(No Model.) 2 Sheets—Sheet 1.

R. HARDIE.

BALANCED VALVE.

No. 580,828. Patented Apr. 13, 1897.

Fig. 1.

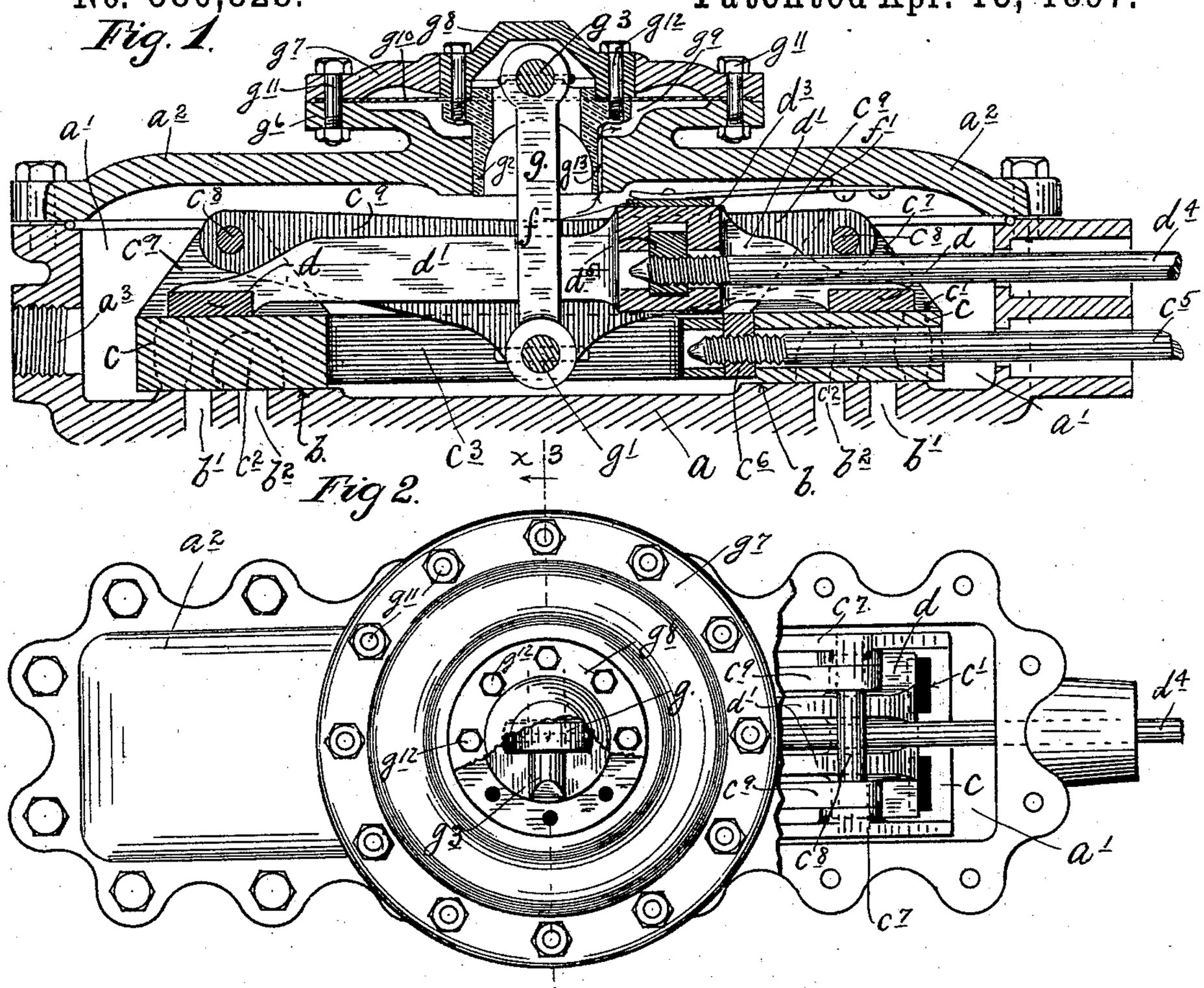


Fig 2.

Fig 3.

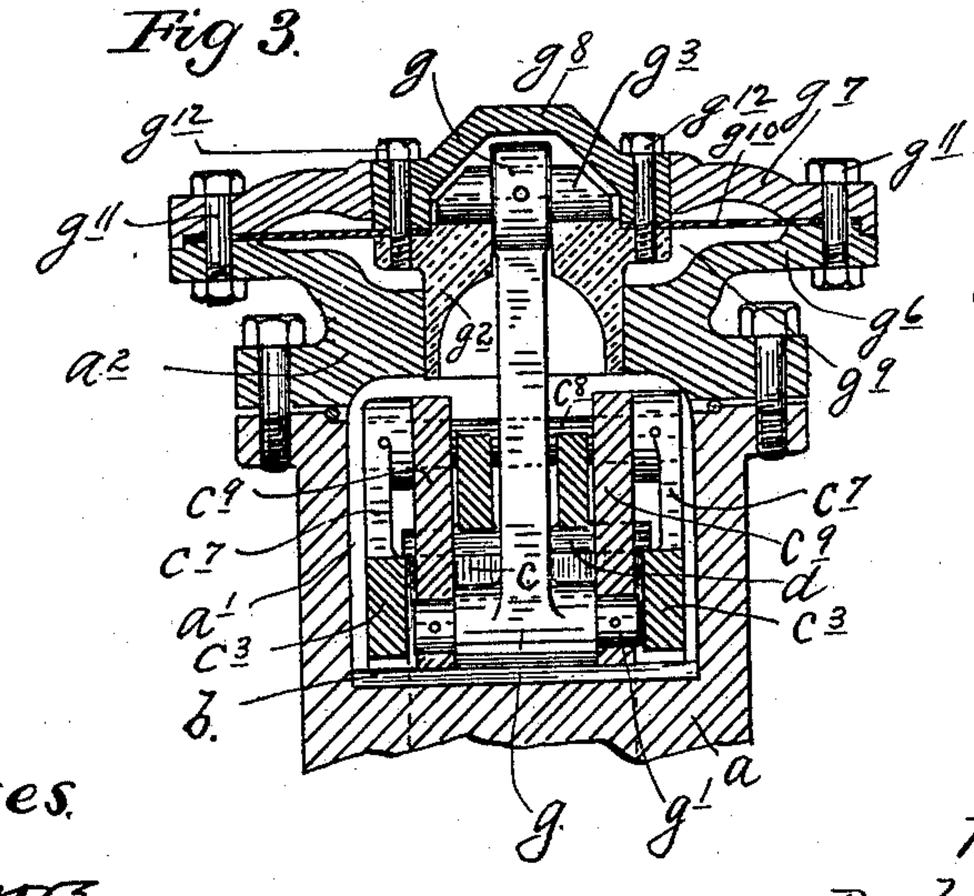
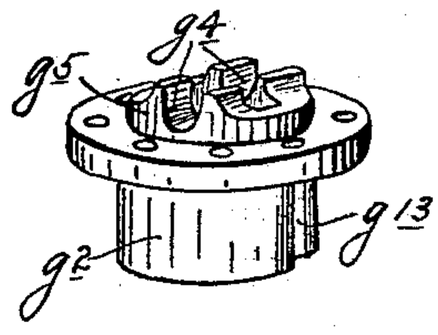


Fig 4.



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By his Attorney
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(No Model.) 2 Sheets—Sheet 2.

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Fig. 6.

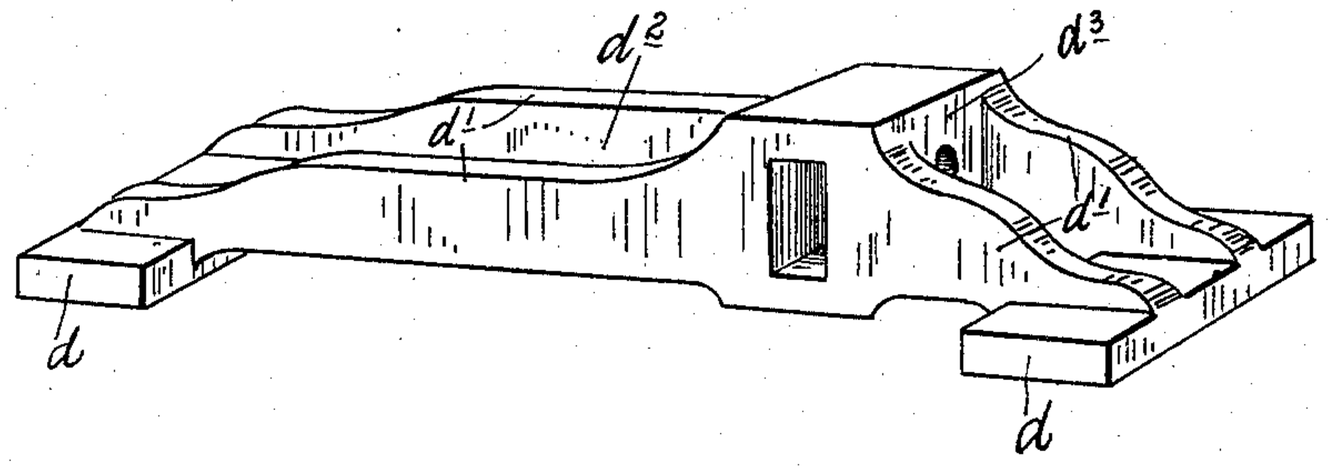
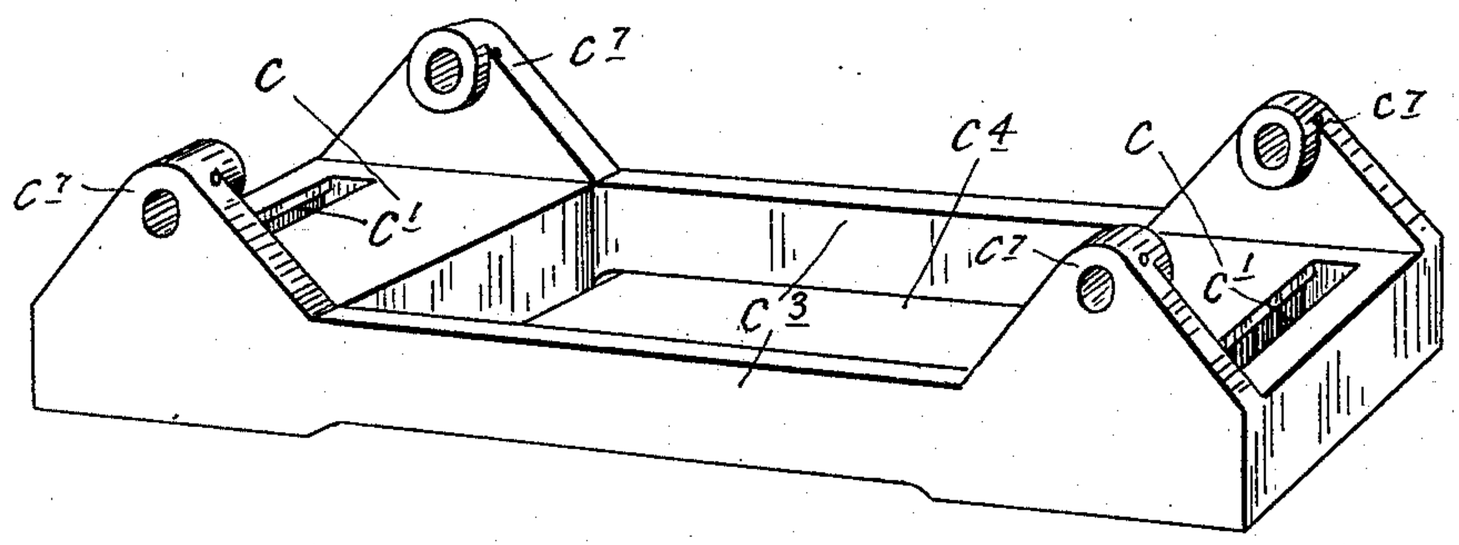


Fig. 5.



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UNITED STATES PATENT OFFICE.

ROBERT HARDIE, OF ROME, NEW YORK, ASSIGNOR TO THE GENERAL COMPRESSED AIR COMPANY, OF NEW YORK, N. Y.

BALANCED VALVE.

SPECIFICATION forming part of Letters Patent No. 580,828, dated April 13, 1897.

Application filed September 2, 1896. Serial No. 604,623. (No model.)

To all whom it may concern:

Be it known that I, ROBERT HARDIE, a citizen of the United States, residing at Rome, in the county of Oneida and State of New York, have invented certain new and useful Improvements in Balanced Valves for Air-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention has for its object to provide a balanced valve adapted for use on compressed-air locomotives. In this class of air-engines the air is normally used or admitted to the chests and cylinders at a pressure of about one hundred and forty to one hundred and fifty pounds; but provision is made for the temporary use of considerably higher pressures when needed for starting a heavy load or for acceleration of speed. The distribution is effected through a main slide-valve and a cut-off slide-valve riding on the back of the main valve and arranged for very early cut-offs, so as to permit the air to be used expansively to the largest possible extent. At the pressures above named the drag on the valve, if unbalanced, is of course very heavy.

The object of my invention is to overcome this difficulty and render the valve comparatively easy to handle.

To these ends my invention consists of the novel devices and combinations of devices hereinafter described, and defined in the claims.

The invention is illustrated in the accompanying drawings, wherein, like notations referring to like parts throughout the several views—

Figure 1 is a longitudinal central section through my improved valve mechanism in working position with some parts broken away. Fig. 2 is a plan view of the parts shown in Fig. 1 with some portions broken away. Fig. 3 is a cross-section on the line x^3 x^3 of Fig. 2. Fig. 4 is a detail in perspective showing one element of the balancing device detached. Fig. 5 is a perspective view of the main valve detached. Fig. 6 is a similar view of the cut-off valve detached.

a represents a part of the cylinder-casting.

a' represents the valve-chest, and a^2 the valve-chest cover.

a^3 is the inlet for the supply of the compressed air.

The valve-chest is provided with a valve-seat for the main valve formed in two sections b, separated from each other, as clearly shown in Fig. 1. The said seat-sections b are each provided with an admission-port b' and an exhaust-port b^2. The two exhaust-ports b^2 of course unite or lead to a common exhaust-outlet. (Not shown.)

The main member of the distribution-valve is constructed in two corresponding sections c, working on the seat-sections b and provided each with an admission-port c' and an exhaust-cavity c^2 for coöperation with the corresponding ports b' and b^2 in the seat-sections b. The said main-valve sections c are connected by bridge-bar portions c^3 of the stock so disposed as to afford the requisite strength while leaving the central space or clearance c^4. (Best shown in Fig. 5.) The said main valve c c^3 connects with its rod c^5 by nut c^6, applied to permit freedom for motion of the valve at right angles to the rod when necessary in the usual way. The main-valve casting c c^3 is provided at its four corners with bearing-lugs c^7, projecting from the back of the valve. To the said lugs c^7 are made fast by pins c^8 a pair of truss bars or levers c^9. These truss-bars c^9 are deepest at their central portion and are applied with their ends on the pins c^8 directly inward of the lugs c^7 and their central or deepest portions projecting downward into the central or cut-away part c^4 of the main-valve casting.

The cut-off member of the distribution-valves is constructed in two corresponding sections d, which ride on the backs of the main-valve sections c as seats and are connected by bridge or yoke sections d' of the stock, which are spaced apart from each other to afford a longitudinal slot or central clearance d^2, as best shown in Figs. 2, 3, and 6. The cut-off-valve sections d control, of course, the admission-ports c' in the main-valve section c. The bridge-bars d' are connected on the rod side of the center of the cut-off valve by boss d^3, to which the rod d^4 for the cut-off valve connects by nut d^5 in

such way as to permit freedom for movement of the valve at right angles to the axis of the rod. The top of the boss d^3 is engaged by a bearing-plate f, carried at the free end of a stiff spring f', having its other end made fast to the inside surface of the chest-cover a^2, as best shown in Fig. 1.

g is a link which works between the bridge-bars d' of the cut-off valve and between the truss-bars c^9, carried by the main valve, and is connected to the central part of said bars c^9 by pin g'. The said link g also works upward through a hollow plunger g^2 and is provided at its upper end with a pin g^3, which rests in bearing-notches g^4 of a combined bearing and guide-rim or flange g^5 on the top or head of the hollow plunger g^2. The stem of the plunger g^2 works with a nice fit through the chest-cover a^2. The chest-cover a^2 is provided with a raised or laterally-extended flange or plate g^6, which coöperates with an annular plate or cover section g^7 and a plunger-cap g^8 to form a chamber g^9. In the said chamber g^9 is mounted a copper diaphragm g^{10}, which is clamped between the plates g^6 and g^7 at its outer margin and between the plunger g^2 and the plunger-cap g^8 at its central portion. The parts g^6 and g^7 are shown as thus clamped together by nutted bolts g^{11}, while the parts g^2 and g^8 are shown as united by bolt-screws g^{12}. The plunger-cap g^8 works through the cover-section g^7 with a nice fit. The diaphragm g^{10} is subject on its under surface to valve-chest pressure by fluid which can pass to the chamber g^9 below the diaphragm through a small duct g^{13}, (shown as formed on the exterior of the stem of the plunger g^2.) The plunger-cap g^8 forms a tight joint with the head portion of the plunger g^2 at the flange g^5.

The plunger g^2 is of tubular form, as hitherto noted, and at its lower end opens into the valve-chest. Hence with the construction above described it is obvious that the plunger-stem g^2 and the plunger-cap g^8, together with that portion of the diaphragm g^{10} outside of the plunger, will be subject to valve-chest pressure for outward movement at right angles to the line of travel of the distribution-valves. Hence by properly proportioning the parts it is obvious that the plunger g^2 and diaphragm g^{10} may be made, through the link g and the truss-bars c^9, to counterpoise any desired part of the pressure on the backs of the distribution-valves. Otherwise stated, by the construction described the distribution-valves may be balanced to the extent desired. The bore of the plunger g^2 is sufficient to permit the necessary angular motion of the link g in respect to said plunger g^2 under the travel of the distribution-valves. For the same purpose the inner wall of the plunger g^2 is cut away or reduced toward its inner or open end, so as to afford increasing clearance for the link g at that point. Under the travel of the distribution-valves it will be understood, of course, that the plunger and the diaphragm will move up and down with a yielding action to compensate for the angular movement of the link g, while permitting the valves to to be held down to their seats.

Owing to the fact that the link g works in the slot or space d^2 between the bridge-bars d' of the cut-off valve it follows, of course, that the said link g does not interfere with the travel of the cut-off valve on the back of the main valve. The link g is made to connect with the main valve by means of the truss-bars c^9, because thereby a construction is afforded which will prevent springing of the valve. If the said link g was connected directly to the central part of the main valve, there would be a strong tendency to spring the valve over the lower connecting-pin of the link as a fulcrum. By the use of the truss-bars c^9 the main-valve casting can be made comparatively light and can be cut away at its central portion for reducing the area thereof exposed to pressure and nevertheless the requisite strength be afforded for the application of the balancing-rig.

By actual experience I have demonstrated the efficiency of the invention herein disclosed for the purposes had in view. I have found that the valve can be successively balanced in this manner so as to render the same comparatively easy to handle under both the normal working pressure and the extraordinary working pressure at which the air is sometimes used for temporary acceleration of speed or starting an extra heavy load.

It will be understood, of course, that the purpose of the spring device $f\,f'$ is to hold the valves up to their seats in the absence of air-pressure within the valve-chest, which device is needed for the reason that the valve-chest is intended to be at the side of the engine-cylinder.

It will be understood, of course, that the details of the construction might be changed without departing from the spirit of my invention.

What I claim, and desire to secure by Letters Patent of the United States, is as follows:

1. The combination with an engine-valve and valve-chest, of a diaphragm and plunger in the chest-cover, connected together, subject to valve-chest pressure, for outward movement at right angles to the line of the valve's travel, and a link pivotally connecting said plunger to the valve, substantially as described.

2. The combination with an engine-valve and valve-chest, of a central diaphragm and plunger in the chest-cover, subject to valve-chest pressure, a link extending from said plunger into the chest, and truss-bars centrally connected to the lower end of said link and having their ends connected to the opposite ends of the valve, substantially as described.

3. The combination with an engine-valve and valve-chest, of a central diaphragm and

hollow plunger, in the chest-cover, both subject to valve-chest pressure, and connections from said plunger to the valve, involving a link working through the hollow stem of the plunger, and provided with a pin at its upper end resting in bearings on the plunger-head directly below the plunger-cap, substantially as described.

4. The combination with an engine-valve chest, of distribution-valves therein comprising a main slide-valve and a cut-off valve riding on the back of the main valve, a central diaphragm and plunger in the valve-chest cover, both subject to valve-chest pressure, for movement outward at right angles to the valve travel, and connections from said plunger to the main valve comprising a link carried by the plunger and working through a slot in the cut-off-valve casting, and truss-bars centrally connected to the lower end of said link and having their opposite ends connected to the main valve, substantially as and for the purposes set forth.

5. In an engine, the combination with the valve-chest, of the main valve composed of the sections c united by the bridge-bars c^3, so disposed as to afford the central opening c^4, the cut-off valve comprising the sections b connected by the bridge-bars b' disposed to afford the central opening or slot b^2, the diaphragm g^{10}, in the chest-cover, having secured thereto the plunger-stem g^2 and the plunger-cap g^8, with said plunger-stem working through the chest-cover as a guide and said cap g^8 working through the cover of the diaphragm-casing, and with both the diaphragm and the plunger subject to valve-chest pressure, the link g carried by the hollow plunger-stem g^2 and the truss-bars c^9 connecting, at their central portions, with the lower end of said link and having their opposite ends connected to the lug c^7, rising from the corners of the main-valve casting, and with said link g working between the bridge-bars b' of the cut-off valve, all substantially as and for the purposes set forth.

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

ROBT. HARDIE. [L. S.]

Witnesses:
HUGH ROSE,
E. G. OSTERMANN.