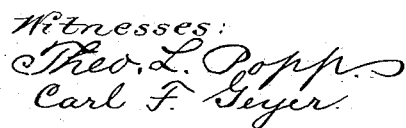


F. HART.
STEAM ENGINE GOVERNOR.

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UNITED STATES PATENT OFFICE.

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STEAM-ENGINE GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 421,931, dated February 25, 1890.

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To all whom it may concern:

Be it known that I, FREDERICK HART, a subject of the Queen of England, residing at Poughkeepsie, in the county of Dutchess and State of New York, have invented a new and useful Improvement in Steam-Engine Governors, of which the following is a specification.

This invention relates more especially to that class of steam-engine governors which consist, essentially, of a valve-casing, a chamber arranged within the casing, a regulating or automatic valve applied to said chamber, whereby the flow of the steam through said chamber is controlled, and a centrifugal governor, whereby the regulating-valve is actuated.

The object of my invention is to construct a compact and reliable governor of this kind which can be readily regulated, and which is conveniently and cheaply manufactured.

In the accompanying drawings, Figure 1 is a longitudinal sectional elevation of my improved governor. Fig. 2 is a vertical cross-section thereof in line *x x*, Fig. 1. Fig. 3 is a cross-section of the automatic valve and its chamber on an enlarged scale in *v v*, Fig. 1. Fig. 4 is a vertical section in line *y y*, Fig. 1. Fig. 5 is a fragmentary sectional elevation, on an enlarged scale, of the stem of the automatic valve. Fig. 6 is a cross-section in line *z z*, Fig. 5.

Like letters of reference refer to like parts in the several figures.

A represents the valve-casing of the governor, which is divided into an inlet-chamber *a* and an outlet-chamber *a'* by a partition *a²*.

b is the inlet-pipe connected with the inlet-chamber *a*, and *b'* the outlet branch connected with the discharge-chamber *a'* and provided with a flange *b²*, whereby it is secured directly to the steam-chest of the engine by bolts passing through openings in said flange.

C represents a bushing or hollow cylindrical chamber seated in an opening formed centrally in the partition *a²* and arranged partly in the inlet-chamber *a* but having its greater portion arranged in the outlet-chamber *a'*. The end of the chamber C arranged in the inlet-chamber is open, while the por-

tion thereof arranged within the outlet-chamber is closed by a screw-cap H, which closes a threaded opening in the rear or inner end of the valve-casing. The cap H is provided on its inner side with an annular groove or depression *c*, in which the adjacent end of the chamber C is tightly fitted. In inserting the chamber in the valve-casing the plug H is first screwed into the opening in the rear end of the valve-casing, and the chamber C is then driven into the opening in the partition *a²*, and its inner end into the annular groove in the plug H from the inlet side of the casing, the chamber being firmly held in place by friction. The chamber C is preferably constructed of a piece or section of piping of the proper diameter.

c' represents ports or openings formed in the peripheral wall of the chamber C within the outlet-chamber, whereby the latter is placed in communication with the inlet-chamber. These ports are preferably formed by transverse slots cut in the piping forming the chamber.

D represents a hand-valve arranged within the inlet-chamber *a* and closing against a flat valve-seat *d*, formed around the open end of the chamber C, whereby the steam may be shut off from the chamber C and prevented from passing through the valve-casing. This valve may be of any ordinary construction, and consists, preferably, of a disk-valve, as shown.

e is the stem of the valve, having a screw-threaded portion, which is arranged in a threaded opening in a threaded cap E. This cap closes a threaded opening in the outer end of the casing, through which the valve and the chamber C are introduced into the valve-casing. The valve-stem *e* passes outwardly through a screw-cap or stuffing-box *f*, which is secured to a projecting threaded shank or screw-stem *f'*, formed on the outer side of the cap E. A hand-wheel is secured to the outer end of the valve-stem for turning it. As the hand-valve is adjustable toward and from the valve-seat at the open end of the chamber or bushing C, the latter need not be accurately adjusted with reference to the valve, but may vary somewhat in length,

thereby dispensing with the necessity of a nice adjustment and saving the cost of accurate fitting.

G represents an automatic or regulating valve sliding lengthwise in the portion of the bushing or chamber C within the outlet-chamber *a'* and controlling the passage of the steam through the ports *c'* of the chamber C by covering said ports to a greater or less extent. This regulating-valve is of hollow cylindrical form and is open at both ends, so as to allow the entering steam to pass through the valve to the front end of the chamber C, and thereby balance the valve.

g is the stem of the throttle-valve, secured to a bridge-piece in the rear end of the valve and extending outwardly through the screw-cap H and a stuffing-box *h*, with which said screw-cap is provided.

I represents a laterally-projecting supporting-arm formed on the valve-casing A, and *i* is a bearing arranged in the outer end of said arm in line with the valve.

J is a sleeve or hollow driving-spindle turning in the bearing *i*, and *k* is a cylindrical block arranged to slide lengthwise in the inner portion of the hollow spindle. The outer end of the stem of the valve is attached to this block. The hollow spindle projects inwardly beyond the bearing *i* and is provided on opposite sides of its inner portion with pairs of parallel lugs or ears *j*.

L L represent the governor balls or weights attached to elbow-levers *l*, which are pivoted between the ears of the hollow spindle, and which project with their outer short arms into a transverse opening or slot *k'*, formed in the cylindrical block *k*, so that as the balls are moved inwardly or outwardly they shift the cylindrical block lengthwise in the hollow spindle and actuate the valve G.

M represents a spiral regulating-spring arranged within the hollow spindle and attached with its inner end to the sliding block *k* and with its outer end to the inner end of a screw-stem *m*. The latter engages in a hollow thumb-nut N, which bears against the outer end of the spindle J and fits with its contracted inner portion into the bore of the spindle. The screw-stem is secured to the spiral spring so as to be practically held against turning. Upon screwing the thumb-nut N in one or the other direction the screw-stem is moved inwardly or outwardly, thereby reducing or increasing the tension of the regulating-spring and varying the resistance of the sliding block and governor-balls correspondingly. The resistance of the governor-balls is by this means readily regulated to the normal pressure of the steam. The regulating-nut is locked in place, after being adjusted, by a pin or projection *o*, arranged on the hollow spindle and projecting into a recess in the inner face of the nut, the regulating-spring tending to hold the nut against the outer end of the spindle while allowing the nut to be moved outwardly to disengage it

from the locking projection when it is desired to turn the nut. The inner portion of the screw-stem is contracted, as shown in Fig. 1, to allow the screw-nut to be freely turned forwardly upon reaching the inner end of the screw-thread, thereby preventing binding of the nut on the stem and avoiding excessive twisting or straining of the regulating-spring.

P represents the driving-pulley of the governor, which is secured to the outer end of the spindle J, preferably by the pin or projection *o*, which latter acts as a key. The pulley P is preferably provided at its outer end with a hub or sleeve *p*, whereby it is secured to the driving-spindle, and the inner portion of the pulley turns upon the cylindrical outer surface of the bearing *i*. This forms a compact construction and affords a wide bearing-surface for the pulley. The driving-spindle J is confined in its bearing by a flange *q*, formed at the inner end of the spindle and abutting against the inner end of the bearing *i* and the shoulder *q'*, formed by the inner end of the hub of the driving-pulley and resting against the outer end of said bearing. The driving-pulley is connected with a pulley on the main engine-shaft by a belt. (Not shown in the drawings.) The stem of the regulating-valve is preferably secured to the cylindrical block *k* by a divided collar or washer *r*, fitting into an annular groove *r'* in the end of the stem and arranged in a cavity or recess *r²* in the block. The end of the stem is held in the block by a screw-gland *r³*, which engages in the threaded cavity of the block and bears against the outer side of the divided washer, as represented in Figs. 1 and 5. This construction forms a comparatively loose connection between the stem and block, which, in conjunction with the flexibility of the valve-stem, allows the latter to spring or yield slightly without affecting the valve in case the supporting-arm I is slightly sprung by an unusual strain on the driving-pulley. This construction also avoids the necessity of a nice adjustment between the parts in packing the stem.

S is an oil cup or lubricator attached to the upper portion of the valve-casing A and communicating with the discharge-chamber so as to lubricate the regulating-valve. When the regulating-valve has become leaky by wear and is in a position in which it closes the ports of the chamber C to a considerable extent, the piston of the steam-cylinder tends to produce a partial vacuum in the chamber C in rear of the valve by exhausting the steam therefrom through the space or leak between the external surface of the valve and the casing C. The partial vacuum so produced causes the valve to be drawn toward the rear end of its chamber, thereby unbalancing the valve and interfering with the proper working of the governor. To overcome this difficulty, the valve is provided in its circumference with an annular steam passage or depression *t*, which communicates with the interior of the

valve by radial passages t' , as represented in Figs. 1 and 3. In case the piston tends to produce a vacuum the steam in the chamber C is drawn into the outlet-chamber of the governor-casing directly from the interior of the valve through the radial passages t' , the annular passage t , and the leakage-space around the valve, instead of from the portion of the chamber C in the rear of the valve, thereby immediately filling any vacuum which may be produced and maintaining the valve in proper balance. The valve-casing, the lateral supporting-arm, and the bearing in the arm are cast complete in one piece, forming a very cheap and compact construction, which enables the governor to be attached directly to the steam-chest without the use of intermediate piping. The openings in opposite ends of the valve-casing and in its partition and the bearing for the driving-spindle are all arranged in line with each other, which permits these openings to be bored at a single operation by a single centering in the lathe, thereby saving time and rendering the boring of the valve-casing more convenient. By arranging the hand or shut-off valve D within the valve-casing and utilizing the adjacent open end of the cylindrical chamber C as a valve-seat, the governor is rendered more compact and cheaper of manufacture than when this valve is arranged in the inlet-pipe of the governor.

I claim as my invention—

1. The combination, with a valve-casing having an inlet and an outlet chamber, of a hollow cylindrical chamber which opens into the inlet-chamber and projects into the outlet-chamber and is provided with ports in the outlet-chamber, a hand-valve closing against the end of the cylindrical chamber in the inlet-chamber, a piston-valve capable of longitudinal movement in said cylindrical chamber, a valve-stem connected with said piston-valve and moving lengthwise with the same, and a centrifugal governor connected with said stem, substantially as set forth.

2. The combination, with the valve-casing having inlet and outlet chambers, of the cylindrical valve-chamber arranged in the casing and having ports within the outlet-chamber, a valve controlling said ports and moving longitudinally in said chamber, a lateral supporting-arm formed on or secured to the valve-casing and having a bearing in its outer portion in line with said valve, a governor-spindle turning in said bearing, and a centrifugal governor connected with said spindle, substantially as set forth.

3. The combination, with the valve-casing provided in opposite sides with openings and caps closing said openings, of a partition dividing the casing into an inlet and an outlet chamber and having an opening arranged in line with the openings in the sides of the valve-casing, a cylindrical chamber secured in the opening of the partition and having ports arranged within the outlet-chamber, a

valve arranged in the outlet-chamber and controlling said ports, a lateral supporting-arm formed on or secured to the valve-casing and having a bearing at its outer end, arranged in line with the openings in the valve-casing and its partition, and a governor-spindle supported in said bearings and connected with said valve, substantially as set forth.

4. The combination, with the divided valve-casing and the cylindrical chamber arranged therein and having ports, of a valve controlling said ports, a bearing arranged on one side of the valve-casing, a hollow driving-spindle arranged in said bearing, a block arranged to slide in said spindle and connected with the valve, and governor-balls having levers pivoted to the spindle and connected with said movable block, substantially as set forth.

5. The combination, with the divided valve-casing and the cylindrical chamber arranged therein and having ports, of a valve controlling said ports, a bearing arranged on one side of the valve-casing, a hollow driving-spindle arranged in said bearing, a block arranged to slide in said spindle and connected with the valve, governor-balls having levers pivoted to the spindle and connected with said movable block, and a tension-spring arranged in said spindle and connected with said block, whereby the resistance of the governor-balls is regulated, substantially as set forth.

6. The combination, with the divided valve-casing and the cylindrical chamber arranged therein and having ports, of a valve controlling said ports, a bearing arranged on one side of the valve-casing, a hollow driving-spindle arranged in said bearing, a block arranged to slide in said spindle and connected with the valve, governor-balls having levers pivoted to the spindle and connected with said movable block, a tension-spring arranged within the hollow spindle and attached at one end to the movable block, a screw-stem attached to the opposite end of the spring, and a regulating-nut arranged upon said screw-stem and bearing against the end of the driving-spindle, substantially as set forth.

7. The combination, with the divided valve-casing and the cylindrical chamber arranged therein and having ports, of a valve controlling said ports, a bearing arranged on one side of the valve-casing, a hollow driving-spindle arranged in said bearing, a block arranged to slide in said spindle and connected with the valve, governor-balls having levers pivoted to the spindle and connected with said movable block, a tension-spring arranged within the hollow spindle and attached at one end to the movable block, a screw-stem attached to the opposite end of the spring, a regulating-nut arranged upon said screw-stem and bearing against the end of the driven spindle, and a locking device whereby the regulating-nut is held in position, substantially as set forth.

8. The combination, with the valve-casing and the lateral supporting-arm, of a bearing

arranged in said arm, a hollow spindle turning in said bearing and provided at its inner end with a flange or rim bearing against the adjacent end of the bearing, a sliding block
5 arranged in the hollow spindle, governor-balls having levers pivoted to the hollow spindle and engaging with the sliding block, and a driving-pulley secured to the outer portion of the hollow spindle, whereby the latter
10 is confined in its bearing between its flange and the driving-pulley, substantially as set forth.

9. The combination, with the throttle-valve having a stem provided in its end portion
15 with an annular groove, of a hollow governor-

spindle, a sliding block arranged in the spindle and provided with a threaded socket in which the grooved end of the valve-stem is arranged, a divided collar or washer arranged in the groove of the valve-stem and
20 seated in the socket of the sliding block, and a screw-gland whereby the washer or collar is confined in said socket, substantially as set forth.

Witness my hand this 3d day of August, 25
1889.

FREDERICK HART.

Witnesses:

GEO. H. SHERMAN,
J. W. RUD.