No. 644,151. Patented Feb. 27, 1900.

T. D. SMITH.

CYLINDER RELIEF VALVE.

(Application filed May 22, 1899.)

(No Model.) 2 Sheets—Sheet 1.

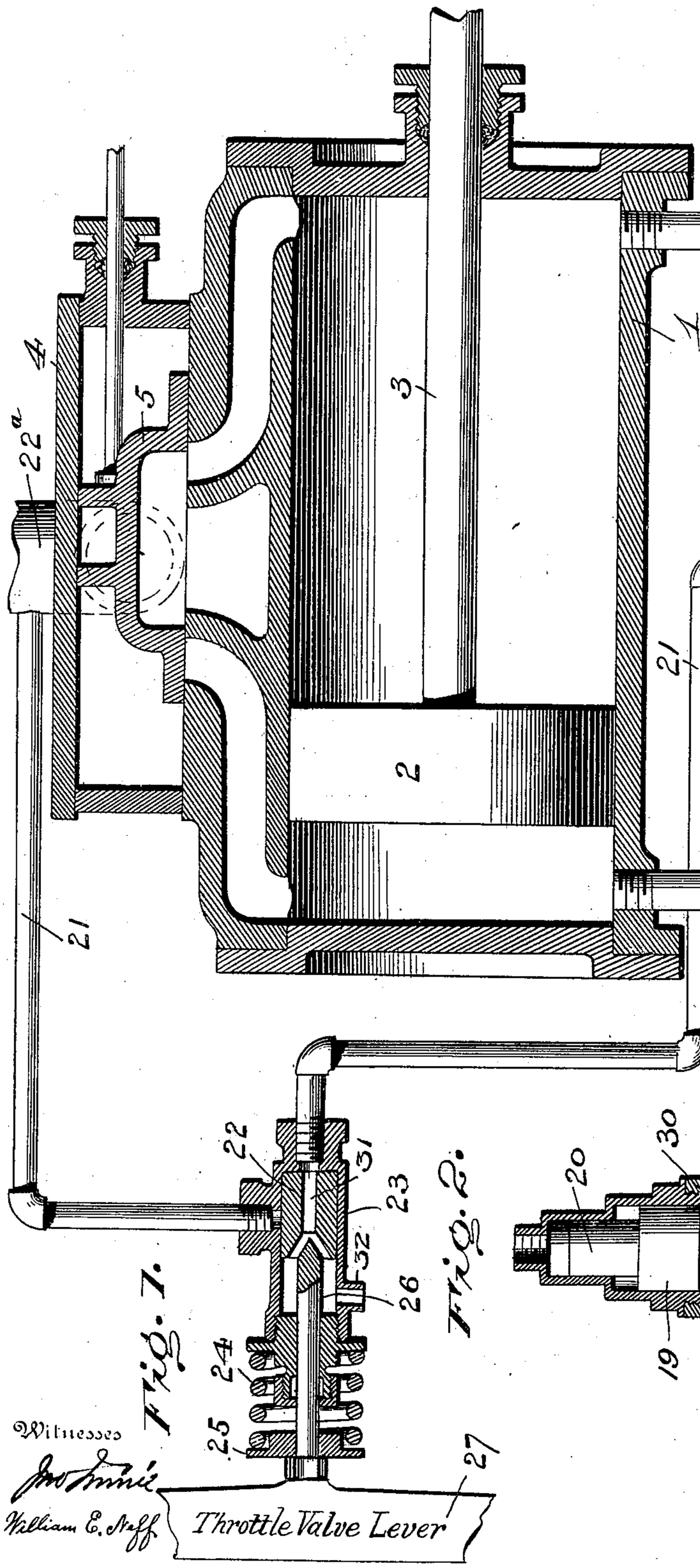

Fig. 1.

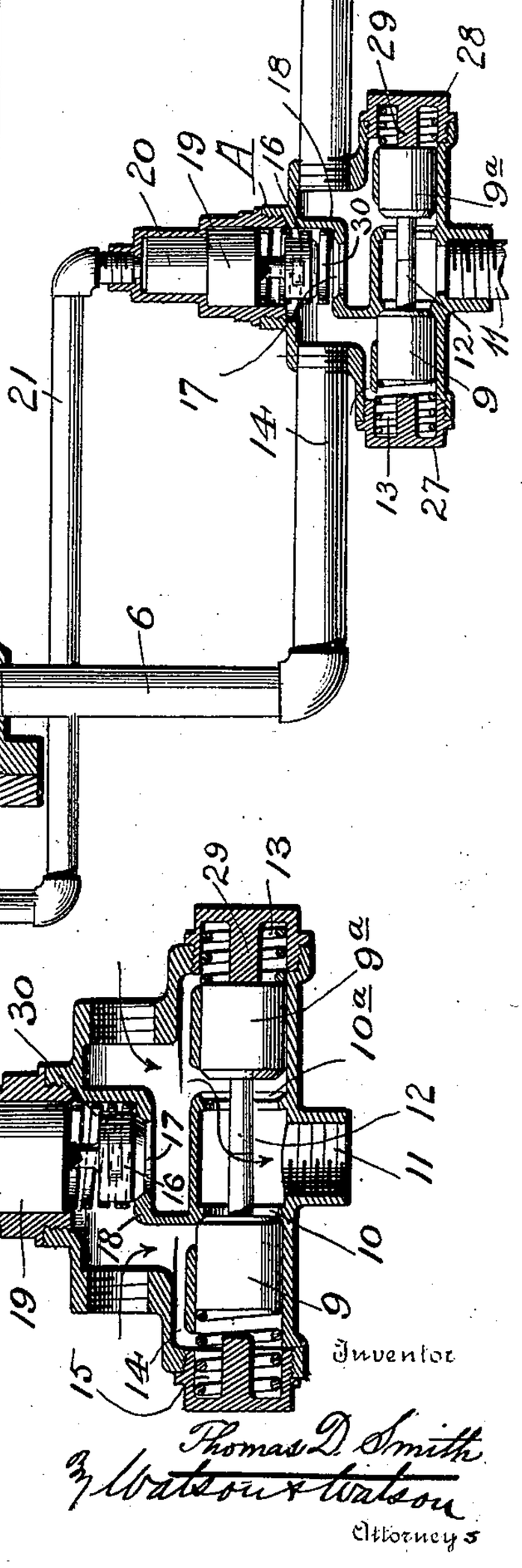

Fig. 2.

Fig. 3.

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Fig. 3.

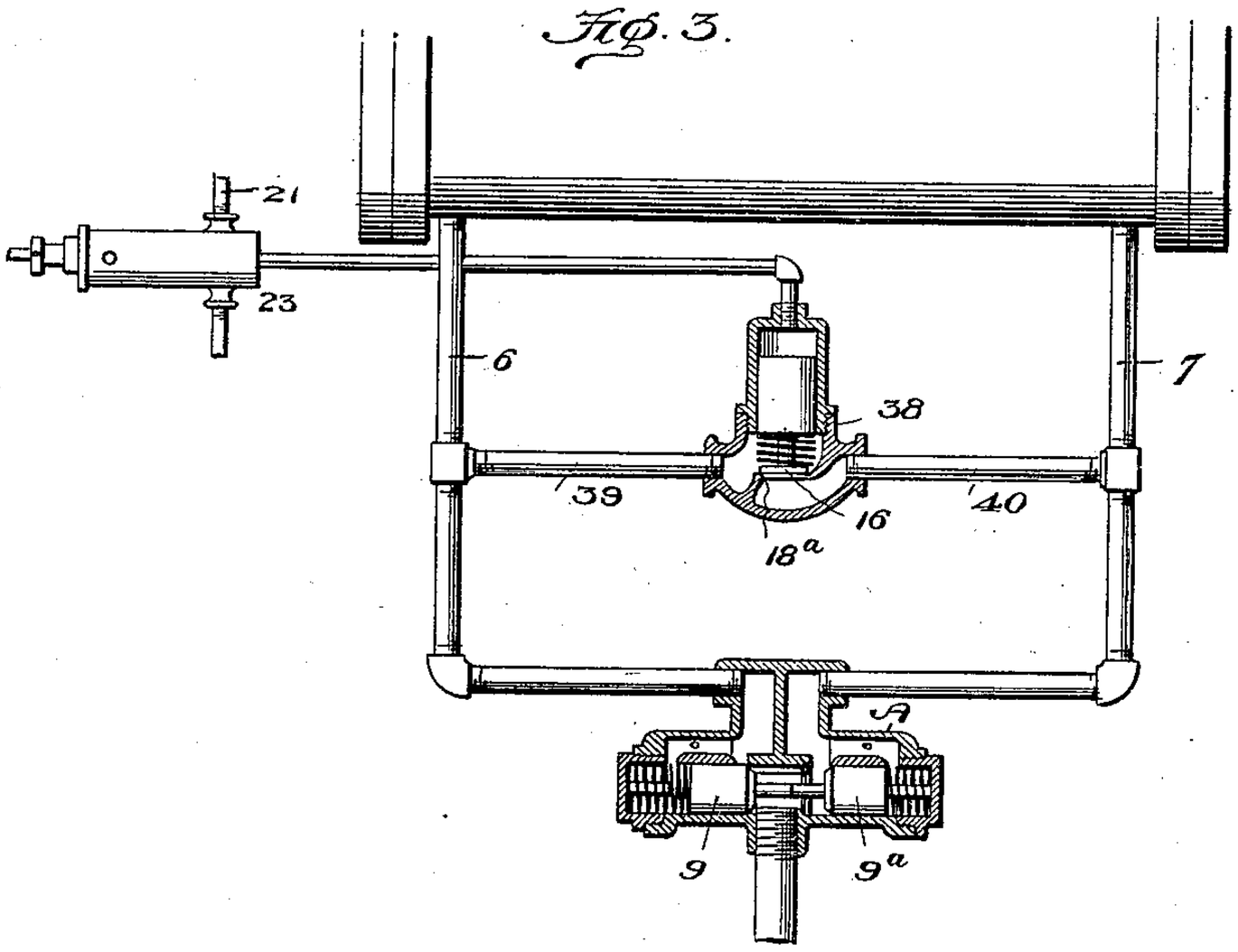
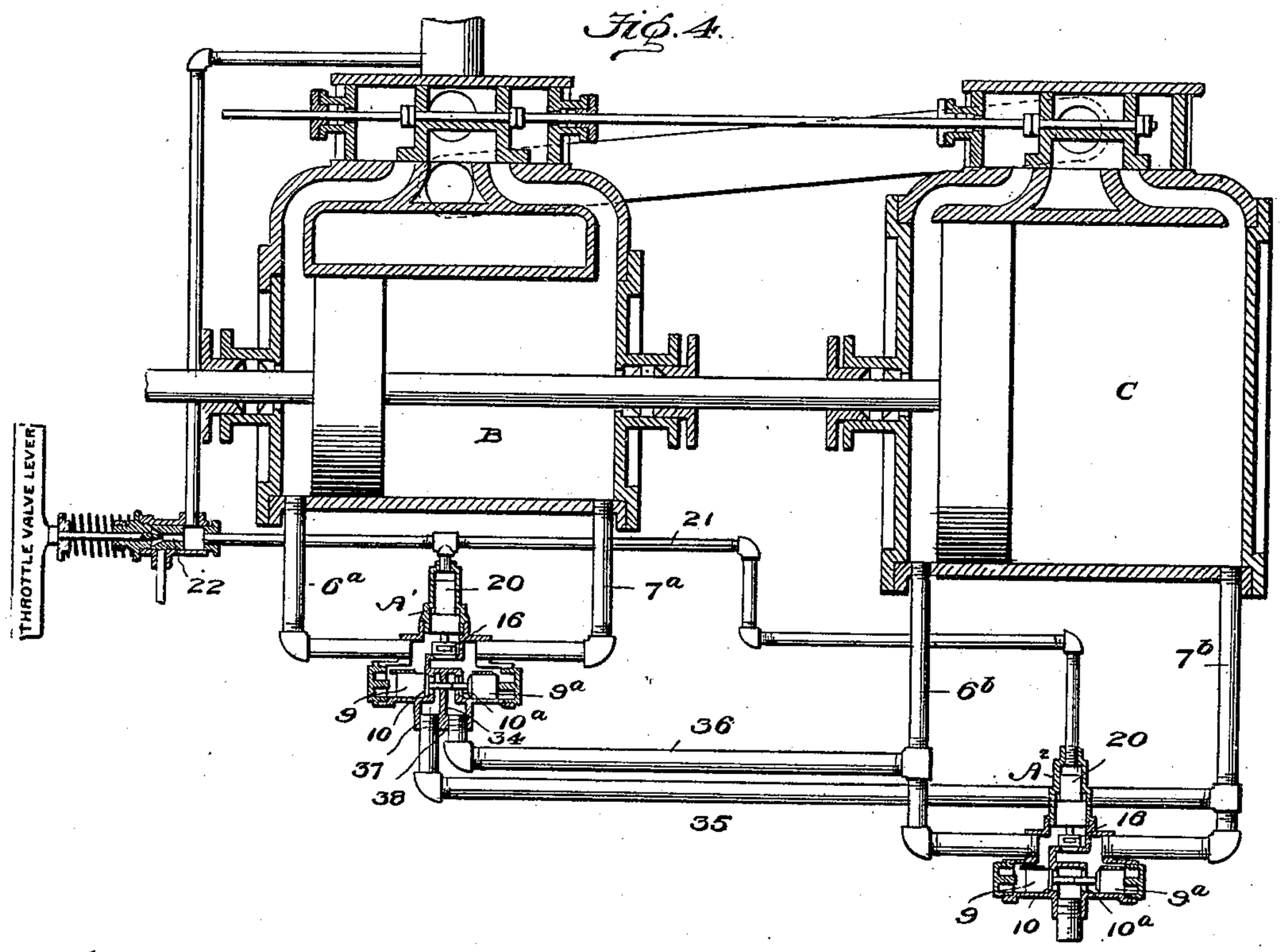


Fig. 4.



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UNITED STATES PATENT OFFICE.

THOMAS D. SMITH, OF WILKES-BARRÉ, PENNSYLVANIA.

CYLINDER RELIEF-VALVE.

SPECIFICATION forming part of Letters Patent No. 644,151, dated February 27, 1900.

Application filed May 22, 1899. Serial No. 717,814. (No model.)

To all whom it may concern:

Be it known that I, THOMAS D. SMITH, a citizen of the United States, residing at Wilkes-Barré, in the county of Luzerne and State of Pennsylvania, have invented certain new and useful Improvements in Cylinder Relief-Valves, of which the following is a specification.

This invention consists of various improvements in cylinder drainage and relief valves and their application to steam-engines, which will be described in detail in the following specification, reference being had to the accompanying drawings, in which—

Figure 1 is a sectional view of a steam-engine cylinder, including a sectional view of the improved drainage and relief valves. Fig. 2 is a sectional view of the drainage and relief valves, showing the parts in a different position. Fig. 3 is a sectional view of a modification, showing the relief-valves in a casing separate from the drainage-valves, and Fig. 4 is a sectional view showing the drainage and relief valves applied to a compound engine.

Referring to Figs. 1 and 2 of the drawings, 1 indicates the cylinder of an ordinary steam-engine; 2, the piston; 3, the piston-rod; 4, the steam-chest, and 5 the valve. At the ends of the lower side of the cylinder are two drain-pipes 6 and 7, which lead to a drainage and relief valve casing A. Within the casing A are arranged two cylindrical valves 9 9^a, which seat upon openings or ports 10 10^a, leading from the upper part of the valve-casing to an outlet 11. The valves 9 9^a are held apart by stems 12, which abut against each other, the valves being farther apart than their seats, with the effect that at least one valve is always unseated. Normally the valves 9 9^a are held off their seats by springs 13, both valves being held open in the central position. This is the position that obtains when the engine is stopped, in which case the drainage is free to run from both ends of the cylinder through the valve-casing A to the outlet 11.

The operation of the drainage-valve above described is as follows: When steam is admitted to one end of the engine-cylinder, it passes down through the drain-pipe 6 at that end and back through a port 14 to the chamber 15 at the rear of the valve 9 at the corresponding end of the valve-casing. The pressure on the valve-piston 9 closes it, and the valve 9^a at the opposite end is simultaneously opened, permitting the drainage from the exhausting end of the cylinder to pass out through the pipe 7 and exit 11. When pressure is introduced at the opposite side of the engine-piston, the valve 9^a is closed and the valve 9 opened, thus permitting the drainage to pass from the opposite end of the cylinder. In this manner the valves 9 and 9^a reciprocate simultaneously with the engine-piston and the drainage-ports are always open at the proper times. When the engine is stopped, the springs 13 force the valves into the middle position, thus opening both valves and permitting the water of condensation to run freely from both ends of the cylinder.

When steam is shut off from the cylinder of the engine and the engine at the same time reversed, the engine acts as a pump, and the drainage-valves above described do not serve to relieve the pressure caused by the compression of the air and water in the cylinder, such compression serving to close the valve 9 or 9^a at the end which requires relief. In this condition of affairs the water of condensation and compressed air would be confined in the cylinder in front of the advancing piston, and damage might be done if no outlet were provided for it. This condition of affairs also arises when the engine is running under its own momentum, the steam being cut off. In order to provide an outlet for this water and for any air which may be in the cylinder and might be highly compressed at the end of the stroke, I provide a relief-valve 16, which seats on an opening 17 in the partition 18, which separates the inlets of the drainage-pipes 6 7 in the valve-casing A. To the relief-valve 16 is connected a large piston 19, which is subject to the internal pressure in the casing, and a smaller piston 20. When the engine is running forward, the valve 16 is closed upon the seat by live-steam pressure on the piston 20, said pressure being conveyed through a pipe 21, leading from the supply-pipe 22^a. When the engine is reversed and compression takes place ahead of the engine-piston, the pressure is transmitted through the pipe 6 to the piston 19, raising said piston and opening the valve 16, which

permits the water of condensation or compressed gases to escape through the partition 18 and the valve 9^a to the outlet-pipe 11. Should undue compression take place at the other end of the engine-cylinder, the water and compressed gases would escape through the pipe 7, and the pressure on the under side of the valve 16 would raise the valve, thus permitting the water and compressed gases to escape in the opposite direction through the partition 18 and thence to the outlet-pipe 11, it being understood that in this condition of affairs the valve 9^a is closed and the valve 9 opened. It may also happen in starting or running under normal conditions that the quantity of water in the exhaust end of the cylinder may be so great that it cannot all pass through the drainage-valve on that side during the stroke of the piston. In that event the pressure on the exhaust side would become so great as to cause the drainage-valve on that side to close and force the valve on the steam side open. The excessive pressure would then open the relief-valve, permitting the water to pass out through the drainage-valve on the steam side until the pressure on the exhaust side fell below the pressure on the steam side.

The pipe 21 is provided with a suitable valve arranged to open automatically when the throttle-valve is opened and to close when the throttle-valve is closed. As shown is Fig. 1, this valve consists of a piston 22, sliding in a casing 23. The piston 22 is normally drawn to the left by a spring 24, which is introduced between the valve-casing and a disk 25 on the end of the valve-rod 26. When steam is shut off, the throttle-valve lever 27 strikes the end of the valve-stem 26 and compresses the spring 24, the valve 22 moving over into the position shown in Fig. 1 and closing the pipe 21. As soon as the throttle-valve is moved to admit steam to the cylinder the spring 24 automatically opens the valve 22 and steam is admitted through the pipe 21 to close the valve 16, thus restoring the relief-valve to its normal condition. When the pipe 21 is connected to the supply-pipe back of the throttle-valve, the piston 22 serves to cut off and admit steam through the pipe 21, as described, to operate the valve 16. When, however, the pipe 21 is connected to the supply-pipe between the throttle-valve and the engine, as is the case in Fig. 1, the admission of steam to said pipe will be controlled by the throttle-valve alone. In this case, however, it is also necessary to close the valve 22 when the throttle-valve is closed, in order to prevent compressed air which escapes past the slide-valve 5 from passing around through pipe 21 to the upper end of the piston 20 and to open said valve 22 when the throttle-valve is opened, so that the steam-pressure may be applied to close the valve 16.

The piston-valve 22 is formed with an opening 31, extending longitudinally through it, and an outlet-pipe 32 is let into the forward part of the casing, so that when the valve 22 is closed so as to shut off the live steam the steam remaining in the pipe 21 between said valve and the piston 20 may escape. Without this provision the steam within said section of pipe would tend to press the valve 16 to its seat until condensation took place within the pipe. The outlet 32 is so situated in the casing that when the piston 22 is forced outward to its full extent by the spring 24 the piston will close said outlet, as shown in Fig. 4.

I preferably place a spring 30 under the piston 19 to raise the valve 16 when the steam is shut off. Without this spring a vacuum caused by the piston when running idle would tend to hold the valve to its seat. When the engine is running without steam, the valve being raised by the spring permits a free flow of air to and from the opposite sides of the piston through the opening in the partition, and the drain-valves also permit the drainage to flow outward through the ports.

The ends of the casing containing the valves 9 and 9^a are closed by circular screw-caps 27 28, which can be removed to obtain access to the valves. These caps are cup-shaped and serve to hold the springs 13. They are also provided with inwardly-projecting stops 29, against which the valves 9 and 9^a abut.

In Fig. 3 I have shown the relief-valve 16 in a casing 38 separate from the casing containing the drainage-valves, the opposite ends of the casing 38 being connected to the drain-pipes 6 and 7 by pipes 39 and 40 and the valve 16 being seated in an opening in the partition 18^a, interposed between the openings of the pipes. The operation is the same as in Figs. 1 and 2, except that the compressed air when the engine is running idle and the drainage when there is excessive pressure on either end of the cylinder will pass through the pipes 39 and 40 and the casing 38.

In Fig. 4 I have shown the application of my drainage and relief valves to the cylinders of a compound engine. In this figure B represents the high-pressure cylinder and C the low-pressure cylinder. A drainage and relief valve casing A′ is connected to the opposite ends of the high-pressure cylinder by a forward drain-pipe 6^a and a rear drain-pipe 7^a, and a casing A^2 is connected to the opposite ends of the low-pressure cylinder by a forward drain-pipe 6^b and a rear drain-pipe 7^b. The casing A^2 is the same in construction as the casing A in Fig. 1, and the casing A′ is similarly constructed, except that a partition 34 is arranged within the casing between the ports 10 and 10^a, so that the drainage from the forward and rear drain-pipes will pass out through independent outlets 37 and 38 into the pipes 35 and 36, respectively, connected to said outlets. The pipe 36 is connected to the forward drain-pipe 6^b of the low-pressure cylinder, and the pipe 35 is connected to the rear drain-pipe 7^b of said cylinder. The pipe 21 and its valve 22 are ar-

ranged the same as in Fig. 1, except that said pipe is extended so as to supply pressure to the pistons 20 of both relief-valves.

In operation when the engine is running under steam-pressure and the pistons moving toward the rear of the cylinders the drainage from the high-pressure cylinder passes through the pipe 7^a, port 10^a in the casing A′, and pipe 36 to the forward drain-pipe 6^b of the low-pressure cylinder. Owing to the fact that steam is being admitted to the forward ends of the cylinders the port 10 in the casing A^2 will be closed and the drainage from the pipe 36 will back up in the pipe 6^b and if sufficient in quantity will enter the cylinder C. In the meantime the drainage from the rear end of the low-pressure cylinder will find an outlet through its drain-pipe 7^b and port 10^a of the valve-casing A^2. Upon the return or forward stroke of the pistons the steam being admitted in the rear of each piston will close the drainage-valves 9^a and open the valves 9. The drainage which has previously passed from the rear end of the high-pressure cylinder through the pipe 36 and into the pipe 6^b will then pass out through the port 10 of the casing A^2, together with the drainage from the forward end of the low-pressure cylinder. During this forward stroke the drainage from the forward end of the high-pressure cylinder will pass out by way of forward drain-pipe 6^a, outlet-opening 10 in casing A′, and pipe 35 to the rear drain-pipe 7^b of the low-pressure cylinder. The valve 9^a in the low-pressure valve-casing being closed during the forward stroke this drainage will pass upward through the pipe 7^b, and upon the following backward stroke of the piston in the low-pressure cylinder will be forced down and out through the port 10^a in the casing A^2, together with the drainage from the rear of the low-pressure cylinder.

The operation when the engine is reversed while running or when the engine is running under its own momentum with steam cut off is as follows: When the pistons are moving forward, the water or compressed air in advance of the pistons will pass through the drain-pipes 6^a and 6^b, the valves 16 will be opened, and the drainage from the high-pressure cylinder passing through said valves, ports 10^a, and pipe 36 will pass out through the outlet 11 of the valve-casing A^2 along with the drainage from the corresponding end of the low-pressure cylinder. When the pistons move backward, the drainage will pass through pipes 7^a and 7^b, the valves 16 will be opened, and the drainage from the cylinder B, passing through valve 16 and port 10 in the casing A′, and thence through pipe 35, will pass with the drainage from the low-pressure cylinder, by way of valve 16 and port 10 of the valve-casing A^2, to the outlet 11.

Having described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a cylinder drainage and relief valve, the combination with the engine-cylinder, of drain-pipes leading from opposite ends of the cylinder, automatic drain-valves adapted to open and close the drain-pipe ports alternately, a relief-valve interposed between and normally separating said drain-pipes when the engine is running under steam-pressure, and means for automatically opening said valve when steam is cut off the engine or there is an excessive pressure on either end of the cylinder.

2. In a cylinder drainage and relief valve, the combination with the cylinder, the drain-pipes and the automatic drain-valves, of the partition between said drain-pipes, the relief-valve normally closing an opening in said partition when the engine is running, the piston, and a connection between said valve and piston and means for communicating steam-pressure to said piston when the throttle-valve is open and for cutting off said pressure when the throttle-valve is closed.

3. In a cylinder drainage and relief valve, the combination with the engine-cylinder, of drain-pipes leading from opposite ends of the cylinder to a valve-casing, automatic drainage-valves within the casing, a partition in said casing separating the chambers into which said drain-pipes discharge, an opening in said partition, a relief-valve normally closing said opening when the engine is running under steam-pressure, and means for automatically opening said valve when steam is cut off the engine or the engine is reversed while running.

4. In a cylinder relief-valve, the combination with the engine-cylinder, of drain-pipes leading from opposite ends of the cylinder to a valve-casing, automatic drainage-valves within the casing, a partition in said casing separating the chambers into which said drain-pipes discharge, an opening in said partition, a relief-valve normally closing said opening when the engine is running under steam-pressure, and a spring for opening the valve when steam is cut off.

5. In a cylinder drainage and relief valve, the combination with the engine-cylinder, of drain-pipes leading from opposite ends of the cylinder to a valve-casing, automatic drainage-valves within the casing, a partition in said casing separating the chambers into which said drain-pipes discharge, an opening in said partition, a valve normally closing said opening when the engine is running, and means for automatically opening the valve when the engine is reversed while running and there is an excess of pressure on either side of said partition.

6. The combination with the drain-pipes and the automatic drain-valves, of the partition 18 between the outlets of the drain-pipes, the valve 16 normally closing an opening in said partition, the pistons 19 and 20 connected to said valve and the pipe 21 through which steam may be directed against the smaller piston 20, the larger piston being subject to

pressure transmitted through the drain-pipe, substantially as described.

7. The combination with the cylinder and the drain-pipes of the automatic drain-valves, the partition separating the outlets of the drain-pipes, the valve for opening and closing said partition, the steam-pipe 21 through which steam is admitted to close said valve, the valve arranged to close said steam-pipe, and means for closing said latter valve when the throttle-valve is closed, substantially as described.

8. The combination with the cylinder and the drain-pipes, of the automatic drain-valves, the partition separating the outlets of the drain-pipes, the valve for opening and closing said partition, the steam-pipe 21 through which steam is admitted to close said valve, the valve 22 arranged to close said steam-pipe when the throttle-valve is closed, and to permit the steam confined between said valve and the relief-valve to escape, substantially as described.

9. The combination with the high and low pressure cylinders of a compound engine, of drainage-valves for each cylinder, forward and rear drain-pipes connected to each of said cylinders and to said drain-valves, a relief-valve interposed between the drain-pipes of each cylinder, a steam-pipe 21 through which steam is admitted to close said relief-valves, and the valve arranged to close said steam-pipe when the throttle-valve is closed.

10. The combination with the cylinders of a compound engine, forward and rear drain-pipes connected to each of said cylinders, a valve-casing for each cylinder into which its drain-pipes discharge and automatic drain-valves within the casing adapted to open and close the drain-pipe ports, of independent outlets in the high-pressure valve-casing for the drainage from the forward and rear drain-pipes, a pipe 35 connecting the outlet of said forward drain-pipe with the rear drain-pipe of the low-pressure cylinder, and a pipe 36 connecting the outlet of the rear drain-pipe in the high-pressure valve-casing with the forward drain-pipe of the low-pressure cylinder, substantially as described.

11. The combination with the cylinders of a compound engine, forward and rear drain-pipes connected to each of said cylinders, a valve-casing for each cylinder into which its drain-pipes discharge and automatic drain-valves within the casing adapted to open and close the drain-pipe ports, of independent outlets in the high-pressure valve-casing for the drainage from the forward and rear drain-pipes, a pipe 35 connecting the outlet of said forward drain-pipe with the rear drain-pipe of the low-pressure cylinder, and a pipe 36 connecting the outlet of the rear drain-pipe in the high-pressure valve-casing with the forward drain-pipe of the low-pressure cylinder, a relief-valve interposed between the drain-pipes of each cylinder, a steam-pipe 21 through which steam is admitted to close said relief-valves, and the valve arranged to close said steam-pipe when the throttle-valve is closed.

In testimony whereof I affix my signature in presence of two witnesses.

THOMAS D. SMITH.

Witnesses:

EDWARD GUNSTER,

HARRY J. ELL.