G. WESTINGHOUSE, Jr.

Governor for Steam-Engine

No. 162,782. Patented May 4, 1875.

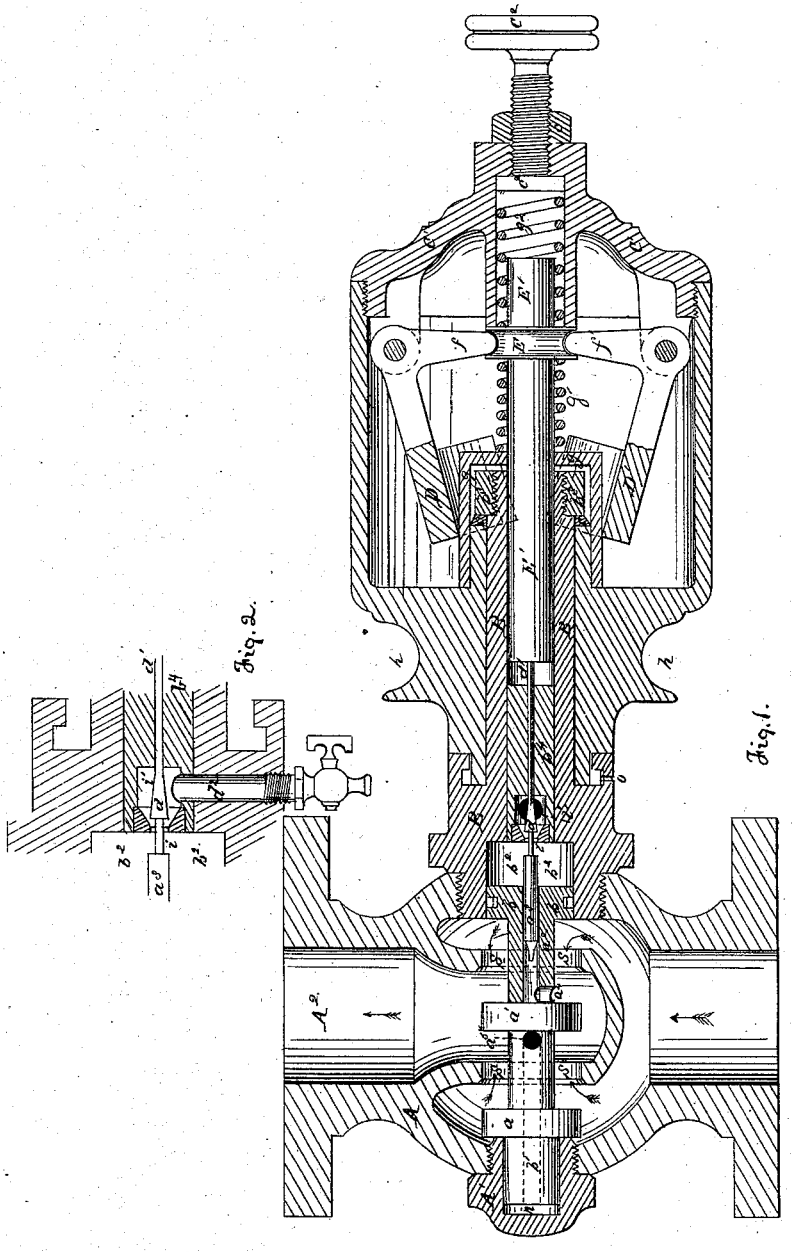

Fig. 2.

Fig. 1.

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UNITED STATES PATENT OFFICE.

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IMPROVEMENT IN GOVERNORS FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **162,782**, dated May 4, 1875; application filed April 3, 1875.

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful Improvement in Governor for Steam-Engine; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawing making a part of this specification, in which—like letters indicating like parts—

Figure 1 is a longitudinal sectional view of my improved governor, and Fig. 2 is an enlarged detached view, presently to be described.

My invention relates to an improved steam-engine governor, whereby the speed of an engine is accurately controlled and made uniform. In steam-engine governors, as heretofore constructed, the valves governing the admission of steam to engines have usually been operated by the centrifugal force of weights connected to the valves, and owing to the friction of the valves and valve-rods large weights have necessarily been employed for large valves, and governors of this class are unusually expensive pieces of machinery.

In the present invention the valves governing the admission of steam to the engine are operated by a piston subject to boiler-pressure, and the steam-pressure on this piston is regulated by a small auxiliary valve, which in turn is regulated in its action by the centrifugal force of light weights. A small valve operated in this manner I have found sufficient to control the action of the largest governor-valves.

In the drawing, A is a globe-valve case, in which two piston-valves, a and a^1, are attached to a common stem, a^2, and control the flow of steam to the engine, in the usual manner, by sliding into cylindrical or annular seats s. The valve-stem a^2 is provided at one end with a piston, b, fitted with the usual steam-packing, and at its opposite end with a piston or projection, b^1, sliding into a cylindrical guide, A^1, screwed into the case A. Into the opposite side of the case A is screwed the cylindrical head B in the chamber b^2, of which the piston b operates. This part B is turned, so as to provide a journal for the revolving case C, which is held in its position by the nut b^3. Beginning at the chamber b^2 the head B is bored throughout its entire length, and the end next to the chamber b^2 is fitted with the piece b^4, containing an auxiliary valve, d, operating through the port i in the end of the piece b^4. The port i and chamber i' are so constructed that if the valve, with the stem d^1, is in the position shown, it will leave an opening from the chamber b^2 to the atmosphere through the port d^2. The end of the valve-stem a^2, carrying the piston b, is made hollow, and contains the small wire a^3, one end of which bears against the valve d. A hole, a^4, is drilled into the cavity containing the stem or wire a^3, so that steam may enter and pass around the wire a^3 into the chamber b^3, a^3 being fitted loosely in the hollow stem. The projection b^1 is made hollow, with an opening, a^5, communicating to the space between the valves a and a^1, this piece b^1 constituting a piston of somewhat smaller area than the piston b. The case C is provided with a cap, C^1, to which are hinged two small weights, D and D′, having arms f and f' engaging in the collar E of the stem E′. The case has also a small piece, g, fitting on its inside hub, so that it revolves with it. Interposed between this revolving piece g and the collar E is a spring, g^1, having a tendency to throw the weights D and D′ toward the center of the circular case C. The cap C^1 is provided with a cavity in its center around the stem E′, in which a second spring, g^2, presses upon the collar E. The case C^1 is also provided with a thumb-screw, C^2, with a jam-nut, c^1, for holding it in position. This thumb-screw C^2 also presses against a washer, c^2, fitted in the chamber occupied by the spring g^2.

By screwing the thumb-screw C^2, and compressing the spring g^2, the tendency is to decrease the force with which the weights D and D′ are held toward the center of the case C by the spring g^1.

The stem E′ is of such a length, with reference to the stem d^2 of the valve d, that when the weights D and D^1 are in the position shown the valve d will leave an open port from the chamber b^2 to the atmosphere through the the opening d^2, the stem d^1 abutting against the stem E′. The case C is provided with a

groove, h, for a round belt, though any other suitable means may be used to effect its rotation. Into the opening d^3 is screwed a cock, whereby the escape from the chamber b^2 to the atmosphere may be closed when desired.

The operation of the governor is as follows: Steam is admitted to the valve-case A in the direction of the arrows, the opening A^2 being nearest to the cylinder of the engine. The case C being at a state of rest, the weights D and D′ are held in the position shown by the action of the spring g^1, this at the same time drawing the stem E′ so that the valve d is in the position shown, leaving an open communication from the chamber b^2, through the parts i and d^2, to the atmosphere. The valves a and a^1 being fitted to the same stem and of the same diameter, and operating through openings of equal diameter, are practically in equilibrium. When steam is admitted, there being only atmospheric pressure in the chamber b^2, the steam-pressure on b will throw it to the right, and bring the valves a a^1 into their seats s. The chamber n, outside of b^1, will also contain only atmospheric pressure. Then, the cock in the opening d^2 being closed, steam will pass, by the port a^4 and around the stem a^3, into the chamber b^2, and there being a practical equilibrium of pressure on the valves a a^1, no resistance in n, and an excess of area in b^2, such steam-pressure will throw the valves a and a^1 into the position shown. In this position steam is admitted at full force to the engine, whereupon the case C begins revolving at a high rate of speed. As soon as the weight D and D′ begin an outward movement, owing to centrifugal force the stem E′ is pressed forward against the valve-stem d^1, forcing the valve d into its port i, at the same time pressing the stem a^3 with it into its chamber. Now, when the case C has attained, or is approaching, the required velocity, the cock is opened in the port d^2, but no steam will escape from the chamber b^2, owing to the valve d closing the escape from the chamber b^2 to the atmosphere.

When the engine attains its proper speed the centrifugal force of the weights D D′ is sufficient to cause the valve d to pass through the port i into the chamber b^2 a sufficient distance to permit of a small escape of steam from the chamber b^2 to the atmosphere. When this escape exceeds the quantity admitted around the stem a^3, so as to decrease the pressure in the chamber b^2, the steam, acting on the piston b, causes the valves a and a^1 to travel toward their seats, and to that extent shut off the supply of steam to the engine, and as the speed decreases the valve d partially closes the escape from the chamber b^2 to the atmosphere, increasing the pressure in the chamber b^2, causing the valves a and a^1 to recede from their seats, giving a larger passage for steam to the engine. The slightest variation in the speed of the revolving case C causes the valve d to increase or decrease the port-opening at i from the chamber b^2 to the atmosphere, thereby causing the piston b to occupy such a position as to accurately regulate the size of the opening around the valves to the engine.

If, for any cause, the case C should stop revolving, the weights D and D′ will be thrown inward by the spring g^1, and at the same time the valve d, being kept against the stem by the pressure of steam acting on the end of the stem a^3, and thus being forced into its chamber i, will make so large an opening from the chamber b^2 to the atmosphere as to exhaust the steam therefrom and allow the valves a and a^1 to be thrown over into their seats, and so cut off steam and stop the engine.

The speed of the engine can be regulated at will by increasing or decreasing the force with which the counterbalancing-spring g^2 is held against the collar E. If it be made stiffer, a less speed will throw the weights D D′ out sufficiently to first close and then open the passage leading from the chamber b^2 to the atmosphere.

It will be observed that in starting the engine the port d^2 is to be closed, so that the pressure in the chamber b^2 may become sufficient to open the valves a a^1, and that it is kept closed until the centrifugal force of the weights D and D′ has pushed the valve d a sufficient distance to close the chamber b^2, and it will also be understood that the valve d, when the engine has attained a proper speed, governs the size of the opening from the chamber b^2 by passing partially into the chamber b^2, it or its port i being made tapering for that purpose. After the engine has attained a sufficient speed the cock in the port d^2 is opened and left open, and permits of a continuous outflow of steam, but this outflow of steam is so small as to be hardly perceptible, depending, however, upon the amount of opening around the stem a^3. The stem a^3, always having a full pressure upon it, assists in forcing the stem of the valve d against the stem E′.

It is not essential that the valves a a^1 be opened solely by the action of the piston b^1, but they may be held open in part by their own weight, or by a spring interposed for that purpose, and it is not essential that the piston b be arranged on the stem in the manner shown, but it may be arranged in a separate chamber, and have a stem communicating with the valves a a^1, the chief object of the invention being the governing of the valves a and a' by the regulation of the difference of steam-boiler pressure on the two sides of a piston, b, by a supplementary or auxiliary valve, d. Many modifications of this apparatus can readily be made. In place of the two springs g^1 and g^2, one spring, g^1, could be used, with nuts or other means interposed for increasing or decreasing the stiffness.

It will be observed that the case C extends into a cavity turned around the journal of the part B, having a groove whereby the drip of oil or water may be collected and allowed to run to the waste-opening o.

The weights D D′, stem and collar E E′,

springs g^1 and g^2, and cap g, all revolve together, the piece g being fitted around the inside of the hub of the case C, for the spring g^1 to act against without friction. The end of the stem E′, against which the stem d^1 presses, is fitted with a piece of hardened steel to prevent wear.

It will be observed that the weights D D′, although the case revolves on a horizontal shaft, counterbalance each other exactly, the weight of D^1, in the position shown, or in all positions, being accurately counterbalanced by that of D, and this form of weights and governor, and arrangement of parts, could be made to operate, by being enlarged, the valve $a\ a^1$ by a direct connection from the valves to the stem E′.

An important feature possessed by this governor is the automatic closing of the governor-valves by the stopping of the case C, any accident, such as the breaking of a belt, or the sticking of a governor upon its journal, causing the engine to stop, instead of running at a much higher velocity with its attendant danger. The same mode of regulating the position of the governor-valve by an auxiliary valve, and a piston subject to steam-boiler pressure simultaneously on both sides, may be applied to governor-valves generally with advantage, and the same is hereby included as a part of the present invention, whether such auxiliary valve be used to open an escape from one side of the piston to lessen the steam-pressure, or to open a supply to the same on the opposite side, so as, by a variation of pressure so made, to change the position of the governor-valve, the latter mode being simply the reversal of the former. The port a^4 in the construction shown will always be open to take steam from the boiler, whether the valves $a\ a^1$ be open or closed, and any suitable port through or past the piston b may be used in lieu thereof.

I claim as my invention—

1. A governor-valve and piston, arranged to operate the same, such piston, when in use, being subject to steam-boiler pressure simultaneously on both sides, in combination with an auxiliary valve and port for increasing or or lessening such pressure on one side, substantially as set forth.

2. A piston b, made subject to constant boiler-pressure on one side, and having a steam-port through or past the same to a chamber, b^2, on the other side, in combination with a governor-valve on one side and a tapering valve, d, and port i, communicating with the atmosphere on the other, substantially as set forth.

3. The combination of the rotating governor, governor-valve, piston, auxiliary valve and port, whereby when the governor ceases to revolve the auxiliary-valve port will be fully opened and the governor-valve closed, substantially as set forth.

4. The valves $a\ a^1$, arranged on the same stem with pistons $b\ b^1$ of different areas, each working in a separate chamber, the piston b taking its steam from the boiler side, whether the governor-valves be open or closed, substantially as set forth.

5. The weights D D′ in the revolving case C, in combination with arms $f\ f'$, collar E, and regulating-springs, arranged and operated substantially as set forth.

6. The combination of stems E′ d^1 a^3, and valve d, with steam-ports, piston b, and chamber b^2, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEORGE WESTINGHOUSE, JR.

Witnesses:
JAMES M. CHRISTY,
G. H. CHRISTY.