(No Model.) 3 Sheets—Sheet 1.

F. M. RITES.

STEAM ENGINE GOVERNOR.

No. 342,307. Patented May 18, 1886.

Fig. 1

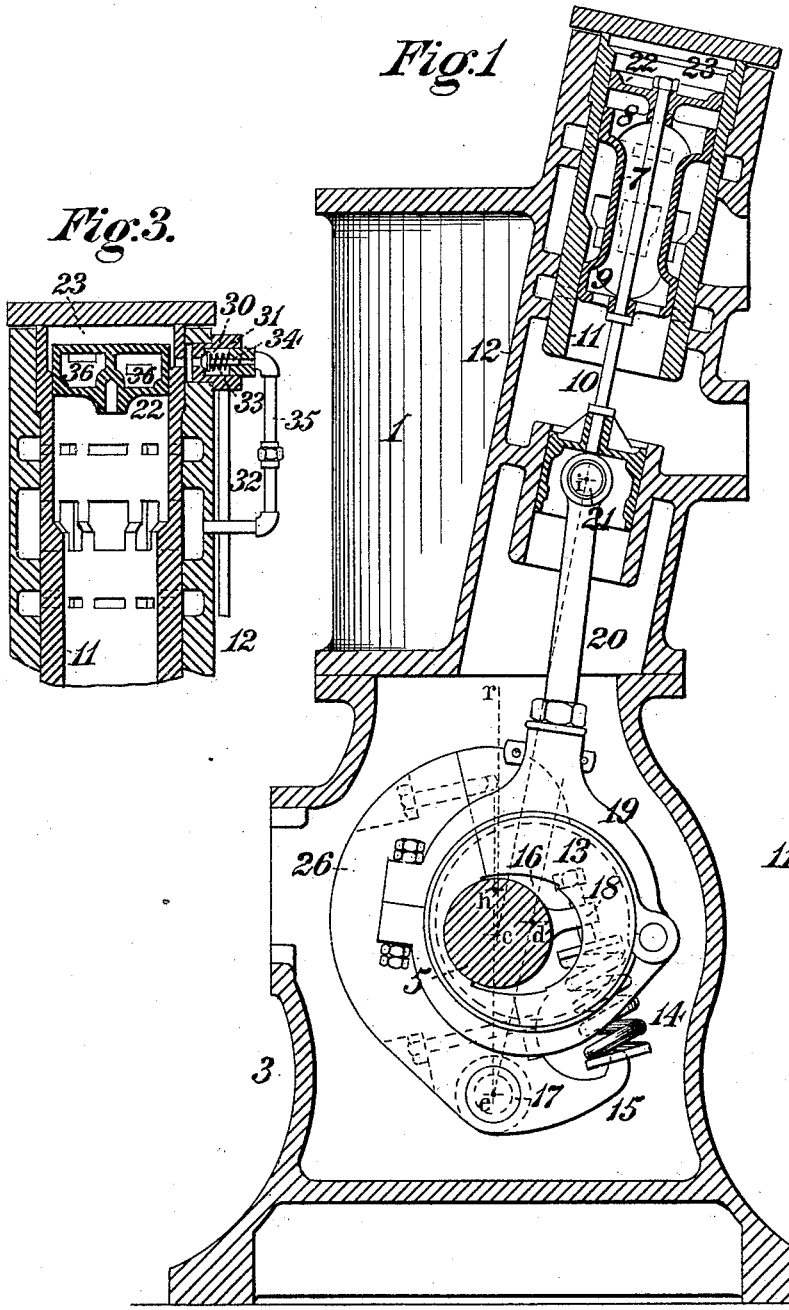

Fig. 3.

Fig. 4.

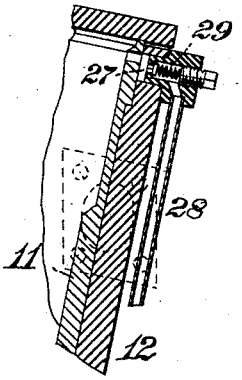

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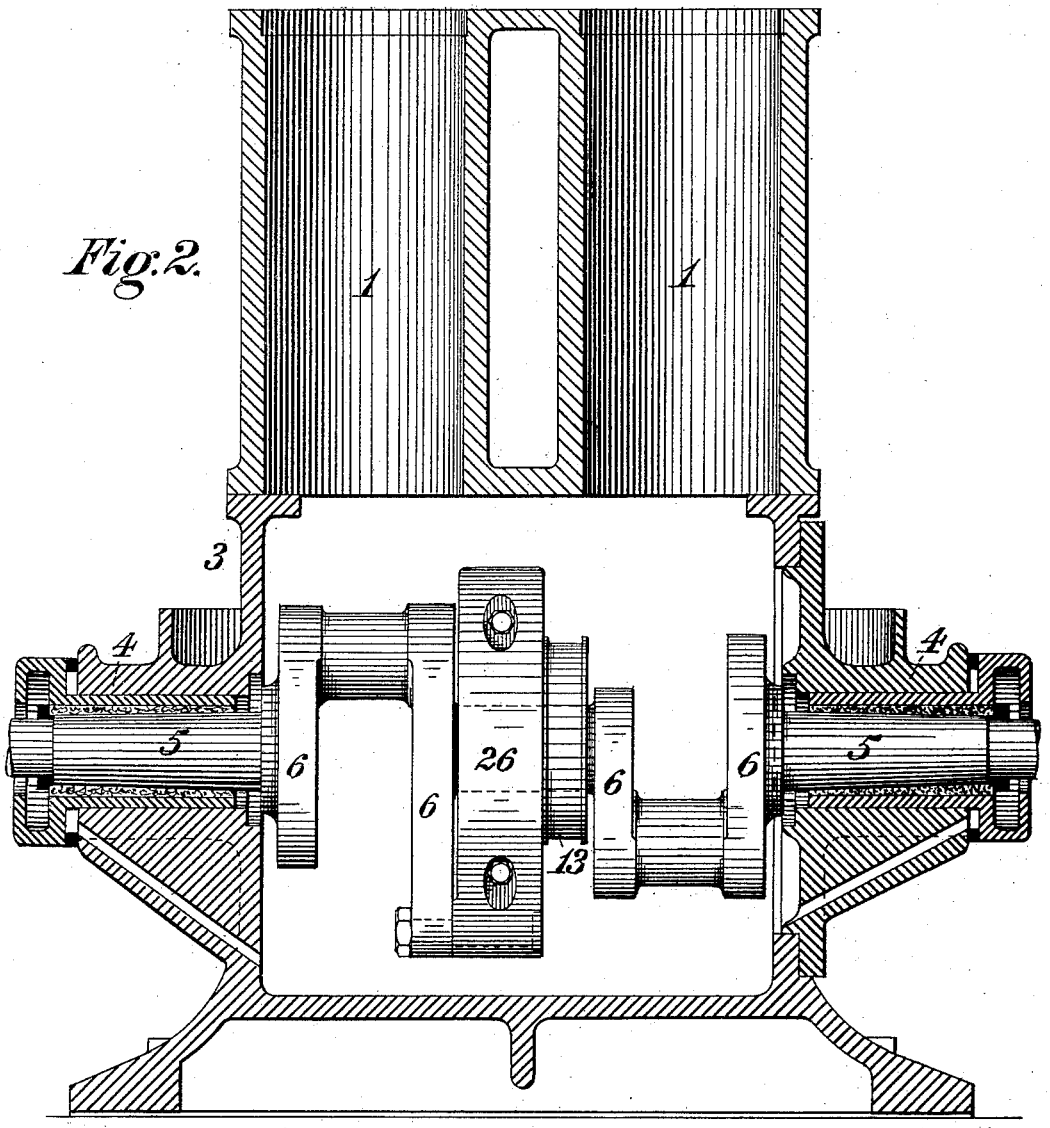
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

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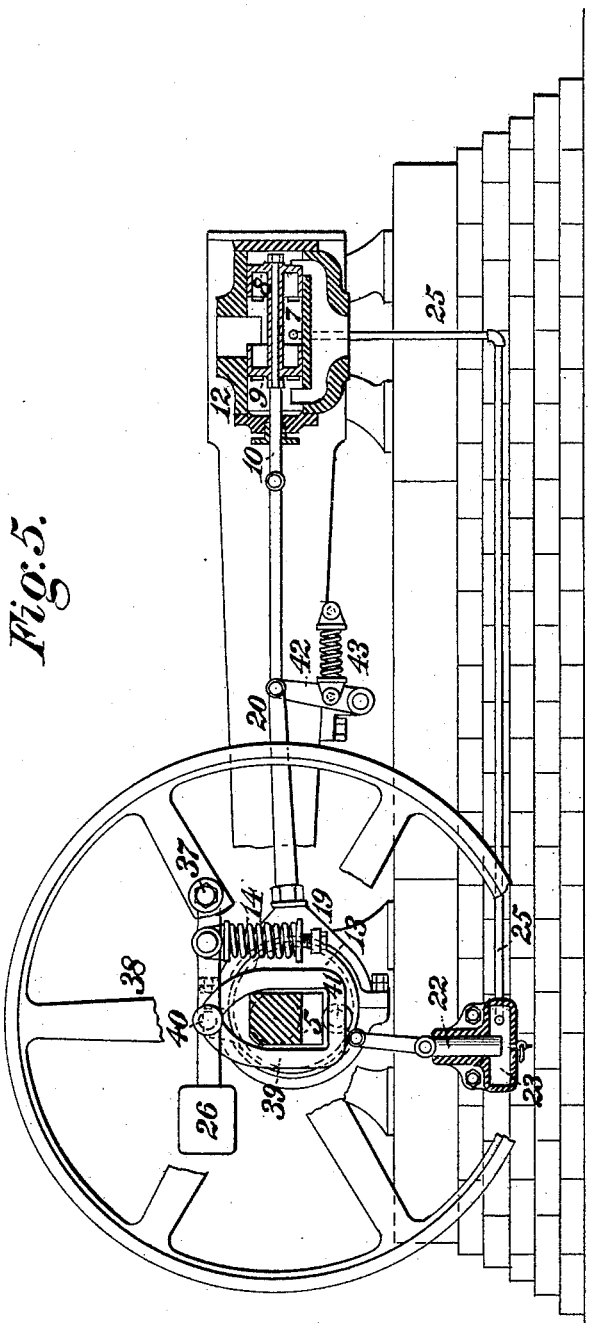

Fig. 5.

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UNITED STATES PATENT OFFICE.

FRANCIS M. RITES, OF PITTSBURG, PENNSYLVANIA.

STEAM-ENGINE GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 342,307, dated May 18, 1886.

Application filed March 17, 1886. Serial No. 195,544. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS M. RITES, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Engine Governors, of which improvements the following is a specification.

My invention relates to governors or regulators for automatic cut-off-valve mechanisms, and its object is to simplify and perfect the construction of a governor of such class and to eliminate in its operation the disturbing influences of gravity and inertia.

To this end my invention, generally stated, consists in the combination of a weighted eccentric mounted adjustably upon a driving-shaft, a distribution-valve actuated by said eccentric, and a pressure device whereby the action of gravity and inertia upon the valve mechanism is balanced by the equivalent opposing action of steam or other fluid.

The improvements claimed are hereinafter fully set forth.

In automatic cut-off mechanisms as heretofore constructed the neutralization of the action of gravity upon the governor and the adjustable eccentric to which it is connected has ordinarily been provided for, as far as practicable, by the employment of two governor-weights coupled together, and pivoted at opposite points to a supporting member on the shaft, and by a counter-balance connected to the eccentric. A further disturbing action, which, so far as I am aware, obtains to a greater or less degree in all automatic cut-off mechanisms is due, more particularly in high-speed engines, to the inertia of the valve and the connected reciprocating members, the tendency and result of which is to move the eccentric into position to effect a longer cut-off or lower grade of expansion. Under my invention I am enabled to dispense with one of the ordinary pair of governor-weights and with the eccentric counter-balance, and counteract the action of gravity by a constant equal opposing force of steam, air, or other expansive fluid, the balance of forces being obtained either by the employment of an auxiliary piston working in a chamber in which a substantially constant pressure of expansive fluid is maintained, or by the employment of an unbalanced distribution-valve—that is to say, one which is subject to a preponderance of pressure in a direction opposite to that in which the action of gravity is exerted. The inertia of the valve and its connected reciprocating members and the resulting disturbing influence above referred to are counterbalanced by the employment of an auxiliary piston, by which the reciprocating parts are cushioned against the pressure of an expansive fluid or equivalently by a spring subject to extension and compression.

Various modifications in the application of my improvements may be made by those familiar with the art of steam-engine construction in accordance with the requirements of engines and valve mechanism of different forms or types, respectively, without departing from the governing principle of my invention, the essential features of which are illustrated in the exemplification thereof herein described and shown.

In the accompanying drawings, Figure 1 is a vertical transverse section through a steam-engine embodying my invention, taken at the center of the valve-chest; Fig. 2, a vertical longitudinal central section through the same; Fig. 3, a longitudinal central section through a portion of the valve-chest, showing a modification of the auxiliary piston; Fig. 4, a similar view showing the relief-valve; and Fig. 5, a side view, partly in elevation and partly in section, through the valve-chest of a steam-engine, showing a modification of my improvements.

Referring to Figs. 1 and 2, my invention is shown as applied in an engine having two vertical single-acting cylinders, 1 1, located above a crank case or box, 3, provided with end bearings, 4, in which are mounted a crank-shaft, 5, having a pair of double cranks, 6 6, to which the pistons of the cylinders 1 1 are coupled by connecting-rods in the ordinary manner. Steam is admitted to and exhausted from the cylinders by a distribution-valve, 7, composed of an upper piston, 8, and a lower piston, 9, fixed upon a valve stem, 10, said valve being adapted to reciprocate in a sleeve or bushing, 11, in a valve-chest, 12, located between the cylinders 1 1 and inclined relatively thereto, and being actuated by an automatic cut-off mechanism consisting of an eccentric which is pivoted to the crank-shaft and slotted to ad-

mit of movement and adjustment transversely thereto, and a centrifugal governor or regulator by which the eccentric is varied in position, to correspondingly vary the travel of the valve and regulate the admission of steam to the cylinders in accordance with variations in pressure or resistance, or both, in the operation of the engine. The governor is composed of a single weight, 26, by which the requisite centrifugal force is exerted, and which in this instance is cast integral with the eccentric 13 and a centripetally-acting spring, 14, the tension of which is exerted in reverse direction to the centrifugal action of the weight. It will be obvious that, if preferred, as may in certain constructions be deemed more convenient and desirable, the weight may be separate from the eccentric and coupled thereto by links in the manner usual in governors of this type. An arm, 15, on the weight below its pivot bears against one end of the spring 14, the opposite end of which is connected to a projection, 18, on the crank-shaft. A slot or opening, 16, is formed in the eccentric 13, to admit of its movement transversely to the crank-line, and the connected weight 26 is pivoted by a pin or stud, 17, to an arm of one of the cranks 6. The strap 19 of the eccentric is secured to one end of the eccentric-rod 20, the opposite end of which is coupled by a pin, 21, to the distribution-valve 7.

So far as described it will be seen that the valve mechanism would in operation be subject to the disturbing action of gravity and inertia, before referred to, to counteract which I provide means for balancing it by steam-pressure acting with equal force in an opposite direction. To this end I make the distribution-valve unbalanced in the direction of its traverse by constructing its upper piston, 8, of sufficiently larger diameter than its lower piston, 9, to effect a preponderance of pressure acting upwardly upon the valve equal in degree to the downward action thereon induced by the dead weight or gravity of the parts. The same result may be equivalently attained, where the valve is balanced by being made with end pistons of equal diameters, by securing upon the valve-stem a supplemental or auxiliary piston of smaller diameter, working in a chamber or cylinder, and subject continuously to fluid-pressure upon its lower side on an area sufficient to afford the upward pressure required. The upward action of the unbalanced steam-pressure being exerted at the center of the eccentric situated on the side of the shaft farthest from the center of gravity of the eccentric and weight, in order that the dead-weight shall be neutralized at any and all points in the revolution of the shaft the following relation of the lines of forces becomes necessary: Assuming h to represent the center of gravity of the eccentric, strap, and weight, the angle $h\ e\ d$, formed by lines drawn from said center of gravity to the center e of the eccentric pivot and from the center of the eccentric pivot to the center d of the shaft, equals the angle $r\ e\ i$, formed by a line, $r\ e$, from a point in a vertical plane to the center of the shaft, and a line, $e\ i$, from the center of the shaft to the center of the valve-connection. Such equation being preserved under all modifications of construction and arrangement of the valve mechanism, it will be seen that the pressure of the steam acts in line or on a dead-center against the eccentric pivot, and the dead weight of the parts acts similarly against said pivot, the rotative effect of the steam-pressure varying equally with but oppositely to the rotative effect of the dead-weight about the same as a center.

As previously stated, the inertia of the reciprocating parts tends, in the ordinary constructions, to defeat the proper automatic adjustment of the eccentric by the governor by moving the eccentric into position to effect a lower degree of expansion or longer cut-off, and induces irregular strains upon the governor, which act to keep its weight constantly in vibration. To counteract and eliminate such disturbing action, I provide an auxiliary or supplemental piston, 22, which is reciprocated by the eccentric coincidently with the valve in a chamber or casing, 23, in which a constant average pressure of steam, air, or other expansive fluid is maintained, such pressure instituting a determined resistance or cushion to the movement of the reciprocating parts at each terminal of the traverse of the valve. As a mechanical equivalent, such resistance may be provided by a spring.

As shown in Figs. 1 and 3, the supplemental piston is fixed upon the stem of the distribution-valve and works in a chamber formed by an extension of the valve bushing and chest; but it may also be applied in the form of a plunger, which is coupled directly by a link to the eccentric-strap and works in a chamber adjacent to the shaft, against the pressure of steam or air, which is supplied to the chamber through a proper pipe. The steam or other fluid in the chamber 23 of the auxiliary piston is maintained at a constant average pressure, and in being alternately expanded and compressed by the movement of the piston acts, as above stated, as a cushion to counteract the inertia of the reciprocating parts. The auxiliary piston may be adapted to compress and expand the cushioning-fluid on each side, in which case air would be preferably used, which is admitted through a check-valve opening inwardly, and in leaking past the piston is alternately compressed and expanded on each of its sides. Further, if desired, the balance for both gravity and inertia may be provided by a single auxiliary piston working in a chamber exterior to the steam-chest, or by two auxiliary pistons working in chambers at opposite ends of the valve, the gravity of the parts being in the latter case counteracted by the exertion of a correspondingly higher pressure in the lower chamber, or in that in which pressure tends to act in opposition to gravity. Undue pressure in

the chamber of the auxiliary piston is prevented by a relief-valve, 27, governing a pipe, 28, leading out of said chamber and held to its seat by a spring, 29.

Inasmuch as the boiler pressure is subject to variations, the action of the steam in the chamber 23 in counteracting gravity will vary correspondingly, while the dead-weight to be balanced remains constant. To obviate an inequality of opposing forces due to such variation, I provide a differential check-valve, 30, Fig. 3, which governs a port leading from the space above the auxiliary piston into a chamber, 31, communicating with a relief-pipe, 32. The valve 30 is held to its seat by a spring, 33, and carries on its outer end a piston or plunger, 34, of smaller diameter, controlling the opening of a pipe, 35, communicating with the valve-chest. The pressure on the smaller piston 34 will vary with variations of boiler pressure, and the resistance to the passage of steam from the space above the auxiliary piston will vary correspondingly, but the sum of the average pressure in the chamber 23 and the boiler-pressure will remain constant.

In the modification shown in Fig. 3 the auxiliary piston is made in the form of a cylindrical box or case, the interior of which constitutes a portion of the space for the reception of the cushioning-fluid. Two or more ports, 36, are formed at different levels in the piston, the effect of which is to cause the expansion of the fluid to be exerted from spaces of different volumes as the ports are successively opened and closed in passing a counterbore in the chamber and inducing a correspondingly-varying resistance at different points of the traverse of the piston.

Fig. 5 illustrates the application of my improvements in a horizontal engine. In this case the governor-weight 26 is cast separately from the eccentric, and is pivoted by a pin, 37, to the fly-wheel 38, and coupled by the double link 39 and pins 40 41 to the eccentric. The eccentric-rod 20 is coupled to a rocker, 42, journaled on the frame, and said rocker is connected to one end of a helical spring, 43, the opposite end of which is fixed to the frame, and which extends substantially parallel to the line of traverse of the valve. The resistance of the spring 43 to compression and extension in the movements of the rocker acts in opposition to the inertia of the reciprocating parts, the spring performing an equivalent function to the elastic fluid in the chamber of an auxiliary piston, before described. The slot of the eccentric is formed with rectangular sides, and fits over a squared guide or bearing on the crank-shaft, in order to admit of the required transverse movement of the eccentric without pivoting the same to the shaft or fly-wheel. The action of gravity is neutralized by an auxiliary piston, 22, actuated by a link, 24, coupled to the eccentric-strap and working in a chamber, 23, having a comparatively large clearance, against a substantially constant pressure of steam, which is supplied through a pipe, 25, leading from the valve-chest.

Among the practical advantages of a governor embodying my improvements are its simplicity and consequent reduced cost and liability to derangement, the reduction of strain to a substantially imperceptible degree by reason of balancing the action of inertia, and the capacity of maintaining uniform speed under variations of steam-pressure, and of imparting a longer travel to the valve with a resultant improved distribution of steam, the degree of expansion being within the control of a governor of less power than has been heretofore required. The center of gravity of the governor-weight may also be brought nearer the center of the shaft, and a spring of correspondingly-reduced tension be made available.

I claim as my invention and desire to secure by Letters Patent—

1. The combination of a weighted eccentric mounted adjustably upon a driving-shaft, a distribution-valve coupled to and actuated by said eccentric, and a pressure device whereby the action of gravity and inertia, or either, upon the valve mechanism is neutralized by an equivalent opposing force, substantially as set forth.

2. The combination of a weighted eccentric mounted adjustably upon a driving-shaft and a distribution-valve coupled to and actuated by said eccentric, said valve being unbalanced as to pressure in the direction opposed to the action of its gravity and that of its operating mechanism, substantially as set forth.

3. The combination of a weighted eccentric mounted adjustably upon a driving-shaft, a distribution-valve coupled to and actuated by said eccentric, and an auxiliary piston working in a chamber adapted to be supplied with steam or other expansive fluid, substantially as set forth.

4. The combination of a weighted eccentric mounted adjustably upon a driving-shaft, a distribution-valve coupled to and actuated by said eccentric, said valve being unbalanced as to pressure in the direction opposed to the action of its gravity and that of its operating mechanism, and an auxiliary piston working in a chamber adapted to be supplied with steam or other expansive fluid, substantially as set forth.

5. The combination of a weighted eccentric mounted adjustably upon a driving-shaft, a distribution-valve coupled to and actuated by said eccentric, an auxiliary piston working in a chamber adapted to be supplied with steam or other expansive fluid, and a differential check-valve governing a passage leading out of the piston-chamber, said valve carrying a piston of smaller diameter, and a pipe or passage leading from the valve-chest to the face of said smaller piston, substantially as set forth.

6. The combination of an eccentric mounted adjustably upon a driving-shaft, a distribu-

tion-valve coupled to and actuated by the eccentric, a governor consisting of a single weight pivoted on said shaft and connected to the eccentric, and a centripetally-acting spring connected to the weight, and a pressure device for counteracting the gravity of the valve and connected operating mechanism by an equivalent opposing pressure of steam or other expansive fluid, substantially as set forth.

7. The combination, with an automatic cut-off mechanism, of a pressure device acting to alternately resist and assist the movement of the reciprocating parts, and thereby to counteract the inertia thereof at each terminal of the traverse of the valve, substantially as set forth.

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