2 Sheets—Sheet 1.

C. B. COOK.

Combined Governor and Self-Adjusting Cut-Off.

No. 218,492. **Patented Aug. 12, 1879.**

Fig. 1.

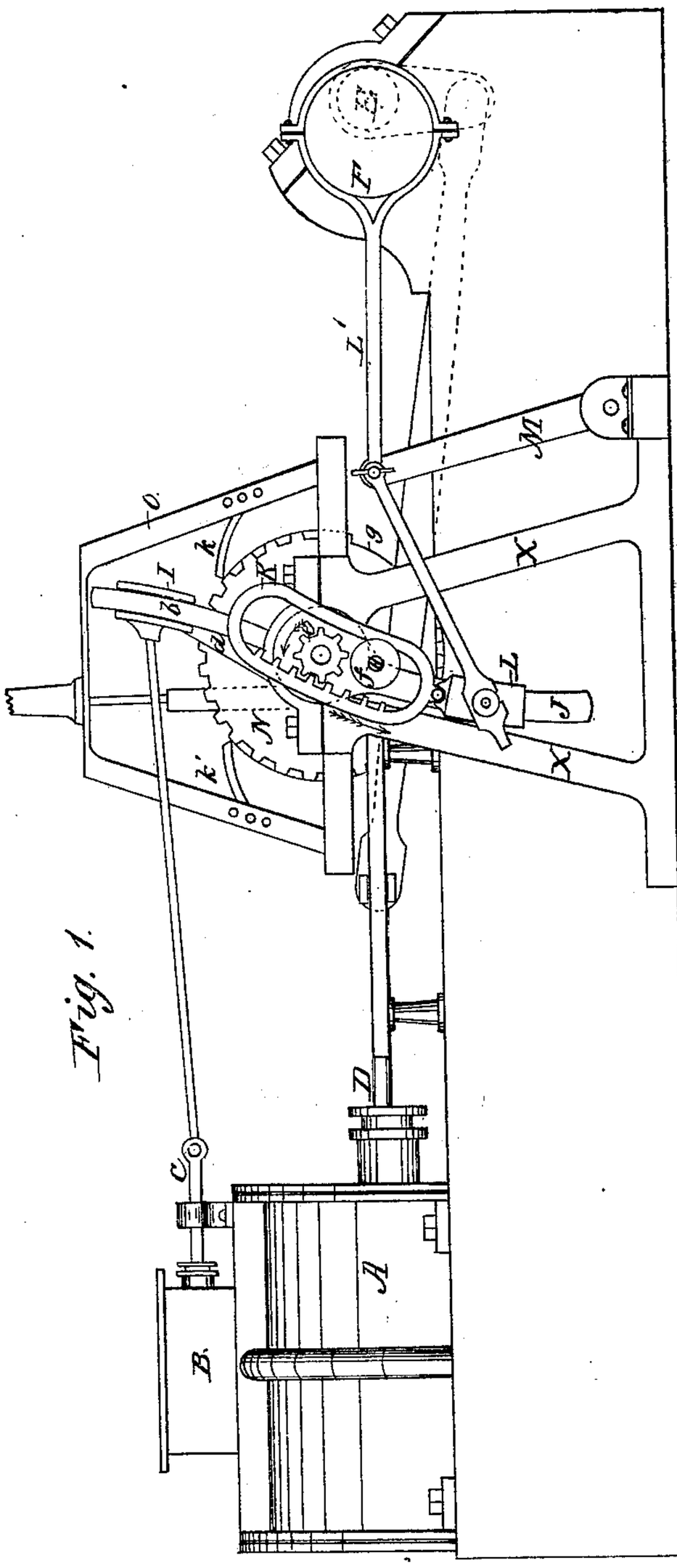
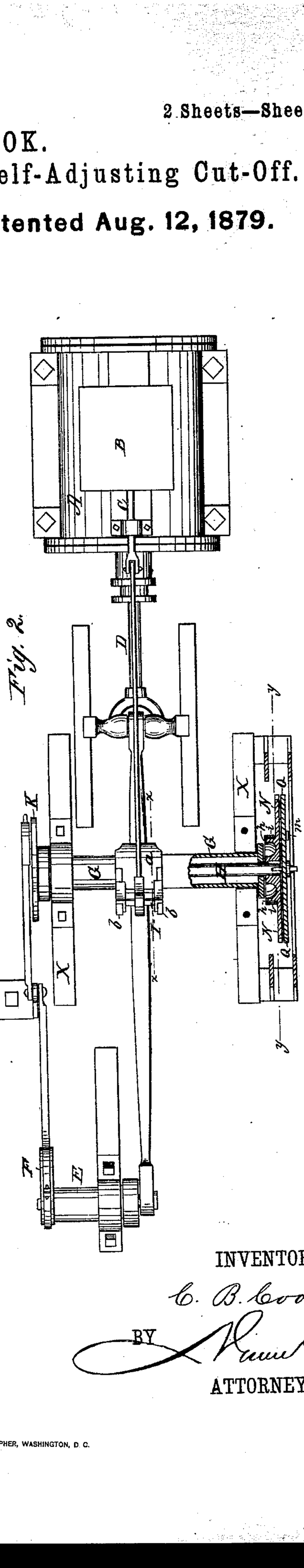


Fig. 2.



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2 Sheets—Sheet 2.

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Combined Governor and Self-Adjusting Cut-Off.

No. 218,492. Patented Aug. 12, 1879.

Fig. 1.

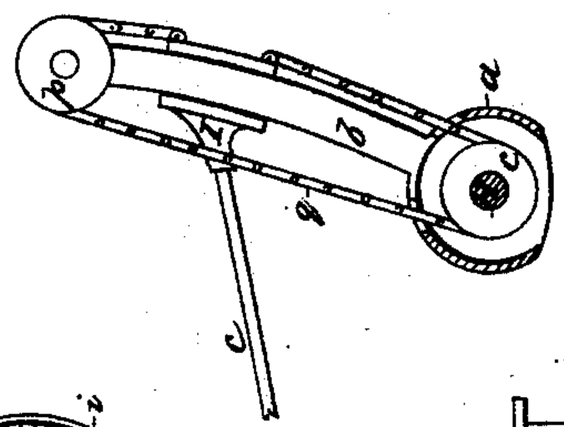

Fig. 5.

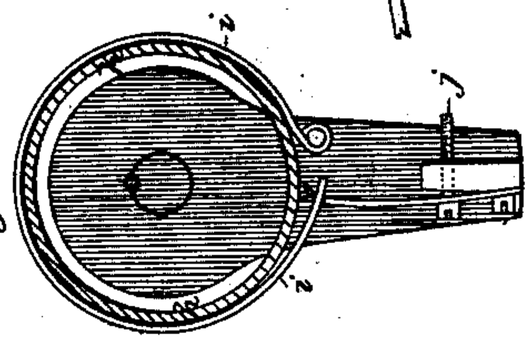

Fig. 6.

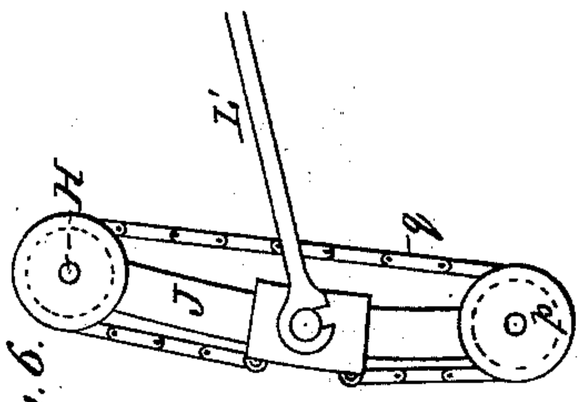

Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE.

CYRUS B. COOK, OF CYNTHIANA, KENTUCKY.

IMPROVEMENT IN COMBINED GOVERNOR AND SELF-ADJUSTING CUT-OFF.

Specification forming part of Letters Patent No. **218,492**, dated August 12, 1879; application filed June 11, 1879.

To all whom it may concern:

Be it known that I, CYRUS B. COOK, of Cynthiana, in the county of Harrison and State of Kentucky, have invented a new and Improved Combined Governor and Self-Adjusting Cut-Off; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side elevation of the whole device. Fig. 2 is a plan view of the same. Fig. 3 is a side elevation taken from the opposite sides from Fig. 1. Fig. 4 is an enlarged sectional detail through line *x x*, Fig. 2. Fig. 5 is an enlarged sectional detail through line *y y*, Fig. 2. Figs. 6 and 7 are modifications of a part of my invention.

The object of my invention is to so combine the governor and slide-valve of an engine as to cause the governor to automatically adjust the range of movement of said valve, and thus shorten or lengthen the cut-off action automatically in proportion to the requirements of the work.

To this end my invention consists in connecting the valve and the governor by a hollow rock-shaft, having a second central shaft within the same, which two shafts are coupled for independent movement, and are combined with an adjustable crank mechanism and a trip mechanism, operated directly by the governor, whereby the governor is made to set in operation the trip mechanism, and allow the engine to act through the independent shafts to alter the crank-throw of the valve-rod.

The invention also consists in the details for carrying out the several steps of the adjustment, as hereinafter fully described.

In the drawings, A represents the cylinder, B the valve-box, C the valve-rod, D the piston-rod, and E the main shaft, of an ordinary engine.

For imparting the motion of the main shaft to the valve-rod, the usual arrangement is to employ an eccentric, F, and a rod connecting the eccentric with a crank from a rock-shaft, which rock-shaft has another crank, connected with the valve-rod.

My devices take the place of this latter mechanism, and consist of the following parts: A tubular rock-shaft, G, is journaled in bearings in the frames X, and is provided in its center with a hollow enlargement or housing, *a*, opening upon its lower side; and rising from the top of the same are two curved guide-arms, *b b*, which serve the purpose of cranks, as hereinafter described. Inside of the hollow shaft G is the adjusting-shaft H, which is provided with a rigid pinion, *c*, Fig. 4, located just inside of the central housing.

I is a cross-head, jointed to the slide-rod, and arranged to slide upon the curved guide-arms *b*. This cross-head has a curved rack-bar, *d*, Fig. 4, projecting downwardly, which rack-bar passes through a hole in the top of the housing *a*, and meshes with the rigid pinion on the adjusting-shaft.

To one of the ends of the tubular rock-shaft G is rigidly fixed a pendent crank-arm, J, Fig. 1, while upon the same end of the central adjusting-shaft H is fixed another rigid pinion, *e*, projecting beyond the crank-arm of the hollow shaft.

K is a curved yoke, which incloses pinion *e*, and has upon one side inwardly-projecting teeth, which mesh with said pinion. A grooved roller, *f*, serves to guide the yoke as it moves over the pinion. Said yoke is connected at its lower end to a cross-head, L, which slides upon the curved and pendent crank-arm J, and which cross-head is coupled to the forward end of the eccentric-rod L′, which latter I prefer to make jointed in the center, with said joint controlled as to direction of movement by being connected to the upper end of a swinging standard, M. Upon the opposite end of the adjusting-shaft H from the pinion *e* is rigidly keyed a disk, N, Figs. 2 and 3, having a periphery notched throughout most of its extent, but left plain and depressed at *g*, Fig. 1. This disk has an annular and laterally-projecting flange, *h*, Figs. 2 and 5, which is encompassed by a tension-band, *i*, connected with the hollow shaft, and adjusted by screw *j*, so that the disk partakes of the motion of the hollow shaft when its motion with said shaft is not resisted; but when it is resisted by a pawl it revolves independently of the hollow shaft.

O is a frame-work, sustaining a centrifugal ball-governor, P, and carrying also two dogs or pawls, *k k′*, which are pivoted to said frame-

work, and have their free ends resting upon the periphery of the notched disk N.

Q is a second disk, placed side by side with the disk N, (see Fig. 2,) and arranged in a bearing in the frame O, so as to be free to move independently of the hollow shaft and central adjusting-shaft. This disk has at one portion of its periphery a depression, *l*, Fig. 3, and is connected by a wrist-pin and pitman, *m*, to the rising-and-falling shaft of the ball-governor, so that as the governor-balls rise and fall in proportion to the speed of the engine the disk Q is correspondingly moved upon its axis.

In the normal position of the device the depressed portion *l* of the disk Q rests between the two pawls *k k'*, and as said depr ssed portion is shorter than the distance between the pawls, the latter rest upon the edges of the higher portion of the disk Q. Now, if the speed of the engine is suddenly increased, as by the throwing out of some of the machinery, the rise of the governor-balls pulls up the pitman *m* and turns the disk Q in the direction of the arrow, and this movement allows the pawl *k* to drop into the depression *l* of the disk Q, and rest upon the notched periphery of disk N. The governor thus trips a piece of mechanism which allows the motive power of the engine itself to give a shorter adjustment to the cut-off, as follows: Pawl *k* being engaged with notched disk N, and the engine being in active motion, the oscillation of the hollow rock-shaft produces the following effect:

On the inward movement of the arms *b* of the hollow rock-shaft, the disk N and adjusting-shaft H move with said rock-shaft in direction of the dotted arrow, by reason of the unresisted frictional relation between the two, caused by the tension-band *i*. When the rock-shaft oscillates in the opposite direction, however, there is nothing to resist said backward movement of the rock-shaft, while the backward movement of the adjusting-shaft and notched disk is opposed by the pawl *k*, which engages with the teeth of the disk. The result is, that as long as the high position of the governor-balls is maintained, and the pawl *k* is allowed to rest in the depression *l*, the disk N will have a step-by-step movement in the same direction, (direction of dotted arrow,) which causes the adjusting-shaft H to revolve inside the rock-shaft, while the hollow shaft rocks. This rotation of the shaft H, acting through pinion *e* on the rack-bar *d* of the cross-head I, (see Fig. 4,) causes said cross-head and the joint of the valve-rod to approach the center of oscillation, thereby shortening the throw and quickening the cut-off action. At the same time, also, the progressive movement of the shaft H, acting through pinion *e* upon the teeth of the curved yoke K, causes the latter to travel down upon the crank-arm J of tubular shaft, and in carrying the joint of the eccentric-rod farther from the center of the rock-shaft still further reduces the throw of the valve-rod.

From this action it will be seen that the only work which the governor is required to do is to trip one of the pawls, which the centrifugal momentum of the balls can easily do, and then the engine immediately runs itself down by its own power to a utilization of just enough steam to do the diminished work which the throwing out of a part of the machinery requires.

When the balls of the governor fall to their normal position, the disk Q is rotated in a reverse direction (or in the direction of the dotted arrow) until the depression *l* is midway between the pawls, and both pawls are upon the higher edges of the disk Q, and out of contact with the notched disk. If an unusual amount of work is suddenly thrown upon the engine, the balls drop, and the disk Q is turned in the reverse direction to the full arrow, and in the direction of the dotted arrow, until pawl *k'* rests upon the notched disk A. Motion is thus given to the adjusting-shaft H reverse to that first described, and the effect is to run up the cross-head on the arms *b* and raise the yoke, so as to diminish the throw of the eccentric-crank, and increase the throw of the valve-rod crank thus admitting more steam by giving a longer stroke to the valve and longer cut-off action.

From the foregoing description it will be seen that the governor is made to automatically control the adjustment of the cut-off, making an automatic variable cut-off; and while this result is attained it will be seen that I do not depend upon the power of the governor to actually make the adjustment, but simply to trip a pawl and allow the power of the engine to make this adjustment. This overcomes a great difficulty heretofore experienced, and, by only using just the amount of steam actually required, effects a saving of at least fifteen per cent. in fuel.

In applying my invention I do not confine myself to its combination with a slide-valve, as it is obvious that it has equal value in connection with an oscillating or vibrating valve.

I do not, moreover, confine myself to the exact arrangement of parts, as they may be modified to produce the same result. Thus, for example, instead of using rack-bars for changing the throw of the cranks, I may use endless chain. In applying such chain to the arms *b b*, (see Fig. 7,) a chain-pulley, *p*, is arranged at the top of the arms *b*, and another one fixed on the shaft H, and around them is passed the chain *q*, which at some point is attached to the adjustable cross-head. A similar arrangement is shown at Fig. 6 for the crank-arm J of the eccentric-rod.

In adapting my improvements to old engines having the old form of rock-shaft, the disks N Q and connecting mechanism may be placed upon the same end of the rock-shaft

with crank-arm J, instead of being placed at opposite ends, as shown.

While the two adjustments of the crank of the valve-rod and the crank of the eccentric-rod are, by preference, used in connection with each other, it is obvious that they may be used independently of each other with good results. The effect, however, is not so sensitive and rapid as when used together.

Having thus described my invention, what I claim as new is—

1. The combination, with the governor and the slide-valve of an engine, of the hollow rock-shaft G and the central independent shaft, H, together with a variable crank mechanism for connecting said shafts with the valve, and a trip mechanism for connecting said shafts with the governor, substantially as shown, and for the purpose herein described.

2. The combination, with the rising-and-falling governor-rod, of the disk Q, having depression *l*, the pawls *k k'*, the central adjusting-shaft, H, having rigid notched disk N, the hollow rock-shaft G, connected with shaft H by a tension, and a crank mechanism made variable through the independent movement of the shafts H and G, substantially as and for the purpose described.

3. The combination, with the valve-rod, the governor, and the driving-shaft of an engine, of the cross-head I, having rack-bar, the hollow shaft G, having arms *b b*, and the shaft H, contained within the hollow shaft and carrying a pinion meshing with the rack-bar, the said shafts H and G being connected for movement in one direction, and free or independent of each other for movement in the opposite direction.

4. The combination, with the eccentric-rod, the governor, and the drive-shaft of an engine, of the cross-head L, the attached yoke K, having inwardly-projecting teeth, the shaft H, having pinion *e*, and the rock-shaft, having crank-arm J, the said shafts G and H being connected for movement in one direction, and having independent relation for motion in the opposite direction, substantially as described.

CYRUS B. COOK.

Witnesses:
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SOLON C. KEMON.