Sept. 26, 1950 J. N. MORRIS ET AL 2,523,964

PUMP

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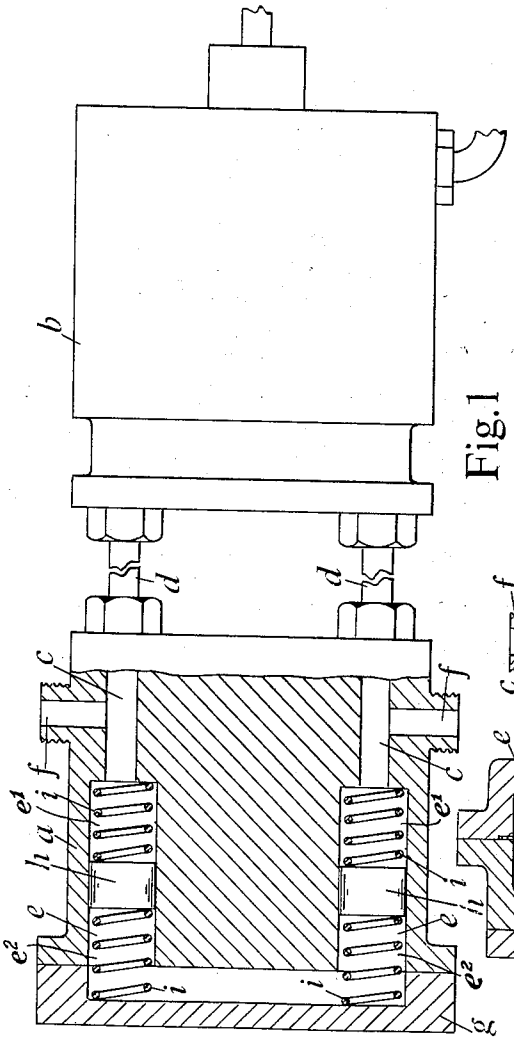


Fig.1

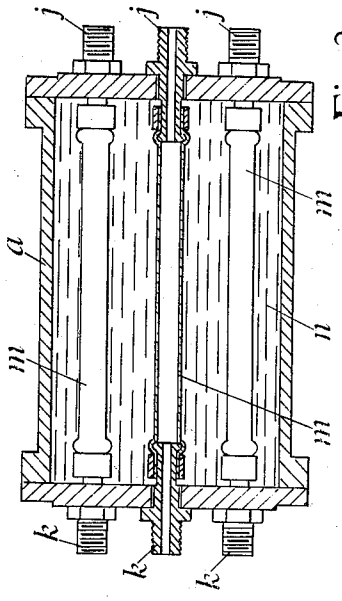


Fig.3

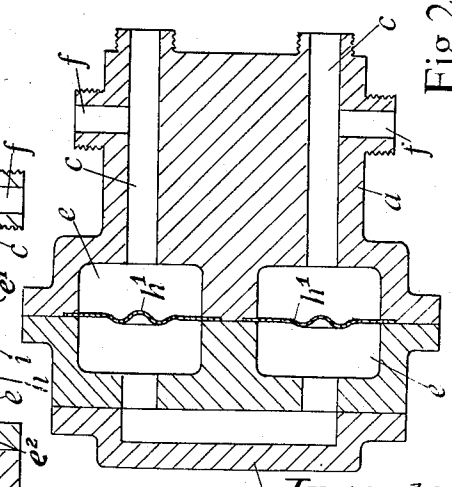


Fig.2

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This invention relates to pumps and particularly liquid fuel pumps, the object of the invention being to provide means for producing uniform rates of delivery at a plurality of discharge positions.

The invention is especially required for use in a liquid fuel supply system in which fuel is discharged through a plurality of separate pipes to corresponding delivery nozzles in the combustion chamber of a turbine or other prime mover, the pump having a plurality of bores and reciprocatory plungers, and valving means whereby communication is successively established between the pump bores and the pipes.

In accordance with our invention, for use with such a pump, we employ a device herein termed a pulsator for minimising intermittency in the flow along the pipes and ensuring uniform rates of flow at the nozzles.

The invention comprises a pulsator having in combination a plurality of chambers of variable volume and adapted to be enlarged intermittently and in sequence by liquid supplied from the pump, and means whereby enlargement of any one of the chambers is accompanied by diminution of, and consequent displacement of liquid from, any one or more of the other chambers.

In the accompanying drawings, Figures 1, 2 and 3 illustrate different embodiments of the invention.

Referring to the example shown in Figure 1, we employ a body part *a* adapted to be arranged in immediate association with the discharge side of the pump represented by *b*. In this body part *a* are formed a plurality of passages *c* each connected directly or by a pipe *d* to a corresponding pump outlet. In the drawing two such passages are shown, but it will be understood that the number of passages provided corresponds with the number of pump outlets, and may be any number more than two. Also in the said body part *a* we form in association with each passage *c* a cylindrical bore *e*, the bores being equally spaced around and parallel with a central axis. Each passage *c* communicates with an outlet *f*, adapted for the connection thereto of a delivery pipe leading to the delivery nozzle. The ends of the bores remote from the passages *c* are in communication with each other, through, for example, a hollow end cover *g*.

In each bore is placed a floating piston *h*, which serves to divide the bore into two coaxial compartments e^1, e^2, and at each side of the piston is placed a spring *i*. If desired a small clearance

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may be provided between each piston and its bore to enable the springs easily to centralise the piston.

When the system is working all the compartments e^2 which are in communication with each other are filled by the liquid fuel. During the action of the pump each compartment e^1 (as well as each delivery pipe) receives in turn a quantity of fuel from the pump, and the consequent movement of the piston in corresponding bore against the action of one of its springs serves to discharge fuel from another compartment or compartments which at that time may be, for example, isolated from the pump by the valving means associated with the discharge side of the pump, the action being transmitted through the liquid at the ends of the bores remote from the pump. By arranging for the volume of each compartment e^1 to be gradually diminished by the action of the associated piston *h* during the whole of the time during which that compartment is not being supplied with liquid by the pump, a substantially continuous flow can be maintained in each pipe.

The example illustrated by Figure 2 is essentially the same as that shown in Figure 1, and differs in that instead of spring loaded plungers slidable in cylindrical bores, a plurality of chambers *e* are provided in the body part *a*, each chamber being divided into two compartments by an elastic diaphragm h^1. One compartment of each chamber communicates by passages *c*, *f* with the associated pump outlet and delivery pipe. The other compartments are in communication with each other through a hollow cover *g*. When any one compartment receives liquid from the pump, the diaphragm is deflected, causing liquid to be displaced from the adjacent compartment to the associated compartments of the other chambers, and the pressure of the displaced liquid on the diaphragm of the compartment or compartments isolated from the pump causes liquid to be displaced therefrom to the associated delivery pipe.

In the example illustrated at Figure 3 we employ a hollow body part *a* having at one end a plurality of pipe connections *j* adapted to be connected to the pump outlets, three such connections being shown, but it will be understood that any number more than two may be used. At the other end are provided corresponding connections *k* for the delivery pipes. Each associated pair of connections *j*, *k*, are interconnected by a hollow elastically deformable chamber. In this example each such chamber is formed by a

flexible elastic tube *m* made from rubber, or rubber like material, or thin corrugated metal. Also the body part *a* is filled with substantially incompressible liquid *n*. When liquid enters any one of the chambers *m* from the pump the chamber is enlarged by the pressure of the pump, causing displacement of the liquid *n*. This liquid *n* is thereby caused to exert pressure on the other chambers *m* causing contraction of the chamber or chambers then isolated from the pump, with resultant displacement of liquid from that chamber to its delivery pipe. Instead of using liquid for transmitting pressure from one expanded chamber to the others, any equivalent mechanical means may be used for performing this function.

Whilst the invention is more especially intended for the particular purpose and for use with a pump of the kind above described, it is not limited thereto, as it may be advantageously used with suitable pumps for the same or other purposes such as the supplying of liquid fuel to furnace burners. Further the invention is not limited to the examples described, and constructional details may be modified to suit different requirements.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is:

1. A liquid flow-controlling device having in combination a plurality of compartments provided with independent inlets and outlets through which liquid under pressure can flow into and out of said compartments, and formed at least in part by independent pressure-responsive members by which the volumes of said compartments are variable in response to the pressure of liquid supplied to said compartments, and means for enabling motion to be transmitted between said members so that increase in the volume of any one of said compartments in response to the pressure of liquid supplied thereto is accompanied by diminution of the volume of, and consequent displacement of liquid from, at least another of said compartments.

2. A liquid flow-controlling device having in combination a plurality of cylindrical chambers each provided at one end with an inlet and an outlet for liquid under pressure, spring-loaded pistons arranged in and responsive to the pressure of liquid supplied to said chambers, and means interconnecting the other ends of said chamber for enabling motion to be transmitted between said pistons.

3. A liquid flow-controlling device having in combination a plurality of chambers each provided at one end with an inlet and an outlet for liquid under pressure, elastic diaphragms situated within said chambers and between the ends thereof, and means interconnecting the ends of said chambers remote from the inlets and outlets for enabling motion to be transmitted between said diaphragms.

4. A liquid flow-controlling device having in combination a hollow body part, and a plurality of elastically deformable chambers in said body part, each chamber having an inlet and outlet for liquid under pressure.

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