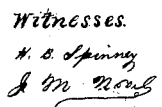


Patented Dec. 6, 1864.

N^o 45,322.



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UNITED STATES PATENT OFFICE.

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IMPROVEMENT IN VARIABLE TUBE-GEAR.

Specification forming part of Letters Patent No. 45,322, dated December 6, 1864.

To all whom it may concern:

Be known that we, GEORGE DODDS and ELIHU DODDS, of the city of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Variable Cut-Offs for Steam-Engines; and we do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a vertical section through the cut-off apparatus and steam-chest. Fig. 2 is a top view of the cams and cam-yoke of the cut-off apparatus, being a horizontal section through *xx*, Fig. 1. Fig. 3 is a perspective representation of the upper or cut-off cams. Fig. 4 is a perspective representation of the spiral cylinder by which the variation of the cut off cams is effected. Fig. 5 is a vertical section through the hollow crown-wheel shaft and spiral cylinder at right angles to the section in Fig. 1.

In the several figures like letters of reference denote similar parts.

Our invention consists in the use and adaptation of certain mechanical contrivances for the purpose of operating the independent cut-off valve in steam-engines in such a manner that the point of the stroke of the piston at which the steam is cut off shall be variable throughout the length of the stroke, and so that the point of cut-off shall change with the increased or diminished force of steam, exactly in proportion to the rapidity of stroke of the engine, thus forming a variable cut-off, which may also be rendered adjustable.

To enable others skilled in the art to construct and use our invention, we will proceed to describe the construction and operation of our cut-off apparatus.

In Fig. 1, *a* is the cylinder of the steam-engine, and *b* the piston. *c* is the steam-chest. *d* is the working slide-valve, above which is placed the cut-off valve *e*, which is also a slide-valve, and which, being placed over the port through which the live steam enters the steam-chest, controls the admission of steam to either end of the cylinder. The cut-off valve *e* is connected by the rod *f* with the cam-yoke *g g'*, which has two working-points, each terminating in a friction-roller, *i*, to reduce the fric-

tion of the working-faces of the cams *h k*. The upper or variable cam, *h*, is the cut-off cam, operating to close the cut off valve *e* and shut the steam from the steam-chest of the cylinder. The lower cam, *k*, operates to open the cut-off valve *e* and admit the steam at the commencement of each stroke of the piston, and, as the steam is admitted always at the same points, the cam *k* is keyed fast to the shaft which operates the governor, and is not adjustable or capable of variation in the relative time of its operation, while the upper or cut-off cam, *h*, is susceptible of variation in its position on the governor-shaft relatively to the lower or opening cam, so as to cut off the steam at any point in the stroke of the piston-rod to within a short distance of the commencement or end of the stroke.

In Fig. 1, *l* is the governor shaft, which is inserted in the vertical hollow shaft *m*, with which it is connected by a pin, *n*, which passes through a slot on each side of the hollow shaft *m*, so that the governor-shaft *l* will revolve with the hollow shaft *m*, and at the same time will fall or rise just as the revolutions of the governor *o* are more or less rapid. The hollow shaft *m* is connected with the engine by crown-wheels *p p'*, or in some other convenient or usual way, so that the increased or diminished speed of the engine is communicated to the governor.

A short hollow cylinder, *q*, (through which the hollow shaft *m* passes,) is attached to the governor-shaft *l* by the pin *n*, so that the short cylinder *q* revolves with the shaft *m* and governor-shaft *l*, while it also rises and falls with the governor-shaft. This short cylinder *q* has two spiral teeth, *r r'*, projecting from the face of the cylinder, the pitch of which is such that each of the teeth passes nearly half-round the cylinder in its whole length, as seen in Fig. 4. These spiral teeth *r r'* fit in corresponding grooves *s* in the central circular hole in the upper or cut-off cam, *h*, through which the spiral cylinder *q* is inserted.

The cut-off cam *h*, the shape of which is shown in Fig. 3, is so situated on the shaft *m*, as that its acting faces are in the same horizontal plane as the friction wheel *i* at the end of the working-point *g'* of the cam-yoke. The cam *h* is not fastened to the spiral cylinder *q*, nor to the shaft *m*, but is supported by

means of annular attachment *t*, which rests on a collar, *u*, on the hollow shaft *m*, as seen in Figs. 1 and 5. The cam *h* has no vertical motion on the shaft *m* or cylinder *q*, but it is caused to revolve with the governor-shaft *l* and short cylinder *q* by means of the spiral teeth *r r'* fitting in the grooves *s*. It has also another motion on its axis independent of the continuous rotary motion, which will be hereinafter explained.

The lower cam, *k*, which opens the cut-off valve *e* and admits steam, has its operative faces in a lower plane than those of the cut-off cam *h*, as seen in Fig. 1 and the operative point *g* of the cam-yoke is in the same plane as the cam *k*. The cam *k* is keyed to the hollow shaft *m* so as to revolve with it, and has a recess around the shaft *m* to allow room for the vertical play of the spiral cylinder *q* of the cut-off cam *h*.

The operation of our cut off apparatus is as follows: When there is full head of steam on and the engine is working too fast, the governor revolves very rapidly, which causes the governor-shaft *l* to descend in the hollow shaft *m*, and at the same time depresses the spiral cylinder *q*, which is fastened to the lower end of the governor-rod *l*, as shown in Fig. 5, and before described. The depression of the spiral cylinder *q* causes the cam *h* to turn on its axis on the cylinder *q* more or less, as the cylinder is more or less depressed, owing to the spiral teeth *r r'* on the cylinder *q* working in the grooves *s* in the cam *h*, for, as the spiral cylinder has a vertical motion with the governor-shaft *l*, and as the cylinder *q*, the governor-shaft *l*, and the hollow shaft *m* are fastened together by the pin *n*, and as the lower cam, *k*, is keyed to the hollow shaft *m*, those parts cannot have any relative motion around their common axes, although they all revolve together. Now, as the vertical motion of the short cylinder *q* inside of the cut-off cam *h* causes that cam to move on its axis relatively to the short cylinder *q*, it will also alter the relative position of the upper and lower cams *h* and *k* and of their operative faces. The increase of speed of the governor-shaft *l*, and the consequent depression of the short cylinder

q, will bring the operative faces *h* of the cut-off cam nearer to the operative faces *k* of the lower cam, as shown in Fig. 2. This position of the parts of the apparatus is shown in Figs. 1 and 2, where the cam-face *h* of the lower cam has opened the cut-off valve *e*. As the cam is revolving in the direction of the arrow in Fig. 2, it will be seen that the cam-face *h* of the cut-off cam is very close to the operative point *g'* of the cam-yoke, by which the cut-off valve *e* will be closed. If, however, the speed of the engine should diminish, the governor-rod *l* would rise and raise with it the spiral cylinder *q*, which would cause the cut off cam *h* to change its relative position to the lower cam, *k*, and assume the position shown by dotted lines in Fig. 2, the effect of which would be that the cut-off valve would not be closed until nearer the end of the stroke.

Thus the relative position of the operative faces of the cams *h* and *k* regulates the length of time which elapses between the admission of the steam and its being cut off, and, as this relative position is altered by the rise and fall of the governor-shaft, the cut-off valve will promptly respond in the action to that of the governor.

Having thus described our improved cut-off apparatus, what we claim as our invention, and desire to secure by Letters Patent, is—

The combination and arrangement of the opening cam *k* and cut-off cam *h*, cam-yoke *g g'*, and the spiral cylinder *q*, as a cut-off apparatus constructed substantially as described, with the governor and cut-off valve of a steam-engine, for the purpose of so regulating the closing of the cut-off valve as that the point of cut-off shall change with the increased or diminished force of steam in proportion to the rapidity of stroke of the engine, thus forming a variable cut-off.

In testimony whereof, the said GEORGE and ELIHU DODDS have hereunto set their hands in presence of us.

GEO. DODDS.
ELIHU DODDS.

Witnesses:

A. S. NICHOLSON,
J. M. NEAL.