(No Model.)

J. H. EICKERSHOFF.

CUT-OFF DEVICE FOR ENGINES.

No. 339,282. Patented Apr. 6, 1886.

Fig. 7.

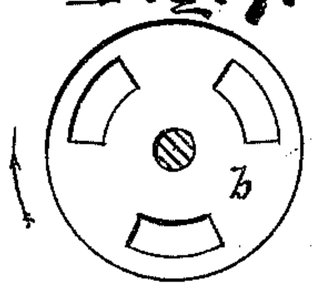


Fig. 8.

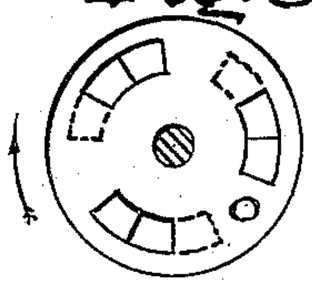


Fig. 1.

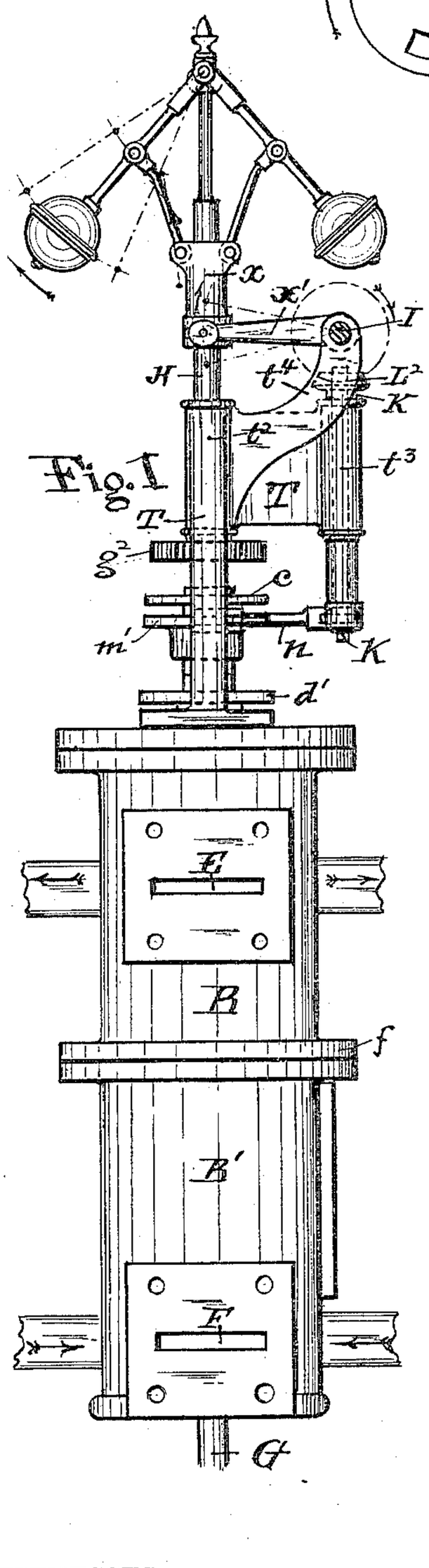


Fig. 3.

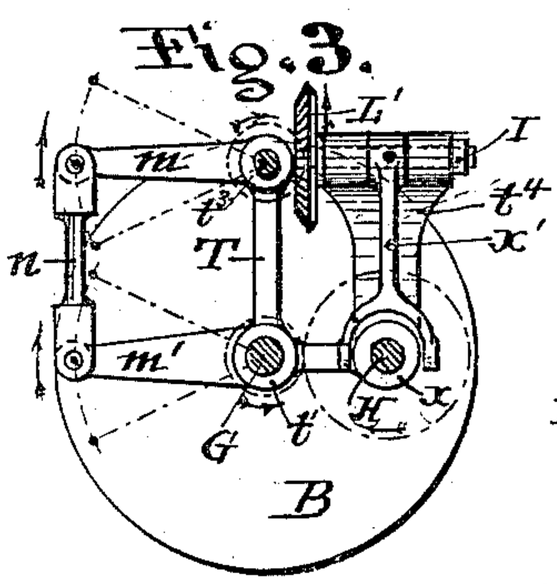


Fig. 4.

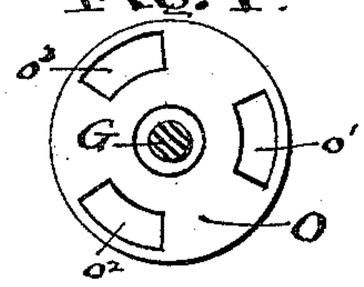


Fig. 5.

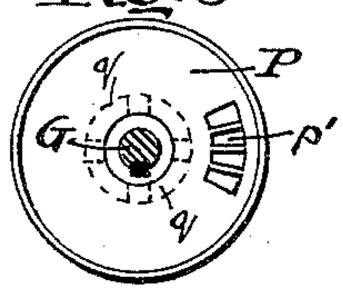


Fig. 6.

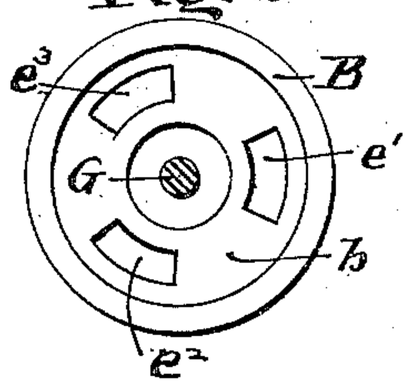
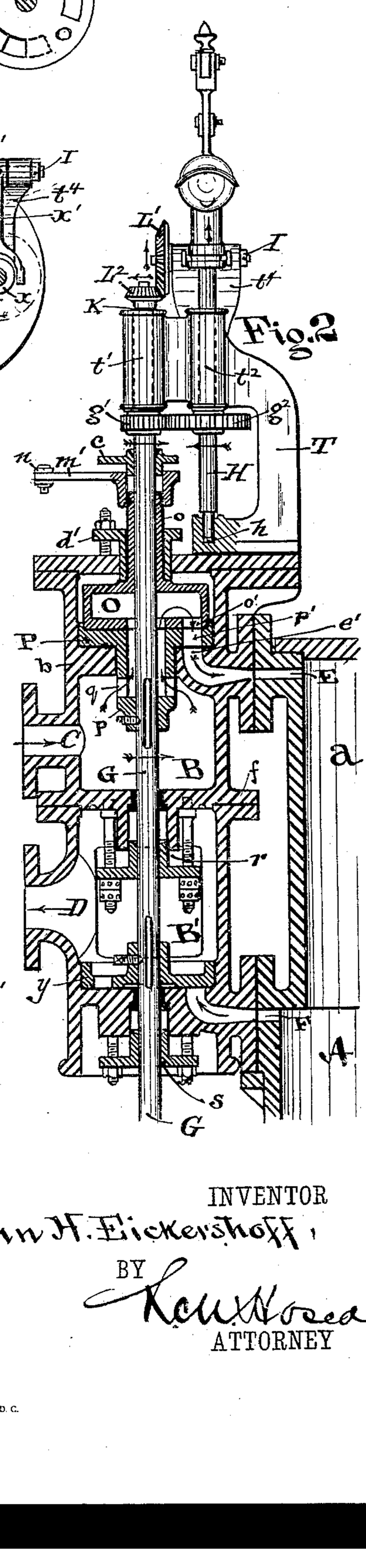


Fig. 2.



WITNESSES:

C. D. Kew

D. D. M. Woodmansee

INVENTOR

John H. Eickershoff,

BY

Kew & Wood

ATTORNEY

UNITED STATES PATENT OFFICE.

JOHN H. EICKERSHOFF, OF CINCINNATI, OHIO.

CUT-OFF DEVICE FOR ENGINES.

SPECIFICATION forming part of Letters Patent No. 339,282, dated April 6, 1886.

Application filed November 14, 1885. Serial No. 182,862. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. EICKERSHOFF, a citizen of the United States, residing at Cincinnati, Ohio, have invented new and useful Improvements in Automatic Cut-Off Devices for Steam-Engines, of which the following is a specification.

My invention relates to automatic cut-off devices for steam-engines, its object being to produce a simple and efficient means for controlling the point of cut-off in the action of the induction-valve, whereby the steam may be worked expansively in the cylinder and thereby economized, and the desired speed-rotation maintained by automatically adjusting such point of cut-off to the varying resistance to be overcome by the engine in its ordinary service.

In the present illustration of my invention I have exhibited it as applied to the rotary disk-valve of a three-cylinder compound engine, fully described in other pending applications; but the principles of its construction may be varied mechanically to adapt it to other forms of engines, whereby all its beneficial results may be realized. In my present application, therefore, I do not confine myself to the precise form of mechanism in detail in which my invention is exhibited as embodied, this form being selected for illustrative purposes, merely, as fully showing its nature and principles; but it is more conveniently applicable to a valve held upon and rotated or oscillated by its valve-rod—as for example, in engines of the Corliss type, or that exhibited in the drawings.

With this explanation my invention may be said to consist, first, in combining with a plate or disk valve an adjustable hollow covering-valve, constituting at the same time, first, a balancing-plate to relieve the induction-valve of steam-pressure otherwise operating to force it against its seat, and, second, a steam-supplying chamber and valve to regulate the admission of steam to the induction-valve independently of the movement of the latter upon its proper seat.

It consists, also, in the constructive mechanism by which the indicated functions are realized and the adjustment of the cut-off valve effected through the medium of the engine-governor, and in certain other details more fully hereinafter pointed out.

In the drawings, accompanying and forming part of this specification, Figure 1 is a vertical front elevation of the valve-chest detached, with the governor and external connections in position; Fig. 2, a vertical axial section of the same, taken through the axial cross-plane of the intermediate cylinder; Fig. 3, a detail plan view of the governor and connecting-lever system; Fig. 4, a plan view of the under side or face of the cut-off valve; Fig. 5, a plan view of the corresponding upper face of the induction-valve; Fig. 6, an upper plan view of the induction-valve seat, and Figs. 7 and 8 diagram views showing the cut-off valve-ports in different positions relative to the ports of the induction-valve seat.

The parts hereinafter referred to are designated on the drawings by the letters of reference.

Referring, now, to the drawings, A *a* designate one of the working-cylinders, which, in the present illustration, is formed in two different diameters in the same axial line, and provided with a correspondingly-formed piston, the upper or smaller portion, *a*, of the cylinder being utilized for the steam at high pressure as directly admitted from the boiler, and the lower or larger portion, A, being utilized for steam entering expansively from the part *a* after partially completing the piston-stroke.

The engine here illustrated being single-acting, the steam is admitted to the cylinder *a* only at one port, E.

B designates the valve-chest, substantially cylindrical in form, and bolted vertically to the cylinder A *a*, its lower portion being the seat-chamber for the exhaust-valve Y, governing the exhaust-port F, (the sole exhaust-port of the cylinder A *a*,) opening from the enlarged portion A of the working-cylinder.

Constructively the upper and lower portions of the valve-chamber B are preferably made as distinct parts, to be bolted together, as will be more fully hereinafter set forth.

P designates the induction-valve, which is substantially a disk having a downward-projecting hollow hub, *p*, which extends through and below the valve-seat. The valve P is keyed to its stem G at the lower extremity of

the hub *p*, which latter, by means of its internal annular enlargement around the stem and suitable openings, *q*, near the bottom of the hub forms a conduit for the live steam entering the chamber B below the partition *b*, constituting the valve-seat, extending through the valve to its upper face.

O designates the cut-off valve. It is in form a shallow cylindrical box with an axial stem or hub, *o*, projecting at the upper side, perforated for the passage and free rotation of the valve-stem G. The under surface of the box-valve O is centrally perforated to correspond with the central hub-perforation of the induction-valve, upon which it seats concentrically, and is also provided with segmental perforations o' o^2 o^3, corresponding in form and relative concentric position with the single opening p' of the induction-valve, or, more properly, with the three openings *e* of the induction-valve seat. The latter, it will be understood, connect, respectively, by suitable ports, E, with the cylinders *a*, for the entrance of steam to the several pistons.

In Fig. 2 the seat-port e', an induction-valve port, p', and the cut-off valve port o' are shown as registering—that is, in a common radial plane—and it may now be explained that the steam, entering by the supply-pipe C into the steam-chest B, passes into the hollow cut-off valve O by the central hub-channel, around the valve-stem G, and thence by the registering ports through the passage E into the cylinder *a*, and that a similar passage will be opened to the other cylinders as the induction-valve in rotating registers successively with the other seat-ports and the corresponding induction-valve ports. The cut-off valve, as will be seen, is thus practically a steam-chest in relation to the induction-valve, and by its form and relation to the steam-pressure, the excess of pressure upon it is upward and tends to lift it away from the induction-valve, while at the same time the tendency of pressure beneath the induction-valve is to lift it also from its seat. Thus the weight of these parts, as a cause of friction, is eliminated, and the combined upward pressure is resisted by the following construction: The stem *o* projects upward through the steam-chest cover inclosing the valve-stem, being itself inclosed by a gland, d', forming (if found necessary on account of any leakage) also a stuffing-box. The gland d' is simply a vertical collar with a horizontal flange at the top, by which it is bolted adjustably to the steam-chest cover. By turning down the bolts the collar is also forced downward, its lower edge bearing against the top of the cut-off valve O close around its stem *o*. This gives a small contact-surface within a limited circle, and reduces friction to the minimum. By the careful adjustment of the bolts the perfect bearing of the valve against its seat and of the cut-off valve against the induction-valve may be had with the least possible friction, requiring but little power to operate the induction-valve and rendering the cut-off valve sensitive to a slight adjusting-force. The upper end of the stem *o* is provided with a horizontal crank-arm, m', and is also provided with a stuffing-box, *c*, surrounding the valve-rod G.

The radial adjustment of the cut-off valve is effected through the crank-arm m' by the following mechanism: To the upper cover of the steam-chest B is secured a vertical frame, T, furnishing, first, a vertical socket-bearing, t', for the upper end of the valve-rod G; second, a vertical guide-bearing, t^2, for the governor-shaft H; third, a vertical guide and support-bearing, t^3, for a counter-shaft, K; and, fourth, a horizontal bearing, t^4, for a short rock-shaft, I, all arranged as presently described. The governor-shaft H is seated in a foot-socket, *h*, in its frame, and extends upward through its guide-bearing t^2, carrying the usual centrifugal ball devices above, and receiving motion by spur-gears g' g^2 from the valve-rod G. The elevating-collar *x* of the governor is connected by a lever, x', with the rock-shaft I, journaled horizontally in the rear extension, t^4, of the frame T. The rock-shaft I by bevel-gears L′ L^2, or equivalent means, transmits its partial rotation to a vertical counter-shaft, K, held in the extension t^3 of the frame T, and to the lower end of the shaft K is attached a crank-arm, *m*, connected by a link, *n*, with the end of the arm m', already described. Thus the rotative effect of the governor is transmitted to the cut-off valve, and determines its radial position. The object of this determination of radial position will be more clearly understood when the relative construction of the valve P and its seat in respect to their ports is taken into consideration. The induction-valve seat *b* has its three ports, e' e^2 e^3, of equal size and form, arranged equidistantly from each other and from the axial center of the seat. The induction-valve P has but one port, p', (shown in the drawings, Fig. 5, as crossed by radial bridges, whose office will be presently explained,) and it will be understood that when the valve is upon its seat all the ports *e* are closed, except when the port p' registers with one of them, and that this can occur only successively as the valve rotates. Now, the upper face of the valve, P, being an exact counterpart of its lower face (so far as ports are concerned) and playing against the under face of the cut-off valve O, which face is a counterpart of the valve-seat *b*, (as to ports.) It also acts as an induction-valve as to permitting steam to pass out of the chamber formed within the cut-off valve O, so that by adjusting the cut-off valve O backward (in relation to the rotative direction of the valve travel) the passage of steam outward from the steam-chamber of the cut-off valve O will be cut off sooner than the passage from the valve P into the seat-ports, and this of course by proper adjustment of the parts (as for example, the length of the link *n*) may be varied to suit the demands of use.

It will now be obvious that the cut-off-valve

ports may be set back relatively to the valve-seat ports to any point of cut-off desired; but, in case of an extremely early cut-off, the open ports of the intervening induction-valve might open a passage from the succeeding cut-off port to the preceding valve-port, on account of the overlapping of ports where, as in the present case, three or more cylinders are operated by the same induction-valve, leaving only a limited bridge-space between successive ports of the series. To prevent this, I extend across the port p' a number of radial bridges, Fig. 5, whose upper and lower surfaces are flush with the general face of the valve, by which such passage of steam is prevented, as will be obvious without detailed description.

I have already indicated the preferred construction of the valve-chamber B as being in two parts, bolted together at an intervening horizontal partition. To describe these parts more accurately, the upper portion, B, is a cylindrical casting open at the top for a removable cover, and closed at the bottom, the bottom being extended marginally into a flange, *f*, for bolting on the lower part, B′. Centrally through the bottom passes the valve-rod G, through an ordinary stuffing-box, *r*, secured upon the lower side of the bottom. The upper portion, B, of the chest contains only the induction-valve P and cut-off valve O, and receives live steam from the boiler by a side passage, C. The lower portion, B′, of the valve-chest is also cast open at the top and closed at the bottom, the bottom in this case being formed with three radial ports for the escape of steam through the single port of the valve *y* to the exhaust-pipe D. The parts B and B′ are ground-jointed and bolted together at their meeting surfaces, and a suitable external stuffing-box, *s*, is provided below for the valve-rod G. Suitable man-holes with removable covers may be provided for the parts B′, for access to the valve and the stuffing-box *r*.

I omit a detailed reference to the other constructive parts of the engine as unnecessary to the clear exposition of my present invention. The valve-rod, however, is driven by gearing from the main shaft, and suitable steam-passages are provided, connecting the ports of the induction and exhaust valve-seats with the cylinders, respectively.

It will be obvious that a two-ported valve-seat connected with the opposite ends of an ordinary double-acting cylinder, with only the obvious changes in the other parts required thereby, could be employed with the same advantage; or, that a single-ported valve-seat, with like changes in the other parts, could be employed—as, for example, in Corliss engines—with like results for each end of the cylinder, and both cut-off valves be operated by the same governor. Such adaptations require only obvious mechanical changes quite within the range of the mechanical skill of a competent constructive engineer.

It will also be obvious that the valve O, by a slight constructive modification, could be made to receive steam from above instead of below, and the central steam-orifice through the induction-valve be thereby rendered unnecessary.

All these and similar constructive modifications not affecting the essential principle of operation I conceive to be within the spirit of my invention.

I claim as my invention and desire to secure by Letters Patent of the United States—

1. In a steam-engine, the combination of a circular seat with one or more concentric radial ports, a hollow adjustable cut-off valve, into and through which the live steam passes, having a face with ports corresponding with the valve-seat, and an interposed disk or plate, rotary induction-valve having an aperture corresponding with one of the seat-ports, substantially as and for the purpose set forth.

2. The combination of the steam-chest B, valve-seat *b*, valve-rod G, induction-valve P, cut-off valve O, having the hollow stem *o*, and the adjusting-collar *d*, substantially as set forth.

3. The combination of the steam-chest B, valve-seat P, with enlarged central perforation, valve-rod G, valve P, with down-projecting hollow stem *p*, cut-off valve O, with lower central orifice and vertical hollow stem, *o*, adjustable bearing-collar *d′*, and actuating-arm *m′*, substantially as set forth.

4. In combination with the steam-chest, valve-rod, induction-valve, and cut-off valve, the supporting-frame T, the independent governor-shaft and governor H, driving-gears g' g^2, and interposed connecting mechanism for transmitting the vertical movement of the collar *x* of the governor to the adjusting-arm *m′* of the cut-off valve, substantially as set forth.

5. The combination of the frame T, with extensions t' t^2 t^3 t^4, the governor-shaft H and its collar *x*, the arm *x′* and its rock-shaft I, gears L′ L^2, shaft K, arm *m*, connecting-rod *n*, and arm *m′* of the cut-off valve, substantially as set forth.

6. The combination of the separable steam-chest in two parts, B B′, with the valves O *y*, valve-rod G, and stuffing-boxes *r s*, constructed and arranged as set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JOHN H. EICKERSHOFF.

Witnesses:

L. M. HOSEA,

C. D. KERR.