No. 725,015. PATENTED APR. 7. 1903.

M. R. ZEHNDER.

CYLINDER RELIEF VALVE.

APPLICATION FILED OCT. 22, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

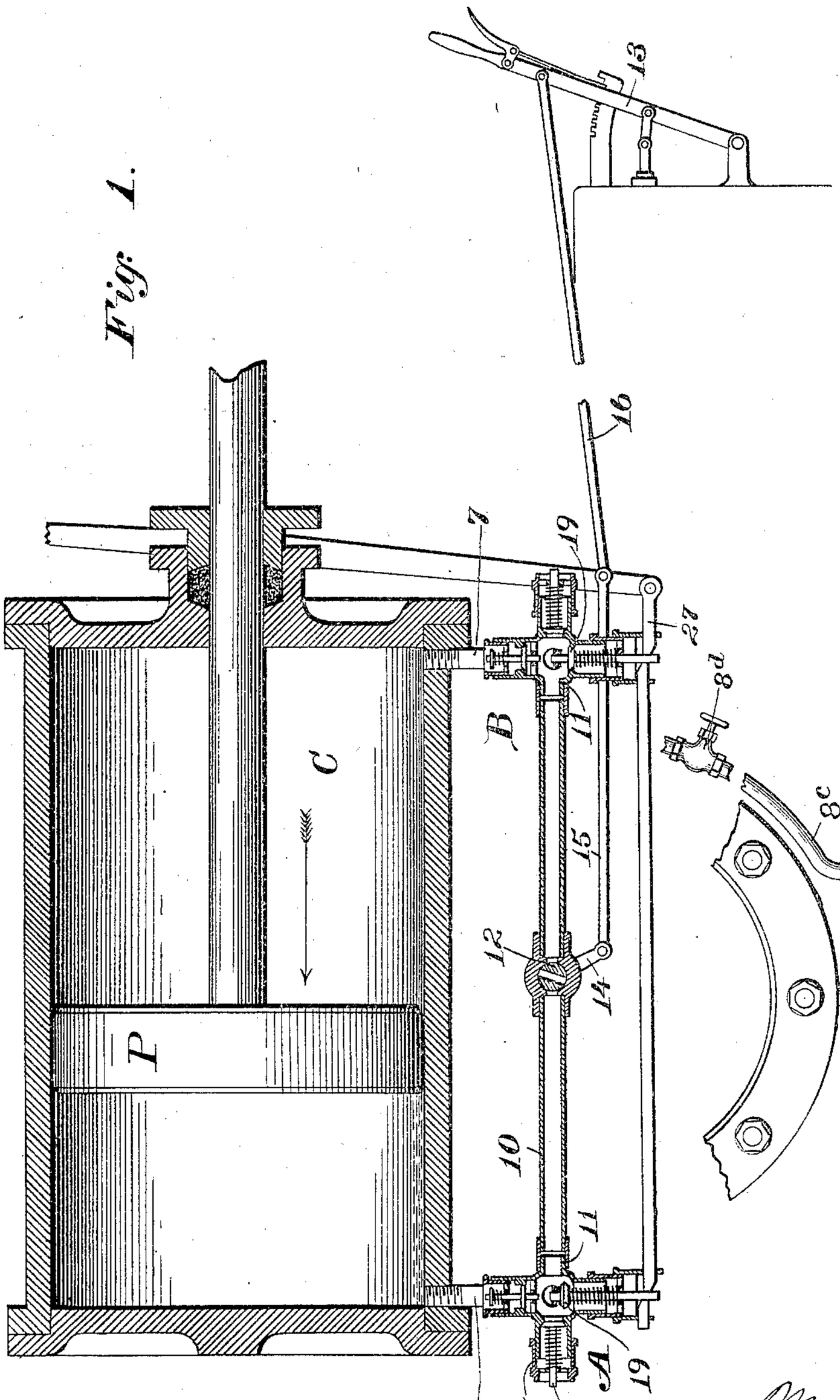
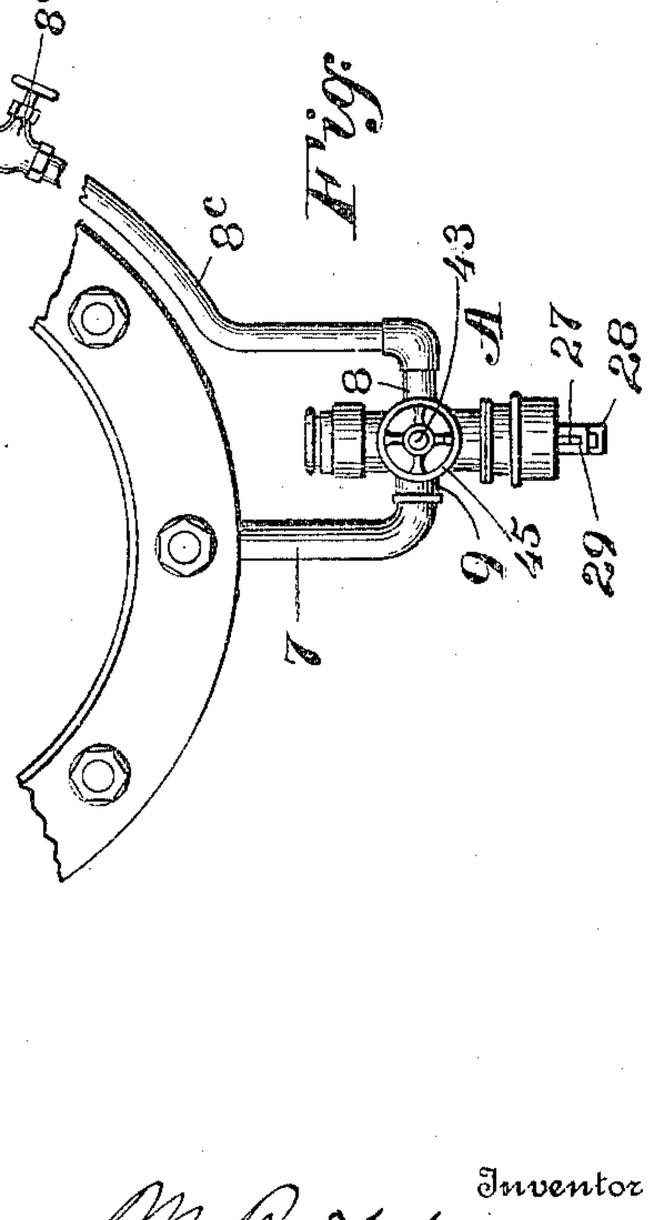


Fig. 2.



Witnesses

Percy C. Bowers.

Arthur L. Bryant.

Inventor

M. R. Zehnder

By Robert Watson

Attorney

No. 725,015. PATENTED APR. 7, 1903.

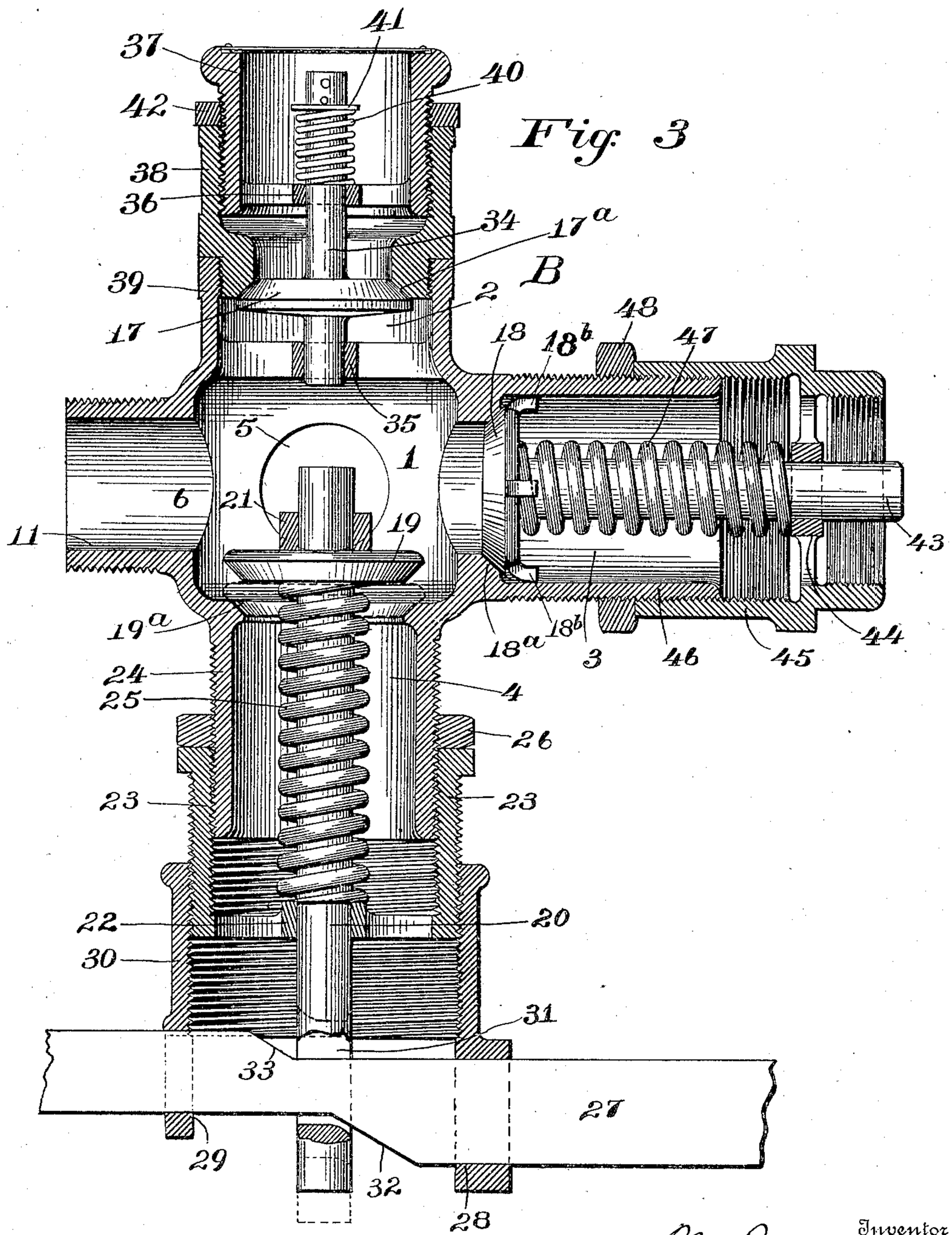
M. R. ZEHNDER.

CYLINDER RELIEF VALVE.

APPLICATION FILED OCT. 22, 1902.

NO MODEL. 3 SHEETS—SHEET 2.

Fig. 3



Witnesses

Percy R. Bowen.

Arthur L. Bryant.

Inventor

M. R. Zehnder.

By Robert Watson

Attorney

No. 725,015. PATENTED APR. 7, 1903.

M. R. ZEHNDER.

CYLINDER RELIEF VALVE.

APPLICATION FILED OCT. 22, 1902.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 5.

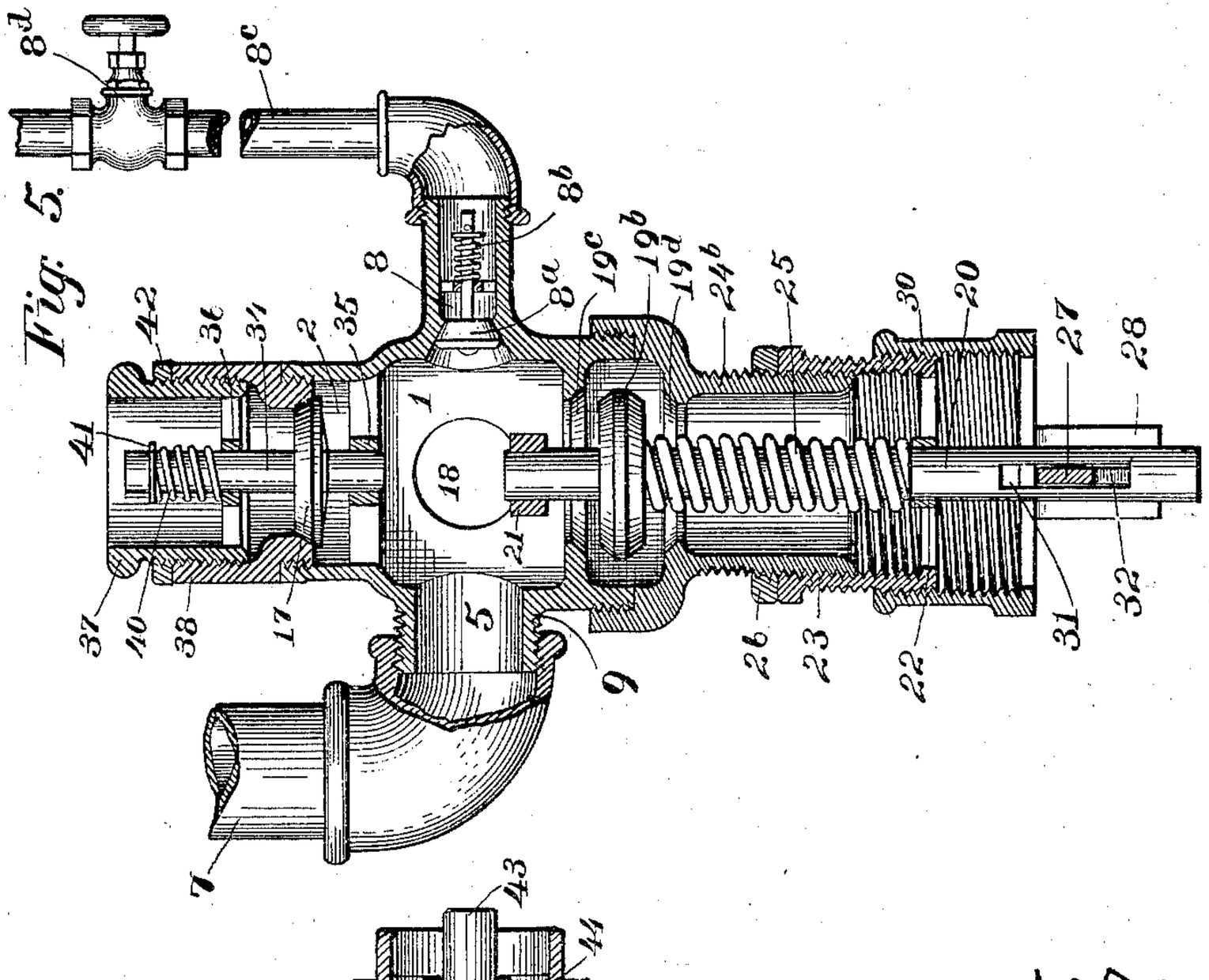
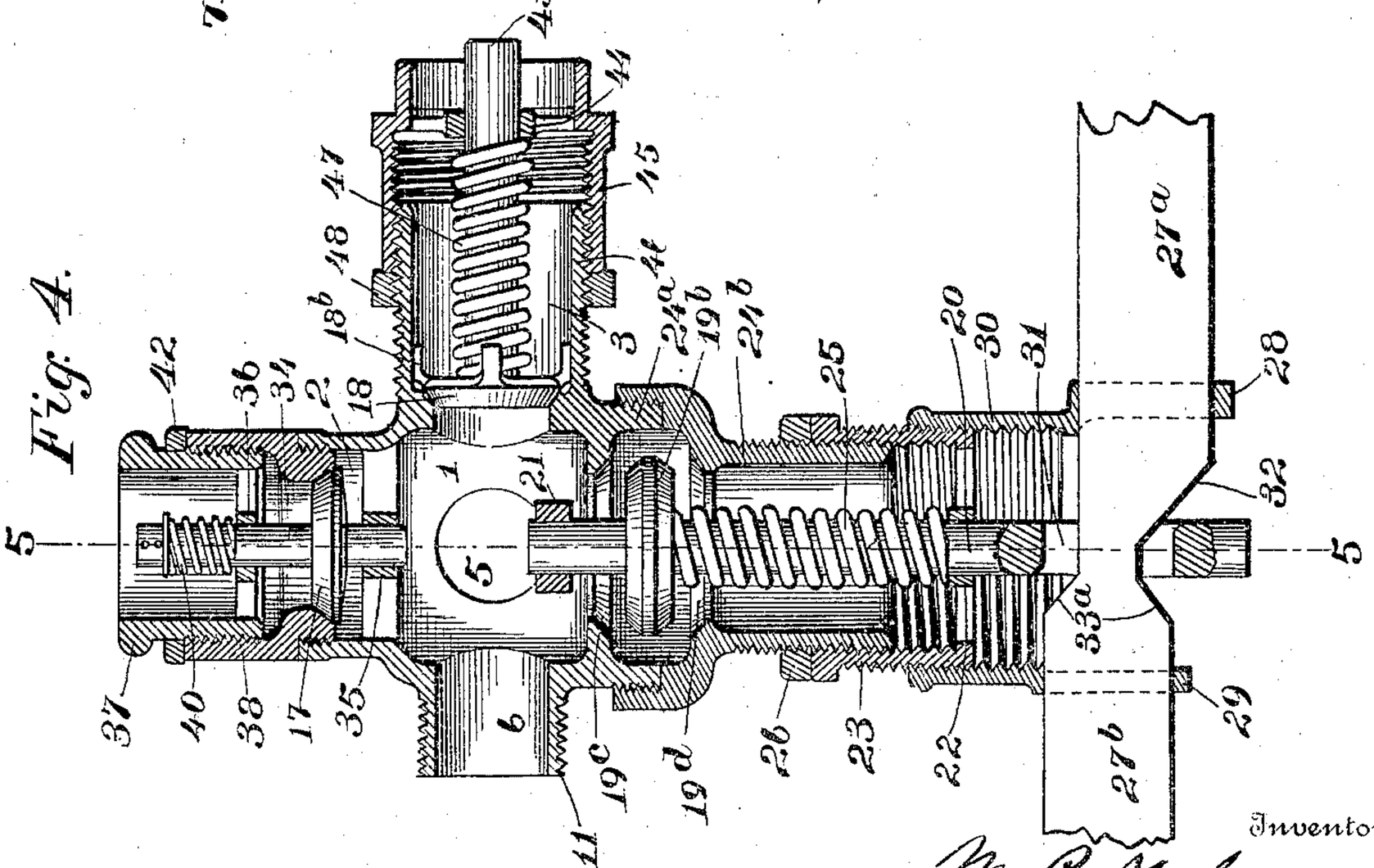


Fig. 4.



Witnesses

Percy C. Bowen

A. Metcheel

Inventor

M. R. Zehnder

By Robert Watson

Attorney

UNITED STATES PATENT OFFICE.

MORRIS R. ZEHNDER, OF SCRANTON, PENNSYLVANIA.

CYLINDER RELIEF-VALVE.

SPECIFICATION forming part of Letters Patent No. 725,015, dated April 7, 1903.

Application filed October 22, 1902. Serial No. 128,225. (No model.)

To all whom it may concern:

Be it known that I, MORRIS R. ZEHNDER, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Cylinder Relief-Valves, of which the following is a specification.

This invention comprises improved means for draining engine-cylinders and relieving them from excessive internal pressure arising from any cause, as well as for regulating or relieving the back pressure upon the piston and for preventing the retarding action upon the piston caused by air compression and suction when the engine is running under its own momentum.

The improvements are applicable in whole or in part to various forms of engines and machines where like conditions prevail; but I have herein illustrated the invention in connection with an ordinary steam-engine cylinder.

In the accompanying drawings, Figure 1 is a view showing an engine-cylinder in longitudinal central section and having my improved drainage and relief mechanism attached, the latter being also shown in central section. Fig. 2 is a partial end view of the cylinder with the attachments thereon. Fig. 3 is a central longitudinal vertical section through the drainage and relief valve casing. Fig. 4 is a similar view through a casing having a double seat for the drainage-valve, and Fig. 5 is a sectional view taken on the line 5 5 of Fig. 4.

In the drawings the drainage-valve in Fig. 3 has only one seat, while in the modification shown in Figs. 4 and 5 provision is made for seating the drainage-valve when moved in either direction from its central position. The remaining valves and ports are alike in all the views.

Referring to the drawings, A and B indicate a pair of similarly-constructed relief-valve casings, each, as shown in Figs. 3, 4, and 5, having a central chamber 1, valve-controlled ports or passage-ways 2, 3, and 4, leading from said central chamber to the atmosphere, ports 5 and 6, and an inlet-port 8 for the admission of lubricants, having a check-valve 8^a, said port 8 and check-valve being shown in Fig. 5. The chambers 1 of the valve-casings A and B are in constant communication with the interior of the engine-cylinder C through drip-pipes 7, which lead from the ends of the cylinder to pipe connections 9 upon the valve-casings surrounding the port 5. The ports 6 in the two valve-casings are connected by a pipe 10, attached to threaded connections 11 upon the casings, and a cut-off valve 12 is arranged in said pipe. This cut-off or by-pass valve is operatively connected with the throttle-lever 13 by suitable connections 14, 15, and 16, so arranged that when the throttle-lever is moved to admit steam to the cylinders the valve will close and when the lever is moved to shut off steam the by-pass valve will open. Provision is thus made for the circulation of air between the opposite ends of the cylinders when the steam is cut off and the engine is moving under its own momentum, and communication between the valve-casings is cut off when the engine is moving under steam-pressure, the purpose of which construction will be hereinafter explained.

In each casing the port or passage-way 2 is provided with a normally closed valve 17, opening inwardly into the chamber 1. The port or passage-way 3 is provided with a normally closed valve 18, opening outwardly from the central chamber. The port 8 is provided with the check-valve 8^a, opening inwardly, and the valve-chamber or passage-way 4 is provided with a normally open valve 19, which in Fig. 3 opens inwardly into the central chamber. In the modification shown in Figs. 4 and 5 the drainage-valve 19^b normally stands midway between two valve-seats 19^c and 19^d and is adapted to close when moved in either direction from its normal position.

The drainage-valve 19 (shown in Fig. 3) is mounted upon a valve-stem 20, which is carried by a fixed guide 21 and an adjustable guide 22, the latter being within a sleeve 23, which, as shown, is internally and externally screw-threaded and fits around the externally-threaded wall 24 of the chamber or passage-way 4. A compression-spring 25 is interposed between the adjustable guide 22 and the valve 19, and the tension of this spring may be varied by adjusting the sleeve 23 in-

ward or outward. The valve may thus be arranged to close against its seat 19ª at any predetermined internal pressure and will automatically open as soon as the pressure is relieved. The sleeve 23 may be locked in any desired position of adjustment by means of a lock-nut 26. The valves 19 in both casings may also be simultaneously closed manually when desired by means of a longitudinally-movable rod 27, which extends through guide-openings 28 and 29 in a tubular hanger 30, having internal threads which fit the external threads on the sleeve 23, one of said hangers being fitted to each valve-casing. The rod 27 extends through slots 31 in the valve-stems 20, and said rod is provided with cam-surfaces 32, which when the rod is moved to the left in the drawings engage the lower walls of the slots and force the valves to their seats against the tension of their springs. Cam-surfaces 33 are also formed upon the upper edge of the rod, by means of which the valves may, if desired, be manually raised against the pressure of the steam upon the valves by reverse movement of the cam-rod. In the mid-position of the rod the valves are free to open and close automatically. As the connection between each hanger and adjusting-sleeve is a threaded one, the sleeve may be turned for the purpose of varying the tension on the spring without disturbing the connection between the hanger and cam-rod or the positions of said parts relatively to the valve-casing. The vacuum-valve 17 is mounted upon a valve-stem 34, which is movable longitudinally in a fixed guide 35 and an adjustable guide 36, the latter being arranged within a sleeve or bushing 37, having external threads which engage with corresponding internal threads upon a valve-seat fitting 38. This fitting has a threaded connection with the wall 39 of the chamber or passage-way 2 and forms an extension of said chamber, and the inner end of the fitting forms a valve-seat 17ª for the valve 17. A compression-spring 40 is interposed between the guide or bearing 36 and a suitable stop or shoulder 41 near the outer end of the valve-stem. The spring 40 thus tends normally to hold the valve against its seat, and the degree of tension upon the valve may be varied by adjusting the bushing inwardly or outwardly. The bushing may be locked in any given position by a lock-nut 42.

The excess-pressure valve 18 fits against a valve-seat 18ª at the inner end of the chamber 3. The valve is provided with projections 18ᵇ, which guide it within the passage-way 3, and its stem 43 extends through a guide 44 in a sleeve 45, which sleeve is threaded onto the exterior of the wall 46 of the chamber or passage-way 3. A spring 47, interposed between the guide 44 and the valve, holds the latter to its seat, and the tension of the spring may be varied by the adjustment of the sleeve. The latter may be locked in position by means of a lock-nut 48. The tension of the spring 47 is adjusted by the sleeve to hold the valve to its seat against the normal operative pressure in the cylinder and to open at any desired pressure above the normal. The check-valve 8ª is held to its seat by a suitable spring 8ᵇ.

In operation when the throttle-valve lever is moved to admit steam to the cylinder the by-pass valve 12 is closed, as shown in Fig. 1, and communication is thus cut off between the valve-casings A and B. Under normal conditions when steam is admitted to the right-hand end of the cylinder and the piston P is moving in the direction indicated by the arrow the normal operative pressure at that end of the cylinder will close the drainage-valve in the casing B during the piston-stroke, thus preventing the escape of steam, while the corresponding valve in the casing A, which is subject only to the pressure of the exhaust-steam, will remain open during the stroke, thus permitting the water of condensation to escape past said valve and through the passage-way 4. When steam is admitted to the opposite end of the piston at the commencement of the return stroke, the drainage-valve in the casing A closes by the normal operative pressure and the drainage-valve in the casing B at the exhaust side of the cylinder opens under the tension of its spring and permits the water of condensation to escape from the right-hand end of the cylinder, this operation being repeated while the engine is in motion under steam-pressure. When the engine is at rest and also while running under its own momentum with steam cut off, the drainage-valves will be held off of their seats by the springs, and the cylinder will thus be drained at all times, whether in motion or stopped. When the engine is running under its own momentum, also as the drainage-valves are held open, air may enter and pass out of the cylinder by way of said valves, and the compression of air in front of the piston and vacuum in the rear of the piston, which naturally results from the pumping action of the piston, are in whole or in part averted. In order to further relieve the retarding effects of this pumping action, the valve 12, which is open when the throttle-valve is closed, establishes communication between the two valve-casings and permits the air to circulate back and forth between the ends of the cylinder while the steam is shut off.

The back pressure in the cylinder, caused by the complete or partial closing of the exhaust-port by the engine-valve before the piston reaches the end of the stroke, results in back pressure upon the piston, which back pressure may be relieved through the drainage-valves if the tension of the springs upon these valves is made sufficient to withstand such pressure, or any desired amount of back pressure may be retained by suitable adjustment of the springs adapting them to close at any predetermined pressure. The valves 19, therefore, in both casings serve the several

useful purposes of draining the cylinder, relieving the air-pressure within the cylinder, preventing the formation of a vacuum, and preventing or regulating the back pressure upon the piston.

It may happen under some circumstances that a pressure above the normal steam-pressure will occur in the valve-casing at the exhaust end of the cylinder—as, for instance, where a considerable amount of water has suddenly accumulated through turning steam into a cold cylinder—in which case the pressure would close the drainage-valve and the water would be confined within the cylinder, resulting in possible damage if some means were not provided for relieving this excess pressure. Under such circumstances the valve 18, which remains closed under normal steam-pressure, opens at a certain pressure above the normal and allows the water to escape, or it may happen that excessive steam-pressure is engendered by reversing the engine while in motion, in which case the steam admitted in front of the advancing piston is compressed by the piston and the excessive pressure opens the excess-pressure valve 18, thus permitting the pressure to drop to about normal or to a point at which no harm can result. If the drainage-valves should be held against their seats by the cam-rods 27 (which may be done with safety with a constantly-running engine operated by dry steam after the cylinder has become heated) and excessive pressure through accumulation of water or otherwise should occur in the cylinder, the excess-pressure valves 18 would under such circumstances open and relieve the pressure and drain the cylinder.

The vacuum-valves 17 open automatically against the tension of their springs whenever from any cause a partial vacuum occurs in the cylinder which is not relieved through the drainage-valves 19. These vacuum-valves may be arranged to open at any given fall of the internal pressure below atmospheric pressure, and in case the drainage-valves are held closed by the cam-rod 27 the air entering past the vacuum-valves will prevent the formation of a vacuum and the retardation of the engine from any cause while running under its own momentum. The air thus admitted will circulate back and forth from one end of the cylinder to the other through pipe 10 and valve 12. It will be noted that when the engine is operating under steam-pressure the valves at each end of the cylinder operate independently, owing to the fact that communication between the casings is closed by the valve 12. The pipe 10 and value 12 might in some instances be dispensed with, in which case caps should be placed upon the connecting-pieces 11 of the valve-casings to close the ports 6.

A dust-guard 49, of gauze or other suitable material, is, as shown, placed over the end of the sleeve or bushing 37 in order to prevent dirt, cinders, &c., from passing into the vacuum-valve chamber.

The cylinder of a steam-engine while in motion under its own steam-pressure is amply lubricated by oil admitted with the steam, and where drainage-valves are applied the valves are also lubricated by the oil from the cylinder. When, however, the engine is moving with steam shut off, the supply of oil is also cut off, and the cylinder and piston are then apt to be cut and worn by friction. This condition occurs with locomotives when drifting downgrade and also when an accident occurs to the valve-gear on one side, such as the breaking of a valve-rod or eccentric-rod, such accident necessitating usually the blocking of the steam-ports of the cylinder on that side and the disconnecting of the driving-rod, so that the piston will remain inactive while the engine proceeds under steam applied to the opposite cylinder. In order to supply oil to the cylinder or cylinders when steam is shut off and to avoid the necessity of uncoupling the driving-rod to prevent piston movement, I admit oil to the relief-valve casing under steam-pressure through the port 8 past the check-valve 8^a, and this oil is carried into the cylinder by the suction of the piston, the drainage-valve, if necessary, being closed by the rod 27 to prevent the escape of oil. The oil may be admitted by means of suitable oiling devices, such as are employed to lubricate cylinders and not necessary to illustrate, such devices being attached to a pipe 8^c, having a valve 8^d for turning on and off the steam.

In Figs. 4 and 5 the drainage-valve chamber is made in two parts 24^a and 24^b, having valve-seats 19^c and 19^d, respectively, said parts having a threaded connection, as shown. The drainage-valve is suitably formed to fit against both seats and is normally supported between said seats by the spring 25. The adjusting device for the spring and the hanger are the same as in Fig. 3. The cam-rod 27^a is provided with a cam-surface 32 for forcing the valve against the lower seat 19^d when moved in one direction from the central position and with a part 27^b, adapted to fit within the slot 31 and hold the valve in its normal open position when the rod is moved in the opposite direction. Beveled or cam surfaces 33^a are provided to facilitate the entrance of the part 27^b into the slot. In the mid-position of the rod the valve is free to close against the seat 19^c by atmospheric pressure when a partial vacuum is formed in the valve-casing or to close against the seat 19^d when subjected to internal pressure. By this arrangement the valve may be closed at will, or it may be held open for any of the purposes heretofore mentioned, or it may be permitted to close and open automatically. By permitting the valve to close by atmospheric pressure the degree of vacuum within the cylinder may be controlled to better advantage than where the valve remains open under atmospheric pres-

sure, as in Fig. 3, this regulation being effected by the adjustment of the spring connected with the vacuum-valve.

While I have shown the most convenient arrangement of valves, it will be understood that their arrangement and construction may be varied without departing from the spirit and scope of my invention.

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

1. In a cylinder relief device, a hollow casing having a port adapted for connection to the drainage-outlet of a cylinder, and ports or passage-ways leading to the atmosphere, in combination with valves controlling said passage-ways and comprising a normally open drainage-valve adapted to close by the normally operative pressure in the cylinder, and a normally closed vacuum-valve adapted to open by atmospheric pressure when the internal pressure falls below that of the atmosphere.

2. In a cylinder relief device, a hollow casing having a port adapted for connection to the drainage-outlet of a cylinder, and ports or passage-ways leading to the atmosphere, in combination with valves controlling said passage-ways and comprising a normally open drainage-valve adapted to close by the normal operative pressure in the cylinder, a normally closed excess-pressure valve adapted to open when the internal pressure exceeds the normal, and a normally closed vacuum-valve adapted to open by atmospheric pressure when the internal pressure falls below that of the atmosphere.

3. In a cylinder relief device, a hollow casing having a port adapted for connection to the drainage-outlet of a cylinder, and ports or passage-ways leading to the atmosphere, in combination with valves controlling said passage-ways and comprising a normally open drainage-valve adapted to close by the normal operative pressure in the cylinder, a normally closed excess-pressure valve adapted to open when the internal pressure exceeds the normal and a normally closed vacuum-valve adapted to open by atmospheric pressure when the internal pressure falls below that of the atmosphere, and means for adjusting said valves to operate at different pressures.

4. In a cylinder relief device, a hollow casing having a port adapted for connection to the drainage-outlet of a cylinder and having two ports or passage-ways leading to the atmosphere, in combination with a drainage-valve adapted to close one of said passage-ways when acted upon by the normal operative pressure in the cylinder, a spring arranged to hold said drainage-valve normally in its open position, and an excess-pressure valve normally closing the other of said passage-ways and adapted to open when subjected to pressure above the normal operative pressure.

5. In a cylinder relief device, the combination with a hollow casing having a port adapted for connection to the drainage-outlet of a cylinder and two ports or passage-ways leading to the atmosphere, of a normally open drainage-valve adapted to close one of said passage-ways when acted upon by the normal operative pressure in the cylinder, an excess-pressure valve normally closing one of said passage-ways and adapted to open when subjected to pressure above the normal, and means for adjusting said valves to operate at different pressures.

6. In a cylinder relief device, a hollow casing having a port adapted for connection to the drainage-outlet of a cylinder and having a tubular passage-way or valve-chamber leading from the interior of the casing to the atmosphere, a valve adapted to open and close said passage-way, a valve-stem to which said valve is connected, a sleeve having a threaded connection with the walls of the chamber, a spring interposed between said sleeve and valve, a hanger having a threaded connection with said sleeve, and a rod supported by said hanger and having one or more cam-surfaces adapted to engage said valve-stem.

7. In a cylinder relief device a hollow casing having a port adapted for connection to the drainage-outlet of a cylinder and having a passage-way leading from the interior of the casing to the atmosphere, a valve adapted to open and close said passage-way, a valve-stem to which said valve is connected, a hanger, a rotatable adjusting-sleeve connecting said hanger with the casing, a spring interposed between said sleeve and valve, and a rod supported by the hanger and having one or more cam-surfaces adapted to engage said valve-stem.

8. In a cylinder relief device, a hollow casing having a port adapted for connection to the drainage-outlet of a cylinder and having a tubular passage-way or chamber leading from its interior to the atmosphere, a valve adapted to open and close said passage-way, a valve-stem within the chamber to which said valve is connected, a sleeve adjustably secured to the walls of said chamber and having a guide for the valve-stem, a spring interposed between said guide and the valve, a tubular hanger having a threaded connection with the sleeve, and a rod supported by said hanger and having one or more cam-surfaces adapted to engage and move said valve-stem to operate the valve.

9. The combination with a cylinder, of a pair of hollow valve-casings each having a port communicating with the cylinder, ports or passage-ways communicating with the atmosphere and valves controlling said latter ports, of a pipe connecting the interiors of said valve-casings, and a valve in said pipe operatively connected with the throttle-valve of the engine and arranged to open communication between the casings when the throttle-valve is closed and to close communica-

tion between said casings when the throttle-valve is opened.

10. The combination with a cylinder of a pair of hollow valve-casings each having a port communicating with the cylinder and having ports or passage-ways communicating with the atmosphere, an excess-pressure valve normally closing one of said passage-ways, a normally open drainage-valve adapted to close another of said passage-ways, and means for holding said drainage-valve in either its open or closed positions.

11. The combination with a cylinder of a pair of hollow valve-casings each having a port communicating with the cylinder and having ports or passage-ways communicating with the atmosphere, an excess-pressure valve normally closing one of said passage-ways, a normally open drainage-valve adapted to close another of said passage-ways, and a rod operatively connected to both drainage-valves and adapted when moved in either direction from its central position to hold the drainage-valves in both casings open or closed.

12. In a cylinder relief device, a hollow casing having a port adapted for connection to the drainage-outlet of a cylinder and having a port or passage-way for the water of condensation said passage-way having two valve-seats therein, of a drainage-valve arranged between and adapted to fit against either of said valve-seats and a spring for holding said valve in an intermediate position between the valve-seats.

13. In a cylinder relief device, a hollow casing having a port adapted for connection to the drainage-outlet of a cylinder and having a port or passage-way for the water of condensation said passage-way having two valve-seats therein, of a drainage-valve arranged between and adapted to fit against either of said valve-seats, a spring for holding said valve in an intermediate position between the valve-seats and means for positively holding said valve in either its open or closed positions.

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

MORRIS R. ZEHNDER.

Witnesses:

W. HAYDEN EVANS,

JOHN C. WILSON.