

Sept. 17, 1946.

G. E. GALL

2,407,923

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Fig. 1

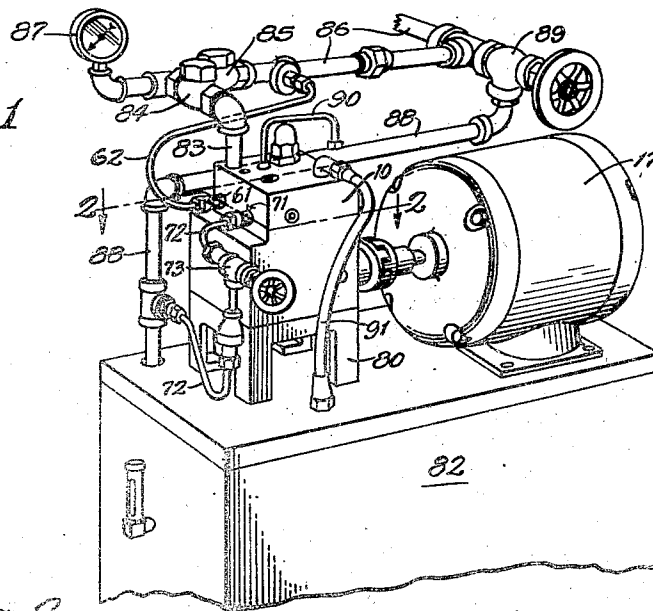
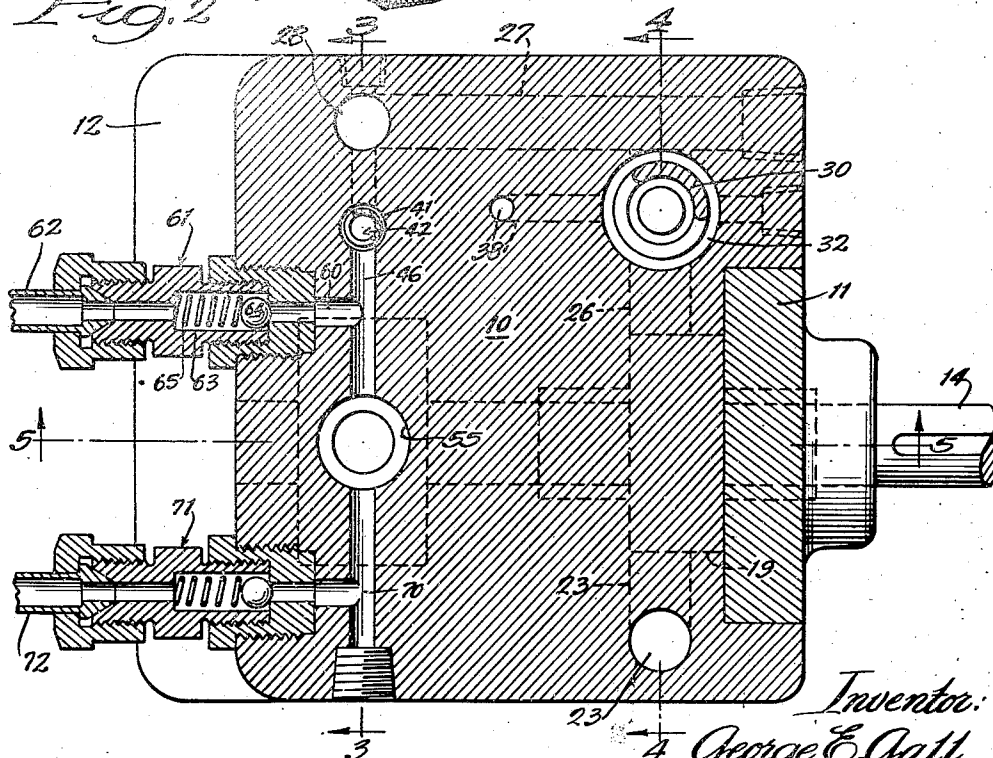


Fig. 2



Inventor:
George E. Gall,

By Dawson, Oms & Borth,
Attorneys.

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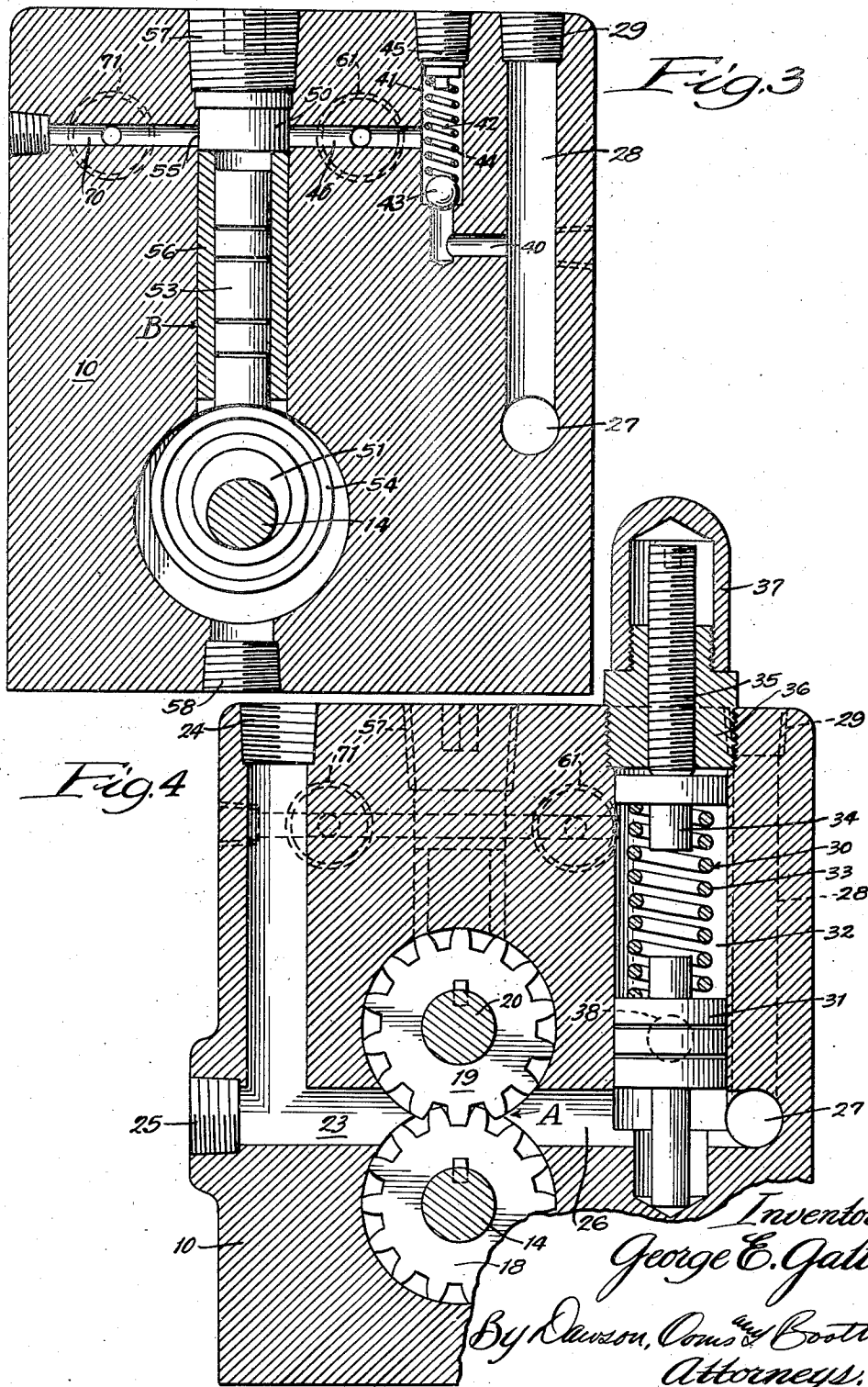
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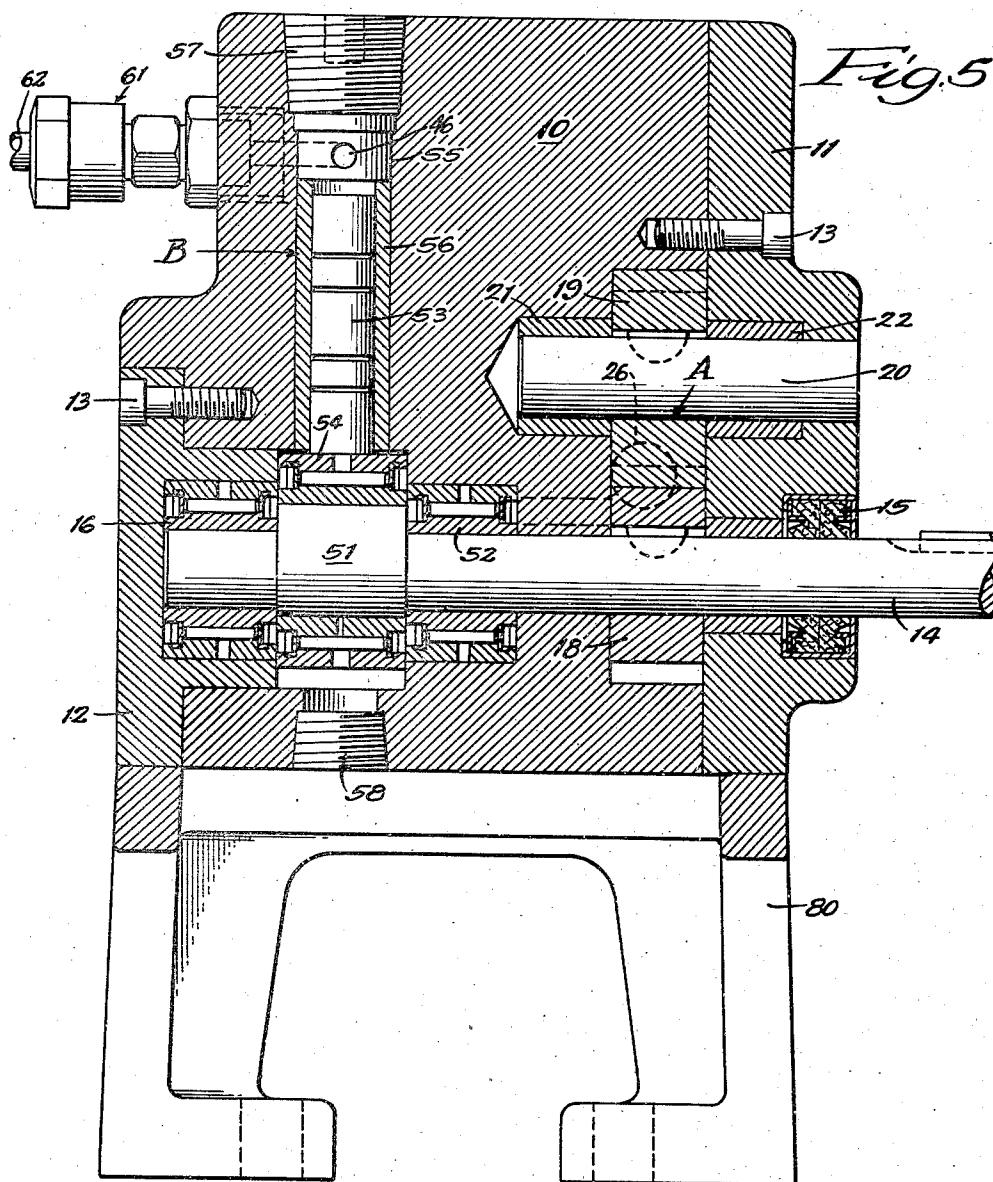
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Inventor:
George E. Gall,
By Dawson, Connors & Borth
Attorneys.

UNITED STATES PATENT OFFICE

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PUMP

George E. Gall, Chicago, Ill., assignor to Anker-Holth Manufacturing Company, Inc., Chicago, Ill., a corporation of Michigan

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7 Claims. (Cl. 103—10)

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This invention relates to a pump, and more particularly to a hydraulic pump for delivering liquid under pressure. The pump may be used for operating hydraulic cylinders to furnish power for various appliances, and can be utilized wherever it is desired to supply hydraulic pressures.

An object of the invention is to provide a pump which will deliver liquid at high pressures when high pressures are required for the work being done, and which will develop these high pressures without the objectionable pulsations or vibrations which are commonly associated with such operation.

Another object of the invention is to provide a pump of this character which is capable of developing very high pressures, but which at the same time will deliver liquid at a rapid rate during periods of operation in which high pressures are not required, so that an overall operation involving periods of low pressure operation and periods of high pressure operation may be performed in a minimum of time. A further object is to provide a pump capable of quickly delivering the liquid necessary for performing an operation which requires high liquid pressures, at least during some periods of the operation, while at the same time keeping to a minimum the power required to actuate the pump.

Another object is to provide effective means for cutting off the delivery of liquid delivered by the pump under high pressure while the pump remains in operation. It is desired that such cut-off means shall be easy to operate and maintain and that it shall not be subject to wear through erosion when in operation.

A further object is to provide a pump unit which is compact and has all moving parts readily accessible.

Other objects and advantages will be apparent as the specification proceeds.

An embodiment of the invention is illustrated in the accompanying drawings, in which—

Fig. 1 is a perspective view of a pump fully assembled; Fig. 2 is a plan sectional view taken as indicated at line 2—2 of Fig. 1; Fig. 3 is an elevational sectional view taken as indicated at line 3—3 of Fig. 2; Fig. 4 is an elevational sectional view taken as indicated at line 4—4 of Fig. 2; and Fig. 5 is an elevational sectional view taken as indicated at line 5—5 of Fig. 2.

As illustrated, the structure includes a pump body 10 to which is secured the front bearing cap 11 and the rear bearing cap 12. Screws 13 serve to fasten these caps tight against the pump body.

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The pump body and caps may be formed of castings of any suitable metal.

A drive shaft 14 extends through the structure, being journaled in the bearing 15 in the front cap 11 and driven by any suitable source of power such as the electric motor 17 shown in Fig. 1.

Inside the front cap 11, and shown more clearly in Fig. 4, is a low pressure pump section A which includes the gear 18 mounted on the shaft 14. Located above and in meshed relation with gear 18 is a second gear 19 mounted on shaft 20 which has its one end journaled in the bearing 21 carried in the body 10 and which has its other end journaled in the bearing 22 carried in the front cap 12.

A passage 23 leads from an opening 24 in the top of the pump body 10 to the gears 18 and 19. A second opening 25, which is in the side of the body 10, also communicates with the passage 23. One of the openings 24 and 25 may be plugged and the other may be connected by conduit with any suitable source of liquid.

When the pump section A is in operation, with the shaft 14 turning in a clockwise direction as seen in Fig. 4, the gears 18 and 19 function under well-known principles to draw liquid from the passage 23 and pass it between the gears and on through the passage 26.

Passage 26 communicates with passage 27 leading rearwardly in the body 10 (shown in dotted lines in Fig. 2), and passage 27 communicates with the passage 28 which leads upwardly to the opening 29 at the top of the body 10 (see Fig. 3).

For controlling the pressure developed by the low pressure pumping section A, there is provided a pressure regulating apparatus 30. This apparatus includes the plunger 31 carried in the cylindrical cavity 32 of the body 10, which cavity communicates at its bottom with passage 26. The upward movement of the plunger 31 is resisted by the spring 33, the upper end of which bears against the centering piece 34, which in turn bears against the bottom of adjusting screw 35 carried in the nut member 36. A cap 37 carried on the nut member serves to enclose the screw 35.

A passage or conduit 38 leads from cavity 32 to an opening in the top of body 10, which opening may be connected by suitable conduit with a low pressure liquid receiver which may be the same as the liquid source with which the inlet passage 23 is connected. As seen more clearly at Fig. 4 of the drawings, when the plunger 31 is moved upwardly against the spring 33 to bring

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the mouth of the conduit 38 into communication with the lower part of the cavity 32, a part of the liquid delivered by the pump section A may be by-passed through the conduit 38 and led through other suitable conduit back to the liquid source.

The apparatus 30 may be adjusted by turning the adjusting screw 35 to permit greater or lesser pressure to be developed by the pump section A as may be desired. When the screw is turned to a lower position, this requires a greater liquid pressure on the bottom of the plunger 31 to raise the plunger sufficiently to allow liquid to be by-passed through the passage 38.

Communicating with the passage 23 is a side conduit 40 which leads to the valve cavity 41 (see Fig. 3). In this cavity is the valve 42 including a ball 43 pressed by spring 44, the top of which is held by the plug 45. The valve arrangement is such as to permit liquid to pass from the passage 40 into the valve cavity, but to prevent the back flow of liquid from the valve cavity into the passages 40 and 23. The valve cavity 45 communicates through the passage 46 with the cylinder 50 of the high pressure pump section B.

The high pressure pump section B (see Figs. 3 and 5) is driven through the rotation of the shaft 14 on which is mounted the eccentric 51. The shaft is journaled in the bearings 16 and 52 on each side of the eccentric 51. The cylinder 55 extending vertically above the eccentric 51 is lined with a bushing 56 and a piston 53 is mounted for reciprocal movement within the cylinder. The base of piston 53 rests on the bearing 54 of the eccentric 51 and is adapted to be moved in reciprocal motion through actuation by rotation of the eccentric. Access to the cylinder is provided by the plugged opening 57 at the top, and a plugged opening 58 allows access to the eccentric.

An outlet from the high pressure section is provided by the passage 60 leading from the passage 46 (see Fig. 2). Passage 60 leads through the valve structure 61 to the conduit 62 which may lead to the pump outlet. The valve structure 60 includes a cavity 63 in which is located the ball 64 and spring 65, the arrangement being such as to prevent flow of liquid from the pump outlet back into the high pressure pump section.

A passage 70 leads from the top of cylinder 55 and connects through the valve structure 71 with a conduit 72 which may lead through needle valve 73 (Fig. 1) to a low pressure liquid receiver, suitably the liquid source from which liquid is drawn into the inlet passage 23 of the low pressure section. The opening of the valve 73 serves to permit flow of liquid through passage 70 and conduit 72 to relieve the pressure in the outlet of the high pressure section and stop delivery of liquid under pressure though the reciprocating apparatus of this section continue to operate.

The pump body 10, with the caps 11 and 12 attached, may be mounted on the base 20, as shown in Fig. 1, and set on top of a housing 82 which may contain a receptacle holding a supply of oil or other liquid. The motor 17 is arranged with its drive shaft in drive connection with the shaft 14. As shown in Fig. 1, the pipe 83 connects the low pressure discharge opening 29 with valves 84 and 85, which in turn connect with conduits 86 forming the outlet of the pump. In this particular set-up, a gauge 87 is provided for indicating the pressure developed by the low pressure section.

The pipe 83 provides a passage controlled by the valve 89 for the return of liquid back to the source for reuse.

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The conduit 62 connects the outlet of the high pressure section to the pipe 86 which forms the pump outlet and leads to the particular appliance receiving the hydraulic power. The conduit 72 containing the valve 73 is connected to the pipe 88 which, as before explained, leads back to the source of liquid supply in the housing 82. The inlet conduit 91 has its one end connected with the inlet opening 24 and its other end connected with the source of liquid supply. The conduit 90 connects the passage 38 with pipe 86 leading back to the liquid source.

When the improved pump is started in operation, the valves 72 and 89 are closed, and the rotation of shaft 14 powered by motor 17 serves to actuate both the low pressure section and the high pressure section. The rotation of gears 18 and 19 of the low pressure section serves to draw liquid from the source through the conduit 91 and passage 23, and to pass liquid under pressure through the passage 26. From passage 26, the liquid passes consecutively through passages 27 and 28, and is led through pipe 83 from which it passes through valves 84 and 85 to the outlet of the pump. The construction of this low pressure section permits the delivery of liquid at a relatively rapid rate. However, when the pressure builds up substantially at the pump outlet, liquid is no longer delivered directly from the low pressure section to the pump outlet, as above described.

Pressure at the outlet of the low pressure section above a predetermined amount causes the plunger 31 to rise against the spring 33 to permit a small amount of liquid to be by-passed back to the liquid source, and when a high pressure is called for at the pump outlet so that no liquid can be delivered directly through pipe 83, the plunger rises still further so that a major portion of the liquid passed by the gears is by-passed back to the source. In this way, the pressure of the liquid at the outlet of the low pressure section is maintained at a substantially constant level, irrespective of how much of the liquid passed therethrough is delivered to the pump outlet.

At the same time that liquid is being delivered to the pump outlet through operation of the low pressure section to build up the pressure at the pump outlet, the high pressure section will also have been in operation, and rotation of the eccentric 51 will have produced reciprocation of the piston 53. The retraction or downward movement of piston 53 will permit liquid to pass through the valve 42, impelled by the pressure developed by the low pressure section, and the following advancement or upward movement of the piston will force the liquid which has entered through valve 42 out through the passage 60, valve 61 and conduit 62 to the pump outlet. However, until the pressure at the pump outlet has built up, the liquid delivered through the conduit 62 from the high pressure section will be small in comparison to the volume of liquid delivered through the pipe 83 from the low pressure section.

When the pump outlet pressure is high and full power is needed, the low pressure section, as before stated, ceases to deliver liquid to the pump outlet, and at this point the operation of the high pressure section becomes of importance. The liquid under the relatively low pressure developed by the low pressure section passes through the valve 42 and out by way of valve 61 and conduit 62 to the pump outlet impelled by the advance stroke of the reciprocating piston.

Constructed as it is, the improved pump is able to deliver at a rapid rate during periods when high power is not required, and when high power is required is able to deliver under high pressure. This makes the pump extremely versatile, and it may be actuated with a relatively small motor. For example, a pump of this construction powered by a $\frac{1}{2}$ H. P. electric motor may develop a pressure of about 3,000 pounds per square inch.

An important feature of the improved pump is that the high pressure section is arranged in the liquid flow circuit in series with the low pressure section. In this way, pressure is maintained on the piston as it moves in its downward or reverse stroke, and the objectionable pulsations common in high pressure systems heretofore used are eliminated. By the improved construction, the movement of the piston is smooth and regular, and the usual vibration caused by reversal of pressure on the piston at the change of the stroke is avoided.

It is not necessary to use special oils or other special liquid in the improved pump, and ordinary motor oil may be used. Cooling of the oil usually required on other high pressure systems is not here essential.

The means provided in the improved construction for stopping flow of oil under high pressure is advantageous in that the usual valve in the high pressure line is eliminated. A needle valve in a high pressure line is a source of trouble and is subject to considerable wear since the liquid passing through causes erosion. In the improved structure, the pressure is relieved the moment liquid starts to pass through the valve 73, and erosive wear is substantially avoided.

In the foregoing description, a single embodiment of the invention has been described in great detail. It must be understood that this detailed description has been given for purposes of explanation only, and that the invention may be practiced in many modified forms, and many changes may be made without departing from the spirit of the invention.

In the foregoing explanation and in the claims, the terms "high pressure" and "low pressure" are used in a relative sense to describe the pressures developed by the one pumping section with relation to those developed by the other pumping section, and not for the purpose of designating any particular range of pressures.

I claim:

1. A pumping unit having a main outlet and comprising a high and low pressure section each having an outlet communicating with said main outlet, said low pressure section having its outlet connected also with the inlet of said high pressure section and being adapted to deliver liquid to said main outlet at a relatively fast rate so long as the pressure at said main outlet does not exceed a predetermined pressure, said low pressure section being also adapted to deliver liquid to said high pressure section when the pressure of said main outlet is in excess of said predetermined amount, a shaft for driving both of said pumping sections, a valve preventing backflow of liquid from said main outlet to said high pressure section, and a valve preventing backflow of liquid from the inlet of said high pressure section to said low pressure section.

2. A pumping unit having a main outlet and comprising a high pressure pumping section including a reciprocating pumping apparatus the outlet of which is connected to said main outlet and including valve means for preventing flow of

liquid from said main outlet back to said reciprocating pumping apparatus, a low pressure pumping section including a rotary gear pumping apparatus, pressure regulating means for maintaining the pressure of liquid at the output of said low pressure section at a substantially constant level, a conduit system connecting the output of said low pressure section with the output of said pump and connecting also the output of said low pressure section with the inlet of said high pressure section, a valve preventing flow of liquid from said main outlet back to said low pressure section, a valve preventing flow of liquid back from said high pressure section to said low pressure section, and means for driving both of said pumping sections.

3. A pumping unit having a main outlet and comprising a high pressure pumping section with its outlet connected to said main outlet, a valve preventing the flow of liquid from said main outlet back to the outlet of said pumping section, and means for stopping the delivery of fluid under pressure to said main outlet while said pumping section is in operation comprising a conduit connecting the outlet of said pumping section to a low pressure area, a valve for preventing backflow of liquid from said low pressure area to the outlet of said pumping section, said last mentioned valve being adapted to prevent free flow of liquid from said outlet to said low pressure area, and a valve selectively operable to open and close the passage in said conduit for controlling the passage of liquid through said conduit.

4. A pumping unit having a main outlet and comprising a high pressure pumping section including a reciprocating pumping apparatus the outlet of which is connected to said main outlet and including valve means for preventing flow of liquid from said main outlet back to said reciprocating apparatus, means for stopping flow of liquid from said reciprocating apparatus to said main outlet, said means including a conduit connecting the outlet of said reciprocating pumping apparatus to a low pressure area, a valve preventing backflow of liquid from said area to said pumping apparatus outlet, and a valve selectively operable to open and close the passage in said conduit for controlling the passage of liquid through the conduit, a low pressure pumping section including a rotary gear pumping apparatus, a conduit system connecting the outlet of said rotary gear pumping apparatus to said main outlet and also to the inlet of said reciprocating pumping apparatus, a valve preventing flow of liquid from said main outlet back to said rotary gear pumping apparatus, a valve preventing flow of liquid from said reciprocating pumping apparatus back to said rotary gear pumping apparatus, and means for preventing the rise of pressure at the output of said low pressure pumping section beyond a predetermined amount when the flow of liquid through said conduit system to said main outlet diminishes.

5. A pumping unit having a main outlet, comprising a high pressure pumping section including a reciprocating pumping apparatus the outlet of which is connected to said main outlet and including valve means for preventing flow of liquid from said main outlet back to said reciprocating apparatus, means for stopping flow of liquid from said reciprocating apparatus to said main outlet, said means including a conduit connecting the outlet of said reciprocating apparatus to a low pressure area, a valve preventing backflow of liquid from said area to said pumping appa-

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ratus outlet, a valve selectively operable to open and close the passage in said conduit for controlling the passage of liquid through the conduit, low pressure pumping apparatus, a conduit system connecting the outlet of said low pressure pumping apparatus to the inlet of said reciprocating pumping apparatus, and a valve preventing flow of liquid from said reciprocating pumping apparatus back to said low pressure pumping apparatus.

6. A pumping unit having a main outlet and comprising pumping means for maintaining a supply of liquid at a substantially constant low pressure, a reciprocating pumping section hav-

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ing its inlet connected to the outlet of said pumping means and having its outlet connected to said main outlet, said pumping section being effective for delivering liquid to said main outlet at relatively high pressure, a rotary drive shaft connected with said pumping means and adapted to drive the same, and a cam on said shaft for driving said reciprocating pumping section upon rotation of said shaft.

10 7. A pumping unit as set forth in claim 6 wherein said driving shaft includes a single shaft extending into both said pumping means and said reciprocating pumping section.

GEORGE E. GALL.