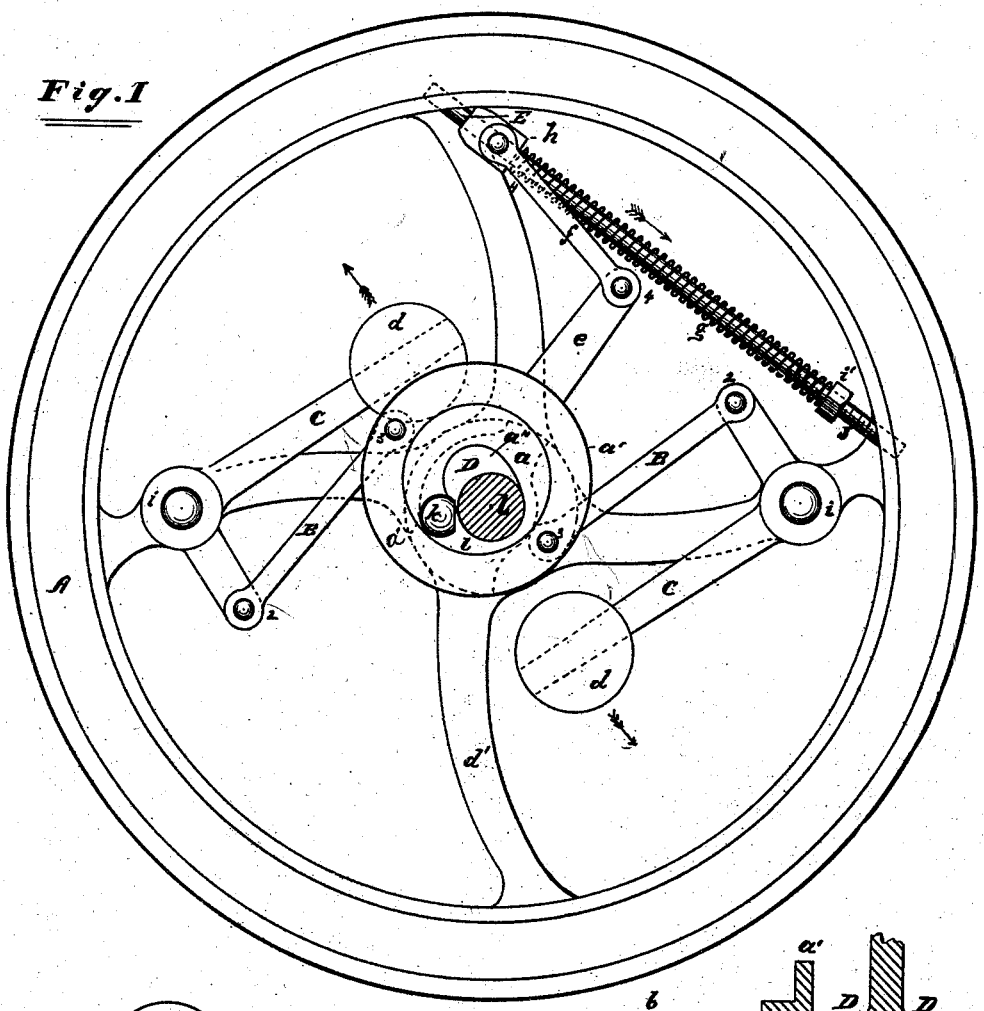
L. H. WATSON.

Automatic-Governor and Cut-Off.

No. 211,309. Patented Jan. 14, 1879.

*Fig. 1*



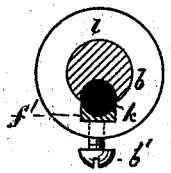




*Fig. 3*

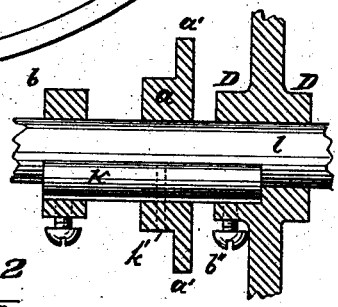



*Fig. 2*

*Attest:*

Geo. A. Brady

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# UNITED STATES PATENT OFFICE.

LEWIS H. WATSON, OF CHICAGO, ILLINOIS.

## IMPROVEMENT IN AUTOMATIC GOVERNOR AND CUT-OFF.

Specification forming part of Letters Patent No. **211,309**, dated January 14, 1879; application filed November 9, 1878.

*To all whom it may concern:*

Be it known that I, LEWIS H. WATSON, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Automatic Governor and Cut-Off, of which the following, in connection with the accompanying drawing, is a specification.

Figure 1 in the drawing is a side elevation of a governor and cut-off embodying my invention; Fig. 2, a central cross-section of the parts carried by the shaft, showing a modification adapting the parts for use in connection with a larger shaft than that represented in Fig. 1; and Fig. 3 is an end view of the shaft, and shows the manner in which the eccentric-pin is applied in the modification of construction shown in Fig. 2.

Like letters of reference indicate like parts.

My invention relates to that class of governors and cut-offs wherein the center of the eccentric is automatically shifted to and from the center of the shaft by means of weights acting centrifugally and springs acting centripetally on arms or levers connected to the eccentric, and moving in orbits about the shaft. I aim to make such improvements that the eccentric will respond quickly and with uniform action to the variations of pressure and load, that the proper conditions of lap and lead will be maintained; and that the parts may be made and applied with facility, and be simple in their construction and operation.

To this end my invention consists in the several features of construction hereinafter fully described, and specifically claimed as new.

In the drawing, *l* represents the crank-shaft of a steam-engine, and A is a fly-wheel mounted rigidly thereon. D is the hub of the wheel A. *a* is an eccentric, flanged, by preference, but not necessarily, as shown at *a'*. *a''* is a slot in the central part of the eccentric, and through this slot the shaft *l* passes freely. The flange *a'*, as represented, is arranged next to the hub D. *k* is a pin passing through a closely-fitting hole in the eccentric, and entering the end of the hub D, in which it is made rigid. The eccentric is allowed to vibrate freely on the pin *k* as a center of motion, and the form of the slot *a''* should be such as to admit of this vibration from full throw to a throw corresponding to the amount of the lap.

In order to determine at what point to set the pin *k* with relation to the shaft *l*, so that, as I believe, the best results will be produced, the following directions may be observed. For example, if this governor is to be used in connection with a half-inch port, and a quarter-inch lap on each side of the valve, the full stroke should be one inch and a half, and the slot *a''* should be amply large to give the shaft free play, and should not touch the shaft at any point. The distance of the pin *k* from the center of the shaft *l* should be equal to the sum of the lap and ports. It is obvious that if the lap is increased, the distance from the center of the pin *k* to the center of the shaft *l* must be decreased correspondingly, and the full stroke of the eccentric increased in the same proportion; and, also, it is clear that if the lap is diminished, the distance between the center of the pin *k* and the center of the shaft *l* must be increased and the throw of the eccentric decreased. It will be found that this rule, if followed, will lead to good results in maintaining a uniform lead, and that the action of the valve will be even and uniform at all times, and adjust itself quickly to changed conditions of pressure and load; but as this formula need not be strictly followed, I do not here intend to restrict myself to the pin *k* when located precisely at the point determined by the formula.

It will follow, when a very large crank-shaft is employed, that the pin *k*, if located in pursuance of the foregoing formula, will have its perimeter within the perimeter of the shaft, the other conditions remaining the same.

In such cases I groove the shaft *l* longitudinally to receive the pin *k*, and arrange the pin in the groove, as represented in Figs. 2 and 3, the said groove and the diameter of the pin being such that the center of the pin will be one inch and a half from the center of the shaft.

With any ordinarily large shaft used in connection with a half-inch port, and quarter-inch lap on each side of the valve, the pin, when set into the shaft in the manner shown and described, will yet extend some way from the convexity of the shaft. I then cut out the

slot $a''$ sufficiently to allow the eccentric to be arranged on the shaft and pin in the manner represented in Fig. 2, and I connect or lock the eccentric and pin to each other by means of a pin, $k'$, so that the pin $k$ will roll in its groove in the shaft when the eccentric is rotated on the center of the pin last referred to.

The width of the groove $a''$ at points near the pin $k$ should be such as to admit of this rotation during the entire oscillation of the eccentric.

It will be perceived that the eccentric will thus be tied pivotally to the shaft, in substantially the same manner as it is to the hub D, when a shaft of smaller diameter is used, and as represented in Fig. 1.

To further secure the pin $k$ in the groove in the shaft, I employ a collar, $b$, fitted on the shaft and pin, as shown in Fig. 2; and $b'$ is a set-screw entering the collar $b$ and extending to the pin $k$, so that the pin may be held more or less tightly by means of the said screw, and lost motion thus prevented. Another screw, $b''$, may also enter the hub D and meet the pin $k$, for the same purpose. $f'$ is a washer arranged between the pin and the screw $b'$, to admit of compensation being made for wear.

C C are bell-cranks, the long arms of which extend in opposite directions from the pins $i\,i$, on which they are pivoted, respectively. $d\,d$ are weights on the outer or free ends of the long arms above referred to, and B B are links connecting the short arms of the parts C C to the eccentric at opposite points on the latter, the links being jointed or pivoted at each end of the parts connected by them, as represented at the points 2 and 3, respectively.

It will be observed that the short arms of the parts C C extend inward, that the long arms are parallel, or nearly parallel, to each other, and that the short arms, as well as the links B B, are, respectively, arranged parallelly, thus causing the weights $d\,d$, during rest, to lie in near the points 3 3 of the eccentric.

The direction in which the weights move when influenced by centrifugal force exerted during the rotation of the shaft is indicated by the arrows shown in Fig. 1.

It will be perceived that when the weights $d\,d$ move outward, the eccentric will be oscillated on the pin $k$, thus carrying the center of the eccentric toward the center of the shaft $l$, and diminishing the throw.

It will also be perceived that while the center of the eccentric approaches the center of the shaft, the eccentric is swung round on the pin $k$, so that the position of the major part or swell of the eccentric is shifted from its original position in relation to a fixed point on the shaft, thus maintaining a proper condition of lead while the steam is being cut off to reduce or equalize the action.

$e$ is a rigid arm or lever extending from the eccentric outwardly. E is a rod extending across the outer part of the wheel A, and $h$ is a loose nut or sleeve on one end of the said rod. The other end of the rod E is screw-threaded, as indicated at J, and $i'$ is a nut run upon this screw-threaded portion of the rod. $g$ is an open spiral spring on the rod E, and is arranged between the sleeve $h$ and the nut $i'$. $f$ is a link or connecting-arm, connecting the sleeve $h$ to the outer end of the lever $e$, the link being pivoted or jointed to each of the parts connected by it. As the weights $d$ $d$ move out, the lever $e$ moves in the direction of the arrow there shown, thus drawing the sleeve $h$ against the spring $g$, which yields as the sleeve is so drawn along on the rod E, and which is constantly tending to push the sleeve back.

When the centrifugal force exceeds the force of the spring $g$, or, in other words, when the rotation of the shaft is too rapid, the spring yields to the advancement of the sleeve $h$ on its rod, and consequently the eccentric is shifted in the manner already described. As soon as the rotation becomes slower the centrifugal force diminishes, and the spring then exerts its force on the sleeve sufficiently to push it back toward the position from which it started, and consequently the eccentric is shifted back toward its original position.

To regulate the speed of the engine, the pressure of the spring is either increased or diminished by turning the nut $i'$, in a direction according to the speed desired, until a proper equilibrium is established between the force of the spring and the force required to move the weights $d$ $d$ outward, and until the proper speed is obtained. Thereafter a variation, either in the pressure or in the load, will be responded to automatically by a movement of the eccentric, which will result in making the engine run at the desired speed and evenly at all times.

If the desired adjustment cannot be obtained with a spring of given size, a larger or smaller spring must be substituted therefor.

A considerable leverage for overcoming the resistance offered by the eccentric ring and rod to the movement of the eccentric on or about the shaft is furnished through the instrumentality of the arm or lever $e$, and the means for varying the force of the centripetal spring are simple and effective.

I have shown the parts, now fully described, as applied to the fly-wheel; but they may, in like manner, be applied to a disk on the shaft.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a governor and cut-off, as a means of overcoming the resistance of the valve and friction of the eccentric, the pivoted eccentric, with arm or lever rigidly secured thereto, controlled by weighted levers, and counteracted by a spring, substantially as shown and described.

2. In a governor and cut-off, as a means for securing leverage for overcoming the resistance of the valve and friction of the eccentric-strap, an eccentric hung pivotally to the main shaft, and having an arm extending there-

from, in combination with a resisting medium, and also connected to the eccentric weighted levers for giving motion to the same, all substantially as shown and described.

3. In a governor and cut-off wherein an oscillating eccentric is controlled automatically by means of yielding weighted arms or levers, the combination of the rod E, for supporting the spring *g*, a sleeve on the said rod, and an arm or lever connecting the said sleeve to the eccentric, substantially as and for the purposes specified.

4. The combination of the spring *g*, the screw-threaded rod E, having thereon the nut *i'* and sleeve *h*, and the arm or lever *e*, all operating together substantially as described, in connection with a pivoted and oscillating valve-eccentric automatically adjustable with relation to its shaft, substantially as and for the purposes specified.

5. The combination of the pivoted and open eccentric *a*, the shaft *l*, the pivoted and weighted and yielding bell-crank levers *c c*, and the pivoted connecting-arms B B, when the said crank and levers are arranged in the manner shown and described.

LEWIS H. WATSON.

In presence of—
S. S. SCHOFF,
G. A. BRADY.