(No Model.) 3 Sheets—Sheet 1.

W. A. HARRIS.

CUT-OFF FOR STEAM ENGINES.

No. 469,696. Patented Mar. 1, 1892.

Fig: 1.

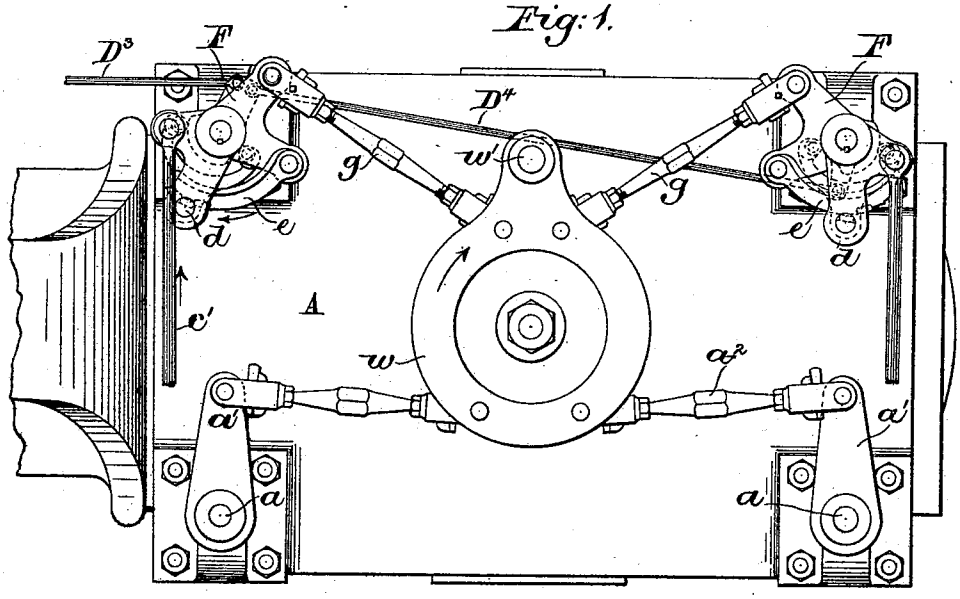


Fig: 9.

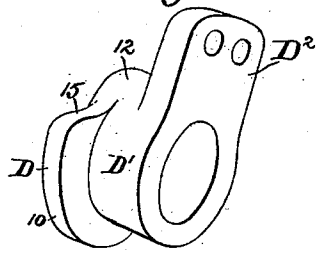


Fig: 6.

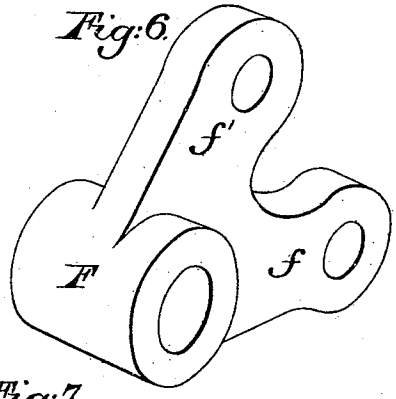


Fig: 8.

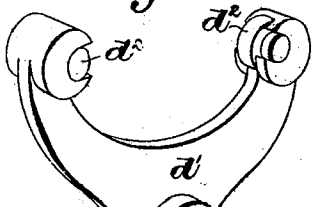
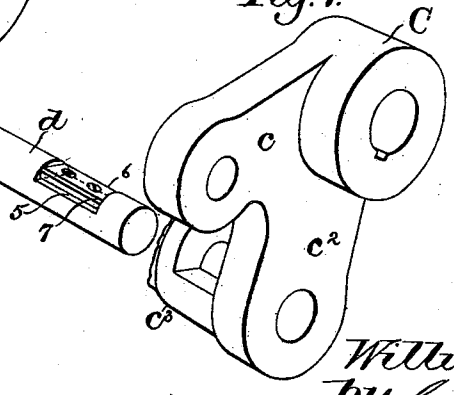


Fig: 7.



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(No Model.) 3 Sheets—Sheet 2.

W. A. HARRIS.

CUT-OFF FOR STEAM ENGINES.

No. 469,696. Patented Mar. 1, 1892.

Fig: 3.

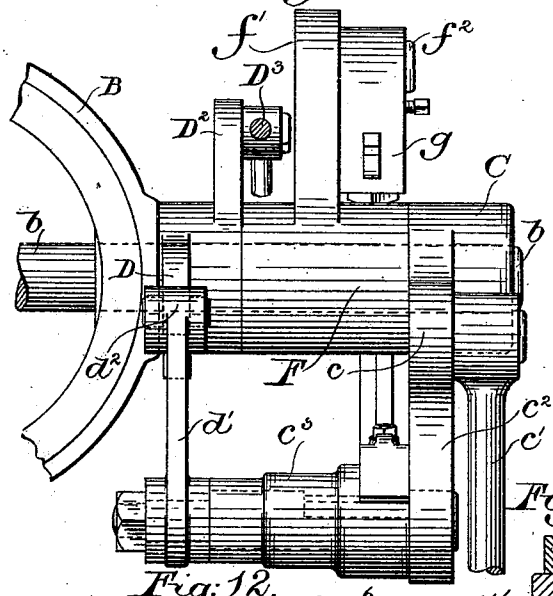


Fig: 2.

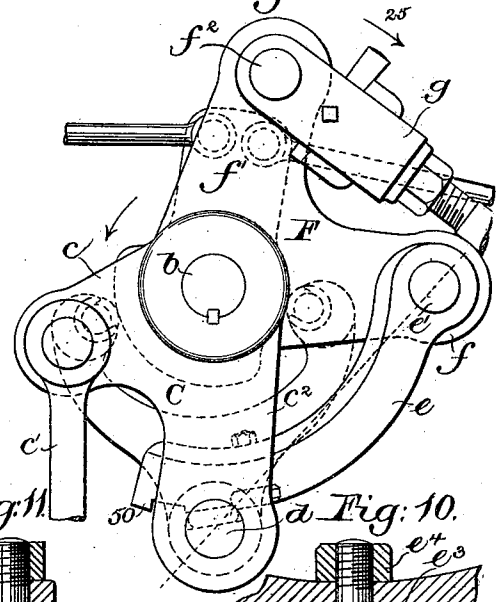


Fig: 11.

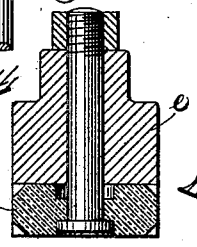


Fig: 10.

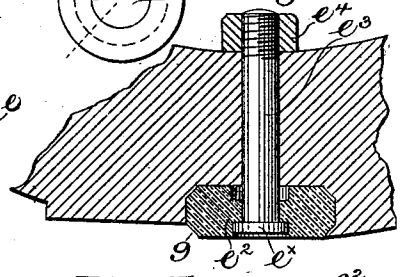


Fig: 12.

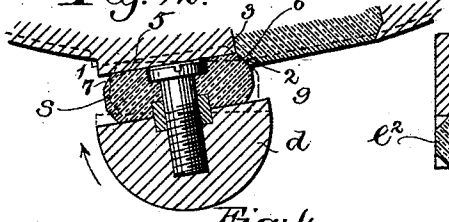


Fig: 4.

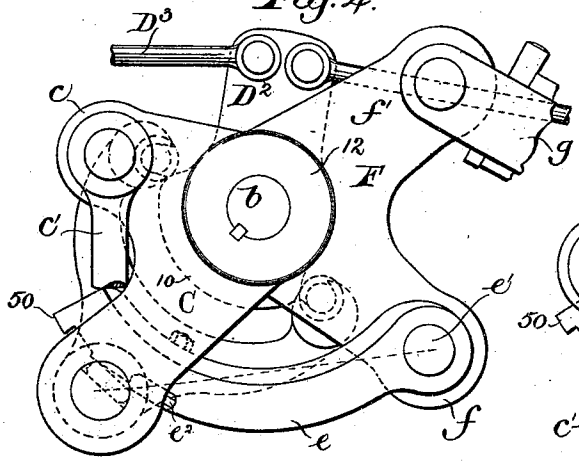
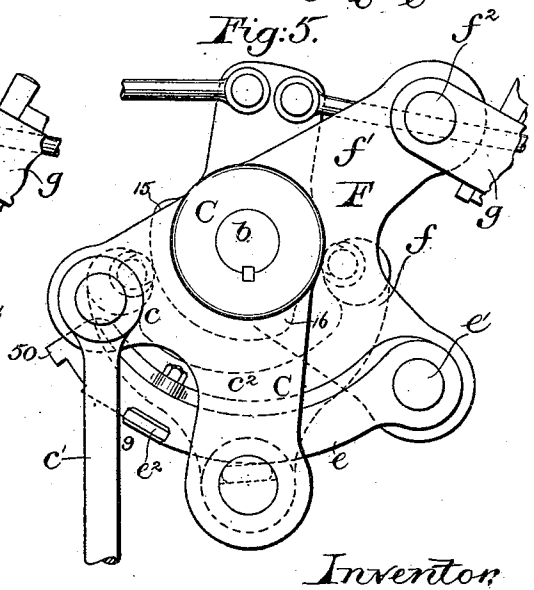


Fig: 5.



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(No Model.) 3 Sheets—Sheet 3.

W. A. HARRIS.

CUT-OFF FOR STEAM ENGINES.

No. 469,696. Patented Mar. 1, 1892.

Fig: 13.

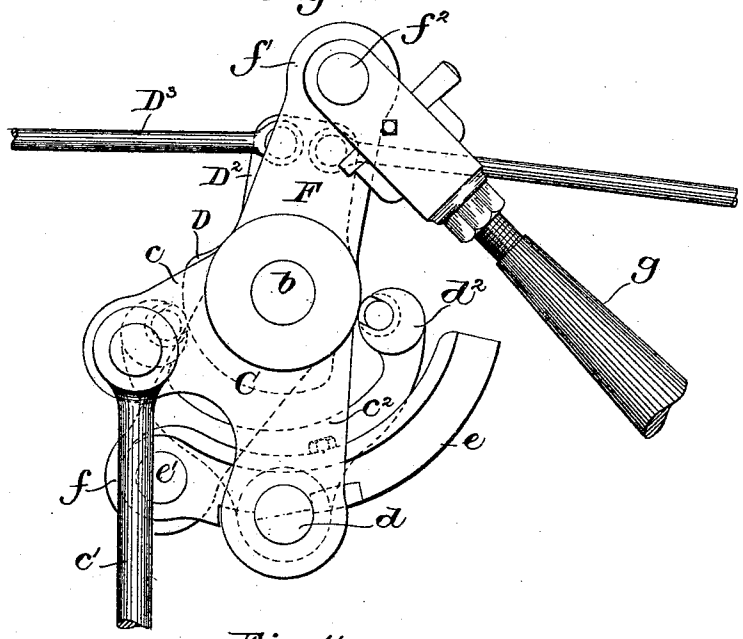
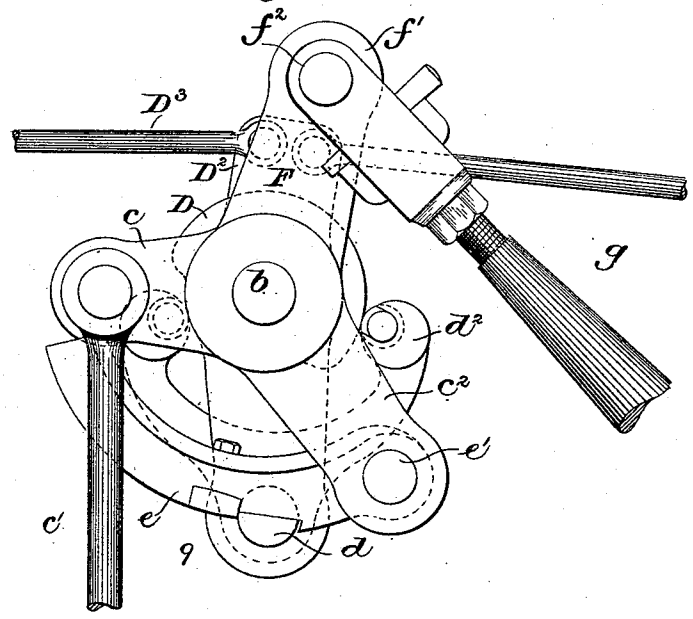


Fig: 14.



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UNITED STATES PATENT OFFICE.

WILLIAM A. HARRIS, OF PROVIDENCE, RHODE ISLAND.

CUT-OFF FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 469,696, dated March 1, 1892.

Application filed April 16, 1891. Serial No. 389,128. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. HARRIS, of Providence, county of Providence, State of Rhode Island, have invented an Improvement in Automatic Cut-Offs for Steam-Engines, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention relates to automatic cut-off valve-gears of what are commonly known as the "Corliss" type of steam-engines; and it has for its object to improve such valve-gears, whereby a quicker and closer regulation of the cut-off may be effected, and, further, to effect a more uniform movement of the various parts.

In accordance with this invention the valve-stem is moved by an actuating-arm, the same being actuated by means of a suitable connection from an operating-lever, the said connection in effect engaging the actuating-arm with its operating-lever. A pivoted tripping device is provided, which when moved acts at both sides of its pivotal center or fulcrum to operate on the said connection, to thereby disengage the actuating-arm from its operating-lever and permit the former to resume its normal or closed position for the purpose of cutting off the steam, as will be hereinafter described. The movement of the tripping device in the present instance is effected by means of the cam and its yoke, to be hereinafter referred to as forming another branch of my present invention.

One part of this invention therefore consists in an automatic valve-gear, an actuating-arm for the valve-stem, an operating-lever for the said actuating-arm, and an engaging connection between said members having engaging surfaces, combined with a tripping mechanism for said connection, which in operation moves the said surfaces in opposite directions to sever or disengage the actuating-arm from its operating-lever, substantially as will be described.

Another part of my invention consists in an automatic cut-off, the combination, with a cam, of a yoke adapted to act at opposite sides upon said cam and to be moved thereby, and a tripping mechanism controlled by said yoke, substantially as will be described.

The other features of this invention will be hereinafter described, and fully pointed out in the claims.

Figure 1 represents in side elevation a sufficient portion of a steam-engine provided with my improved valve-gear to enable my invention to be understood. Fig. 2, on an enlarged scale, shows the cut-off mechanism for one of the valves; Fig. 3, a left-hand elevation of the same. Figs. 4 and 5 show the cut-off mechanism in different positions. Figs. 6, 7, 8, and 9 show some of the parts detached; Figs. 10 and 11, partial vertical, longitudinal, and cross sections of the connection or dog; Fig. 12, a diagram to be referred to; Figs. 13 and 14, modifications to be described.

Referring to the drawings, A represents the cylinder of an engine, which cylinder is provided at its opposite ends with the usual steam and exhaust valves arranged and constructed in a manner common to engines of the four-valve or Corliss type, the valve-stems a of the exhaust-valves being provided with arms a', actuated by links a^2 from the usual wrist-plate w, pivoted to the center of the cylinder-casting and taking its motion in usual manner from an eccentric placed on the crank-shaft (not shown) and having its eccentric-rod connected to the wrist-pin w'.

Referring to Figs. 2 and 3, the valve-stem b of each steam-valve, mounted in a suitable support or bonnet B, has keyed or otherwise made fast to its outer end, as herein represented, the bell-crank valve-actuating lever C, one arm c of which has jointed to it the usual drop-rod c', carrying at its lower end a weighted piston moving in a vacuum-chamber or dash-pot. (Not shown.) The other arm c^2 of the said lever in the present embodiment of my invention carries the tripping mechanism. The particular form of tripping mechanism which is herein shown and which I prefer to employ comprises a trip-shaft d, journaled in a hub c^3 on the outer end of the arm c^2 of the actuating-lever C, the said shaft d presenting a preferably flat face 5 and an engaging shoulder 6, adapted to be engaged by a shoulder 9 on a dog or connection e, pivoted at e' to an arm f of a preferably bell-crank operating-lever F, journaled on a suitable bearing or hub formed, as represented, on the bonnet B. (See Fig. 3.) The hub c^3 is

milled or cut away at its upper side (see Figs. 3 and 7) for the dog or connection *e*, to permit the said dog to engage the trip-shaft *d*. The arm *f'* of the operating-lever F is provided with a stud or pin f^2, to which is jointed one end of the usual actuating-link *g*, jointed at its opposite end to the wrist-plate *w*, (see Fig. 1,) the said wrist-plate when rocked transmitting a corresponding movement to the lever F, causing the shoulder 9 on the dog or connection *e* to engage the shoulder 6 on the trip-shaft *d* and turn or rock the lever C and valve-stem *b* to admit steam to that end of the cylinder. To disengage the trip-shaft *d* from the dog or connection *e* before the latter has completed its forward movement and thus cut off the admission of steam to the cylinder at some point early in the stroke, the said trip-shaft has fast to its inner end a forked arm or yoke *d'*, having rolls d^2 journaled in its ends, which act at opposite sides upon the surface cam D, herein shown as forming a part of the sleeve D', journaled on a bearing or hub on the bonnet B and provided with an arm D^2, to which is connected a controlling-rod D^3, moved by any desired governing mechanism. (Not shown.)

The cam D, as herein shown, comprises two idle or concentric surfaces 10 12, one of the rolls d^2 normally bearing against one of the concentric surfaces and the other roll d^2 bearing against the other concentric surface; but when the trip-shaft *d* and the actuating-arm C are moved by the dog or connection *e* about the axis of the valve-stem *b* the yoke will also be moved about the cam D, the rolls d^2 running upon the concentric surfaces until they reach the working surfaces 15 16, which surfaces will act upon the rolls to turn or rotate the yoke about its axis, rotating the trip-shaft *d* sufficiently to disengage its shoulder 6 from the shoulder 9 on the dog or connection *e* and permit the drop-rod *c'* to immediately return the arm C and its valve-stem *b* to their normal closed position, Figs. 2 and 5, to cut off the steam from that end of the cylinder.

The shoulder 6 on the trip-shaft *d* is herein represented as formed by a hardened steel or other block *s*, fitted in a suitable recess milled in the shaft, the said block being held in position by bolts or screws *s'*. The block *s* is preferably made double the length of the engaging surfaces to permit the block to be turned end for end, in order that both ends may be utilized. The block is also counterbored at its opposite sides to permit it to be turned, in order that both edges of each face may be utilized for the shoulder 6.

The shoulder 9 on the dog or connection *e* is herein represented as formed by a hardened steel block e^2, fitted in a suitable groove milled in the dog and held in place by a bolt e^3 and nut e^4. The block e^2 is preferably counterbored at its opposite sides to receive the head $e^\times$ of the bolt e^3, thus permitting the block to be turned or reversed to utilize both edges of all its faces for the shoulder 9 as one or another of them becomes worn, each of the said faces being properly shaped, as shown, for this purpose.

Assuming the parts to be in the position shown in Fig. 2, the operation of my improved valve-gear is as follows: As the piston in the cylinder approaches the inner or left-hand end of the cylinder, Fig. 1, the wrist-plate will be moved to the right, as indicated by the arrow thereon, and, acting through the link *g*, will turn or rock the operating-lever F in the direction of arrow 25, Fig. 2, causing shoulder 9 on the dog or connection *e* to engage the shoulder 6 on the trip-shaft *d* and push the same and its actuating-arm C before it, rotating the valve-stem, as shown at the left in Fig. 1, to admit steam to that end of the cylinder and lift the drop-rod *c'*. As the actuating-arm and valve are rotated, the yoke *d'* will be moved about the cam D until its rolls d^2 reach the working surfaces 15 16 thereon, when the said yoke will be turned or rotated about its axis into the position shown in Fig. 4, thereby rotating the trip-shaft *d* sufficiently to disengage its shoulder 6 from the shoulder 9 on the dog, as shown in said figure, and permit the drop-rod *c'* to return the actuating-arm C and its valve quickly to their normal or closed position, as shown in Fig. 5, to cut off the steam from that end of the cylinder, the lever F and its dog or connection *e* continuing to the end of their movement, the dog riding over the surface 5 of the trip-shaft. As the steam-arm C and its valve are returned to their normal positions, Figs. 2 and 5, the yoke is moved back about the cam D to its former normal position, turning the trip-shaft *d* into position again for its shoulder 6 to be again engaged by the shoulder 9 on the dog or connection *e* when the latter is drawn back by the return movement of the lever F to its first position, Fig. 2, ready for the beginning of a new stroke of the piston. As the speed of the engine varies, the governor will operate through the rod D^3 to rotate the cam D about its bearing, so that the rolls d^2 on the yoke *d'* will reach the working surfaces of the cam earlier or later in the stroke, and thus give to the engine an earlier or later cut-off.

In automatic cut-offs of this class as heretofore constructed, so far as I am aware, there has been provided a stationary member and a hooking member to co-operate therewith, the operation of unhooking having been performed entirely by movement of the hooking member alone. It therefore follows that the time consumed in unhooking is the length of time required for the moving of this hooking member from the other or stationary member, whereas in this my present invention the trip-shaft is so moved as to cause it on one side of its fulcrum to be moved away from the hooking member and partly unhook the parts, while at the same time another portion of said trip-shaft on the opposite side of its axis or fulcrum acts upon the hooking member to

cause it to be moved away from and out of engagement with said trip-shaft, the resultant of the two movements being equivalent to the heretofore single movement of the hooking member of the other and prior contrivances, whereby in the present instance I am enabled to disengage the parts in less time than formerly. For instance, by reference to Fig. 12, when the rolls in the yoke reach the working surfaces of the cam the shaft *d* will be rotated in the direction of the arrow from its full-line position to its dotted-line position 1 2, the heel 7 of the face 5 acting at the same time against the under side of the dog or connection *e*, lifting the same into its dotted-line position 1 3 to assist in disengaging the shoulder 6 from the shoulder 9 on the dog. It is necessary, therefore, to rotate the shaft *d* a distance substantially equal to one half only of the depth of the engaging shoulder 9 on the dog, for the reason that the heel 7 of the face 5 moves or lifts the dog itself the other half or the remaining distance, and as both the trip-shaft and dog are moved at the same time in opposite directions it requires only one-half the time for the operation of tripping as has heretofore been required where one member only was made movable, and not only is the time required for hooking and unhooking greatly reduced, but the work thrown upon the governor is further greatly reduced by reason of the increased leverage gained by reason of the difference between the radial length of the yoke *d'* and the radial distance from the shoulder 6 and heel 7 to the center of the shaft *d*, and further by the difference between the radial distance of the shoulder 6 and heel 7 from the center of the shaft *d* and the length of the dog or connection *e*, so that a very slight thrust exerted upon the cam is sufficient to easily and quickly unhook or trip the connection *e* and shaft *d*.

By employing the yoke *d'*, acting at opposite sides of the cam D, I am enabled to use the well-known form of surface cam and dispense with the spring heretofore employed and at the same time get a positive and certain movement of the parts in both directions, while at the same time, not being put to the necessity of employing expensive groove-cams, and by reason of the arms of the yoke acting at opposite sides of the said surface-cam, the movement of one arm of the yoke equalizes or counterbalances the movement and strain of the other arm of the yoke, thus obtaining a more even and uniform motion and taking undue strain from the governor.

The point at which the actuating force is applied, the point of suspension of the dog or connection *e*, and the point of contact of the shoulder 9 on said dog are preferably equidistant from the center of rotation of the valve-stem *b*, as shown, the forces thus acting in the same arc and avoiding lateral strain and uneven movements. The curve given to the dog or connection *e* will preferably be such that the dog will be supported in a substantially fixed position with relation to its center of rotation as it is drawn back over the trip-shaft.

The yoke *d'*, being carried by the valve-actuating arm, is returned to its normal position immediately after performing its function—viz., the tripping of the dog or connection *e*—thus bringing the parts to a state of rest as soon as their work is completed.

If for any reason the drop-rod *c'* should fail to return the actuating-arm and its valve to their normal closed positions when properly released, they will be positively returned upon the return movement of the dog or connection *e* by a hook 50 on the end thereof, as shown.

The valve-actuating mechanisms for the steam-valves are precisely alike in construction and operation, except they are reversed and operate in opposite directions, and for this reason the arms D^2, controlling the cams D for the steam-valves, are placed at the opposite sides of their pivotal centers, they being connected by a rod D^4 (see Fig. 1) to operate or move in unison.

Fig. 13 shows a modified form of contrivance embodying my invention, wherein the operating-lever F carries the connection *e* in such manner that it acts like a hook to pull or draw the actuating-arm C after it in its movement rather than to push it before it, as in Figs. 1 to 12, inclusive, the tripping mechanism being, however, the same in both instances.

Fig. 14 shows another modification embodying my invention, wherein the connection *e* is carried by the actuating-arm C and the trip-shaft and the yoke *d'* are carried by the operating-lever F. In this instance the trip-shaft moves continuously with the operating-lever independent of the movement of the valve-actuating arm, the cam being slightly changed in form, as shown, to give the proper release to the tripping mechanism.

This invention is not limited to the particular arrangement and construction shown, as it is evident the same may be varied and still come within the scope of the invention.

I claim—

1. In an automatic valve-gear, an actuating-arm for the valve-stem, an operating-lever for the said actuating-arm, and an engaging connection between said members having engaging surfaces, combined with a tripping mechanism for said connection, which in operation moves the said surfaces in opposite directions to sever or disengage the actuating-arm from its operating-lever, substantially as described.

2. In an automatic valve-gear, an actuating-arm for the valve-stem, an operating-lever for the said actuating-arm, and an engaging connection between said members having engaging surfaces, combined with a tripping mechanism for said connection, which in operation moves the said surfaces in opposite directions to sever or disengage the actuating-arm from its operating-lever, the combined

movement of the said engaging surfaces in opposite directions being equivalent to the bite or hold of said engaging surfaces when in engagement, substantially as described.

3. An actuating-arm for the valve-stem, and an operating-lever therefor, and an intermediate connection joining said members, combined with a tripping device, the movement of which at both sides of its fulcrum is utilized to disengage said members, substantially as described.

4. An automatic valve-gear containing the following instrumentalities, viz: a valve-stem, an actuating-arm therefor, a trip-shaft journaled in the said actuating-arm and means to rotate the same in said actuating-arm, an operating-lever, and a connection carried by said lever to move said actuating-arm to operate substantially as described.

5. An automatic cut-off valve-gear containing the following instrumentalities, viz: a valve-stem, an actuating-arm therefor, a trip-shaft journaled in the said actuating-arm, a cam and means controlled thereby to rotate said trip-shaft in its journal-bearing, an operating-lever, and a connection carried by said operating-lever to move the said actuating-arm, substantially as described.

6. An automatic cut-off valve-gear containing the following instrumentalities, viz: an actuating-arm for the valve-stem, an operating-lever, and a connection between said members to move the former by the latter, and a tripping device movable with and carried by the said actuating-arm to disengage said members, substantially as described.

7. In an automatic cut-off, the combination, with a cam, of a yoke adapted to act at opposite sides upon said cam and to be moved thereby, and a tripping mechanism controlled by said yoke, substantially as described.

8. In an automatic valve-gear, a valve-stem, an actuating-arm therefor, a trip-shaft *d*, journaled in said arm, a cam, and a yoke *d'*, acting at opposite sides thereon, combined with an operating-lever, means to move the same, and a dog carried thereby to engage said trip-shaft, to operate substantially as described.

9. In an automatic valve-gear, a valve-stem, an actuating-arm therefor, a trip-shaft *d*, journaled in said arm and formed to present a substantially flat face 5, a shoulder 6 and heel 7, the yoke *d'*, and a cam to move the same, combined with an operating-lever, means to move it, and a dog *e*, carried thereby and presenting a shoulder 9, to operate substantially as described.

10. In an automatic valve-gear, a valve-stem, an actuating-arm therefor, a trip-shaft *d*, journaled in said arm and formed to present a substantially flat face 5, a shoulder 6 and heel 7, the arm *d'*, and a cam to move the same, combined with an operating-lever, means to move it, a dog *e*, carried thereby, and the block e^2, counterbored at its opposite sides, to operate substantially as described.

11. In an automatic valve-gear, a valve-stem, an actuating-arm C therefor, the drop-rod *c'*, shaft *d*, arm *d'*, and cam D, combined with the operating-lever F, means to move the same, and the dog *e*, all to operate substantially as described.

12. In an automatic valve-gear, a valve-stem, an actuating-arm therefor, a trip-shaft *d*, journaled in said arm and formed to present a substantially flat face 5, a shoulder 6 and heel 7, the yoke *d'*, and a cam to move the same, combined with an operating-lever, means to move it, and a dog *e*, carried thereby and presenting a shoulder 9 and hook 50, all to operate substantially as described.

13. In an automatic valve-gear, a valve-stem and actuating-arm therefor, an operating-lever, and a connection between the said actuating-arm and operating-lever, combined with the trip-shaft *d*, means to rotate it in its bearing, and the block *s*, to operate substantially as described.

14. An actuating-arm for the valve-stem and an operating-lever therefor, combined with a curved dog or connection joining said members and a tripping device therefor, the curve of the said dog or connection being such as to support it during operation in a substantially fixed position with relation to its center of rotation, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM A. HARRIS.

Witnesses:
BERNICE J. NOYES,
EDWARD F. ALLEN.