D. A. WOODBURY.

STEAM ENGINE CUT-OFF.

No. 107,746. Patented Sept. 27, 1870.

Fig 1

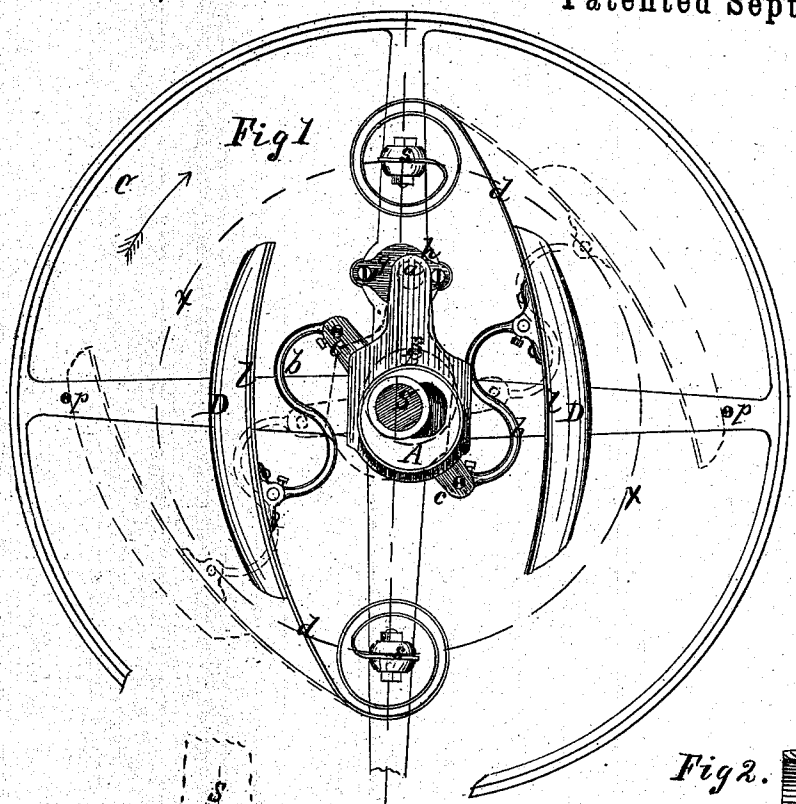


Fig 3

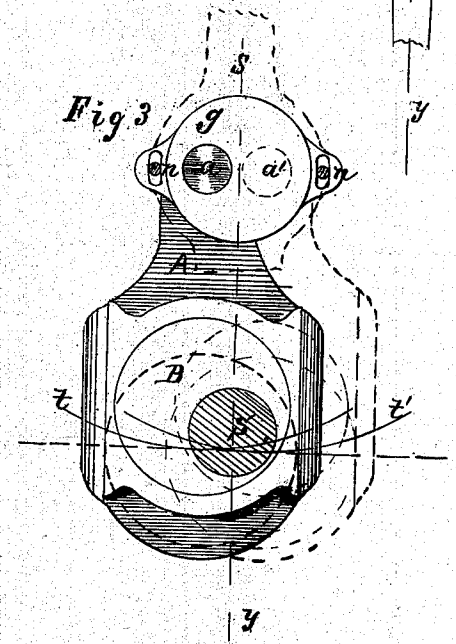
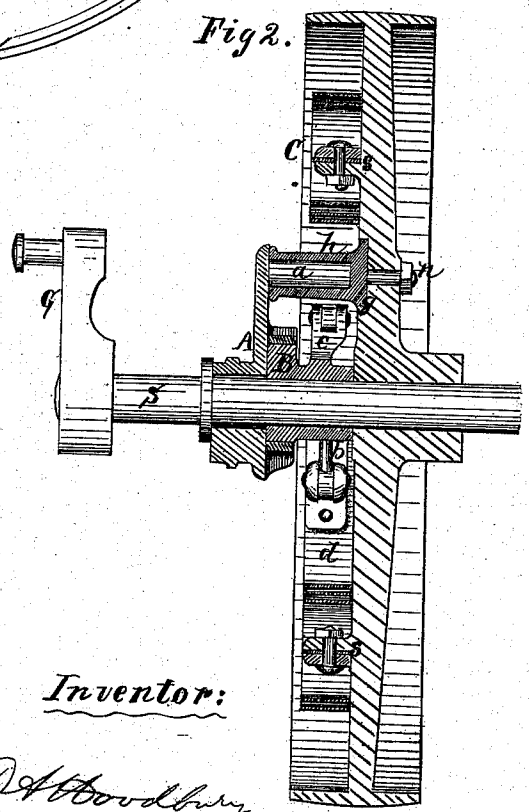


Fig 2.



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DANIEL A. WOODBURY, OF ROCHESTER, NEW YORK.

Letters Patent No. 107,746, dated September 27, 1870.

IMPROVEMENT IN AUTOMATIC CUT-OFFS FOR STEAM-ENGINES.

The Schedule referred to in these Letters Patent and making part of the same

I, DANIEL A. WOODBURY, of Rochester, in the county of Monroe and State of New York, have invented certain Improvements in "Automatic Cut-Offs for Steam-Engines," of which the following is a specification.

My invention relates to the arrangement, upon an engine crank-shaft, of a governor, which controls the adjustment of an eccentric swinging from a point outside of the shaft, and thereby regulates the travel of the valve, and, consequently, the point of cut-off.

In the drawing—

Figure 1 is a side elevation of my invention.

Figure 2 is a central section at the dotted line *y*, fig. 1.

Figure 3 is an obverse view of the swinging eccentric.

The main eccentric A is suspended from an axis, *a*, upon a hub fixed to the crank-shaft S, or upon an arm of the fly-wheel C, and is adjusted laterally by means of the auxiliary eccentric B, shown in dotted lines in fig. 1, as fully described in my application for a patent filed March 15, 1870.

The governor-weights D are firmly secured to springs *d*, which are in turn secured to an arm of the fly-wheel, or to a disk provided for that purpose upon the crank-shaft.

It is preferable that the springs *d* be given two or three turns around the points of attachment, as shown in fig. 1, whereby the centers of coils become very nearly the pivoting points of the weights.

The auxiliary eccentric B is provided with arms *c*, to the extremities of which the links *b* are hinged, such links being also hinged at the opposite end to the weights D.

It is obvious that, when the crank-shaft is put in motion, the centrifugal force of the weights D will swing them outward, as indicated by dotted lines in fig. 1, partly revolving the auxiliary eccentric B, whereby the throw of the main eccentric is reduced and the valve caused to cut off sooner. If the motion of the crank-shaft ceases or slackens, the weights produce an opposite effect upon the eccentric and valve, and it is plain that any variation of speed of the engine will thus be corrected.

The arrangement of the weights D is such that they precede their points of suspension *s* in the direction of motion, and, when at rest, they lie near the crank-shaft and within the circle *x*, fig. 1, described by such suspending-points. By this means the liability of the weights to be thrown outward by their inertia, when the engine is started suddenly, is avoided, since it is evident that the further their centers of gyration are within the circle *x*, the easier such inertia is overcome. Thus, a difficulty often experienced in starting engines is obviated, viz., that of the valve cutting off the steam so soon as to allow the engine to stop on the "center."

It will be observed, however, that, as the weights D swing outward, they pass the circle *x*, and since the effect of their inertia is increased, as the distance between them and the crank-shaft center increases, I am enabled to use their inertia as well as their centrifugal force for governing purposes.

In my former application I described the main eccentric A as swinging from a rigid center, *a*. Since, however, the stroke of A, when at the central point of its adjustment, is equal to the sum of the lap and lead of the valve, the openings made by the latter will be uneven when A is swung over to the extremity of its adjustment; for its eccentricity on the line of suspension will thus be decreased, as well as its relative position altered, as indicated by the curve *t*, fig. 3, described by its center.

I therefore locate the axis *a* slightly one side of the center line *y*, figs. 1 and 3, of the crank, and make the hanger *h*, in which *a* has a bearing, adjustable laterally to such center line, as indicated by the dotted circle *a'*, fig. 3. Consequently, when it is desired to swing the main eccentric to the opposite extremity of its adjustment, and run the engine in the opposite direction, if the hanger *h* and axis *a* be shifted laterally in the same direction as the eccentric, the two curves *t t'*, described by the center of A from the two positions of its axis *a* and *a'*, coincide very nearly with a straight line, as indicated in fig. 3, whereby the variation of lead and openings of the valves is hardly noticeable, except when the main eccentric A is at the point of its least eccentricity on the line of suspension, indicated by the intersection of the curves *t* and *t'*, at which point the valve opens neither port, the lead being neutralized. Thus, when the engine attains such a speed as to force the weights D against the stops *p*, fig. 1, the eccentric A being at that point of its adjustment above stated, no steam is admitted to the cylinder, and the speed must slacken, giving the governor complete control over the engine, although the throttle may be wide open.

The adjustment of the hanger *h* is obtained by means of the eccentric disk *g*, provided upon it, which revolves in a recess formed in the fly-wheel arm, and is secured to the latter by bolts *n*. A half revolution of the disk *g* thus shifts the axis *a* to correspond with the direction of motion.

To adjust the amount of lead upon the valve, the bolt-holes in the disk *g* are slotted somewhat circumferentially, as shown in fig. 3, whereby the axis *a* may be shifted in the line of the crank by a slight axial movement of the disk. The eccentricity of A in the line of suspension is thus increased or decreased, and, consequently, the lead of the valve regulated.

It will be found necessary to proportion the weight of the balls D to the speed of crank-shaft required, and for this purpose strips of metal, *l*, fig. 1, may be

interposed between them and the springs, the weights being made readily removable, or it may be more convenient to make the weights hollow and run a sufficient quantity of soft metal into them.

When it is desired to run the engine in the opposite direction from that indicated by the arrow in fig. 1, the weights and springs are detached from fastenings *s*, and turned over upon the opposite side of the wheel, and again secured. They thus project in a reverse direction from their points of suspension, and the eccentric *g* being given a half turn at the same time, the valve, and consequently the motion of the crank-shaft, are reversed, and the governor is ready to act, as before.

If the stops *p* were removed, the weights D might be so extended as to completely reverse the valve and engine, but in this position the governor would not control the motion, neither would the lead of the valve be equal at both ends. In many cases, however, it may be desirable to reverse the engine in this manner by means of a friction-wheel attached to the eccentric B.

A single bolt, *n*, fig. 2, may be used in place of the two shown in figs. 1 and 3, such bolt being located eccentrically to the axis *a*, and tightened by a nut upon the outer end, obviating the necessity of the disk *g* and its retaining recess.

The form of the weights D is a mere matter of taste or convenience, and does not in any way affect the operation of the device.

What I claim as my invention is—

1. The swinging eccentric A and auxiliary eccentric B, in combination with a suitable automatic governor, for the purposes set forth.

2. The eccentric A, swung from a center outside of the crank-shaft of an engine, when such center is adjustable forward or backward of the center line of the crank, and radially to said eccentric, either or both, for the purposes set forth.

3. The governor-weight or weights D, when attached to a disk or hub secured to the crank-shaft, or to an arm of the fly-wheel, by means of suitable counteracting and suspending springs, for the purposes set forth.

4. The within-described arrangement of the weights D with relation to their points of suspension *s* and the center of the crank-shaft, when they precede such suspending points in the direction of motion, for the purposes set forth.

5. The hanger *h*, when provided with an eccentric axis, whereby the pivoting-point of the main eccentric A may be adjusted radially, or shifted to the reverse position, for the purposes set forth.

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