to its normal position, as shown in the drawing, by reason of its inherent flexibility and the decrease in pressure applied to the upper surface thereof by reason of the retraction of the piston 17 in the cylinder bore 18. The pressure exerted upon the fluid within the chamber 29 is thus decreased to cause the check-valve 38 to be closed and the check-valve 37 to be opened. When the latter valve is opened, a quantity of the fluid to be pumped is drawn into the chamber 29 from a suitable source or reservoir (not shown) through the conduit 36, the passageway 34 and the valve 37. Thus, it will be seen that a predetermined quantity of the fluid to be pumped will be drawn into the chamber 29 with each upward stroke of the piston 17 and that a like quantity will be forced out of the chamber 29 in response to each downward stroke of the piston 17. The fluid is thus transferred from the source to which the conduit 36 is connected to the reservoir or container to which the conduit 39 extends as long as reciprocation of the piston 17 is maintained by reason of the continued rotation of the cam-shaft 13.

The operation of this pump is effected without utilizing any mechanical connection to the diaphragm 27. The resilient mounting of the diaphragm 27 between the pliable gaskets 25 and 26 together with the method of flexing the diaphragm 27 by fluid pressure insures the maximum degree of protection to the diaphragm and prevents injury thereto and failure thereof by reason of crystallization. In this connection it will be understood that the designation of the members 25 and 26 as "gaskets" is not to convey the impression that said members are provided simply to prevent leaks between the separable members 10 and 23. Their primary function is to protect the diaphragm 27 against injury by reason of their resiliency or pliability, as above described, and they are designated as "gaskets" simply for convenience in terminology, which is entirely proper because they are made in the form of gaskets and also perform the usual leak-preventing function of gaskets. The method of admitting actuating fluid to the lower portion of the cylinder bore 18 and to the chamber 28 is such that the volume of liquid so admitted is maintained exactly constant by reason of the fact that the port 30 is opened and closed each time that the piston 17 is reciprocated. Thus, the same degree of pressure is applied to the diaphragm 27 in response to each downward stroke of the piston 17.

Since the chamber containing the fluid to be pumped is entirely separated from the piston and cylinder parts of the pump by the diaphragm 27, it is impossible for this fluid to become mixed with the lubricating fluid to effect dilution thereof. This feature is of great importance where the pump is utilized to supply liquid fuel to an engine and where the lubricating liquid that is supplied to the moving parts of the en-

gine is utilized for actuating the diaphragm. The piston 17 is amply lubricated at all times by reason of the fact that the lower extremity thereof is surrounded by the lubricating fluid.

The modified form of our invention shown in Figs. 3 and 4 of the drawings, comprises a housing 10^a that is secured to the main body portion 11 of the engine, or other machine, by cap-screws 12, in the same manner that the housing 10 of the machine shown in Figs. 1 and 2 of the drawings is so connected. The cam-shaft 13, gears 14 and 15, and the chamber 16 are all arranged in similar manner to corresponding parts of the device shown in Figs. 1 and 2. A piston 17^a is disposed within a cylinder bore 18^a and is adapted to operate directly upon the fluid to be pumped without the interposition of a diaphragm. The piston 17^a is biased upwardly into operative engagement with the cam 21 by a compression spring 19^a, which is operatively disposed between the bottom of the piston 17^a and the top of an upwardly extending portion 40^a of a closure member 40 at the lower end of the cylinder bore 18^a.

The member 40 is secured by cap-screws 41 to the bottom of the housing 10^a and includes, in its upwardly extending portion 40^a, a vertical passageway 42 and a transverse passageway 43 communicating with the passageway 42 through a ball check-valve 44. A passageway 45 in the wall of the cylinder bore 18^a near the lower extremity thereof connects the passageway 43 with a passageway 46 in an outwardly extending portion 47 of the housing 10^a. A conduit 36 is connected to the other extremity of the extended portion 47 in operative relation to the passageway 46 for the purpose of supplying the fluid to be pumped to the cylinder bore 18^a. A strainer 48 is disposed within the passageway 46 for the purpose of preventing solid particles from being carried into the pump.

An outwardly extending portion 49 of the housing 10^a includes a passageway 50 communicating at its inner extremity with the cylinder bore 18^a, and connected at its outer extremity to a conduit 39 through a check valve 38^a.

The piston 17^a comprises an intermediate reduced diameter portion 17^b which forms an annular cavity 51 within the upper portion of the cylinder bore 18^a. A passageway 52 extends through the wall of the cylinder bore 18^a and serves to connect the cavity 51 with the upper extremity of a vertical passageway 53, which extends downwardly to communicate with the passageways 45 and 46. A cap-screw 54 is disposed within the outer end of the passageway 52 to constitute a closure therefor and to support a pin 55 that extends inwardly through the passageway 52 into the cavity 51 to constitute a limit stop for the piston 17^a. The pin is effective to keep the piston 17^a in the cylinder bore 18^a in the event of removal of the housing 10^a from the main body portion 11 of the engine or in the event of removal of the closure member 40 from the bottom of the housing 10^a.

As the cam-shaft 13 of this device is rotated, the piston 17^a is reciprocated and operates directly upon the fluid to be pumped to transfer the same from the source (not shown), to which the conduit 36 is connected, to the reservoir (not shown), to which the conduit 39 extends. This operation corresponds in every respect to that of any ordinary reciprocating pump. Lubricating fluid is supplied to the interior of the cylinder bore 18^a from the interior of the housing 10, wherein such lubricant is supplied to the gears 14 and 15 in any well known manner. The essential feature of this modification of our invention is the method of construction whereby leakage of fluid to be pumped into the interior of the housing 10 is prevented. This result is accomplished by reason of the peculiar construction of the piston 17^a and the provision of the passageways 52 and 53.

Any fluid which escapes from the cylinder bore 18^a past the walls of the piston 17^a is collected in the cavity 51 which is connected by the passageways 52 and 53 to the intake passageway 45 of the pump. Since the pump effects a reduction in pressure in this passageway, any fluid which collects in the cavity is immediately drawn back into the intake portion of the pump, thereby preventing such fluid from escaping into the interior of the housing 10^a to dilute the lubricating fluid therein. The reduced pressure or partial vacuum maintained in the cavity 51 by reason of its connection with the intake portion of the pump also causes a certain amount of lubricating fluid to be drawn into the cylinder bore 18^a from the interior of the housing 10^a to effect lubrication of the piston 17^a.

While we have shown only certain specific embodiments of our invention, it will be seen that various modifications and changes may be made in the details of construction thereof without departing from the spirit and scope of our invention, as set forth in the appended claims.

We claim as our invention:

1. The combination with an internal combustion engine having a cam-shaft, actuating mechanism therefor and a housing for said actuating mechanism adapted to be secured to the body of the engine, of an auxiliary fluid pump comprising a piston adapted to be reciprocated within a cylinder bore provided in an integral portion of said housing, a cylindrical cam eccentrically

mounted on said cam-shaft, a compression spring co-acting between a portion of said housing and said piston to bias the latter into operative engagement with said cam, inlet and outlet conduits for conducting fluid to and from said pump, and a check-valve disposed within each of said conduits to prevent the flow of fluid therethrough in the reverse of normal direction.

2. A fluid pump comprising two fluid chambers, a flexible diaphragm arranged to separate said fluid chambers, means for conducting the fluid to be pumped to and from one of said chambers, a body of actuating fluid disposed within the other of said chambers, means comprising a piston reciprocable within a cylinder bore connected with said last-mentioned chamber for periodically applying pressure to said body of actuating fluid and means located above the level of the major portion of said last-mentioned chamber for supplying actuating fluid thereto, whereby the volume of said body of actuating fluid is maintained at an invariable predetermined value throughout the effective reciprocations of said piston.

3. A fluid pump comprising two fluid chambers, a flexible diaphragm arranged to separate said fluid chambers, means for conducting the fluid to be pumped to and from one of said chambers, a body of actuating fluid disposed within the other of said chambers, means comprising a cylinder having a bore connected with said last-mentioned chamber and a piston reciprocable within said cylinder bore for periodically applying pressure to said body of actuating fluid and means including a port opening into said cylinder bore and controlled in effectiveness by said piston for maintaining the volume of said body of actuating fluid at an invariable predetermined value throughout the effective reciprocations of said piston, the major portion of said last-mentioned chamber being located below the level of said port.

4. A fluid pump comprising two fluid chambers, a flexible diaphragm arranged to separate said fluid chambers, means for conducting the fluid to be pumped to and from one of said chambers, a body of actuating fluid disposed within the other of said chambers, means comprising a cylinder having a bore connected with said last-mentioned chamber and a piston reciprocable within said cylinder bore for periodically applying pressure to said body of actuating fluid, a body of fluid disposed within a third chamber and means including a port connecting said third chamber and said cylinder bore and controlled in effectiveness by said piston for maintaining the volume of said body of actuating fluid within said second-mentioned chamber at an invariable predetermined value throughout the effective reciprocations of said piston, the major portion of said second-mentioned chamber being located below the level of said port.

5. The combination with an internal combustion engine having a cam-shaft, actuating mechanism therefor and a housing for said actuating mechanism adapted to be secured to the body of the engine to form a reservoir for lubricating fluid for said mechanism, said housing having a cylinder bore and a port connecting said bore and said reservoir therein, of an auxiliary fluid pump comprising a piston disposed within said bore, means co-acting between the cam-shaft and said piston for reciprocating the latter to open and close said port alternately and means including a flexible separating diaphragm forming two chambers, one of said chambers being connected with said cylinder bore whereby it is filled with lubricating fluid from said reservoir through said port to cause said diaphragm to be flexed in accordance with the reciprocations of said piston, and the other of said chambers being provided with an inlet conduit for conducting the fluid to be pumped into said chamber when the diaphragm is flexed in one direction and an outlet conduit for conducting said fluid away from said chamber when the diaphragm is flexed in the opposite direction.

6. In an internal combustion engine including a cam-shaft and driving means therefor, a housing for said cam-shaft-driving means and an auxiliary fluid pump built into the same.

7. In an internal combustion engine including a cam-shaft and driving means therefor, a removable housing for said cam-shaft-driving means and an auxiliary fluid pump built into the same to be removable therewith.

8. In an internal combustion engine including a cam-shaft and driving means therefor, a housing for said cam-shaft-driving means and an auxiliary fluid pump of the pulsating diaphragm type built into the same and adapted to contain fluid lubricant for said driving means, said fluid lubricant also serving as the pulsating medium for the diaphragm of said pump.

In witness whereof, we have hereunto subscribed our names.

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WILLIAM EDWARD RICHARD.