Jan. 16, 1940. H. E. GRAU 2,186,968

PUMPING APPARATUS

Filed July 18, 1938 2 Sheets-Sheet 1

Fig. 1

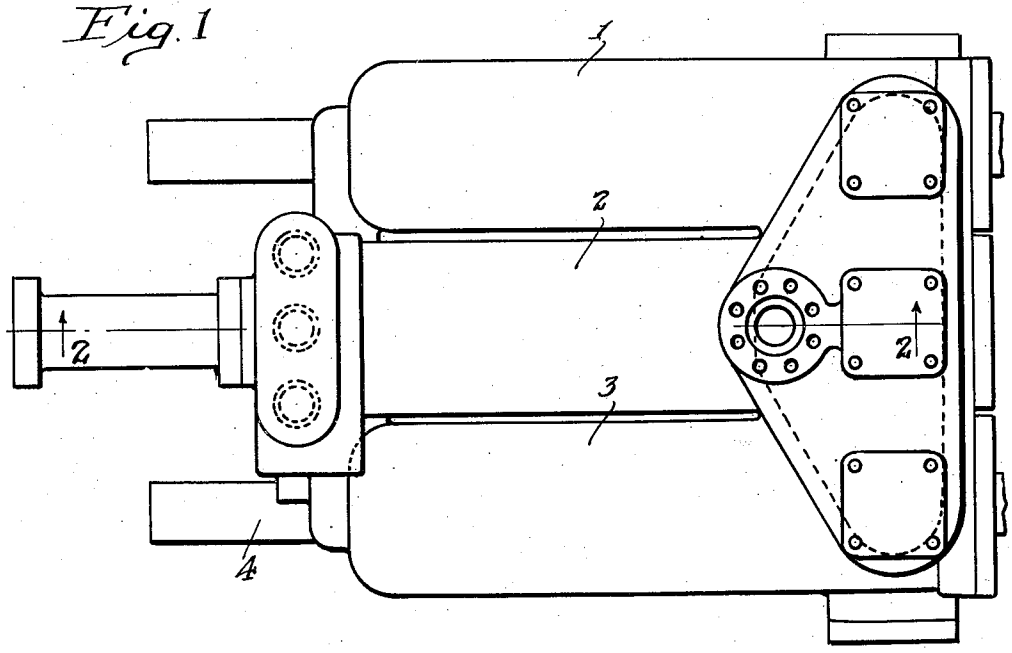
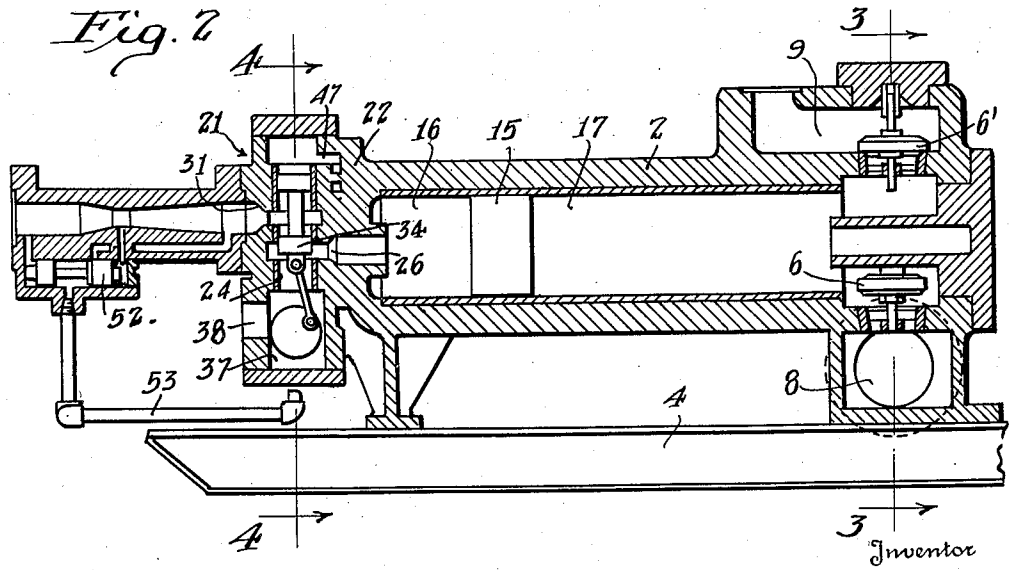


Fig. 2



Inventor

Herbert E. Grau

By Lyon & Lyon

Attorneys

Jan. 16, 1940. H. E. GRAU 2,186,968

PUMPING APPARATUS

Filed July 18, 1938 2 Sheets-Sheet 2

Fig. 3

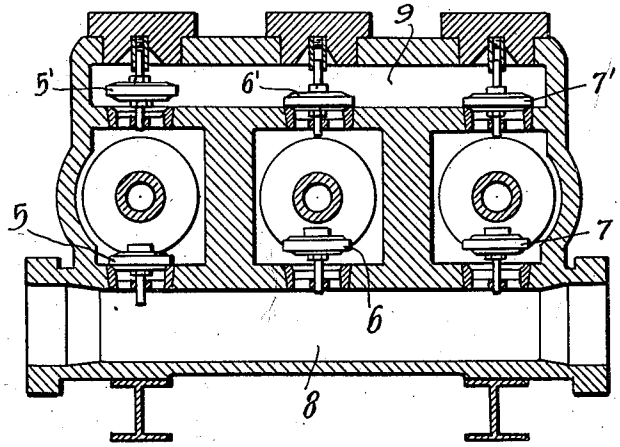


Fig. 4

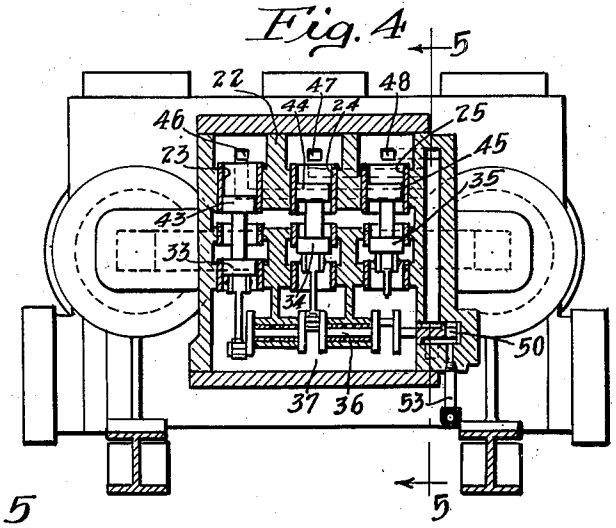
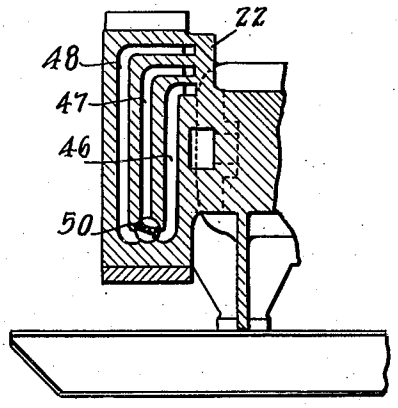


Fig. 5



Inventor

Herbert E. Grau

By Lyon & Lyon

Attorneys

Patented Jan. 16, 1940 2,186,968

UNITED STATES PATENT OFFICE

2,186,968

PUMPING APPARATUS

Herbert E. Grau, Vernon, Calif., assignor to Byron Jackson Co., Huntington Park, Calif., a corporation of Delaware

Application July 18, 1938, Serial No. 219,805

1 Claim. (Cl. 103—52)

This invention relates to hydraulic pumps, and is directed particularly to improvements in a multi-cylinder piston pump wherein motive liquid is applied directly to the pumping pistons.

In an application of Aladar Hollander and Waldemar F. Mayer, Ser. No. 219,804, filed concurrently herewith, there is disclosed a triplex hydraulic pump of the type wherein motive liquid under relatively high pressure is admitted to cylinders on one side of flexible diaphragms therein, to move the diaphragms in a direction to force pump liquid from the cylinder spaces on the opposite sides of the diaphragms. Pump liquid under relatively low pressure is forced into the cylinders on the opposite sides of the diaphragms between intervals of admission of motive liquid, to force out spent motive liquid from the cylinders and to charge the latter with pump liquid preparatory to the succeeding pumping strokes.

An inherent characteristic of a diaphragm pump is the practical limitation on the length of stroke, or the displacement during each stroke. In many cases, short, frequent strokes are desirable, while in other instances a long stroke with relatively infrequent reversals is preferable. The latter is true particularly in the pumping of drilling mud during drilling deep oil wells.

It is a principal object of this invention to provide a pump of the same general type as that described in the aforementioned application, embodying most of the advantageous features thereof, and eliminating the limitation on the length of the stroke.

Other more specific objects will be apparent from the following description, taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a top plan view of the pump;

Fig. 2 is a central longitudinal section taken on line 2—2 of Fig. 1;

Fig. 3 is a transverse section taken on line 3—3 of Fig. 2;

Fig. 4 is a transverse section taken on line 4—4 of Fig. 2; and

Fig. 5 is a fragmentary vertical section taken on line 5—5 of Fig. 4.

Referring to the drawings, the pump comprises generally a plurality of cylinders 1, 2, and 3 mounted on a base 4 and provided respetctively with pump liquid inlet and discharge valves 5, 5', 6, 6', and 7, 7'. The inlet valves control communication between the cylinders and a common suction header 8, and the discharge valves control communication between the cylinders and a common discharge header 9.

Reciprocable in each cylinder is a piston 15, freely floating in the cylinder and movable solely in response to the pressure differential across the piston. The piston divides the cylinder into a motive liquid compartment 16 and a pump liquid compartment 17.

Motive liquid under relatively high pressure is admitted intermittently to each of the compartments 16 in predetermined sequence, to move the pistons to the right and force pump liquid from the compartments 17. Between intervals of admission of motive liquid to compartments 16, pump liquid is forced into compartments 17 to move the pistons to the left and force spent motive liquid from compartments 16. This is accomplished by supplying pump liquid to the suction header under low pressure, the reduction of motive liquid pressure in compartments 16 allowing the inlet valves 5, 6, 7 to open and admit pump liquid to the cylinders.

The admission and exhaust of motive liquid is controlled by valve mechanism generally designated 21. This valve mechanism is similar to that illustrated and described in detail in the aforementioned application, and consequently a brief description thereof will suffice. A valve body 22 extending transversely across the motive liquid end of the pump has formed therein a plurality of vertically extending bores 23, 24, and 25. As shown in Fig. 2, the bore 24 communicates by a port 26 with the motive liquid chamber 16 of cylinder 2, and in a similar manner bores 23 and 25 communicate with the motive liquid chambers of cylinders 1 and 3 respectively.

A motive liquid inlet 31 (Fig. 2) communicates with each of the valve bores, whereby motive liquid is admitted to the cylinders in predetermined sequence under the control of shuttle valves 33, 34 and 35 reciprocable in the bores 23, 24, and 25, respectively. The valves are interconnected to reciprocate in equally spaced phase relationship, by connecting rods secured to the vlaves and to a crank shaft 36. In their uppermost positions the valves cut off communication between the inlet 31 and their respective cylinders and establish communication between the latter and a discharge chamber 37 from which a discharge outlet 38 leads back to the source of motive liquid. Likewise, in their lowermost positions the valves admit motive liquid from inlet 31 to their respective cylinders, the discharge chamber 37 being closed to the cylinders during the admission of motive liquid.

The valves are actuated by motive liquid acting on shuttle pistons 43, 44, and 45 connected respectively to the valves 33, 34, 35 and reciprocable in the bores 23, 24, and 25. Motive liquid is ad-

mitted in sequence to the bores above the pistons through ports 46, 47, and 48 (Figs. 4 and 5) under the control of a rotary valve 50 mounted on one end of the crank shaft 36.

The flow of motive liquid to the valve motor is regulated in accordance with the flow to the main cylinders, and for this purpose a Venturi regulator 51 is interposed between the motive liquid supply line and the inlet 31. A throttle valve 52 in the regulator controls the flow of motive liquid to conduit 53 leading to the valve 50, the extent of opening of the throttle valve being controlled by the flow of motive liquid through the throat of the Venturi nozzle.

From the foregoing description, the mode of operation of the pump will be apparent. As motive liquid is admitted successively to the chambers above the shuttle pistons 43, 44, and 45, the valves 33, 34, and 35 are reciprocated to alternately admit motive liquid to the main cylinders and exhaust spent motive liquid therefrom in equally spaced phase relationship. The floating pistons 15 are caused to move to the right, as viewed in Fig. 2, to discharge pump liquid from the chambers 17 under relatively high pressure, and on release of the motive liquid pressure the pistons are moved to the left by pump liquid supplied to the suction header 8 at relatively low pressure.

It will be evident that a simple, rugged pump has been provided, wherein the pump liquid is separated from the motive liquid by freely floating pistons movable in the cylinders in predetermined sequence by the alternate application and release of motive liquid. The flow of both motive liquid and pump liquid is steady and uninterrupted, and by employing floating pistons in lieu of diaphragms, as in the aforementioned application, the pumping strokes may be made as long as desired.

I claim:

Hydraulic pumping apparatus comprising a plurality of cylinders, a floating piston reciprocable in each cylinder, said pistons being freely reciprocable solely in response to differences in pressure on opposite sides thereof, a common source of motive liquid at relatively high pressure, valve means for alternately admitting and exhausting said motive liquid in predetermined sequence to and from each of said cylinders on one side of their respective pistons, to move the latter in one direction and permit their return, a common source of pump liquid at relatively low pressure, valve means for admitting said pump liquid to said cylinders on the opposite sides of said pistons between intervals of admission of motive liquid, to move said pistons in the opposite direction, and valve means for discharging pump liquid from said cylinders in response to movement of said pistons in said one direction.

HERBERT E. GRAU.