No. 816,348.

PATENTED MAR. 27, 1906.

J. W. MILLER.

CYLINDER COMPRESSION RELIEF VALVE.

APPLICATION FILED JUNE 14, 1905.

3 SHEETS—SHEET 1.

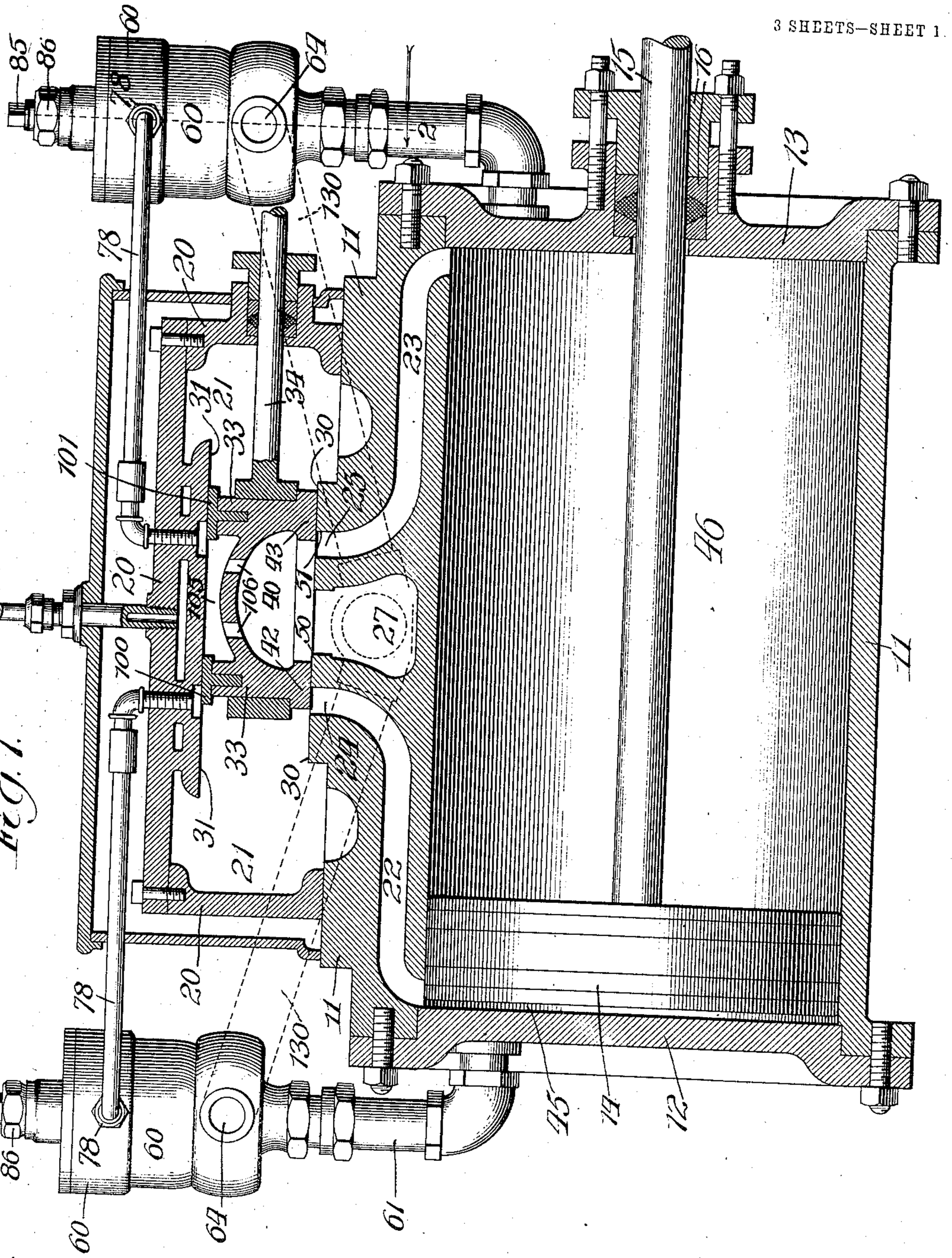

FIG. 1.

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Chas. A. Buell.

Inventor:
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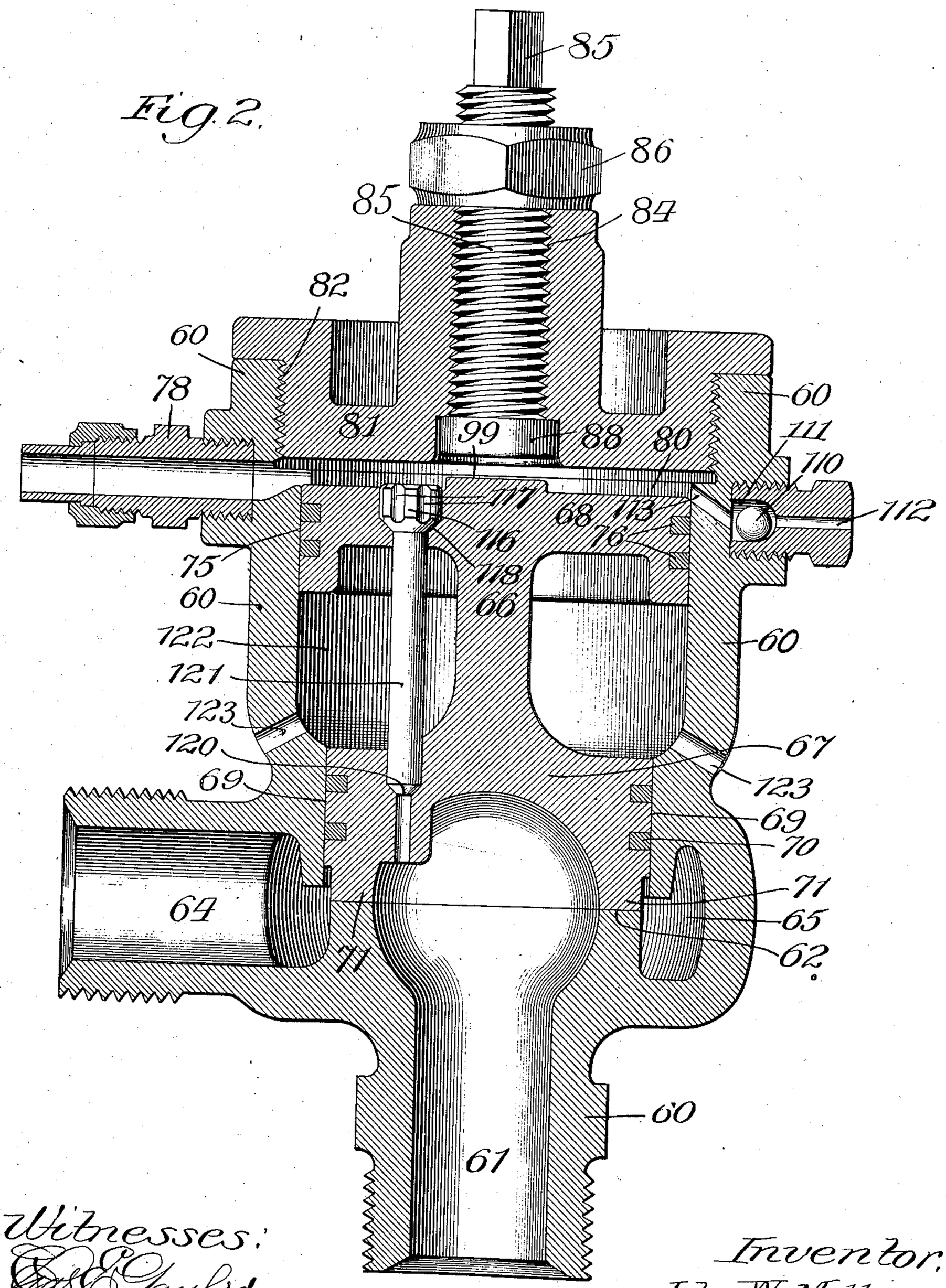
3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

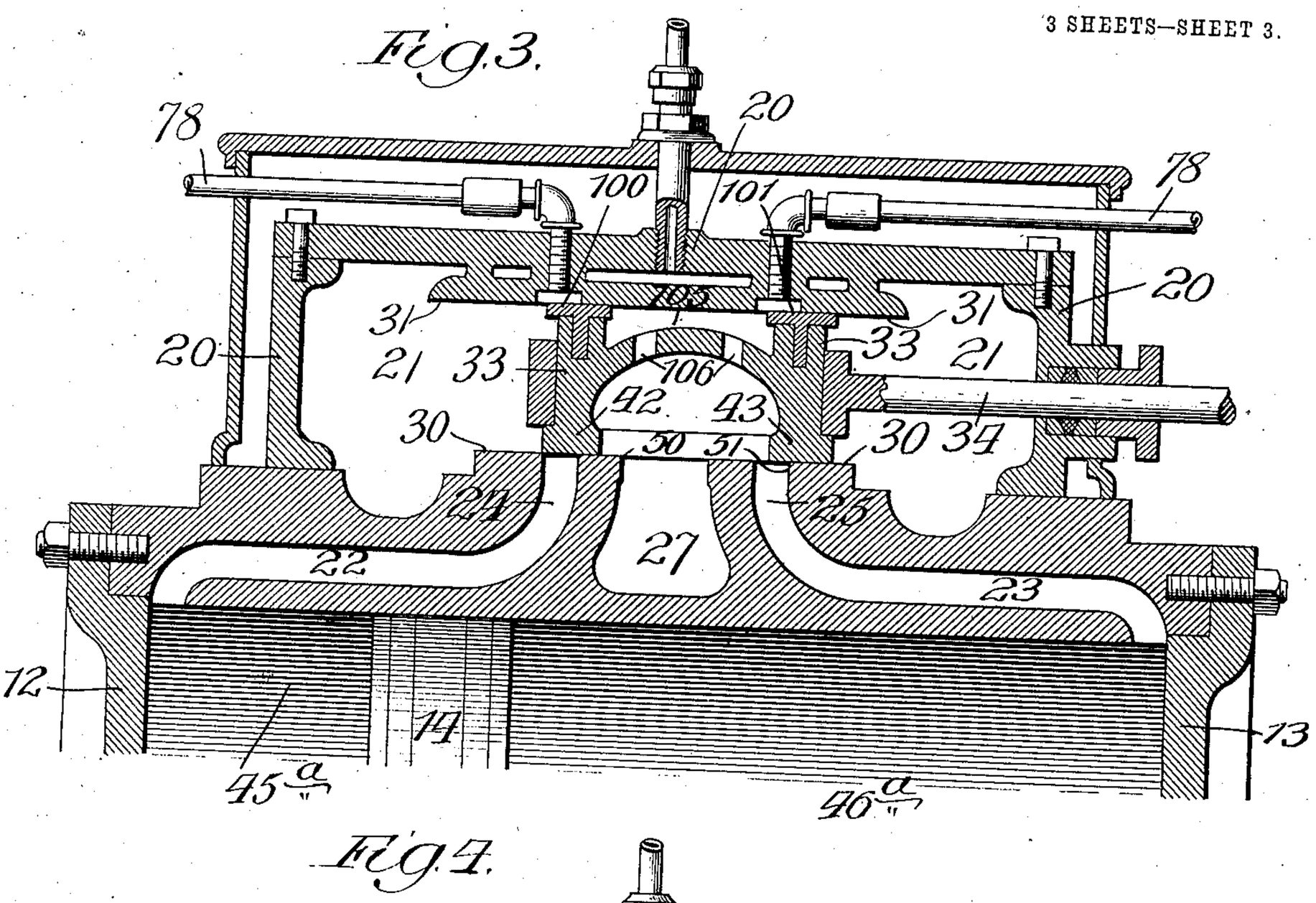
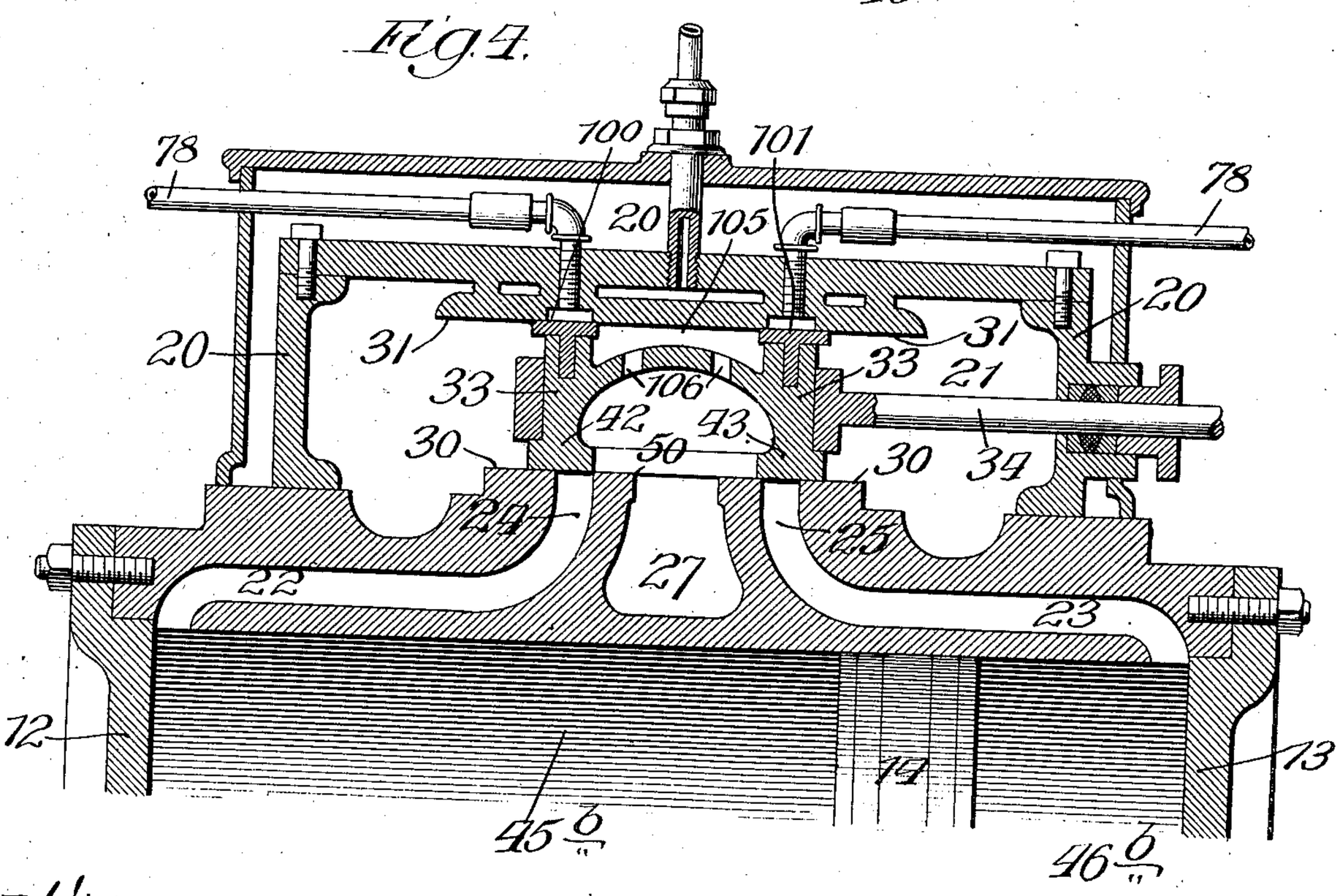


Fig. 4.



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UNITED STATES PATENT OFFICE.

JOHN W. MILLER, OF CHICAGO, ILLINOIS.

CYLINDER-COMPRESSION-RELIEF VALVE.

No. 816,348. Specification of Letters Patent. Patented March 27, 1906.

Application filed June 14, 1905. Serial No. 265,221.

To all whom it may concern:

Be it known that I, JOHN W. MILLER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Cylinder-Compression-Relief Valves, of which the following is a specification.

My invention relates to steam-engines, and particularly to means for relieving the compression in a steam-engine cylinder at the end of the stroke of the piston.

The object of my invention is to provide mechanism by means of which the compression or back pressure which occurs in any steam-engine cylinder after the exhaust-port is closed and before the piston reaches the end of its stroke may be automatically relieved, thereby doing away with the danger of the cylinder-head blowing out or other parts of the mechanism being broken, as frequently occurs. The occasion for the use of the invention arises principally when the steam is cut off in the cylinder before the piston reaches the end of its stroke and is used expansively in the cylinder from that point to some other predetermined point in the cylinder.

My invention, broadly stated, consists in the use of a compression-relief valve normally held closed by the pressure of live steam which is adapted when the live-steam pressure is removed to be opened by the compression-pressure in the cylinder and allow that compression-pressure to escape, thereby relieving the cylinder from all strain due to such back pressure or compression.

My invention further consists in the details of the valve itself and in other features, which will be hereinafter more fully described and claimed as the specification proceeds.

The valve of my invention may be applied to any form of engine-cylinder and steam-valve mechanism by making connections at the proper places, as will readily appear to any one familiar with the different types of such engines, and I have in the drawings shown the device applied to a simple slide-valve engine for the purpose of illustrating the connection of my relief-valve to one form of engine; but I do not thereby intend to limit myself to the application of the device to this or any particular form of engine construction except as the same may be specifically limited in the claims.

As is well understood in the engine art, there are two ways in which steam may be used in a cylinder—first, full-stroke direct pressure, and, second, the expansion method. In the first live steam is admitted to one end of the cylinder throughout the entire length of the stroke of the piston, the exhaust-port at the opposite end being wide open. There is therefore no compression or back pressure in the cylinder to resist the forward pressure of the steam, and consequently no back pressure or compression occurs, and my device is of no use here. In the second method steam is admitted to the cylinder while the piston is moved a certain distance and is then cut off, the steam within the cylinder being allowed to expand to drive the piston farther along the cylinder, the exhaust-valve at the opposite end being open. If an engine-valve is used which will allow the steam to thus expand to the end of the cylinder before the exhaust-valve at the opposite end is closed could be practically designed, there would be no compression or back pressure and no cause for my device; but when in practice steam expansion is sought beyond a certain point in the cylinder (obtained by adding inside lap in a plain slide-valve engine) the exhaust-port in the end of the cylinder to which the piston is moving is necessarily closed, with the result that steam, air, or gas remaining in that end of the cylinder is compressed, thereby creating compression or back pressure in that end of the cylinder, which negatives the effective force of the expanding steam and at the same time is apt to blow out the cylinder-head or otherwise injure the engine. My device is designed to do away with this back pressure or compression in any and all forms of engine in which it may occur. For the purpose of illustration merely I have shown it applied to a plain slide-valve engine having inside lap.

With the understanding above noted, Figure 1 is a central sectional detail view of the engine-cylinder having the valves of my invention applied thereto, the slide-valve being in a position where steam is just being admitted to the left-hand end of the cylinder. Fig. 2 is a central sectional detail view of the relief-valve of my invention, taken on line 2 of Fig. 1. Figs 3 and 4 correspond with Fig. 1, except that in Fig. 3 the valve and piston are shown at cut-off position and in Fig. 4 they are shown in the position where the exhaust-port is closed and compression begins at the right-hand end of the cylinder.

Again referring to the drawings, the nu-

meral 11 indicates the cylinder, closed by heads 12 and 13. In the cylinder is a piston 14 on a piston-rod 15, adapted to slide back and forth through a stuffing-box 16 in the cylinder-head 13. This piston-rod is connected beyond the figure to the cross-head, which is in turn connected to the drive-wheels of a locomotive or the fly-wheel of a stationary engine. Above the cylinder is the steam-chest 20, having means for admitting steam within it in the space 21. At each end of the cylinder is the usual port or passage-ways 22 and 23, entering the steam-chest 20 at points 24 and 25 near the middle, as shown. Between these ends or ports 24 and 25 there is cut in the top of the cylinder an exhaust passage or port 27, as shown. Slidably mounted within the steam-space 21 and adapted to slide backward and forward on the surface or seat 30 on the top of the cylinder and also adapted to slide upon the surface 31 upon the under side of the steam-chest 20 is a slide-valve 33, mounted upon a valve-rod 34, passing through the stuffing-boxes 35 in the end of the steam-chest. This valve has in its under side an opening 40 of such a length that in one position it affords an opening between the steam-passage 24 and the exhaust-port 27, the solid parts or valve-faces 42 and 43 of the valve closing the opposite steam-passage 22 or 23 from the one which is opened. As is well known in this form of valve, the "inside lap" of the valve is produced by adding to the inside edges of the solid parts or faces 42 and 43, or, in other words, making the distance 40 between them less than the distance between the two inside edges of the steam-ports. Assuming now that this engine is used without my device, steam is first admitted through chest 21 and passage 22 to the space 45, Fig. 1. The direct pressure of the steam moves the piston to the position of Fig. 3, space 45^a being full of live steam. In this position the slide-valve 33 closes port 22, and the steam in 45^a is "cut off" and ready to expand to volume 45^b. When the piston reaches this position, the face 43 of valve 33 closes port 23, thereby confining air, gas, or steam in the space 46^b, with the result that harmful back pressure or compression, as heretofore described, is produced in space 46^b and continues until the piston reaches the right-hand end of the cylinder. When the piston goes back to starting position, compression is produced in space 45^a in the same way. As heretofore described, the object of my invention is to provide a valve to relieve this compression. In order to do this, I provide two valves such as are illustrated in Fig. 2 and connect them to the cylinder in the manner shown in Fig. 1. The valve consists in a shell or casing 60, having at its bottom a pipe 61, connected to the end of the steam-cylinder. The upper end of this pipe terminates in the horizontal valve-seat 62 within the casing. At right angles to this valve-seat 62 is another pipe 64, connecting with an annular space 65 within the valve and open except, as hereinafter described, to the pipe 61, which is one exhaust-pipe from the cylinder. Vertically slidably mounted inside the casing 60 is a differential valve 66, having two pistons 67 and 68, the lower piston 67 being smaller than the upper and adapted to slide up and down in the bearings 69, making a tight joint therewith by means of the packing-rings 70. This valve is adapted to rest at 71 on the valve-seat 62, thereby, as shown, closing the communication between the pipes 61 and 64. The upper piston 68 is adapted to slide up and down in the portion 75 of the casing and is packed in contact therewith by the packing-rings 76. Entering the side of the casing 60 above the piston 62 is a pipe 78, normally connected to the steam-chest of the engine, as shown in Fig. 1, so that steam may be admitted into the space 80 between the top of the piston 62 and the cap 81, screw-threaded at 82 into the top of the casing 60. This cap may be constructed to be bolted on, if desired. In the cap 81, screw-threaded at 84, is a rod 85, adapted to be held in position by a check-nut 86. On the lower end of this rod 85 is a head 88, adapted to bear against a projecting lug 89 on the top of the piston 68 of the valve 66. By adjusting this head 88 up or down by means of the rod 85 and check-nut 86 I can vary the distance which the piston 66 can move up and down from the valve-seat 62. This adjustment, however, should always be such that the space 80 above the valve 66 always exists—in other words, so that the top of the piston 68 cannot come in contact with the bottom of the cap 81.

From an inspection of Fig. 2 it will be seen that if steam is allowed to pass through the pipe 78 into the space 80 it will hold the valve 66 down upon the valve-seat 62 against an equal pressure per square inch of steam in the pipe 61, bearing against the under side of the piston 69, but that if the steam-pressure in the space 80 is reduced or removed, the pressure in the pipe 61 remaining the same, it will raise the valve 66 a distance equal to the distance between the parts 88 and 89, heretofore described, and allow the steam, air, or gas in the pipe 61 to pass between the valve-seat 62 and the lower end 71 of the piston 67 through the passage-way 64 out into the air. In practical operation I connect the device to the cylinder as shown and so arrange the top plates 100 and 101 of the valve 33 that steam is admitted in the position of Fig. 1 to the pipe 78 just an instant before it is admitted through the passage-way 22 to the space 45 in the cylinder, from which it follows that during the time the live steam is in spaces 45 and 45^a the valve 66 is held down against the

valve-seat 62 and none of the live steam can escape through the pipe 61 over the valve-seat 62 and out of the pipe 64. While these conditions prevail at the right-hand end of the cylinder in Fig. 1 the relief-valve at the left hand of the cylinder has its steam-valve 78 open, via the space 105 and ports 106, to the exhaust-port 27, so that there is no pressure upon the top of the piston 68 in that valve. When expansion in the main cylinder begins, as shown in Fig. 3, the passage-way 100 still remains open, so the left-hand valve 66 still is held closed until the pressure in the cylinder is considerably reduced. When now the piston has moved to the position of Fig. 4 and compression begins, as heretofore described, in the space 46^b, the compression air or gas in that space immediately raises the valve 66 in the right-hand compression-valve of Fig. 1 and allows that air or gas to escape through the pipe 130 into the exhaust-pipe 27, and thereby absolutely relieve the cylinder from the compression. When the piston reaches the extreme right-hand end of the cylinder, all of the parts are in the reversed position from that shown in Fig. 1 and steam is admitted to the top of the right-hand relief-valve, while the left-hand one has its steam-pipe 78 open to the exhaust, the same as the right one has in Fig. 1, and the operation is repeated as the piston moves back to its original position, the left-hand relief-valve allowing the compression which then occurs in the space 45^a to escape into the pipe 27 through the left-hand pipe 130.

In order to provide that no water shall collect in either relief-valve, I provide two systems of drainage, one consisting of a ball-valve 110, lying in a recess 111 and adapted to allow the passage 112 to remain open when there is no steam-pressure in the space 80 and to close that passage-way 112 when steam passes from the passage or space 80 through the pipe 113 against the ball 110. I also provide a piston-valve 116, having serrated edges 117, through which water may pass from the space 80 when the valve is lifted off from its seat 118 by the action of steam or gas from the pipe 61 bearing against the lower end 120 of the valve-stem 121. In this case the water drains down into the space 122 surrounding the valve 66 and passes out through the openings 123. As the top of this valve 117 is larger than the area of the bottom 120 exposed to the pressure in the pipe 161, this valve is always closed in exactly the same way that the main valve 66 is closed when live steam is in space 80, as heretofore described.

By the use of my valves it is possible to increase both the "inside" and "outside" lap of the main valve, and thereby greatly increase the expansion range of the engine.

As heretofore stated, I do not wish to be limited to the application of my valve to any particular form of engine, nor do I intend to limit myself to exact forms of valve shown and described. For convenience the invention has been described throughout the specification as one relating to a steam-engine; but manifestly air or some other gas may be used in place of steam without departing from my invention.

By defining the supplemental relief-valve as connected to the cylinder or to one end of the cylinder I do not mean that it shall be connected directly to the cylinder in the manner shown. It may be connected as a branch of any pipe or passage leading from the cylinder—as, for instance, the passage 22 or 23.

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

1. In combination with an engine having a cylinder, a piston and piston-rod in the cylinder, and valve mechanism to control the admission and exhaustion of steam to and from the cylinder; a supplemental valve connected to the cylinder adapted when opened to allow the gas within the cylinder to exhaust, adapted to be opened by pressure of gas in the cylinder, and mechanism connecting said supplemental valve with the main-valve mechanism adapted to hold the supplemental valve closed during the portion of the engine-stroke that steam is working in the cylinder and to release the supplemental valve during the remainder of the stroke of the engine.

2. In combination with an engine having a cylinder, a piston and piston-rod in the cylinder, and valve mechanism to control the admission and exhaustion of steam to and from the cylinder; an independent exhaust-pipe at or near one end of the cylinder, a valve in said exhaust-pipe normally closed but capable of being opened by the pressure of steam, air or gas passing from the cylinder through the said exhaust-pipe and mechanism connecting said supplemental valve with the main-valve mechanism of the engine adapted to hold the supplemental valve closed thereby closing the independent exhaust-pipe during the time steam is working in the portion of the cylinder adjacent to the exhaust-pipe.

3. In combination with an engine having a cylinder, a piston and piston-rod in the cylinder, and valve mechanism to control the admission and exhaustion of steam to and from the cylinder; an independent exhaust-pipe at or near one end of the cylinder, a valve in said exhaust-pipe normally closed but capable of being opened by the pressure of steam, air or gas passing from the cylinder through the said exhaust-pipe and mechanism connecting said supplemental valve with the main-valve mechanism of the engine adapted to hold the supplemental valve closed thereby closing the independent exhaust-pipe during the time steam is working in the portion of the cylinder adjacent to the exhaust-pipe

and to release the supplemental valve during the remainder of the stroke of the engine.

4. In combination with an engine having a cylinder, a piston and piston-rod in the cylinder, and valve mechanism to control the admission and exhaustion of steam to and from the cylinder; another exhaust-pipe at or near one end of the cylinder, a supplemental valve mounted in the said exhaust-pipe, said valve being normally closed but adapted to be opened by the pressure of air, gas or steam passing from the cylinder through said exhaust-pipe, and a steam-pipe so connecting the supplemental valve with the main-valve mechanism that live steam holds the supplemental valve closed during the portion of the piston-stroke that steam is working in the part of the cylinder adjacent to the supplemental valve.

5. In combination with an engine having a cylinder, a piston and piston-rod in the cylinder, and valve mechanism to control the admission and exhaustion of steam to and from the cylinder; an independent exhaust-pipe leading from at or near one end of the cylinder, a supplemental valve mounted in said exhaust-pipe adapted to be opened by the pressure of steam, air or gas passing from the cylinder through said exhaust-pipe to allow said gases to escape, and a steam-pipe so connected with the supplemental valve and with the main-valve mechanism that live steam holds the supplemental valve closed during the time steam is working in the end of the cylinder adjacent to the supplemental valve and also so connected that said steam-pressure is cut off from the supplemental valve at or before the main exhaust-valve of the engine opens to the same end of the cylinder.

6. In combination with an engine having a cylinder, a piston and piston-rod in the cylinder and valve mechanism to control the admission and exhaustion of steam to and from the cylinder; an independent exhaust-pipe at or near the one end of the cylinder, a differential piston-valve mounted in said exhaust-pipe having its smaller area adapted to be engaged by steam, air or gas passing from the cylinder through the independent exhaust-pipe to open said valve, to permit said gases to pass out of the cylinder, and a steam-pipe connecting the larger end of the differential valve with the main-valve mechanism of the engine; said connection being made at such a point that live steam is admitted to the larger end of the supplemental valve to hold it closed during the portion of the stroke of the engine that steam is working in the end of the cylinder adjacent to the supplemental valve.

7. In combination with an engine having a cylinder, a piston and piston-rod in the cylinder and valve mechanism to control the admission and exhaustion of steam to and from the cylinder; an independent exhaust-pipe at or near each end of the cylinder; a supplemental valve mounted in each of said independent exhaust-pipes; said valves being adapted to normally close said pipes and to be opened by the pressure of steam, air or gas in the end of the cylinder to which each supplemental valve belongs, a steam-pipe connecting each of said supplemental valves to the main-valve mechanism of the engine in such a way that while steam is being used for work in one end of the cylinder the supplemental valve at that end of the cylinder is held closed by steam admitted by the main-valve mechanism of the engine and at the same time there is no steam-pressure tending to close the supplemental valve at the opposite end of the cylinder.

8. A cylinder-compression-relief valve comprising a casing having, in one portion two ports or openings, one adapted to be connected to an engine-cylinder and the other for the exhaustion of steam, air or gas and in another portion a port or opening adapted to be connected to a source of live steam, a piston-valve within the casing adapted to have one end engaged by steam, air or gas entering the valve through said cylinder-port to move said valve to open a communication between said first two openings or ports and the other end adapted to be engaged by steam entering the casing through said steam-port, to move said valve in the opposite direction to close the connection between said cylinder and exhaust ports in the casing.

9. A cylinder-compression-relief valve comprising a casing having in one portion two ports or openings, one adapted to be connected to an engine-cylinder and the other for the exhaustion of steam, air or gas; and in another portion a port or opening adapted to be connected to a source of live steam; a piston-valve within the casing adapted to have one end engaged by steam, air or gas entering the valve through said cylinder-port to move said valve to open a communication between said first two openings or ports and the other end adapted to be engaged by steam entering the casing through said steam-port, to move said valve in the opposite direction to close the connection between said cylinder and exhaust ports in the casing; the area of the piston engaged by the live steam being greater than the area engaged by the exhaust-steam.

10. A cylinder-compression-relief valve comprising a casing having in one portion two ports or openings, one adapted to be connected to an engine-cylinder and the other for the exhaustion of steam, air or gas and in another portion a port or opening adapted to be connected to a source of live steam; a piston-valve within the casing adapted to have one end engaged by steam, air or gas entering the valve through said cylinder-port to move said valve to open a communication between said first two openings or ports and the other

end adapted to be engaged by steam entering the casing through said steam-port to move said valve in the opposite direction to close the connection between said cylinder and exhaust ports in the casing; and means for draining the live-steam space in said mechanism.

11. A cylinder-compression-relief valve comprising a casing having in one portion two ports or openings, one adapted to be connected to an engine-cylinder and the other for the exhaustion of steam, air or gas, and in another portion a port or opening adapted to be connected to a source of live steam; a piston-valve within the casing adapted to have one end engaged by steam, air or gas entering the valve through said cylinder-port to move said valve to open a communication between said first two openings or ports and the other end adapted to be engaged by steam; a drainage-valve in communication with the live-steam space in said mechanism adapted to be closed by the pressure of steam within the mechanism and adapted to open for drainage when the steam-pressure is removed.

12. In mechanism of the class described, the combination of a casing 60 having at one end ports or openings 61 and 64 communicating with each other through the casing, and at the other end a steam port or opening 78, a piston-valve 66 having one end 68 adapted to be engaged by steam from port or pipe 78, and another end 67 adapted to be engaged by exhaust-steam in pipe 61; and means for adjusting the length of travel of the piston 66.

13. In mechanism of the class described, the combination of a casing; a piston-valve adapted to be moved backward and forward within the casing under the action of steam admitted at either end of the piston, and a supplemental drainage-valve larger at one end than the other, through the main valve adapted to be engaged by the steam at either end of the casing substantially as described for the purposes set forth.

In witness whereof I have hereunto subscribed my name in the presence of two witnesses.

JOHN W. MILLER.

Witnesses:
DWIGHT B. CHEEVER,
CAROLYN RAFTERY.