(No Model.) 2 Sheets—Sheet 1.

C. C. WORTHINGTON.

PRESSURE EQUALIZER.

No. 451,148. Patented Apr. 28, 1891.

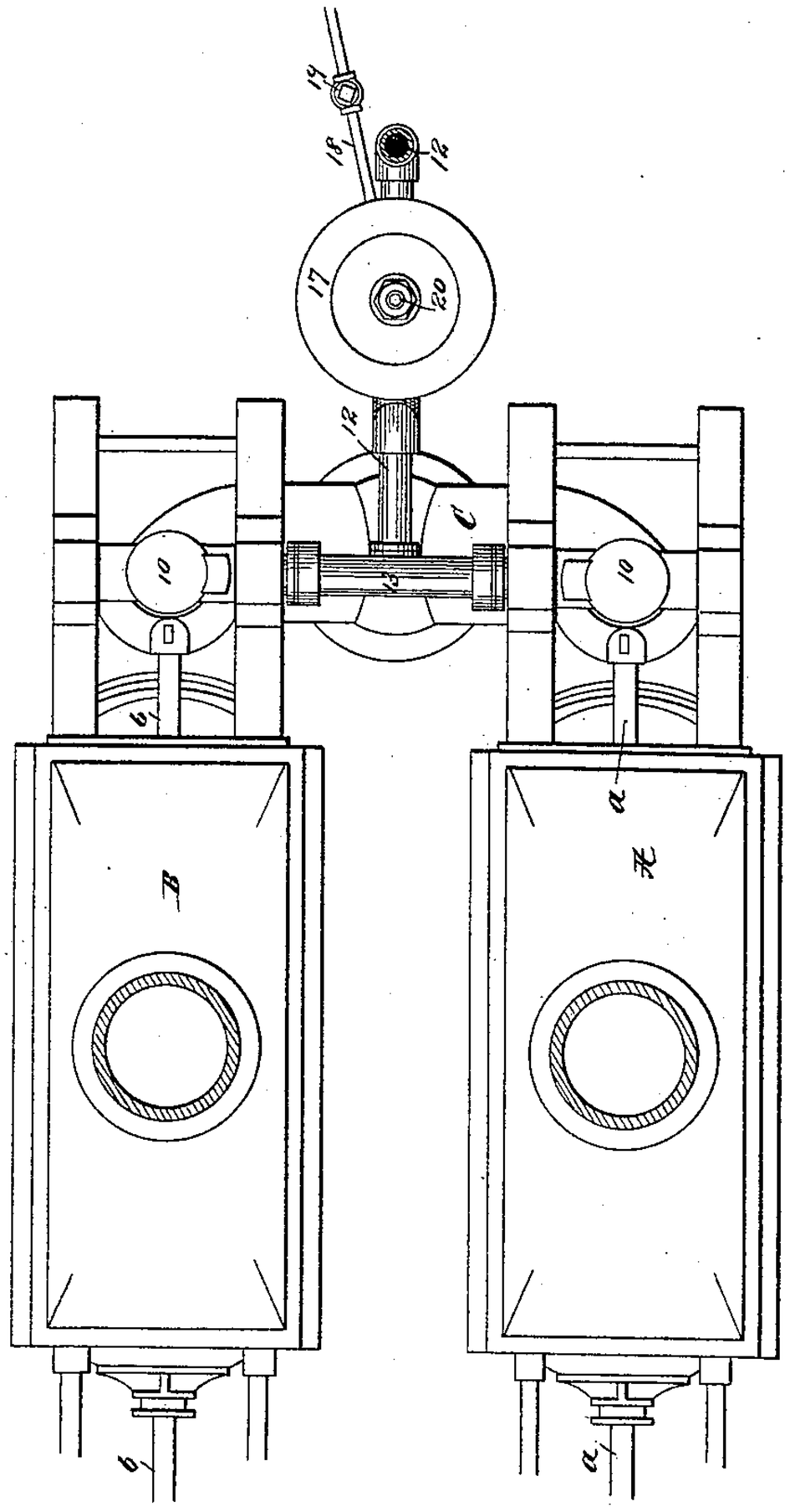

Fig. 1.

Attest
Geo. H. Botts
J. M. Boyer

Inventor:
Charles C. Worthington
By Philipp Phelps & Hovey
Attys.

(No Model.) 2 Sheets—Sheet 2.

C. C. WORTHINGTON.

PRESSURE EQUALIZER.

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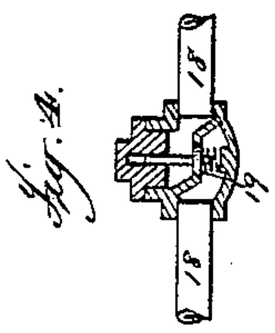

Fig. 4.

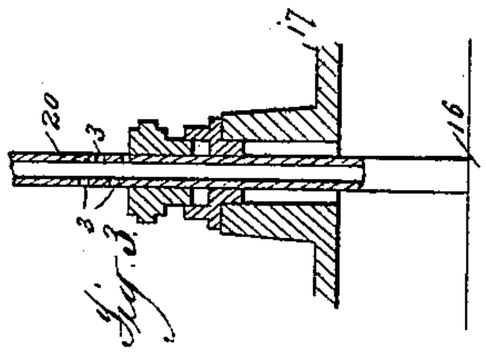

Fig. 3.

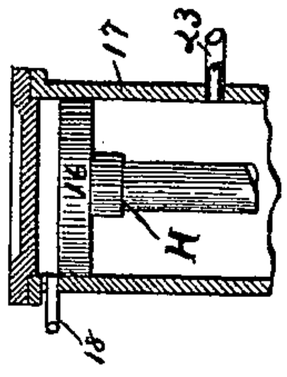

Fig. 7.

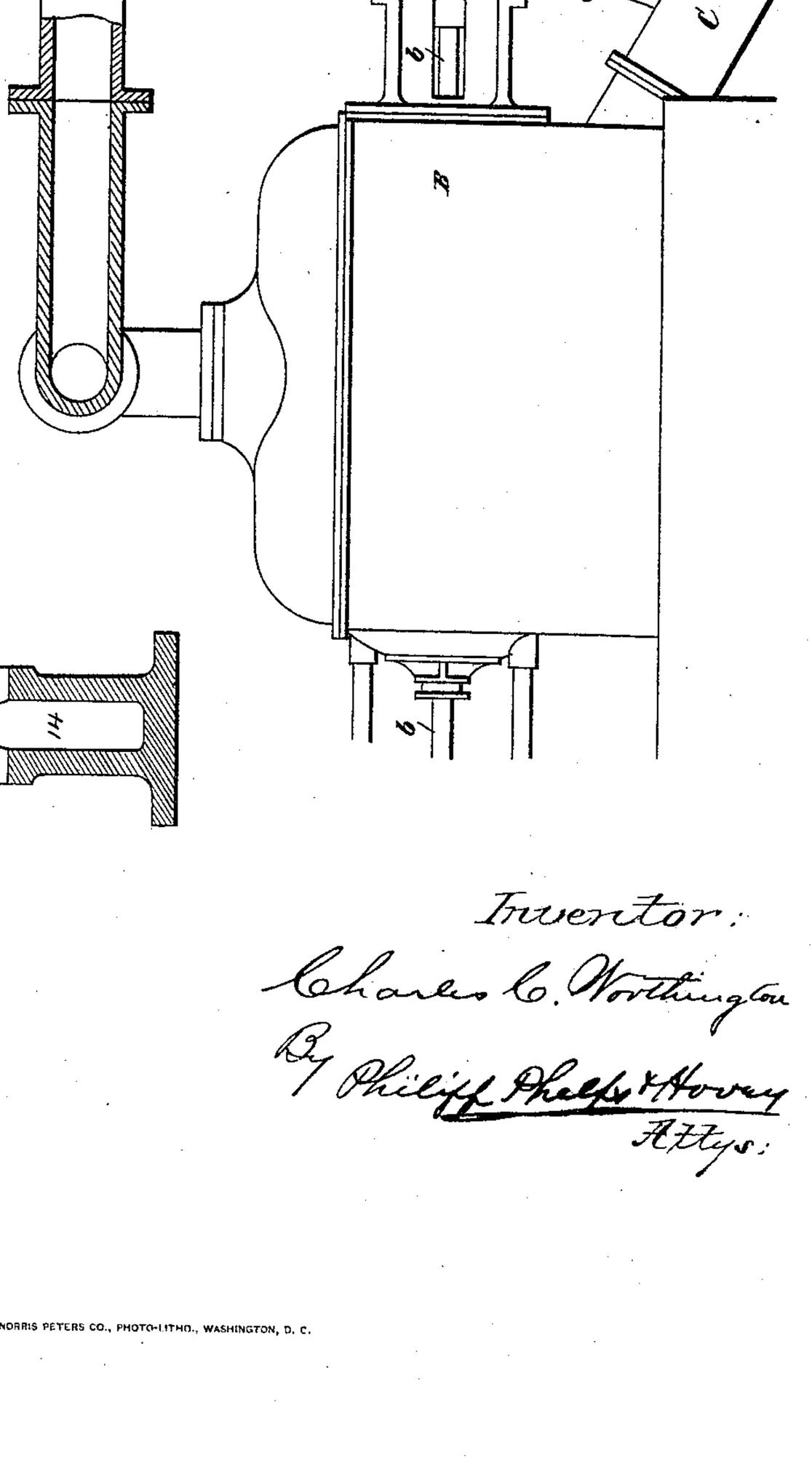

Fig. 2.

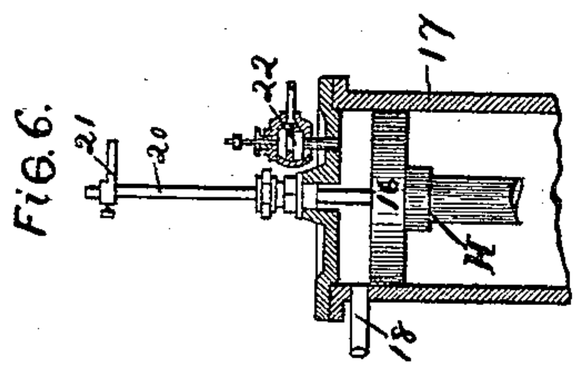

Fig. 6.

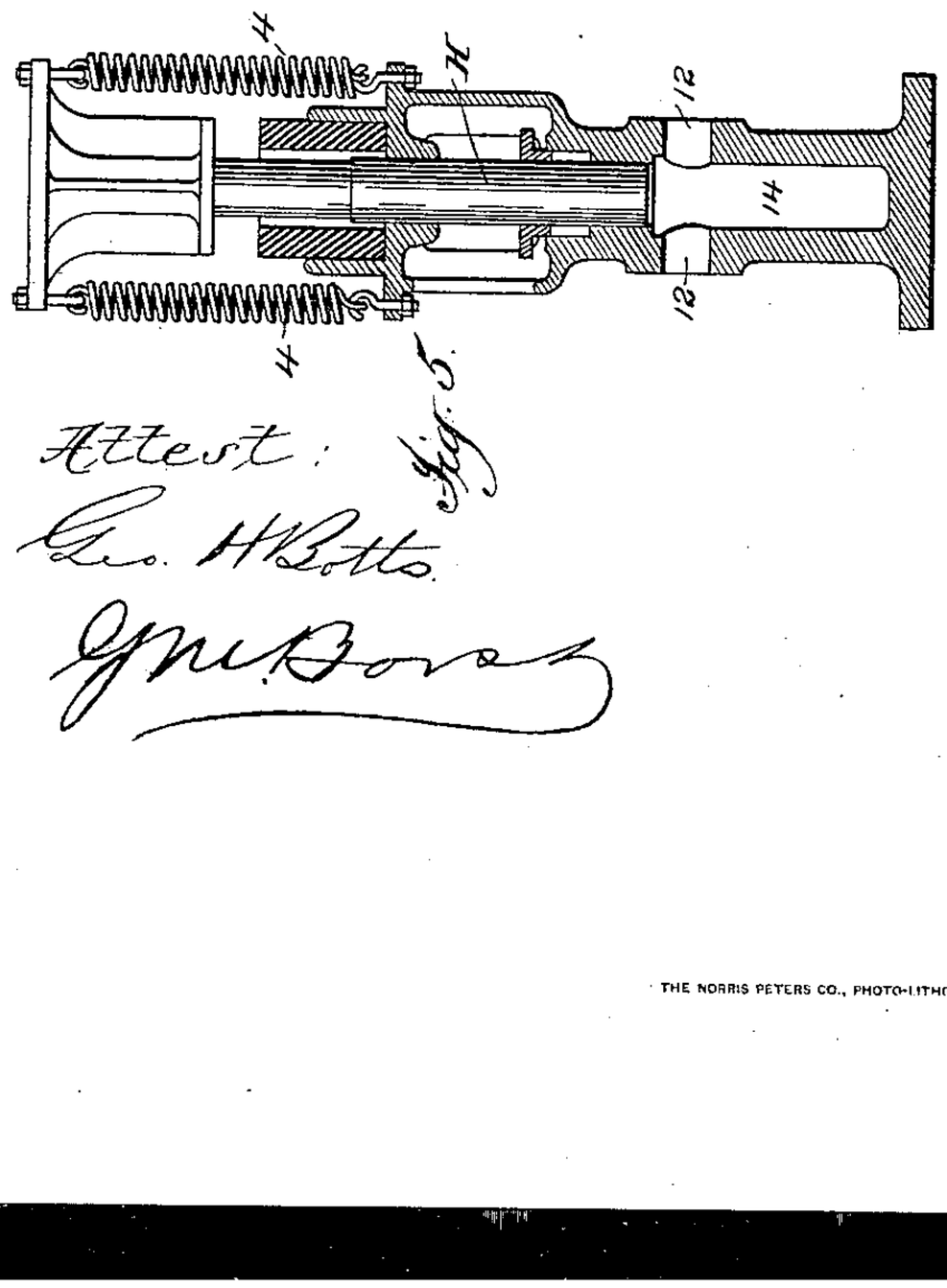

Fig. 5.

Attest:
Geo. H. Botts.
J. M. Bowers

Inventor:
Charles C. Worthington
By Philip P. Wales & Harvey
Attys.

UNITED STATES PATENT OFFICE.

CHARLES C. WORTHINGTON, OF IRVINGTON, NEW YORK.

PRESSURE-EQUALIZER.

SPECIFICATION forming part of Letters Patent No. 451,148, dated April 28, 1891.

Application filed September 5, 1890. Serial No. 364,017. (No model.)

To all whom it may concern:

Be it known that I, CHARLES C. WORTHINGTON, a citizen of the United States, residing at Irvington, county of Westchester, and State of New York, have invented certain new and useful Improvements in Pressure-Equalizers, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to an attachment which is designed primarily for use in connection with that class of direct-acting engines in which one or more compensating cylinders and pistons is or are employed to act in opposition to the main piston or pistons during the first part of the stroke and in conjunction therewith during the last part in order to allow the steam to be worked expansively. Examples of engines of this class are shown in United States Letters Patent Nos. 292,525, 309,676, 332,857, 341,534, and 422,680, heretofore granted to me. The motor-fluid which operates upon the compensating piston or pistons in engines of this class may, as explained in the Letters Patent referred to, be either steam, air, water, or other fluid, and, as also explained in said Letters Patent, where air or water is employed as the motor-fluid for the compensating pistons the necessary pressure may be derived either directly or indirectly from the force-main of the pump.

The improvements constituting the present invention are especially applicable to those engines in which the pressure of the motor-fluid for the compensating pistons is derived directly from the force-main, the purpose of the improvements being to equalize the flow of the motor-fluid into and out of the compensating cylinders, so as to prevent pulsations in the column of liquid passing through the force-main. These engines may be either pressure pumping-engines in which air-chambers are undesirable, oil-engines, or others of similar character. The present invention may, however, be applied in many other cases where it is desired to prevent pulsations and equalize the flow and pressure of a column of liquid.

In order to convey a full understanding of my invention, a full description of an apparatus embodying the same will now be given, reference being had to the accompanying drawings, in which—

Figure 1 is a plan view of the water end or pump proper of an ordinary duplex pumping-engine, showing the same provided with compensating cylinders and with the preferred form of apparatus embodying the present invention. Fig. 2 is a sectional elevation taken between the two water-cylinders. Figs. 3 and 4 are enlarged sectional details, which will be hereinafter referred to; and Figs. 5, 6, and 7 show modifications.

Referring to said figures, it is to be understood that A B represent the two water-cylinders or pumps proper of a direct-acting duplex pumping-engine.

C represents the suction-main of the engine, and D the force-main. The piston-rods *a b* of the engine are extended and pass through the outer ends of the water-cylinders, and are connected to the piston-rods of two pairs of oscillating compensating cylinders 10, which are arranged and act in the manner described in the Letters Patent before referred to, opposing the main pistons of the engine during the first part of the stroke and assisting them during the last part of the stroke. The motor-fluid which acts upon the pistons of the compensating cylinders 10 is in the case illustrated water or other liquid, and its pressure is derived directly from the force-main D by means of a pipe 12, which communicates with the force-main and is provided with branches 13, which communicate with the compensating cylinders through their trunnions in the manner shown in the aforesaid Letters Patent. When the pressure upon the compensating pistons is derived directly from the force-main, the flow of the fluid into and out of the cylinders causes pulsations in the column of liquid in the main, which are objectionable. To prevent these pulsations is the object of the present invention, and for this purpose the pipe 12 communicates with a chamber or cylinder 14, in which works the smaller end 15 of a differential plunger or piston H, the larger end 16 of which works in a cylinder 17. The cylinder 17 is provided at its upper end, or the end outside the piston 16, with a pipe 18, through which the cylinder is supplied with a column of air or other elas-

tic fluid under the required pressure. The pipe 18 may be provided with a check-valve 19, past which the fluid can be forced into the cylinder 17 to maintain the necessary supply and pressure, but which operates to prevent the fluid from escaping from the cylinder; but this valve is not absolutely necessary. The necessary pressure upon the fluid supplied to the cylinder 17 can be produced in any suitable manner—as, for example, by a compresser E, of any suitable form, which will be operated from time to time either through connections with the engine or otherwise, as desired. The pipe 18 may lead from the air-compressor into a tank or reservoir from which the air is supplied to the cylinder 17, or it may be connected directly to the cylinder 17, as shown.

The operation of the apparatus thus organized is as follows: The pressure of the fluid in the cylinder 17 above the piston H will be so adjusted that when the parts are in their normal position the piston 16 will occupy a position about midway the length of the cylinder, the pressure of the fluid in the cylinder above the piston being counterbalanced by the pressure of the liquid in the force-main and chamber 14, these pressures being in equilibrium when the fluid in the cylinder is thus compressed. The engine being set in motion, the liquid during the first part of the stroke will be forced out of the compensating cylinders 10, thereby increasing the pressure in the chamber 14, which pressure, instead of being communicated directly to the column of liquid in the main D, so as to produce a sudden increase of pressure and a pulsation in the main, will raise the piston H and compress the fluid in the cylinder 17 and in the tank, if one is provided, until the pressure on the two sides of the piston are again in equilibrium, and thus the increased pressure in the chamber 14, instead of being expended in producing a pulsation in the main, will be expended in compressing the volume of fluid above the piston H, and the pressure in the chamber and main will be gradually equalized. During the last part of the stroke of the engine the operation will be reversed and the liquid will flow from chamber 14 to the compensating cylinders, thus tending to cause a sudden reduction of pressure in the chamber and consequently a pulsation in the main. This reduction will be compensated for, however, by the pressure of the fluid above the piston H, which will be transmitted to the chamber 14 through the piston, and the latter will move downward until the pressure in the force-main, chamber 14, and in chamber 17 above the piston H have been gradually equalized. In order to prevent the differential piston from being lowered too far and causing damage in case the pressure in the chamber 14 should be reduced below the proper point, or in case an undue amount of fluid be forced into the upper end of the cylinder, the upper end of the piston is connected to a pipe 20, which passes through a stuffing-box in the upper end of the cylinder and is open at its upper end. The pipe 20 is provided at a suitable point with one or more perforations 3, which are so located that when the piston 16 moves downward beyond the proper point the perforations 3 will be brought below the stuffing-box, so as to open into the cylinder 17, and thus allow the fluid to escape through the pipe until the pressure in the cylinder 14 raises the piston H and carries the perforations 3 into or through the stuffing-box. The fluid confined in the upper end of the cylinder 17 above the piston will always be sufficient to cushion the piston in its upward movement and prevent it from striking violently against the cylinder-head, so as to occasion damage.

While I prefer to employ the construction shown, in which the pipe 20 is perforated, it is evident that various other devices may be used for the same purpose without departing from my invention. Thus the pipe 20, instead of being provided with perforations, may operate a valve attached to the cylinder in such a manner as to open the valve and let the fluid escape when the piston 16 has reached a certain point in the cylinder 17, as shown in Fig. 6, in which valve 22, mounted upon the body of the cylinder, is closed by spring-pressure or the pressure inside the cylinder, and opened by arm 21 or pipe or rod 20, the arm 21 being adjustable to vary the point at which the cylinder is opened; or the cylinder 17 may be provided with a port at a certain point, as shown at 23 in Fig. 7, so that the fluid is allowed to escape through said port when the piston 16 has passed over it.

In Fig. 5 I have shown a construction in which the pressure upon the piston H is produced by springs 4, secured to the head of the piston and to the frame, these springs being the equivalent of the elastic fluid used in the construction previously described.

Although the equalizing apparatus is designed especially for use in connection with a compensating cylinder or cylinders and force-main in the manner described, it is also of general application in all cases in which it is desired to prevent pulsations in a column of liquid by subjecting the same to spring-pressure.

It will be understood that the apparatus shown may readily be varied by one skilled in the art without departing from my invention, and that other forms of springs or their equivalents and other means of employing elastic fluids may be employed.

By the term "spring-pressure" used in the claims I intend to cover not only the pressure produced by the two forms of construction shown, but also any pressure produced by any elastic medium, whether fluid or solid.

What I claim is—

1. The combination, with a pumping-engine having one or more compensating cylinders and pistons, of connections through which

the pressure in said cylinder or cylinders is derived from the force-main, and a piston H, acted on upon one side by the fluid between the main and said cylinder or cylinders and upon the other side by spring-pressure, substantially as described.

2. The combination, with a pumping-engine having one or more compensating cylinders and pistons, of connections through which the pressure in said cylinder or cylinders is derived from the force-main, and a piston H, acted on upon one side by the fluid between the main and said cylinder or cylinders and upon the other side by an elastic fluid, substantially as described.

3. The combination, with a pumping-engine having one or more compensating cylinders and pistons, of connections through which the pressure in said cylinder or cylinders is derived from the force-main, and a differential piston H, acted on upon one side by the fluid between the main and said cylinder or cylinders and upon the other side by an elastic fluid, substantially as described.

4. The combination, with a pumping-engine having one or more compensating cylinders and pistons, of connections through which the pressure in said cylinder or cylinders is derived from the force-main, and a piston H, acted on upon one side by the fluid between the main and said cylinder or cylinders and upon the other side by a yielding pressure, substantially as described.

5. The combination, with the chamber 14, communicating with a column of liquid under pressure, of the piston H, entering the chamber, the cylinder 17 for confining a body of elastic fluid to act upon the opposite end of the piston, and the pipe 20, moved by the piston through the head of the cylinder and having the opening or openings 3, substantially as described.

6. The combination, with a chamber communicating with a column of liquid under pressure, of a piston entering said chamber, a cylinder confining a body of elastic fluid acting upon the opposite end of the piston, and means for allowing the escape of elastic fluid from the cylinder when the pressure of the fluid has moved the piston past a certain point, substantially as described.

7. The combination, with a pumping-engine having one or more compensating cylinders and pistons, of connections through which the pressure in said cylinder or cylinders is derived from the force-main, a piston acted upon at one end by the pressure in said connections, a cylinder confining a body of elastic fluid acting upon the opposite end of the piston, and means for allowing the escape of elastic fluid from the cylinder when the pressure of the fluid has moved the piston past a certain point, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

CHAS. C. WORTHINGTON.

Witnesses:

LOUIS R. ALBERGER,

B. W. PIERSON.