(No Model.) 2 Sheets—Sheet 1.

S. E. CRAWFORD.

VALVE GEAR.

No. 321,583. Patented July 7, 1885.

Fig. 1

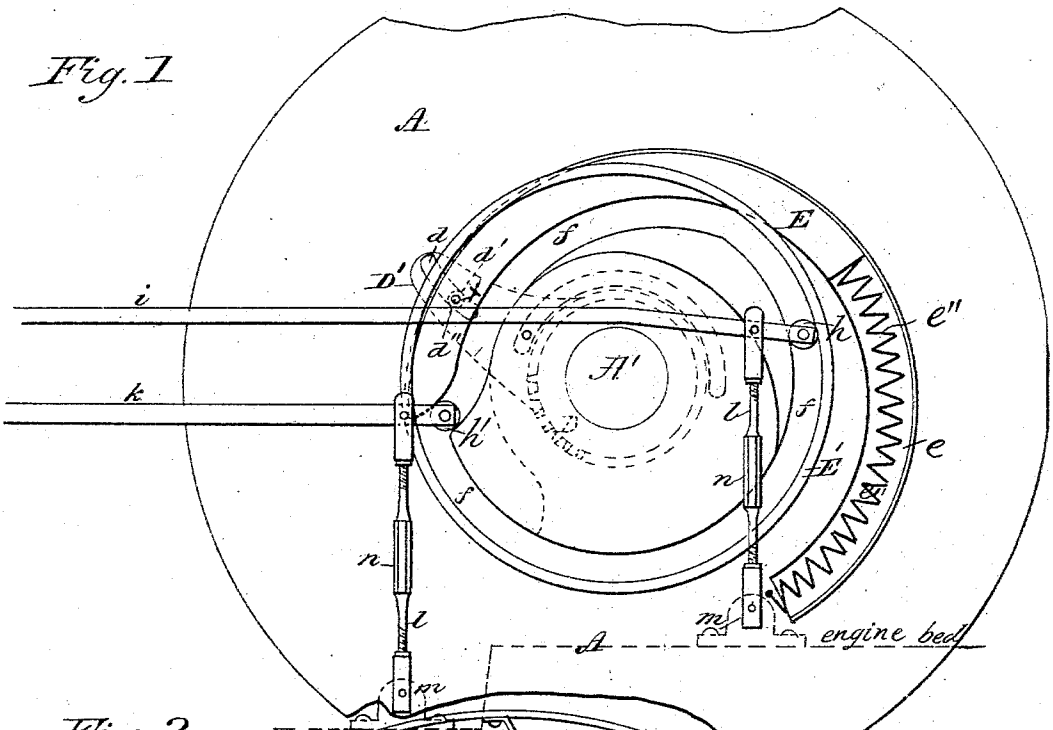
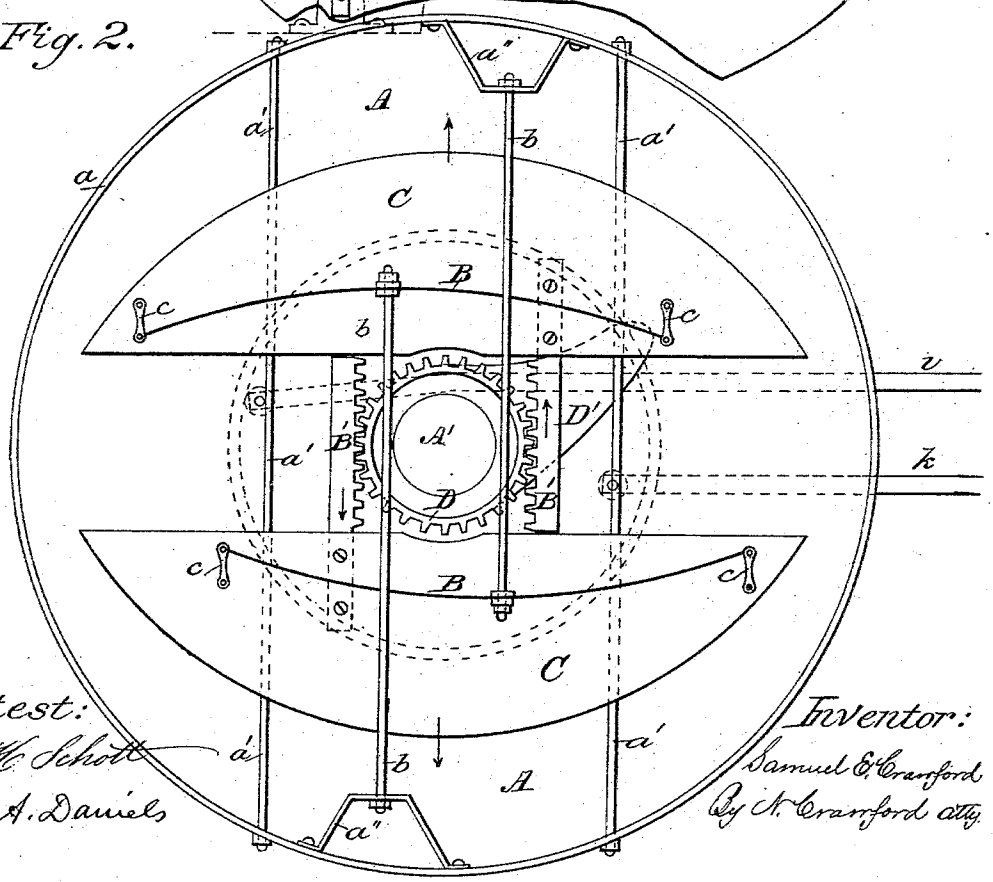


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

S. E. CRAWFORD.

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Fig. 3.

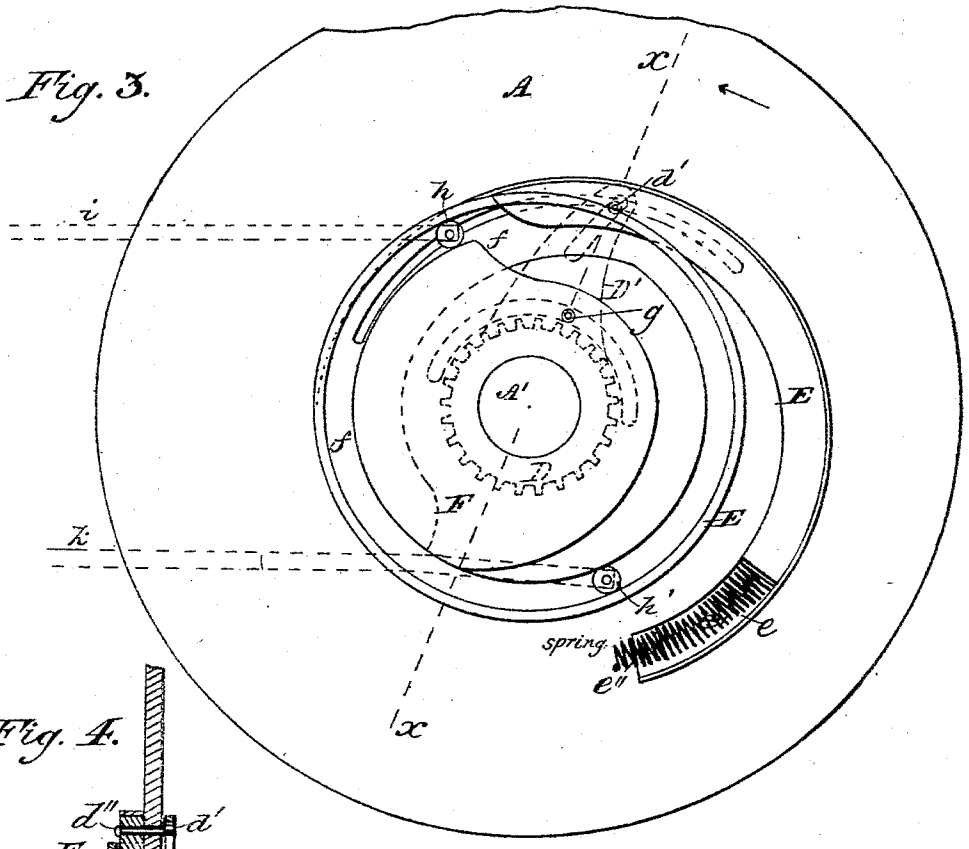


Fig. 4.

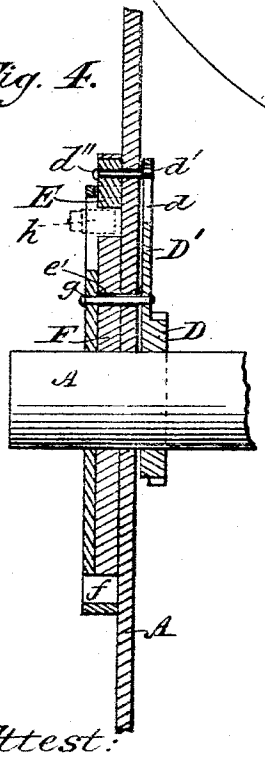


Fig. 5.

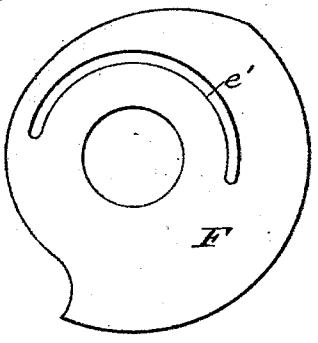
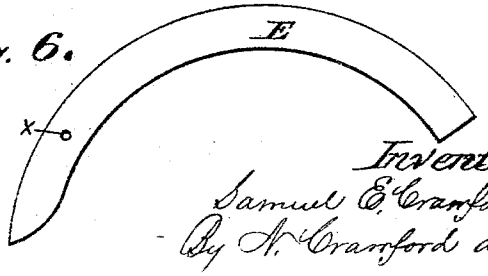


Fig. 6.



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UNITED STATES PATENT OFFICE.

SAMUEL E. CRAWFORD, OF RIPON, WISCONSIN.

VALVE-GEAR.

SPECIFICATION forming part of Letters Patent No. 321,583, dated July 7, 1885.

Application filed April 21, 1885. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL E. CRAWFORD, a citizen of the United States, residing at Ripon, in the county of Fond du Lac and State of Wisconsin, have invented certain new and useful Improvements in Valve-Gear for Steam-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to that class of cut-off-valve gear which operates automatically by the speed of the engine acting upon a centrifugal governor attached to the main engine-shaft; and the object is to produce a very sensitive, positive, and reliable valve gear that operates and at the same time regulates the opening and closing of the valves according to the increase and decrease of the speed of the engine and the load to be acted upon, thus performing such operation in an automatic manner, and that without the necessity of the attendant adjusting any of the valve-gear by hand to suit the varying speed of the engine; and it consists in the construction and arrangement of the operating parts, as will be fully hereinafter described.

In the drawings like letters indicate the same or similar parts in the several different figures, in which—

Figure 1 represents an upright one-side view of the devices that govern the cut-off valves as attached to the engine shaft or wheel; Fig. 2, a view of the devices upon the opposite side of the wheel. Fig. 3 is a side view of Fig. 1 with the parts in a changed position relatively. Fig. 4 is a cross-section on line *x x* of Fig. 3. Fig. 5 is a side view of an actuating-cam, and Fig. 6 is a side view of a segmental cam.

A represents a disk or wheel permanently secured to the crank-shaft A′, revolving with the said shaft, and having a flange, *a*, at a right angle with the body or web of the wheel and projecting from the web far enough to receive and have secured thereto the guide-rods *a′* and metal brackets *a″* upon opposite sides.

B B are springs of any suitable form; but in this instance they are plate-springs elliptical in form.

b b are parallel rods. One end of each is secured in one of the brackets *a″*, while the other end of such rod is attached centrally to a spring, B, as seen in Fig. 2.

C C are weights of any suitable form, constructed to freely slide upon the guides *a′ a′* toward or from the crank-shaft. Weights C are attached to the ends of spring B by the links *c*, that allow the weights to move from shaft A′ when the force that causes such movement is greater than the power of the spring; but when such force is withdrawn or suspended the power in the springs should be sufficient to bring the weights back toward the shaft to their normal positions.

B′ B′ are parallel-toothed racks, one end of each securely attached to a weight, C, as seen in Fig. 2, and far enough apart to receive the toothed pinion D, that is secured to the crank-shaft, and have the teeth of the pinion gear into the teeth on the racks.

Pinion D has an arm, D′, extending radially a distance from its periphery, and toward its outer end is a curved slot, *d*, in which is a friction-roller, *d′*, that is secured around bolt *d″*, which roller moves backward and forward in the variation of the movement of the engine. The bolt *d″* passes through the web of wheel A, and has a segment, E, that forms a movable cam by means of said bolt *d″* passing through the segment at *x* and on the opposite side of the web of wheel A. This segmental cam moves in and out as the speed of the engine varies, and in its outward movement is carried into the passage or way *e* against the spring *e″* and outward from the concentric circle E′. The inner edge of said segment E forms part of the cam-groove *f*.

F is a cam, secured by a bolt, *g*, that passes through the web of wheel A and through the arm D′ of pinion D, and in connection with the circle or ring E′ and segment E, the cam-groove *f*, in which groove the rollers *h* and *h′* on the valve-stems *i* and *k* travel and open and close the valves as the speed of the wheel A or the engine varies, being connected to the valve-stems that actuate the valves. A curved slot, *e′*, in cam F serves as a guideway to bolt *g* as the pinion with its arm D′ moves in one or in the opposite direction.

To change or adjust the point of contact of the cam and rolls on the valve-stems *i* and *k* and adjust or limit them in their movements, two

links or rods, *l* and *m*, are attached to the valve-stems, Fig. 1, and pivoted at their opposite ends to the engine-bed or to some other fixed part, and are made adjustable by the use of turn-buckles *n n*, having right and left hand screws, in the usual way of such adjustments.

The exhaust-valves may be operated by any known cam or eccentric, and as there should be always a free or open exhaust of the steam to prevent back-pressure, they are arranged to permit the exhaust-steam to escape freely and quickly. The friction-rollers that are attached to the valve-stems that operate the cut-off valves work in groove *f*, and as the motion of the engine increases the weights are forced apart, or when the motion decreases the springs will overcome the centrifugal force, that the greater speed of the wheel induced and force the weights back toward the center, for in this movement the segment and cam form a perfect circle, and the valves are then stationary. The opening of the valves also commences at the same point, and will not be opened to their full extent, which is not necessary, as the piston travels slowly in the beginning, and increases in speed until it reaches the quarter-stroke, when the largest opening of the port is required to supply the engine with steam at full pressure, which will then be maintained as long as the ports are open, and as the motion decreases the weights drawn toward the center will cause the movement of the segment and cam back to their normal positions.

Those skilled in the art will readily see and understand the advantages of the above-described construction as to its utility over what is in common use, and especially is it adapted to be of use in reciprocating-engines running at high rates of speed; that it is positive in its action as well as automatic; that there is no unnecessary movement or travel of the valves, and that the expansive force of the steam can be utilized when the engine is not overloaded.

I am aware that valve-gear for cut-off, regulated by a governor directly secured to the crank-shaft of an engine, and having centrifugal weights, with springs, racks, and pinion, is not new, and I do not claim for such devices, broadly. I am also aware that valve-gear for cut-offs actuated by cams secured to the crank-shaft of the engine, with weights, springs, pinion, and movable racks, has also been used, and I do not claim for such device, broadly; but

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

1. The combination, in a governor-valve gear, of the movable segment-cam E, pinion D, having the radially-extending arm D′, and its curved slot *d* therein, with the bolt *d″*, friction-roller *d′*, wheel A, and engine-shaft A′, substantially as described.

2. The centrifugal weights C C, racks B′, springs B, and pinion D, having arm D′, in combination with the segmental cam E, constructed and operating substantially as described.

3. The centrifugal weights C C, racks B′, springs B, pinion D, having the slotted arm D′ and segmental cam E, moving in the circle E′, in combination with the cam F, having slot *e′*, as described.

4. The valve-stems *i* and *k*, having the friction-rollers *h* and *h′*, traveling in groove *f*, in combination with the links *l* and *m*, having turn-buckles *n n* thereon, substantially as described.

5. The combination, in a governor-valve gear, of the wheel A, secured to shaft A′, having upon one of its sides the toothed pinion D, its slotted arm D′, racks B′, springs B, weights C, guide-rods *a′*, and rods *b*, with the segment-cam E, cam F, groove *f*, valve-stems *i* and *k*, and their friction-rollers *h h′*, arranged and operating upon the other, substantially as and for the purposes described.

In testimony whereof I affix my signature in presence of two witnesses.

SAMUEL E. CRAWFORD.

Witnesses:
J. P. STONE,
G. F. HORNER.