W. WATTS & F. A. PHELPS.

CUT-OFF FOR STEAM ENGINES.

No. 110,943. Patented Jan. 10. 1871.

Fig. 1.

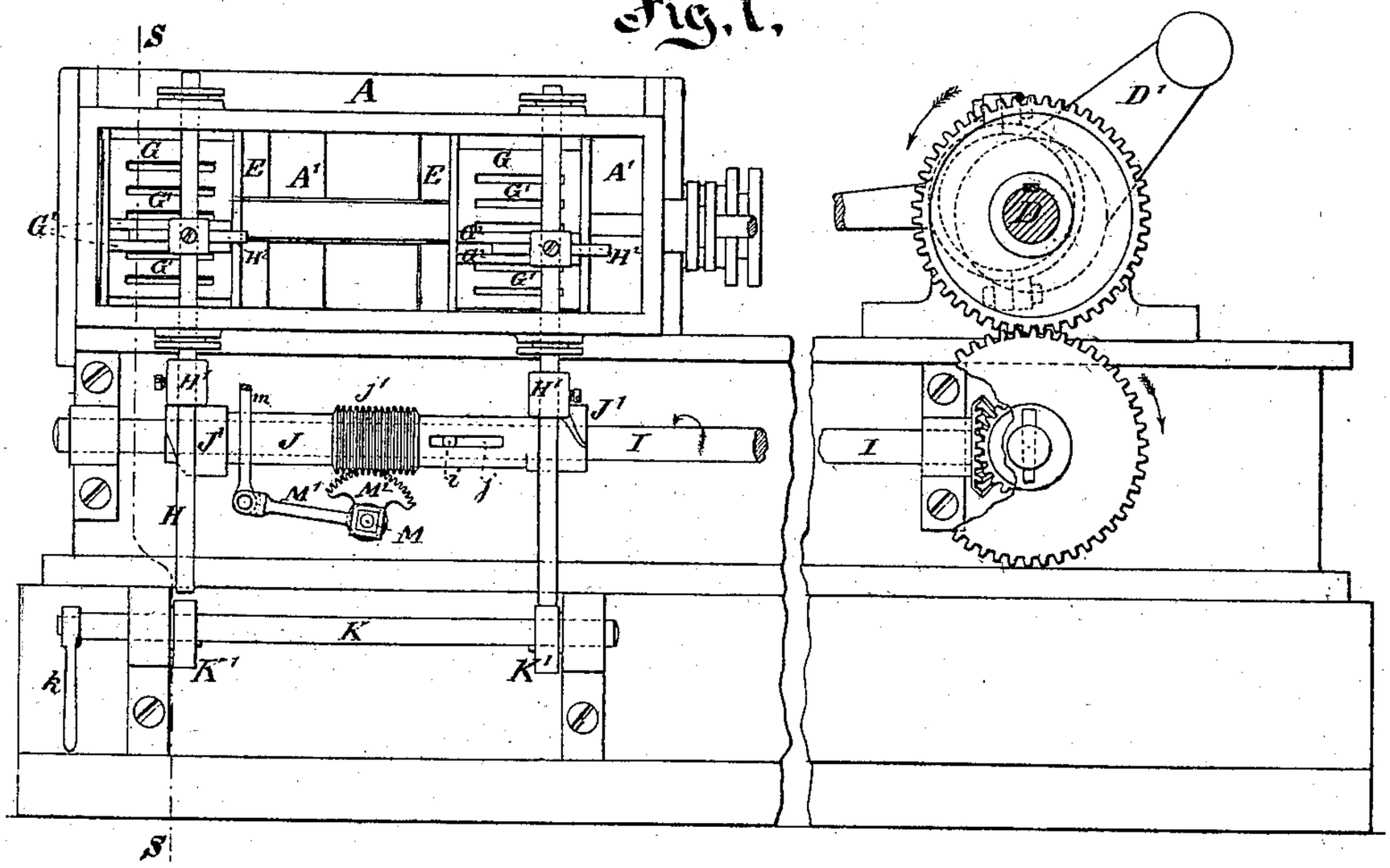


Fig. 3.

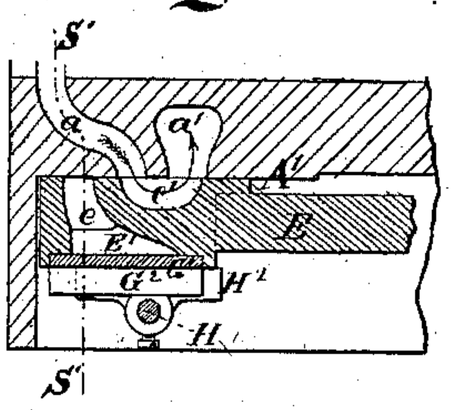


Fig. 4.

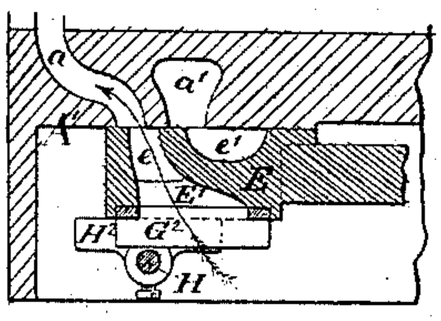
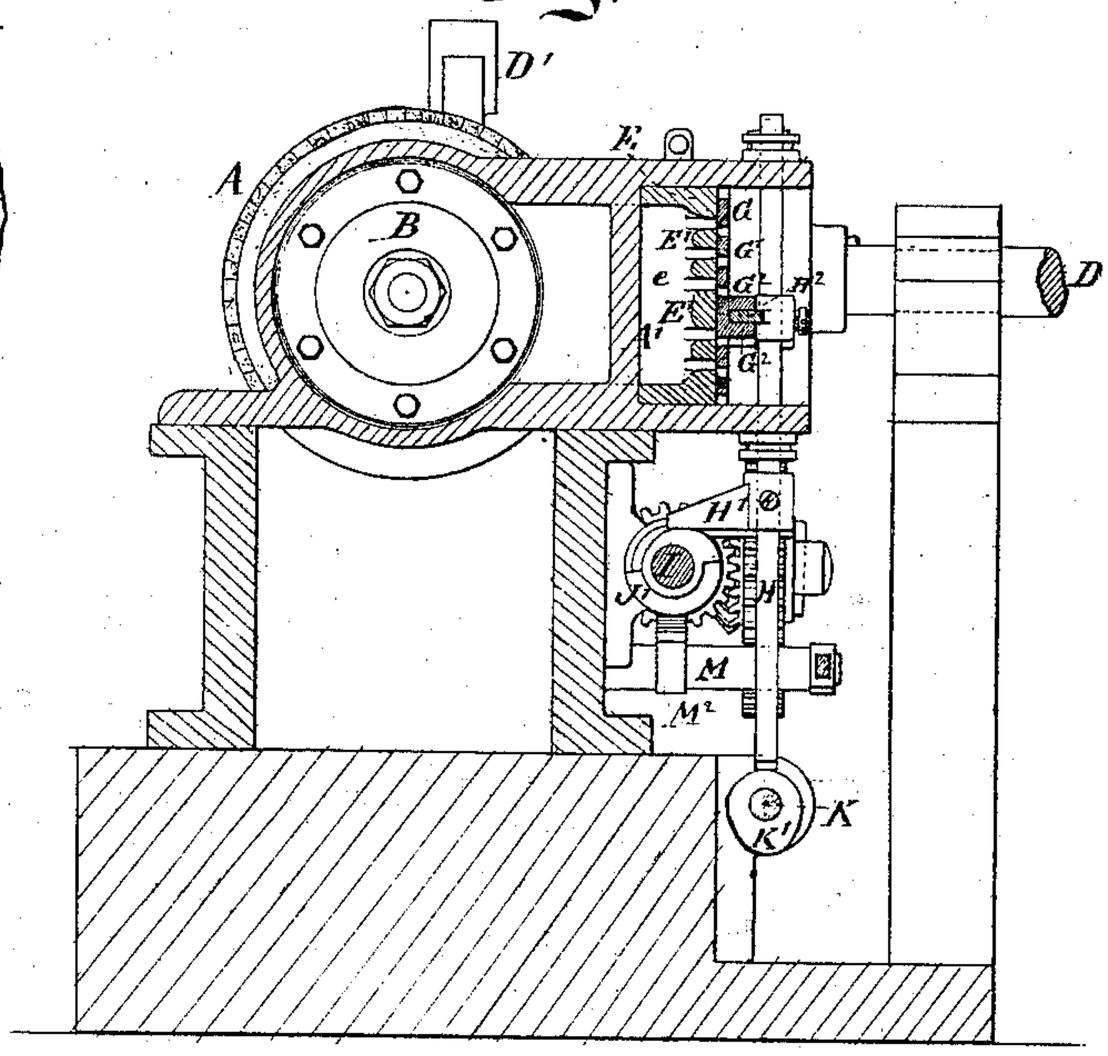


Fig. 2.



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Letters Patent No. 110,943, dated January 10, 1871.

IMPROVEMENT IN CUT-OFFS FOR STEAM-ENGINES.

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

To all whom it may concern:

Be it known that we, WILLIAM WATTS, of the firm of Watts, Campbell & Company, of Newark, New Jersey, and FREDERICK A. PHELPS, mechanical engineer and draughtsman, of the same place, have invented certain new and usefel Improvements in Cut-Offs or Valve-Motions for Steam-Engines; and we do hereby declare the following is a full and exact description thereof.

We operate by the aid of a shaft geared to the main shaft and extending out parallel to the line of travel of the piston.

The cut-off valves are slides, and are opened by a positive motion, and shut automatically.

Our invention involves important modifications in the details of the mechanism.

The operation involves no tendency to disturb the governor, which, it will be understood, controls the point of cut-off.

We will proceed to describe what we consider the best means of carrying out our invention, and designate the points which we believe to be new.

The accompanying drawing forms a part of this specification, and represents the novel parts, with so much of the ordinary parts as is necessary to show their relation thereto.

Figure 1 is a side view of the novel parts of an engine constructed according to our invention, with so much of the ordinary parts as shows the relations thereto. The crank-shaft and adjacent parts are in practice separated by a greater space from the steam-chest and cylinder.

Figure 2 is a cross-section on the line S S;

Figure 3 is a horizontal section of a portion of the main slide, and of the cut-off valve at that end in the position for exhaust; and

Figure 4 is a similar section of the same parts in the position for taking steam.

Similar letters of reference indicate like parts in all the figures.

A is a cylinder; and

A′, the cylinder-face.

It will be understood that the cylinder has two ports, *a a*, one at each end, and that by the side of each is an exhaust-port, *a′*. These being arranged in the ordinary manner, need not be particularly described, and we have drawn these ports only at one end of the cylinder. The other is the same, but, of course, in a reversed order.

B is the piston.

The piston-rod, cross-head, guides, and connecting-rod convey the force, as usual, to a crank, D′, on the main shaft D, which is provided with the usual fly-wheel, and a belt or other means, not represented, conveys away and utilizes the power.

There are two main slides, marked E, connected together and operated by an eccentric-rod leading from an eccentric on the main shaft, which may be constructed in the usual manner, and either keyed firmly or made adjustable in position by screws or the like. The slides E are of such size as always to cover both of the ports *a a′*.

An opening, *e*, allows the steam free access to the port *a* when the slide is in the proper position, and a hollow throat, *e′*, allows the exhaust-steam to escape into the port *a′* when the valve has sufficiently changed its position.

The lower end of the passage *e* is narrow, but the upper end is very greatly widened, so as to cover nearly the whole upper surface of the slide, and is cast with stout bridges or cross-gratings, E′, arranged equidistant from each other, as represented.

The cut-off valve is a correspondingly-grated plate of cast-iron, G G^1.

The bridges E′, on the main slide E, and the bridges G^1, on the cut-off valve G, are each considerably wider than the spaces which intervene between them.

It will be understood that when the grated cut-off valve G G^1 is moved into such position that its openings correspond with the openings in main slide, so that the steam can flow freely through and enter the cylinder, the cut-off valve is of no effect, and that, to make the cut-off valve effective at any period in the stroke, it is necessary simply to move it into such position that its bridges G^1 entirely cover the spaces between the bridges E′ on the main slide.

The gravity of the cut-off valve tends to move it into the shut position. The gravity of any part attached would contribute to make its movement into such position still more certain as soon as it is liberated.

On the back of each cut-off valve are two parallel bridges or projections, G^2 G^2.

These receive between them a corresponding horizontal bar, H^2, fixed on a vertical rod, H, and pass through stuffing-boxes in the steam-chest, so that that they are free to rise and sink.

Each carries a rigid toe, H^1, projecting out horizontally over the operating-shaft, I, which receives its motion from the main shaft D, and turns in exactly the same time, being connected by gear-wheels, as represented.

The operating-shaft I carries a pin or feather, *i*,

which stands in a longitudinal slot, *j*, in a sleeve, J, which is free to be moved longitudinally on said shaft, according as the governor-balls rise and sink.

M is a little rocking-shaft, having an arm, M^1, connected to the rod *m*, of a governor, not represented.

A segment, M^2, fixed on this shaft M, takes in a series of rings, *j'*, which encircle the sleeve J, and cause it to be continually in gear with the governor, while allowing it to rotate freely.

It will now be seen that any rise or fall of the governor-rod *m*, due to a change in velocity of the engine, results in moving the sleeve J, to a corresponding extent, endwise on the shaft I.

The sleeve J carries a cam, J', at each end, which operates the corresponding cut-off valve by acting on the toe H^1 of the lifter H.

The cam is peculiarly formed, and has a width nearly equal to the extreme longitudinal traverse of the sleeve J. Its lifting side is uniformly sloped, so as to lift the cut-off valve uniformly, and, by reason of the fact that this lifting side is uniform the whole breadth of the cam, its action in lifting the valve has no disturbing effect on the governor.

The high portion of the cam determines the period during which the cut-off valve shall remain open. At one end of the cam the high part is very wide; at the other end it is very narrow.

The high part of the cam tapers, so as to give in the intermediate positions all the intermediate gradations of the period during which the cut-off valve will remain open.

The lowering side of the cam is not sloped, but is an abrupt descent. It is preferable that it should be a little under-cut, so as by no possibility to allow the rapidly-descending toe H^1 to exert any disturbing influence on the cam, and, through it and its connections, on the governor.

It will be understood that the valve-chest is covered in the ordinary manner, and may be provided with removable bonnets, hand-holes, and all other facilities for obtaining access to or inspecting the work inside; but we have tested our invention for several months and have not found it necessary to give the internal mechanism any attention. We find that a small and very delicately-adjusted governor is sufficient for a large engine.

Any decrease in the speed of the engine lowers the governor-rod *m*, and moves the sleeve J, with the cams J', into such position that a wider portion of the high part of the cam becomes effective, and the toe H^1, and, consequently, the cut-off valve G G^1, is held up for a longer period. A too high speed in the engine induces a change in the reverse direction.

In either or any position the toe H^1, and, consequently, the valve G G^1, is raised by the positive action of the lifting portion of the cam J'. This may be effected at any period before the main slide has moved into such position as to uncover the port *a*. At the proper period the main slide uncovers the port and gives steam, at full pressure, to act on the piston, and the piston retreats under its influence, as usual, until, at a period earlier or later, according to the position of the governor, the high portion of the cam J' ceases to support the toe H^1, and, consequently, it and the cut-off valve thereby supported drops rapidly by gravity.

A buffer or cushion may be provided on the stem H to strike against a suitable stop and soften any concussion experienced by a too strong descent of the parts.

The horizontal arm or bar H^2 has sufficient length to afford a fair and sufficient bearing between the parts G^2, on the back of the cut-off slide, in all positions of the latter. The cut-off valve is carried, it will be observed, forward and backward with the motion of the main slide E, being guided in this respect between ridges provided for the purpose. The ridges may be planed out a little dove-tailing and made to match corresponding edges on the cut-off valve, if preferred.

Our invention involves no delicate or easily-derangeable parts. Its operation is certain, and the closing of the valve is sufficiently rapid for all ordinary purposes. Springs may be provided, if preferred, to hasten the closing of the slide-valves in very quick-working engines.

Bristol rollers or analogous devices may be employed to lessen the friction of the main slide upon the cylinder face. The same may be employed to lessen the friction of the cut-off slides upon the back of the main slides.

K is a shaft, turned by means of a hand lever, *k*, and carrying two eccentrics, K' K', which stand under the ends of the lifting-rods H H. In starting the engine from a state of rest, we turn this hand-shaft K so as to lift both the lifters H, and, consequently, the cut-off valves G G^1. In this condition the engine takes steam throughout the whole stroke, and must be regulated temporarily by the throttle-valve in the ordinary manner. When the engine has got into motion in this manner, we gradually turn the shaft K into its ordinary position, that represented in fig. 1, and allow the lifting-rods and cut-off valves to be raised and lowered at each stroke by the cams, as above described.

We provide for stopping the engine in case the connection for driving the governor is deranged or broken and the governor stopped. In such case the governor-balls descend to their lowest position. The first commencement of the descent of the balls moves the sleeve J, and, consequently, the cams J', so as to hold the cut-off valves open longer.

A further descent of the governor-balls moves the sleeve J still further in that direction, and holds the cut-off valves open still further; but an extreme descent of the governor-balls, moving the sleeve J to an extreme extent, the cams J' are so constructed and so mounted on the sleeve that in such case each cam J' is carried entirely beyond its corresponding toe H^1, and thereafter fails to lift the same at all, and the engine, getting no steam, is rapidly stopped.

Although this is a rare occurrence, it is highly important to provide conveniently and efficiently for such an exigency. We have provided for this, as above described, and also for the resumption of the functions of the governor and its connections on properly connecting the same.

So soon as the governor-balls commence to rise and to draw the sleeve J back to its usual position, the cams J', being made, one a little longer than the other, so that one presses against the corresponding toe H^1 before the other touches its toe, and the toes H^1 being held at such an elevation that it is possible for the low part of each cam to get under its toe, it follows that the low part of the most forward cam gets under its toe at the proper time, and the fact that the other cam does not yet bear against its toe allows the sleeve in this position to move with its two cams until the second and more backward cam strikes against its toe. One cam is now working, and the engine will in this position take steam to the full extent at one end of the cylinder. The next revolution allows the second and more backward cam to get under its toe at its lowest point, and now the governor is free to move the entire sleeve into its desired position, and then the engine works and regulates itself in the ordinary manner.

We claim—

1. The cams J', formed and operating as represented, in combination with cut-off valves G G^1 and their connections, so as to drop the valves without in any degree disturbing or tending to disturb the position of the governor, as herein set forth.

2. The broad lifters H^2, fixed on the lifting-rod H, and inclosed loosely between broad parallel surfaces, G^2, on the back of the slide-valves G G^1, so as to unite the lifting mechanism with the valves and provide ample bearing in all positions of the latter, substantially as and for the purposes herein specified.

3. The arrangement of the toes H^1 in relation to their respective cams J′ J′, whereby, in case the governor ceases operation, said toes drop entirely off said cam and remain unaffected thereby.

4. The construction and arrangement in relation to each of the said toes and cams, whereby the latter are enabled, when the governor resumes operation and impels the sleeve endwise, to be thrust successively under their respective toes, substantially as hereinbefore described.

5. The hand-shaft K and its cams or eccentrics K′, with suitable means for turning it, when arranged, as represented, relatively to the lifting-rods H, the cut-off valves G G^1, and connections H^2 G^2, so as to allow the cut-off valves to be held temporarily or permanently at will, independently of the cams J′ J′ and their connections, as specified.

In testimony whereof we have hereunto set our names in presence of two subscribing witnesses.

WILLIAM WATTS.
FREDERICK A. PHELPS.

Witnesses:
WM. BRADSHAW,
ELIAS W. CRAWFORD.