

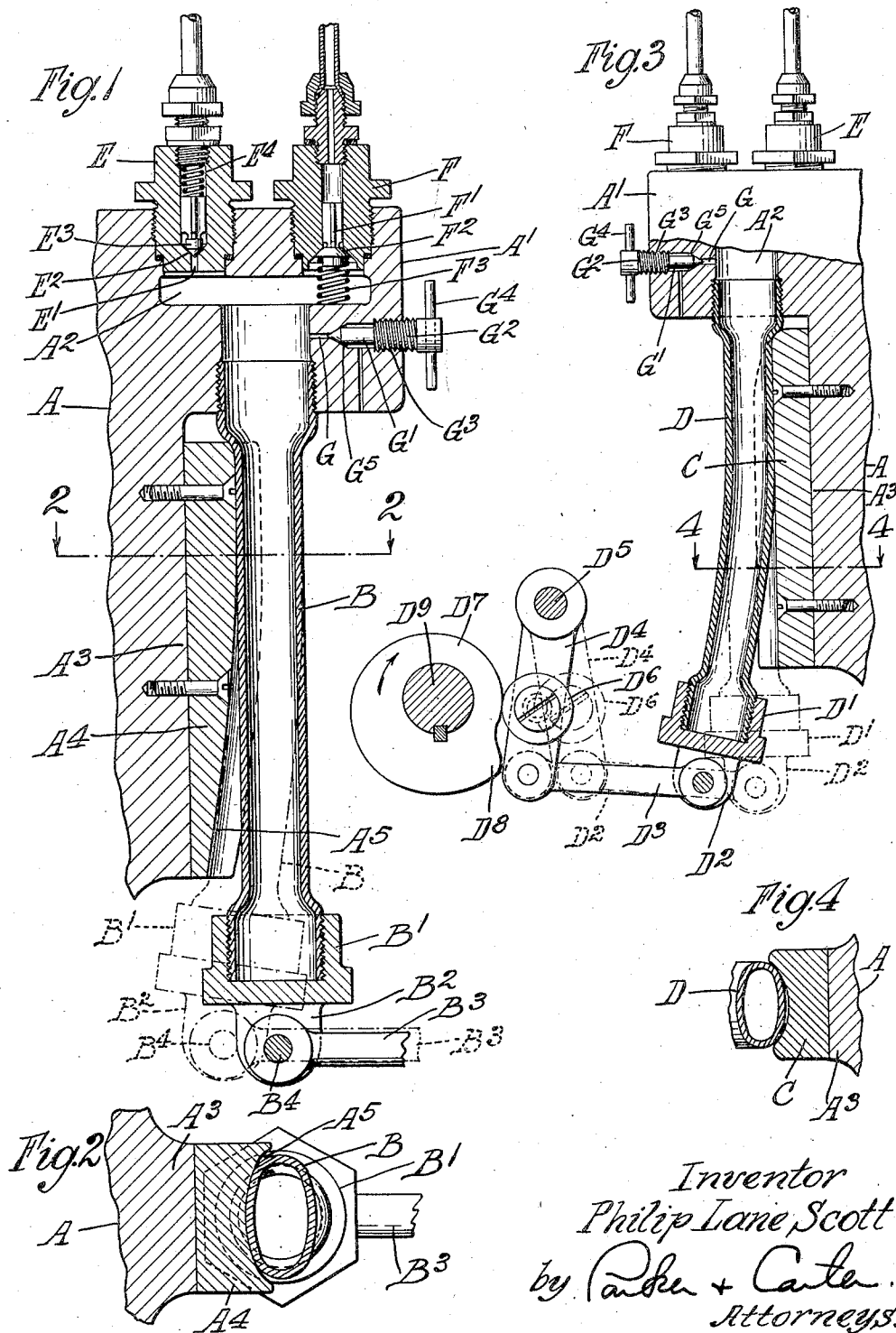
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PUMP

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This invention relates to a pump and has for one object to provide a pump capable of handling small quantities of liquid with great rapidity and under high pressure.

Another object is to provide a pump of this type which shall deliver, at great speed and under great pressures, small quantities of liquid, irrespective of the total quantity handled or compressed by the pump. A further object is to provide a pump in which the quantity of liquid under high pressure may be kept at a minimum relative to the amount discharged by the pump. Another object is to provide a pump of this type in which leakage past sliding surfaces is eliminated. Another object is to provide a pump in which there are no relatively sliding parts within the compression chamber of the pump. Another object is to provide a pump which, in its operation, will avoid mechanical shock.

Other objects will appear from time to time in the specification and claims.

In one form this invention is peculiarly adaptable to use for pumping or supplying liquid fuel to the spray nozzle of an oil engine. The particular requirements of this problem are that relatively small quantities of oil must be delivered positively and with great rapidity at pressures which may be in the neighborhood of 10,000 lbs. per square inch and in some cases may be in excess of this, and with speeds which are of the order of magnitude of .001 of a second. The problem is further complicated by the fact that such pressures may have to be built up from zero to a maximum within .0001 of a second.

In solutions of the problem which have been attempted in the past, it has been common practice to rely upon a plunger pump. The disadvantages of this type are many. It has been difficult to provide a reciprocating joint of sufficient tightness under the high pressures involved. There have been substantial metal masses to be accelerated and stopped and started. Such pumps do not lend themselves easily to the requirement that the total quantity of liquid under pressure shall be at a minimum relative to the amount discharged at each discharge period. These and other difficulties are avoided by the pump of the present invention.

This invention embodies a pump which includes a pump chamber having an elastic wall. The entire chamber wall may be elastic or a portion of it may be elastic. Since the quantities of liquid to be delivered by the pump are small it is possible to flex such an elastic wall or an entire elastic container an amount sufficient to

secure the desired delivery of fluid while keeping well within the elastic limit of the material. Since the quantity of fluid delivered is so small and since the amount of movement is small, the elasticity of the container or its wall or a part of its wall, is so slight that the container or the wall need not be formed as a spring, and, in the ordinary sense of the word, it is the opposite of a spring. Nothing is done by shape or formation to make it a spring and, in fact, a typical form of my invention involves a pump chamber in which the walls are of heavy steel and the amount of flexure which they undergo during the pumping operation may be of the order of .002 inches.

My invention is illustrated more or less diagrammatically in the accompanying drawing, wherein—

Figure 1 is a longitudinal cross section of one form of the pump;

Figure 2 is a transverse cross section taken at line 2—2 of Figure 1;

Figure 3 is a view similar to Fig. 1 illustrating a modified form of my invention;

Figure 4 is a transverse section taken at line 4—4 of Figure 3.

Like parts are designated by like characters throughout the specification and drawing.

A is a pump body having a laterally off-set portion A¹ in which is provided a threaded cavity A² in which are seated an intake and an exhaust valve, described below. The pump body A may have relatively raised portion A³ as illustrated in detail in Figure 2, and upon this may be fastened a cradle A⁴ which has an oval or concave groove A⁵ running along its outer edge.

B is a pump tube. It is threaded into the portion A¹ of the pump body at one end and at its lower end is closed by a cap B¹ which carries a pair of ears B² to which a drive rod B³ is pivoted as at B⁴. The drive may be accomplished in any suitable manner but its effect is to reciprocate the rod B³ and to bend the pump tube on the cradle.

In the modified form illustrated in Figures 3 and 4 the pump body A, A¹ and A² is the same as that shown in the earlier figures. A cradle C which is generally the same as the cradle A⁴ is mounted on the part A³ of the pump body A.

D is a pump tube threaded at one end to the pump body A¹ and communicating with the cavity A² in which are located intake and outlet valves. At its lower end it is closed by a cap D¹ similar to the cap B¹ and carrying ears D². Piv-

oted to the ears D² is a connecting rod D³ which is pivoted at its other end to a link D⁴ which is itself pivoted upon a shaft or stud D⁵. The link D⁴ carries a roller D⁶ which contacts a cam D⁷ having a nose or raised portion D⁸. The cam is fixed to rotate about a shaft D⁹.

Each of the forms of my pump is provided with an intake and an outlet valve. They may be positioned so as to communicate with the cavity A². The discharge valve is mounted in a housing E which is removably positioned in the portion A¹ of the pump body. The housing E is provided with an opening E¹ about which is formed a seat portion E². A valve member E³ may be seated on the seat portion and is normally held seated by a spring E⁴.

F is an inlet valve housing positioned in the portion A¹ of the pump body and communicating with the cavity A². Within it a valve body F¹ is mounted for reciprocation. It may be seated on a seat portion F² of the valve body. A spring F³ tends normally to hold it in the seated position.

G is an air vent communicating with the cavity A² in the pump body. G¹ is a valve member carried on a valve body G² which is mounted in a threaded perforation G³ and carries projections or handles G⁴ by means of which it may be readily rotated. The threaded portion G³ has a seat portion G⁵ in which the valve G¹ may be seated. The valve G¹ may be manipulated to open or close the air vent. Such manipulation will normally be manual and will be carried out whenever it is necessary to free the system from air or gas.

It will be realized that whereas I have herewith shown and described a practical operative device, nevertheless many changes might be made in the size, shape, number and disposition of parts without departing from the spirit of my invention and I wish therefore that my showing be taken as in a sense diagrammatic. Particularly the form of pump chamber and the flexing mechanism might be almost infinitely varied. The entire chamber need not be made flexible and need not be flexed. The major portion of the pump chamber might be rigid and only a small portion might be flexible. The air vent might be omitted.

The use and operation of my invention are as follows:

In the form shown in Figures 1 and 2 a steel tube is used. It is substantially straight and in normal position it is of oval cross section as shown in Figure 2. The upper end is fixed and the lower end is free and by means of the drive which is indicated diagrammatically in Figure 1, the lower end is oscillated or moved. The particular form of driving mechanism will cause the oscillation to take place generally at right angles to the axis of the tube. This, however, is not an essential feature and for some purposes it will be sufficient so long as the tube is bent in any fashion. As illustrated in Figure 1, the tube will be bent or drawn down to one side against the cradle and as its bending increases it is somewhat flattened, the major axis being slightly increased and the minor axis being slightly decreased. The bent position is indicated in dotted lines. The decrease in cross sectional area decreases the volume of the tube content and increases the pressure within the tube, thus unseating the outlet valve and permitting discharge of a portion of the contents of the tube. When the drive mechanism moves

in the reverse direction the tube is released from its bending or distorting load and tends to return to its original straight form. As this takes place, its elliptical cross section increases in the minor axis to its original size, the volume of the tube again increases and thus the pressure is reduced. The inlet valve is forced open and a suction stroke occurs and liquid is drawn into the pump again.

As illustrated in Figures 3 and 4 the pump is initially bent. When the shaft D⁹ rotates the nose D⁸ of the cam D⁷ will contact the roller D⁶ and thus through the movement of the link D⁴ and the rod D³ the tube is moved in a straightening direction. This straightening movement of the curved or bent tube increases the volume of the tube, suction is developed, the intake or inlet valve is opened and fluid is drawn into the pump. Thus a suction stroke occurs. When the cam D⁸ passes beyond the roller the tube is free and moves or snaps back to its original bent position, thus decreasing its volume, raising the pressure within, forcing open the outlet or discharge valve and discharging fluid. Thus a compression stroke occurs.

In each of the forms of the invention it is the pump tube or pressure chamber the walls of which are flexed. The amount of flexure is extremely slight and the tube itself is approximately rigid. It is not in any accepted sense to be considered as a spring or a spring form and it is given no particular shape to increase or accentuate any spring action.

The pump tubes of my invention, of any form, are subject to strains well within their elastic limit. This is accomplished without the necessity of corrugating, fluting or otherwise specially forming the elastic metal wall. The pump chamber is enclosed by walls, wholly or in part approximately rigid, capable of yielding minutely and of returning to their original position of their own elasticity when free to do so. If parts of the wall are not approximately rigid, they are rigid.

It will be understood that the degree of movement or the amount of movement indicated for the tubes in the drawing is intended only to be diagrammatic and is exaggerated, and that the amount of movement of the tubes as shown is greater than it would normally be in practice.

I claim:

1. In a pump, a tubular member, intake and outlet means communicating with said tubular member and means for moving it, and a supporting member, contacting a portion of said tube and adapted to be additionally contacted by the tube when it is moved.

2. In a pump, an approximately rigid tubular member, intake and outlet means communicating with said tubular member and means for moving it, and a supporting member, contacting a portion of said tube and adapted to be additionally contacted by the tube when it is moved.

3. In a pump, a tubular member, intake and outlet means communicating with said tubular member, one end of the tube being rigidly held, the other being free for limited movement and means for moving it, and a supporting member, adapted to be contacted by the tubular member in its movement.

4. In a pump, a tubular member, intake and outlet means communicating with said tubular member, one end of the tube being rigidly held,

the other being free for limited movement and means for moving it, and a supporting member provided with a groove of a cross sectional shape different from that of the tube.

- 5 5. In a pump, an approximately rigid tubular member, forming a part of a pumping chamber, intake and outlet means communicating with said tubular member, one end of the tube

being rigidly held, the other being free for limited movement and means for moving it, and a curved supporting member provided with a groove, generally in axial alignment with the tube and of a cross sectional shape different from that of the tube. 80

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