No. 890,692.

PATENTED JUNE 16, 1908.

H. W. McCOMBS.

CYLINDER RELIEF VALVE.

APPLICATION FILED SEPT. 26, 1907.

2 SHEETS—SHEET 1.

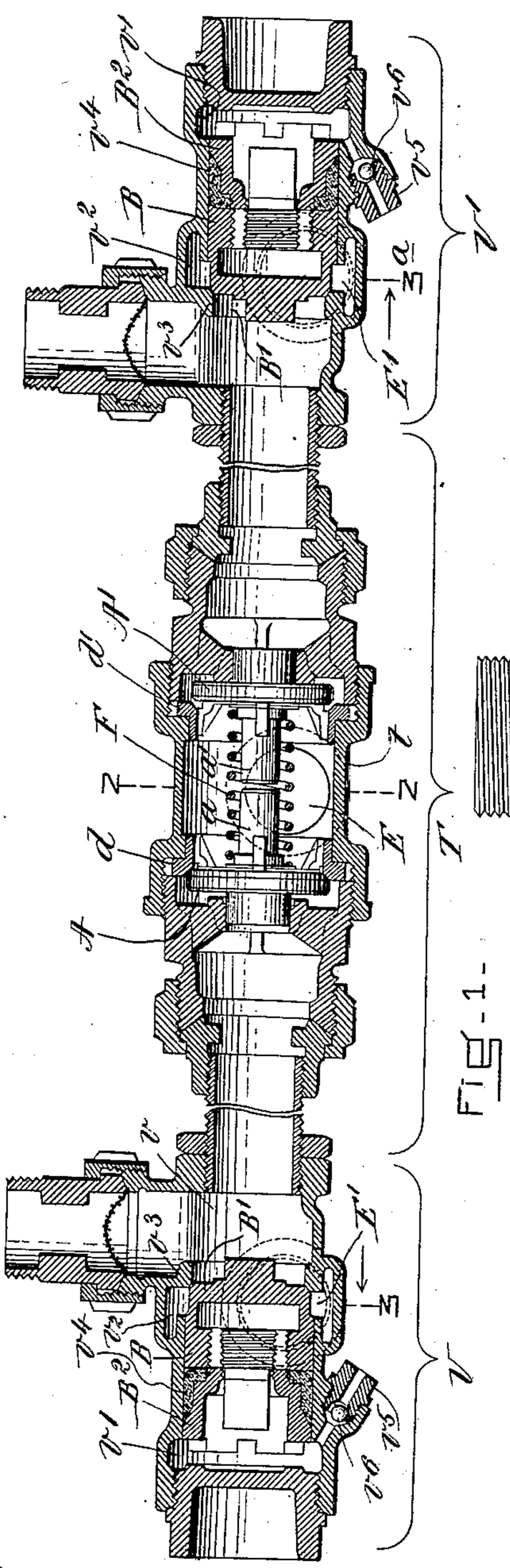

Fig. 1.

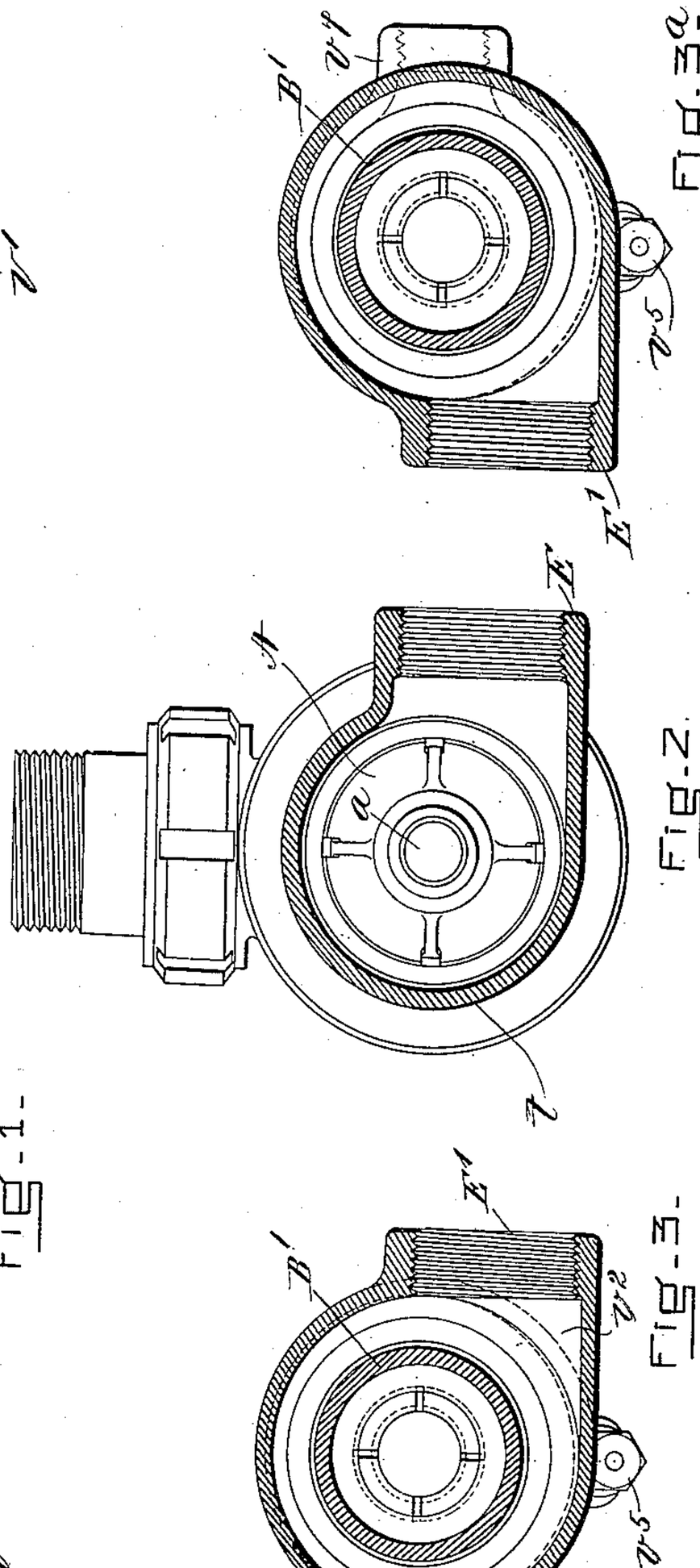

Fig. 2.

Fig. 3.

WITNESSES:

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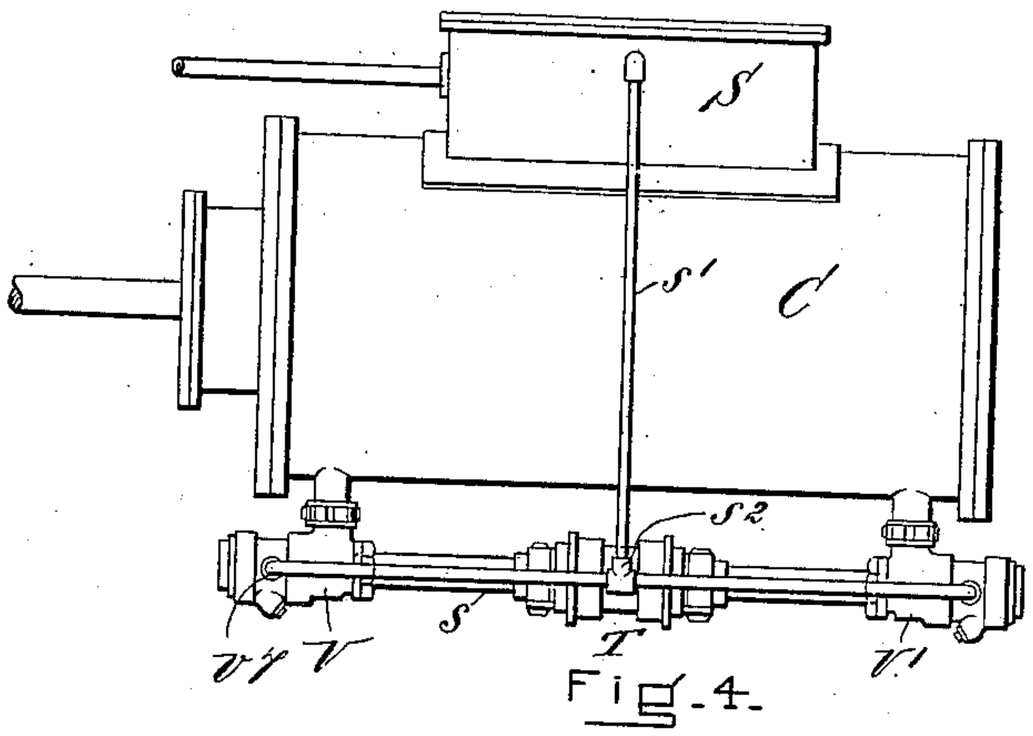

Fig. 4.

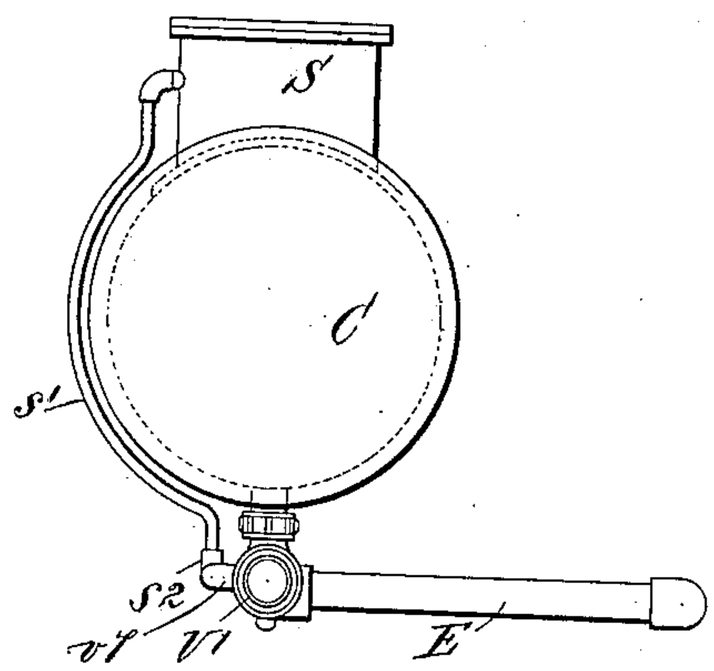

Fig. 5.

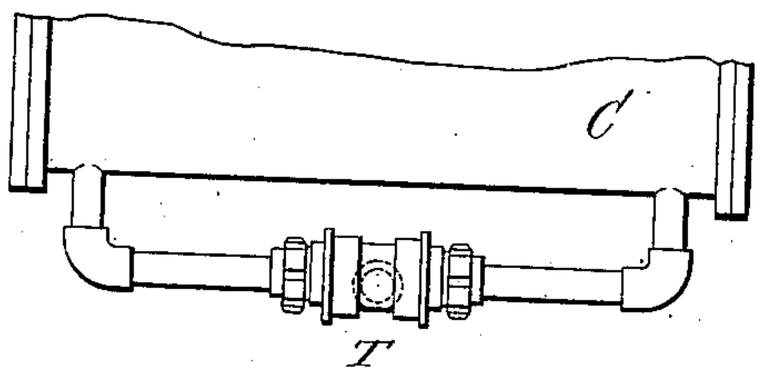

Fig. 6.

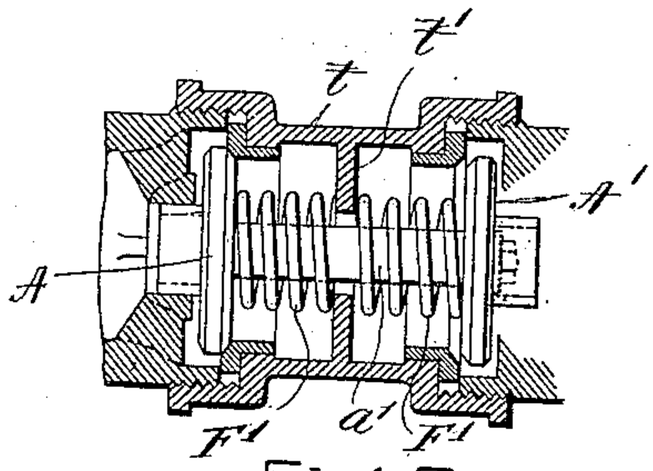

Fig. 7.

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UNITED STATES PATENT OFFICE.

HENRY W. McCOMBS, OF WORCESTER, MASSACHUSETTS.

CYLINDER-RELIEF VALVE.

No. 890,692. Specification of Letters Patent. Patented June 16, 1908.

Application filed September 26, 1907. Serial No. 394,597.

To all whom it may concern:

Be it known that I, HENRY W. McCOMBS, a citizen of the United States, and resident of Worcester, in the county of Worcester and State of Massachusetts, have invented new and useful Improvements in Cylinder-Relief Valves, of which the following is a specification.

My invention relates to relief attachments for steam engine cylinders and its object is the provision of automatic means for relieving the cylinders of abnormal compression or vacuum and disposing of water of condensation.

These improvements are especially adapted to locomotive engine practice and are designed to guard automatically against accidents due to excessive compression or vacuum and to relieve the engineer of the necessity for vigilance in respect to water relief devices.

The usual practice heretofore prevailing has been to provide engine cylinders with drip cocks communicating with the clearance spaces, to be opened by the engineer upon starting his engine and closed again as soon as the cylinder has become sufficiently heated to prevent excessive condensation of steam therein. There are, however, situations wherein drip cocks which are under voluntary control of the engineer fail to relieve the cylinder. For instance, when a railway engine is allowed to coast on a down grade with a closed throttle, the cylinders thus operate reversely as pumps and may accumulate excessive pressure in the clearance spaces, especially when as is often the case at present, piston valves are employed instead of the older form of D-section sliding valves. Again, the vacuum produced under such conditions during part of the travel of the pistons imposes an undesirable load upon the engine.

My improvements presently to be described may be embodied in a form which provides automatically for cylinder relief under all possible conditions of operation.

In the drawings hereto annexed which illustrate embodiments of my invention; Figure 1 is a longitudinal section of a cylinder relief apparatus; Fig. 2 is a cross section taken at line 2—2 in Fig. 1 looking toward the left; Fig. 3 is a cross section taken at line 3—3 Fig. 1 looking toward the left (the valve therein being shown in end elevation); Fig. 3ª is a section taken on line 3ª Fig. 1 looking toward the right (this section being similar to that shown in Fig. 3); Fig. 4 is a side elevation of a steam engine cylinder showing a mode of attachment of my relief devices; Fig. 5 is an end elevation of the cylinder and attachments shown in Fig. 4; Fig. 6 shows a portion of my apparatus, as used separately; and Fig. 7 is a modification of the valve arrangement of Fig. 1.

Figs. 1 to 3ª inclusive show the complete form in which I prefer to embody and employ my invention; certain component parts of this complete embodiment may however be employed with useful results to the exclusion of certain other parts, thus: In Fig. 6 there is shown in elevation an automatic relief attachment substantially similar to that shown in Fig. 1, the vent casings and vents at the ends being omitted; these devices may be employed with utility, and while I believe the combination shown in Fig. 6 is inferior in automatic capacity to the complete apparatus as shown in Fig. 1; nevertheless, for some purposes and in some situations it may be found adequate and desirable.

Referring to Fig. 1, those portions of the apparatus parenthetically indicated by the letters V V′ are vent casings, each of which is adapted to be secured to the engine cylinder at the end thereof and to communicate with a clearance space as indicated in Fig. 4. These vent casings V V′ are shown as identical in construction and reference to the details of the vent casing V will serve to explain the construction of both. The vent casing V is preferably made as a single casting of brass or other non-corrodible composition and is formed with an inner chamber v at the inner side, that is to say, on the side in immediate communication with the cylinder C (Fig. 4).

At the outer side the vent casing contains the chamber v' and between the chambers v and v' the intermediate chamber v^2 is situated; a sliding valve B is fitted to slide in the interior cylindrical portion v^4 of the casing V and is provided with an inner valve portion B′ which seats upon the web v^3, thus closing the passage between the chambers v and v^2 and controlling the vent opening E′ which leads from the intermediate chamber v^2. The outer chamber v' is provided with a supplementary vent or drip opening at v^5 which is controlled by an outwardly closing check shown as a ball check at v^6. From one

side of the vent casing V, and communicating with the external chamber v', the screw threaded boss v^7 projects; the casing V′ is provided with a similar boss (see Figs. 3 and 3ª.) Pipes s (see Fig. 4) are connected with the bosses v^7 and are joined by the T-union s^2 to which the pipe s' is attached, this pipe leading to and communicating with some portion of the steam passages of the engine which are normally at live steam pressure; in the arrangement shown in Fig. 4, the pipe s' leads to the steam chest S so that the outer chambers v', v' of the vent casings V, V′ are at all times under live steam pressure unless the throttle valve be closed.

Each of the valves B is so proportioned that its outer effective area, that is to say, the area of its piston portion, is a little greater than its inner effective area where said valve is seated at v^3. Consequently, should the pressure in the inner chamber v be raised in the operation of the engine to a point substantially in excess of the pressure in the outer chamber v', the valve B will be opened and the inner chamber v will be vented into the intermediate chamber v^2 from which the vent opening E′ leads to the outer air.

The two vent casings V V′ are connected by the tubular connection parenthetically indicated in Fig. 1 by the letter T. The shape and proportions of this tubular connection may be varied to suit the notions of the designer. In this tubular connection and preferably midway between the vent casings V, V′ there is located a valve casing t which forms part of the tubular connection. Valves A, A′ have their seats in mutual opposition at d and d' and are mounted to move, preferably within moderate limits, within the tubular connection. Connections are provided between the valves A and A′ whereby the simultaneous seating of these two valves is prevented. This may be accomplished by providing the valves A, A′ with a common stem of sufficient length, but in the specific embodiment shown in Fig. 1 these connections consist of the mutually opposed stems a, a' which, when they abut against each other, hold the seating faces of the valves apart a distance slightly greater than between the seats d and d'. By making the two valves separate as shown in Fig. 1 and providing such an abutting connection between them, I am enabled to introduce and employ the spring F which normally tends to force the valves A A′ apart and which will, when the engine is at rest, cause both of these valves to remain open but which will also, when the engine is in operation, yield sufficiently to allow the abutting connection provided by the stems a a' to operate and prevent the simultaneous seating of the two valves while permitting the closure of the valves alternately.

In Fig. 7 there is shown a modification wherein the valves A and A′ are mounted on the common stem a'; springs F′, F′, abutting against the web t', will, in this construction serve to lift both valves from their seats when the engine cylinder is not in operation.

The operation of the complete and preferred device shown in Fig. 1 is as follows:

1. *When the engine is at rest.*—The spring F holds the valves A A′ off their respective seats and any water of condensation which may for any reason be formed in the cylinder finds its way to the tubular connection T and flows through the valve openings to the center vent opening E through which it is disposed of. Consequently as soon as the engine is stopped and there is no pressure in the cylinder, the vent opening E is automatically opened and by no chance can water accumulate in the cylinder, so that the engineer may at any time start his engine without fear of trouble due to water.

2. *When the engine is in operation under steam.*—The admission of live steam to the head end of the cylinder C (Fig. 4) causes steam pressure to be communicated to the valve A′ which seats itself and by so doing forces valve A from its seat and prevents it from being seated so that if any water remains in the end of the cylinder toward which the piston is moving it has full opportunity to escape freely past the valve A and through the vent opening E. When in the travel of the piston from right to left (Fig. 4) the compression point is reached the increasing pressure will be exerted on the back of the valve A, which, when pressure balance is overcome, will be seated forcing valve A′ from its seat. By this time, however, the exhaust point of the right hand or head end of the cylinder will have been reached so that the opening of the valve A′ will serve to provide a supplemental exhaust passage for that end of the cylinder. Should the compression in the left hand end of the cylinder reach a point in excess of steam chest pressure the preponderance of pressure on the inner side of the valve B will cause it to move outward against the steam chest pressure in the chamber v' so that the chamber v will be automatically vented through the intermediate chamber v^2 and the vent opening E′. The instant, however, that the excess of pressure in the inner chamber v is relieved, the steam chest pressure in the outer chamber v' will return the valve B to its seat upon the web v^3. The reverse operation of the piston produces the same sequence of operations in my relief apparatus though in the reverse order in respect to the working parts named. In respect to the valves A and A′ and the vent devices in the casings V′ it will be observed that in the normal operation of the engine cylinder the valves A and A′ are alternately opened and closed so that under all ordinary conditions they will provide sufficient op-

portunity for the passage and escape of water of condensation and will keep the cylinder properly vented without requiring any attention on the part of the engineer.

3. *When the engine (if a locomotive engine) is coasting.*—Under these conditions we will assume that the throttle valve is closed and that there is no steam pressure in the cylinder or the steam chest. The movement of the piston in either direction creates a partial vacuum which is responded to by the opening and closing of either the valve A or A′ according to the direction in which the piston is traveling. Any tendency to excess of compression is disposed of by the vent valves B which, now that the outer chambers v' are relieved of steam chest pressure, open far more readily than when the cylinder is under steam. Furthermore should any water of condensation have found its way into the outer chamber v', the ball checks v^6 will, now that there is no pressure in the chambers v', allow the water of condensation to pass out through the vents v^5. Moreover, these checks v^6 will relieve the steam chest of any vacuum which may tend to form therein. Under these conditions the alternate opening and closing of the valves will provide ample opportunity for the expulsion of any water of condensation which may accumulate.

As shown in Fig. 7, the tubular connection T from one clearance space of the cylinder to the other with the oppositely closing valves A A′, a device substantially similar to that described in connection with Fig. 1, may be used advantageously even without the end vent casings V V′. The elastic connection provided by the spring F will when the engine is at rest hold the valves A A′ off their seats and allow water of condensation to drain off freely. When the engine is started and the cylinder is still cold the passages contained in the tubular connection T are of sufficient capacity to take care of water of condensation which may accumulate between each successive stroke of the engine; the valves A A′, opening and closing alternately, will drain off the accumulated water piecemeal until the normal conditions of the engine are assumed when substantially all water will be removed from the relief device. The employment of the said combination of parts shown in Fig. 7 necessarily takes no account of the accumulation of the compression of gases as distinguished from liquids but does however, provide a relief apparatus sufficient for all ordinary emergencies.

What I claim and desire to secure by Letters Patent is:

1. The combination with a steam engine cylinder of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said connection, the space between said oppositely seating valves provided with a drain opening.

2. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said connection, the space between said oppositely seating valves provided with a drain opening, and connections between said oppositely seating valves to prevent their seating simultaneously.

3. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said connection, the space between said oppositely seating valves provided with a drain opening, connections between said oppositely seating valves to prevent their seating simultaneously, and connections from each of said vent casings at the back of the check valves therein to a live steam space normally under substantially boiler pressure.

4. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said connection, the space between said oppositely seating valves provided with a drain opening, connections between said oppositely seating valves to prevent their seating simultaneously, connections from each of said vent casings at the back of the check valves therein to a live steam space normally under substantially boiler pressure, supplementary vents from the vent casings back of the check valves therein, and checks to control said vents.

5. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, the space between said oppositely seating valves provided with a drain opening and an elastic connection under compression between said oppositely seating valves.

6. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely

seating in said tubular connection, the space between said oppositely seating valves provided with a drain opening, an elastic connection under compression between said oppositely seating valves, and connections from each vent casing at the back of the check valves therein to a live steam space.

7. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, the space between said oppositely seating valves provided with a drain opening, an elastic connection under compression between said oppositely seating valves, connections from each vent casing at the back of the check valves therein to a live steam space, supplementary vents from the vent casings back of the check valves therein, and checks to control said vents.

8. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, the said valves provided with mutually opposed stems which abut to prevent simultaneous seating of both valves, the space between said oppositely seating valves provided with a drain opening.

9. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, the said valves provided with mutually opposed stems which abut to prevent simultaneous seating of both valves, the space between said oppositely seating valves provided with a drain opening, and connections from each vent casing at the back of the check valves therein to a live steam space.

10. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, the said valves provided with mutually opposed stems which abut to prevent simultaneous seating of both valves, the space between said oppositely seating valves provided with a drain opening, connections from each vent casing at the back of the check valves therein to a live steam space, supplementary vents from the vent casings back of the check valves therein and checks to control said vents.

11. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, said valves provided with mutually opposed stems which abut to prevent simultaneous seating of both valves, and an elastic connection under compression between said oppositely seating valves.

12. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, said valves provided with mutually opposed stems which abut to prevent simultaneous seating of both valves, an elastic connection under compression between said oppositely seating valves, and connections from each vent casing at the back of the check valves therein to a live steam space.

13. The combination with a steam engine cylinder, of vent casings communicating with the cylinder ends and provided with vent openings, check valves controlling said vent openings, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, said valves provided with mutually opposed stems which abut to prevent simultaneous seating of both valves, an elastic connection under compression between said oppositely seating valves, connections from each vent casing at the back of the check valves therein to a live steam space, supplementary vents from the vent casings back of the check valves therein and checks to control said vents.

14. The combination with a steam engine cylinder, of vent casings containing each an inner chamber in communication with a cylinder end, and an outer chamber communicating with a live steam space normally under substantially boiler pressure and a check valve seated in an opening from the inner chamber, an intermediate chamber provided with a vent, said check valve extending through the intermediate chamber to the outer chamber, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, the space between said oppositely seating valves provided with a drain opening.

15. The combination with a steam engine cylinder, of vent casings containing each an inner chamber in communication with a cylinder end, and an outer chamber communi-

cating with a live steam space normally under substantially boiler pressure and a check valve seated in an opening from the inner chamber, an intermediate chamber provided with a vent, said check valve extending through the intermediate chamber to the outer chamber, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, the space between said oppositely seating valves provided with a drain opening, and connections between said oppositely seating valves to prevent their seating simultaneously.

16. The combination with a steam engine cylinder, of vent casings containing each an inner chamber in communication with a cylinder end, and an outer chamber communicating with a live steam space normally under substantially boiler pressure and a check valve seated in an opening from the inner chamber, an intermediate chamber provided with a vent, said check valve extending through the intermediate chamber to the outer chamber, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, the space between said oppositely seating valves provided with a drain opening, connections between said oppositely seating valves to prevent their seating simultaneously, and connections from each vent casing at the back of the check valves therein to a live steam space normally under substantially boiler pressure.

17. The combination with a steam engine cylinder, of vent casings containing each an inner chamber in communication with a cylinder end, and an outer chamber communicating with a live steam space normally under substantially boiler pressure and a check valve seated in an opening from the inner chamber, an intermediate chamber provided with a vent, said check valve extending through the intermediate chamber to the outer chamber, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, the space between said oppositely seating valves provided with a drain opening, connections between said oppositely seating valves to prevent their seating simultaneously, and supplementary vents from the outer chambers of said vent casings, and checks to control said vents.

18. The combination with a steam engine cylinder, of vent casings containing each an inner chamber in communication with a cylinder end, and an outer chamber communicating with a live steam space normally under substantially boiler pressure and a check valve seated in an opening from the inner chamber, an intermediate chamber provided with a vent, said check valve extending through the intermediate chamber to the outer chamber, a tubular connection between the inner chambers of said vents, two valves oppositely seating in said tubular connection, the space between said oppositely seating valves provided with a drain opening and connections between said oppositely seating valves to prevent their seating simultaneously.

19. The combination with a steam engine cylinder, of vent casings containing each an inner chamber in communication with a cylinder end and an outer chamber communicating with a live steam space normally under substantially boiler pressure, a check valve seated in an opening from the inner chamber, an intermediate chamber provided with a vent, a seated check valve extending through the intermediate chamber to the outer chamber, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, said valves provided with mutually opposed stems which abut to prevent simultaneous seating of both valves, and a space between said oppositely seating valves provided with a drain opening.

20. The combination with a steam engine cylinder, of vent casings containing each an inner chamber in communication with a cylinder end and an outer chamber communicating with a live steam space normally under substantially boiler pressure, a check valve seated in an opening from the inner chamber, an intermediate chamber provided with a vent, a seated check valve extending through the intermediate chamber to the outer chamber, a tubular connection from one vent casing to the other, two valves oppositely seating in said tubular connection, said valves provided with mutually opposed stems which abut to prevent simultaneous seating of both valves, a space between said oppositely seating valves provided with a drain opening, supplementary vents in the vent casings from the outer chambers thereof, and checks to control said vents.

21. The combination with a steam engine cylinder, of vent casings containing each an inner chamber in communication with a cylinder end, and an outer chamber communicating with a live steam space, normally under substantially boiler pressure, a check valve seated in an opening from the inner chamber, an intermediate chamber provided with a vent, said check valve extending through the intermediate chamber to the outer chamber, a tubular connection between the inner chambers of said vent, two valves oppositely seating in said tubular connection, said valves provided with mutually opposed stems which abut to prevent simultaneous seating of both valves, the space between said oppositely seating valves provided with a drain opening, and an elastic

connection under compression between said oppositely seated valves.

22. The combination with a steam engine cylinder, of vent casings containing each an inner chamber in communication with a cylinder end, and an outer chamber communicating with a live steam space, normally under substantially boiler pressure, a check valve seated in an opening from the inner chamber, an intermediate chamber provided with a vent, said check valve extending through the intermediate chamber to the outer chamber, a tubular connection between the inner chambers of said vent, two valves oppositely seating in said tubular connection, said valves provided with mutually opposed stems which abut to prevent simultaneous seating of both valves, the space between said oppositely seating valves provided with a drain opening, an elastic connection under compression between said oppositely seated valves, supplementary vents from the outer chambers of the vent casing, and checks to control said vents.

Signed by me at Boston, Suffolk county, Massachusetts this thirteenth day of September 1907.

HENRY W. McCOMBS.

Witnesses:
JOSEPH T. BRENNAN,
JOSEPHINE H. RYAN.