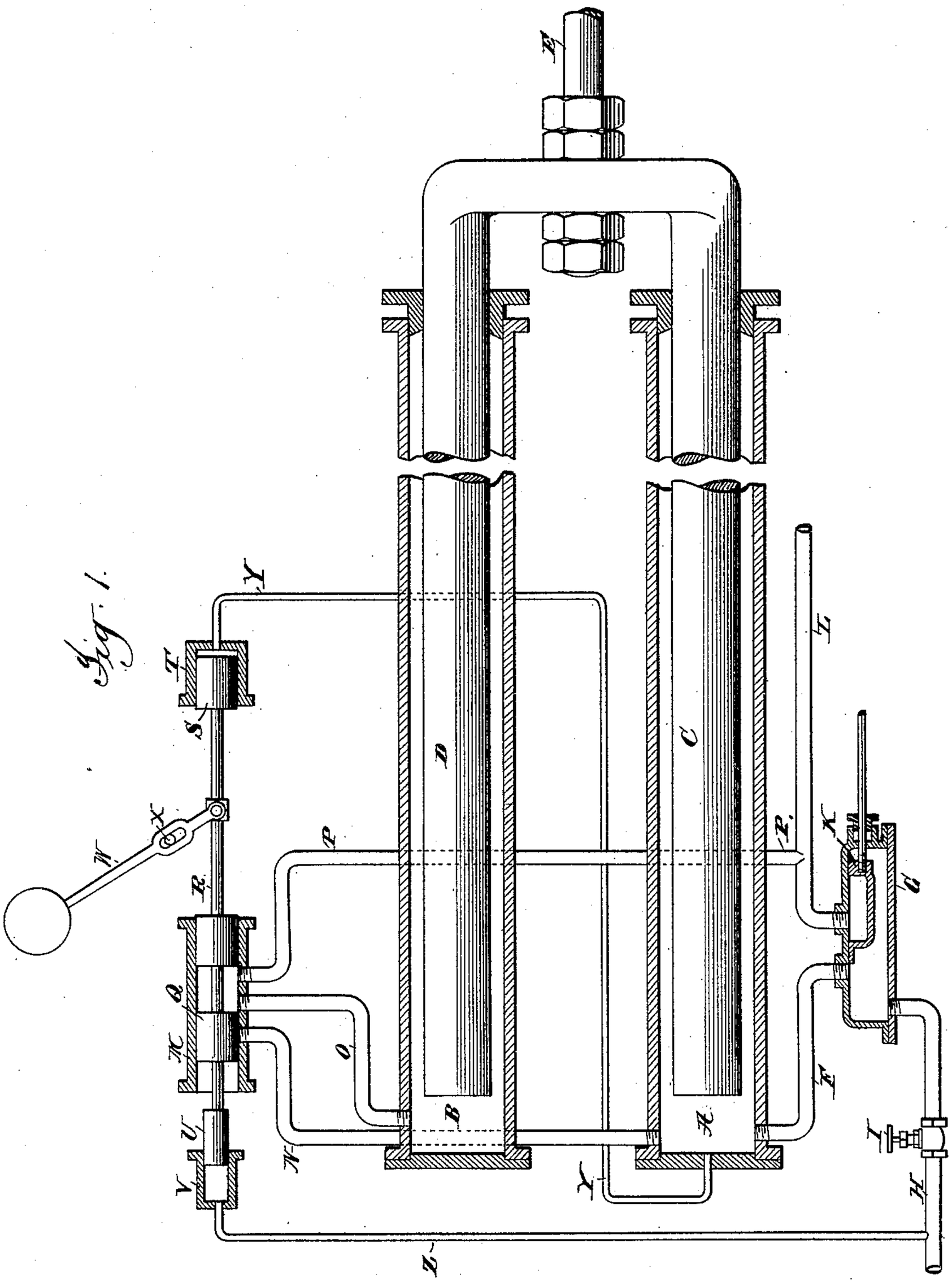
(No Model.) 3 Sheets—Sheet 1.

R. H. THORPE.

APPARATUS FOR REGULATING HYDRAULIC POWER.

No. 446,799. Patented Feb. 17, 1891.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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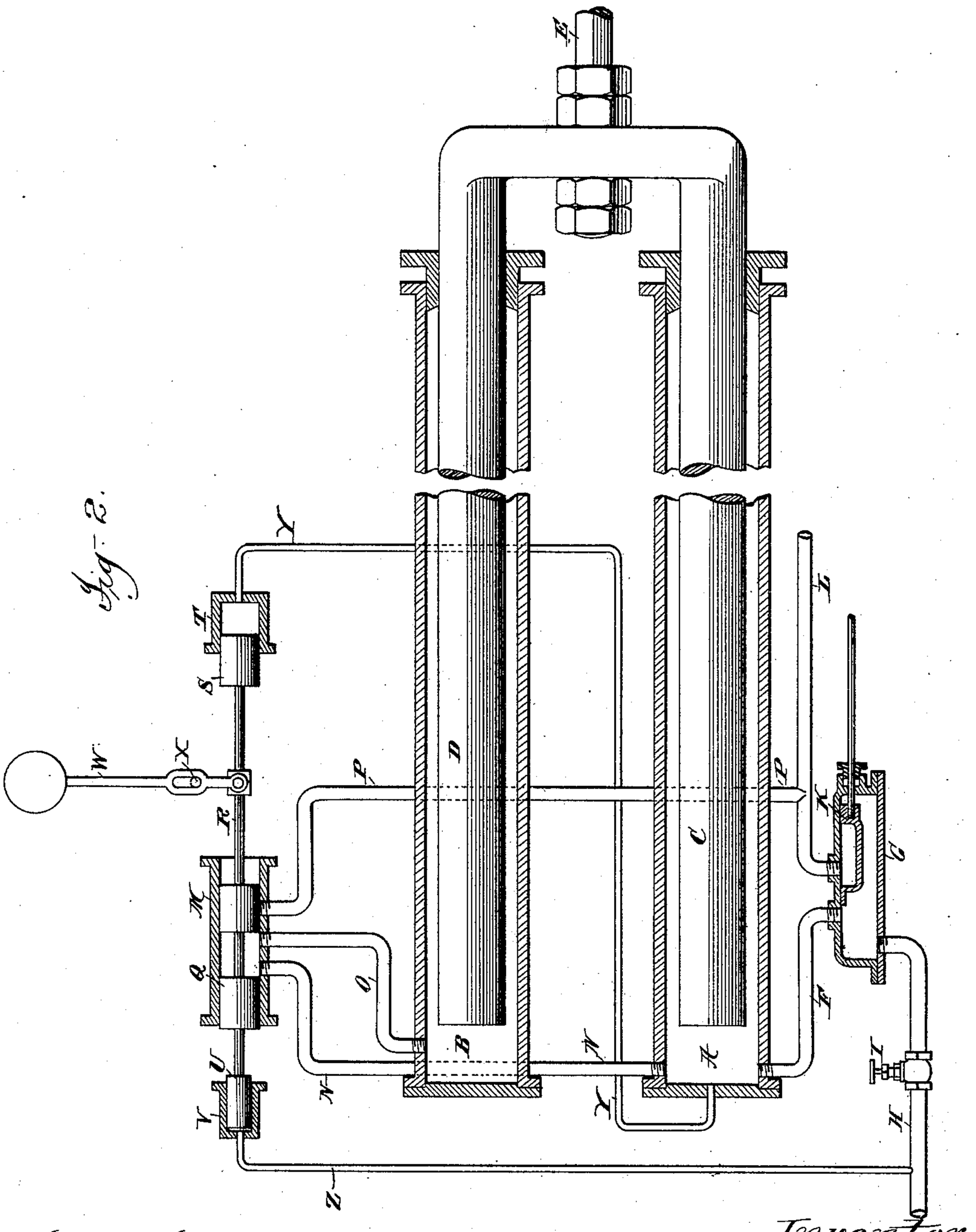
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

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Fig. 3.

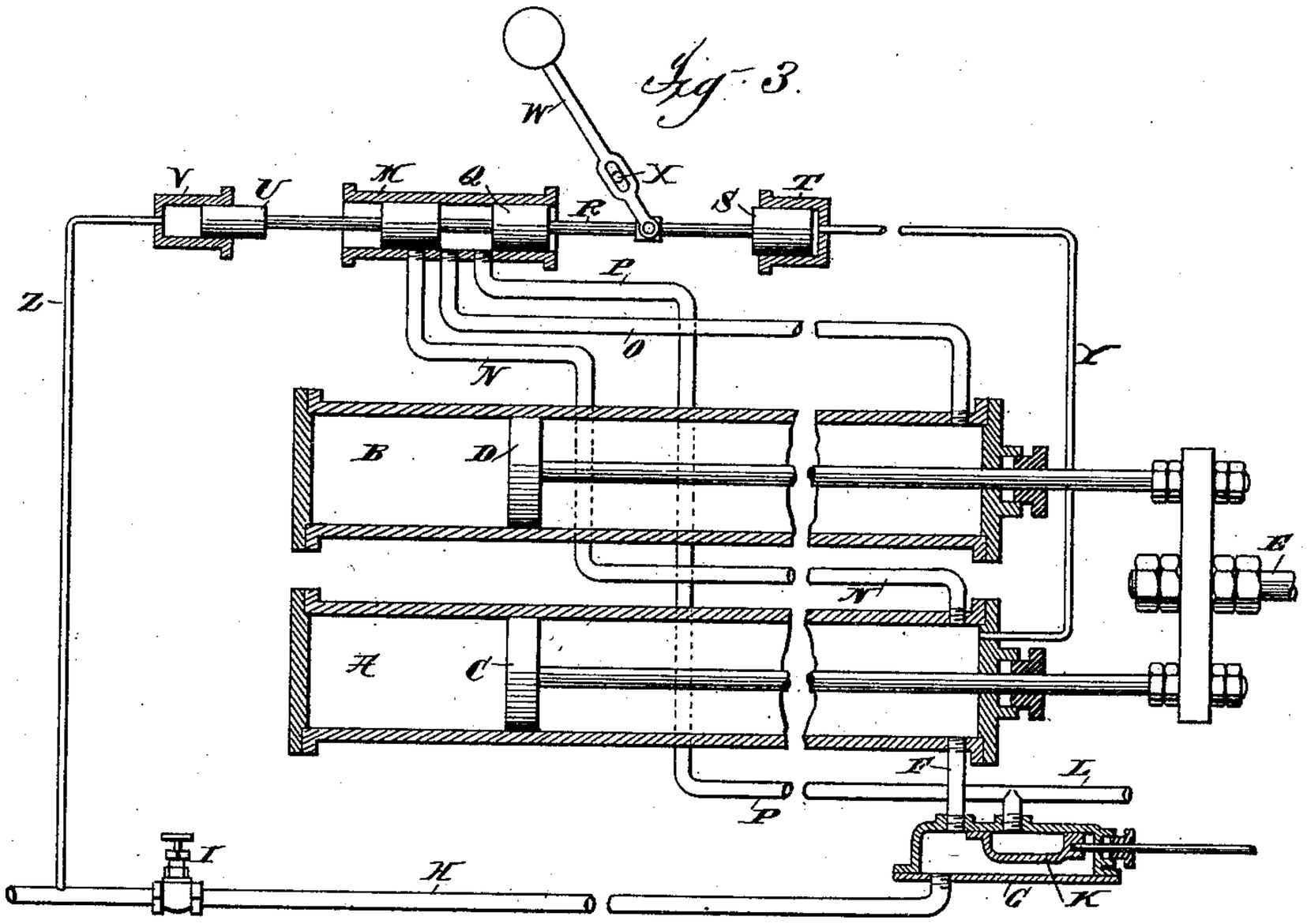
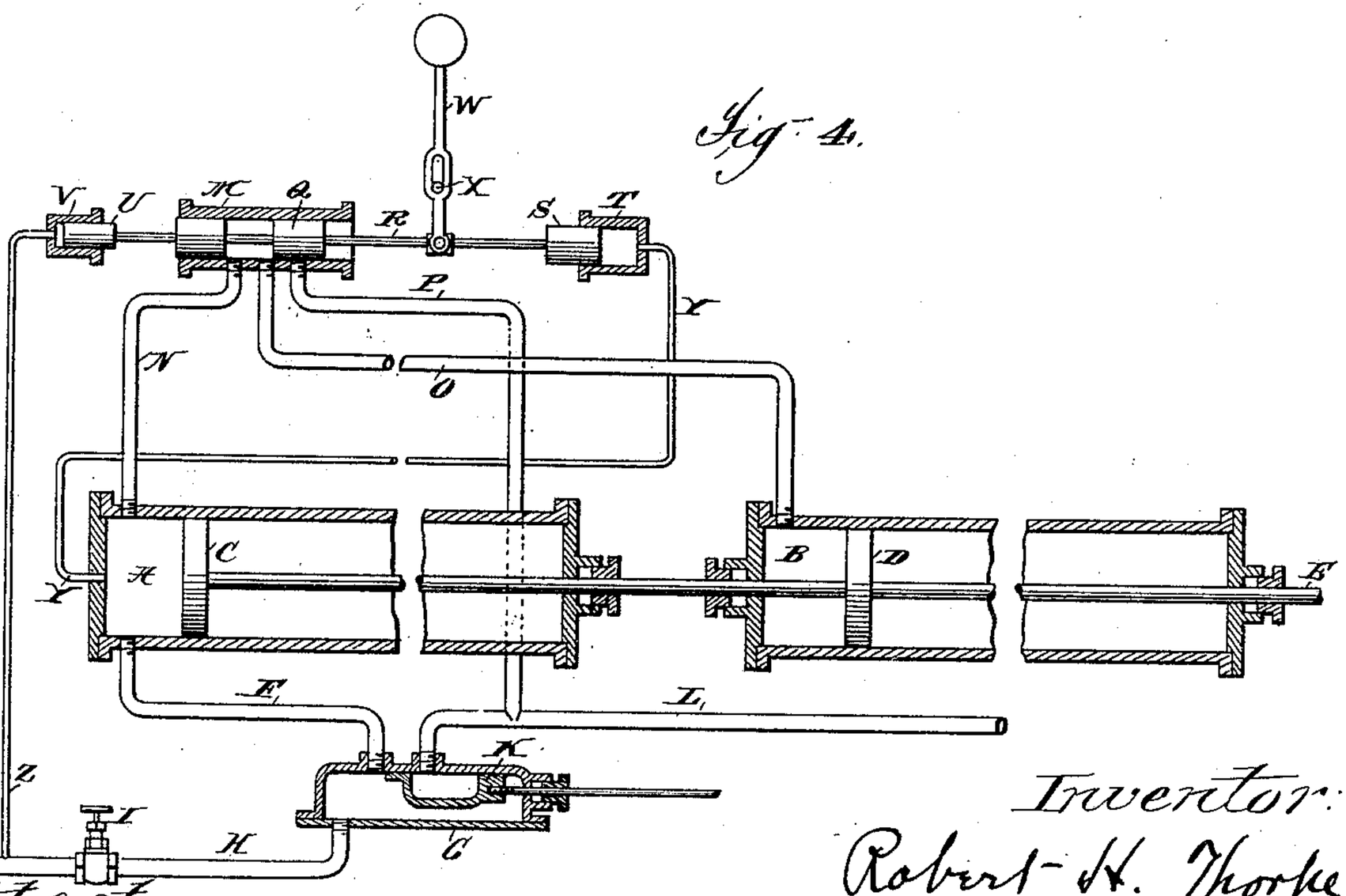


Fig. 4.



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UNITED STATES PATENT OFFICE.

ROBERT H. THORPE, OF LONDON, ENGLAND.

APPARATUS FOR REGULATING HYDRAULIC POWER.

SPECIFICATION forming part of Letters Patent No. 446,799, dated February 17, 1891.

Application filed August 19, 1890. Serial No. 362,384. (No model.) Patented in England June 10, 1890, No. 8,961.

To all whom it may concern:

Be it known that I, ROBERT H. THORPE, a subject of the Queen of Great Britain, residing at London, England, have invented certain new and useful Improvements in Apparatus for Regulating Hydraulic Power, fully described and represented in the following specification and the accompanying drawings, forming a part of the same, the said improvements being embraced in British Letters Patent No. 8,961, dated June 10, 1890.

This invention relates to hydraulic motors, and especially to that class of apparatus designed for regulating the power and to a certain extent the quantity of liquid employed for effecting varying amounts of work, or, in other words, for enabling the same apparatus to work at a higher or lower power in accordance with the work to be performed without varying the supply or pressure from the main. I accomplish this result in the present case by combining a plurality of motor-cylinders in such a manner that one or more of the cylinders will be operative in accordance with the work to be performed.

For a full understanding of my invention a detailed description of an apparatus embodying the same will now be given, reference being had to the accompanying drawings, forming a part of this specification, in which—

Figure 1 shows a hydraulic-motor apparatus constructed in accordance with my invention employing two cylinders and operating-plungers, the apparatus being shown as working at the lower power. Fig. 2 shows the same apparatus working at the higher power. Fig. 3 is a view similar to Fig. 1, showing my improvements applied to cylinders provided with pistons. Fig. 4 is a view similar to Fig. 2, showing an apparatus in which the motor-cylinders are placed end to end and the pistons carried by the same piston-rods.

Referring now especially to Figs. 1 and 2, A and B are respectively primary and secondary cylinders provided with plungers C D, connected outside the cylinders to the plunger-rod E, through which the movement of the plungers is transmitted to the desired point. The primary cylinder A is connected through the channel F and valve-chamber G with the main H, the supply from the main being controlled by means of the hand-valve I and the slide-valve K, the cylinder A communicating also with the exhaust L through the valve-chamber G, as usual in this class of construction. A valve-chamber M is connected with the primary and secondary cylinders A and B and with the exhaust L by means of pipes or channels N O P, communication through these channels being controlled by means of a balanced piston-valve Q, operated by means of a valve-rod R, connected at one end to a piston S, working in cylinder T, and at its opposite end to a smaller piston U, working in a cylinder V. Attached to the valve-rod R is a weighted lever W, pivoted at X. The larger cylinder T is connected by a pipe or channel Y with the primary cylinder A and the smaller cylinder V by a pipe or channel Z with the main H, preferably outside of the hand-valve I, so that the full main pressure may always be exerted therein.

The operation of the apparatus is as follows: When the parts are in the position shown in Fig. 1, only the cylinder A is employed, the channel N between the two cylinders being closed by the piston-valve Q, and the channels O P, connecting cylinder B with the exhaust, being open. The pressure from the main H, transmitted through the channel Z to the piston U, together with the weight of lever W, is in excess of the pressure upon the larger piston S received from cylinder A through channel Y. This is the position of the parts in the normal operation of the apparatus when only the lower power is required. When the work to be performed exceeds a certain amount, the pressure upon the piston T received from cylinder A will exceed that upon the smaller piston U received from the main H, together with that of lever W, and the piston Q will be moved into the position shown in Fig. 2, in which the channel P, connecting the valve-chamber M with the exhaust, is closed, and the cylinders A and B are connected through the channels N O and the valve-chamber M, the pressure of the main thus being transmitted to both cylinders and the apparatus working at the higher power. During this movement of the valve Q the weighted lever W offers a gradually-reduced resistance until it is brought into a vertical

position, as shown in Fig. 2, in which it exerts no pressure in either direction. The valve Q will remain in the position shown in Fig. 2 and the apparatus work at the higher power until the pressure upon piston S is again reduced below the pressure upon the piston U, when the pressure upon piston U will start the valve, and the weighted lever W being thrown out of its vertical position will then assist the pressure upon the piston and carry the valve Q rapidly home to the position shown in Fig. 1, in which position it will remain until a considerable difference in pressure over that at which the weighted lever was thrown over arises.

The leverage exerted by weighted lever W and the areas of pistons T and U can be proportioned so that the higher power shall only be used when the resistance or work to be done calls for a pressure above any desired amount. Thus let it be assumed that with the parts in the position shown in Fig. 1, it will take a pressure of five hundred pounds to the square inch on piston S to overcome the pressure on piston U, plus the resistance of weighted lever W. When the pressure in cylinder A, which, as is well known, varies in proportion to the resistance on rod E, or the work to be done, is below five hundred pounds to the square inch, the parts will remain in the position shown in Fig. 1 and only the lower power be employed. If, however, the load to be raised or other work to be performed is increased so that the pressure in cylinder A reaches five hundred pounds, the rod R and piston Q will be moved and the cylinders connected for the higher power. When the pressure in cylinder A again falls below five hundred pounds, the valve Q will be quickly shifted by the weighted lever W and the secondary cylinder B disconnected from the primary cylinder A and connected to the exhaust, the apparatus then working at the lower power.

The construction and operation of the apparatus shown in Fig. 3 are identical with that described, except that pistons are employed in place of plungers, thus forming what is known as a "pull-motor" as distinguished from the "push-motor" of Figs. 1 and 2.

The apparatus shown in Fig. 4 will frequently be found a convenient form where the combined length of the cylinders is not an objection, this construction dispensing with one piston-rod, thus producing a simpler and cheaper construction.

It will be understood that any uniform or constant resistance, such as a spring or weight, may be substituted for the piston U and cylinder V, and that this cylinder may be connected to any other source of pressure than the main or to the main inside of the hand-valve I; but I prefer to use the construction shown. It will be understood, also, that a spring or other equivalent device may be substituted for the weighted lever W; but the construction shown is that preferred, as the lever applies a gradually-decreasing resistance to movement in one direction and an increasing assistance to movement in the opposite direction, so that the valve moves quickly in either direction when it is once started by the rise or fall in pressure in the primary cylinder. Many other modifications in the construction and arrangement of the apparatus shown may be made by one skilled in the art without departing from my invention.

While I have shown but two motor-cylinders, it is evident that the number of cylinders employed may be increased, and that the principle of my invention may readily be applied in connection with any number of cylinders, so that the pressure may be varied within wide limits.

While I have shown a simple form of hydraulic motor, it will be understood that this form is selected only for the purpose of illustration, and that my invention is applicable also to other classes of motors operating on a more complex system.

What I claim is—

1. The combination, with primary and secondary motor-cylinders, of an automatically-operated valve opening communication between the primary and secondary cylinders and closing communication between the secondary cylinder and exhaust in one position and closing communication between the primary and secondary cylinders and opening communication between the secondary cylinder and exhaust in another position, said valve being moved in one direction by the working pressure from the primary cylinder and in the other direction by a constant pressure, substantially as described.

2. The combination, with a primary motor-cylinder, of a secondary motor-cylinder, channels connecting the secondary cylinder with the primary cylinder and with the exhaust, and an automatically-operated valve opening communication through one or the other of said channels and closing communication through the other channel in its respective positions, said valve being moved in one direction by the working pressure from the primary cylinder and in the other by a constant pressure, substantially as described.

3. The combination, with a primary motor-cylinder, of a secondary motor-cylinder, channels connecting the secondary cylinder with the primary cylinder and with the exhaust, an automatically-operated valve controlling communication through said channels, and a piston for actuating said valve, said piston being acted upon on one side by the working pressure from the primary cylinder and opposed by a constant pressure, substantially as described.

4. The combination, with a primary motor-cylinder, of a secondary motor-cylinder, channels connecting the secondary cylinder with the primary cylinder and with the exhaust, an automatically-operated valve controlling communication through said channels, a pis-

ton for actuating said valve acted upon on one side by the working pressure from the primary cylinder, and a weighted lever connected to the valve and opposing its movement by the piston, substantially as described.

5. The combination, with a primary motor-cylinder, of a secondary motor-cylinder, channels connecting the secondary cylinder with the primary cylinder and with the exhaust, an automatically-operated valve controlling communication through said channels, and two pistons controlling the movement of said valve, one of said pistons being acted upon by the working pressure from the primary cylinder and the other by a constant pressure, substantially as described.

6. The combination, with a primary motor-cylinder, of a secondary motor-cylinder, channels connecting the secondary cylinder with the primary cylinder and with the exhaust, an automatically-operated valve controlling communication through said channels, two pistons controlling the movement of said valve, one of said pistons being acted upon by the working pressure from the primary cylinder and the other by a constant pressure, and a weighted lever connected to the valve and opposing its movement by the piston operated from the primary cylinder, substantially as described.

7. The combination, with a primary motor-cylinder, of a secondary motor-cylinder, channels connecting the secondary cylinder with the primary cylinder and with the exhaust, an automatically-operated valve controlling communication through said channels, and two pistons of different sizes controlling the movement of the valve, one piston being acted upon by the working pressure from the primary cylinder and the other by the pressure from the main, substantially as described.

8. The combination, with a primary motor-cylinder, of a secondary motor-cylinder, channels connecting the secondary cylinder with the primary cylinder and with the exhaust, an automatically-operated valve controlling communication through said channels, two pistons of different sizes controlling the movement of the valve, the larger piston being acted upon by the working pressure from the primary cylinder and the smaller by the pressure from the main, and a weighted lever connected to the valve and opposing its movement by the larger piston, substantially as described.

9. The combination, with the primary and secondary motor-cylinders, of the valve-chamber M, channels connecting the valve-chamber with the primary and secondary cylinders and the exhaust, a valve controlling said channels, piston U in cylinder V for moving the valve in one direction, piston S in cylinder T for moving the valve in the opposite direction, said cylinders communicating, respectively, with the main and primary cylinders, and a weighted lever W, connected to the valve and opposing its movement by piston S, substantially as described.

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

ROBERT H. THORPE.

Witnesses:
T. H. PALMER,
G. M. BORST.