(No Model.) 2 Sheets—Sheet 1.

M. L. HARRIS.

VALVE ACTUATING DEVICE.

No. 415,671. Patented Nov. 19, 1889.

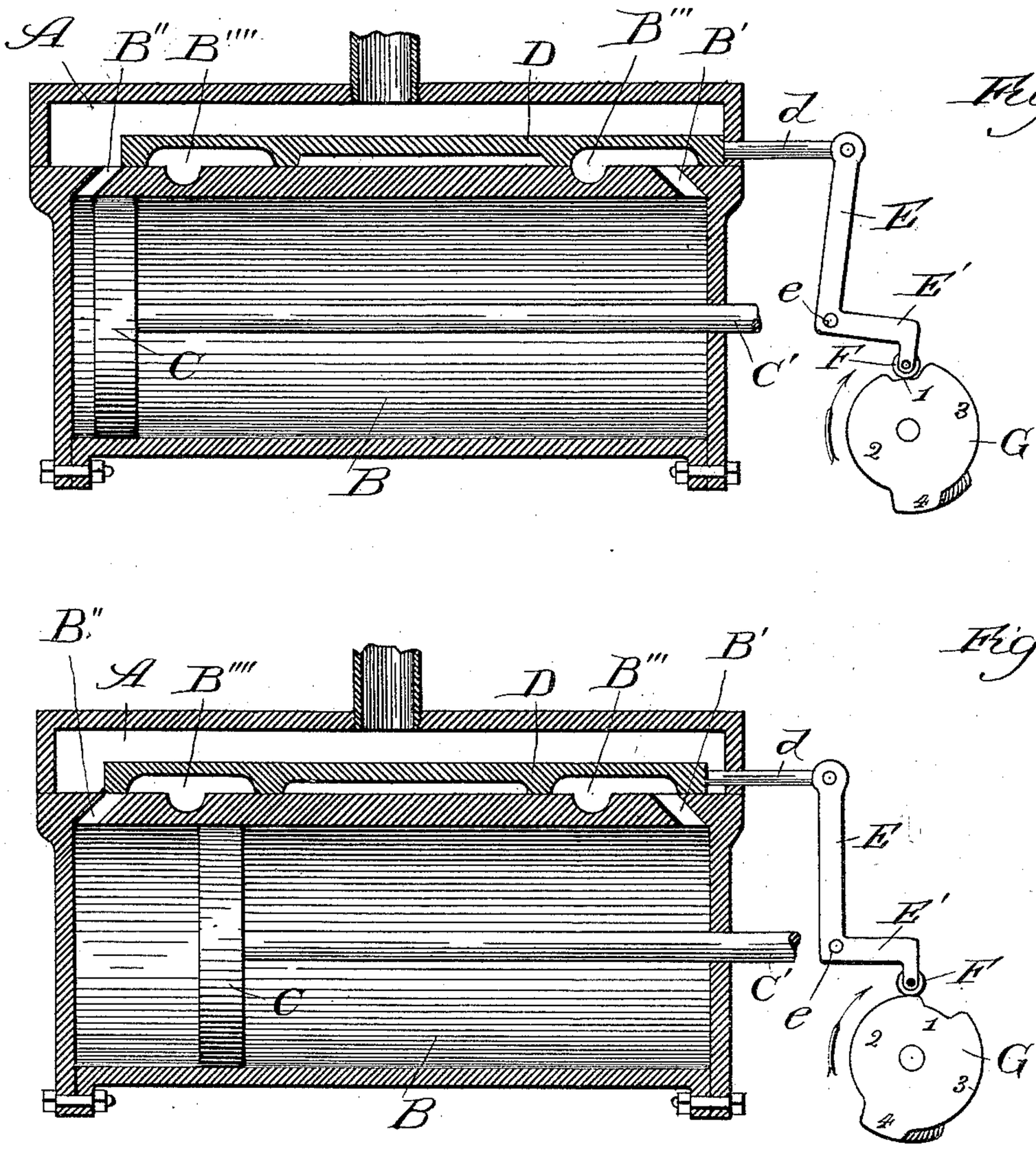

Fig. 1.

Fig. 2.

Fig. 4.

Witnesses:
Chas. E. Gaylord.
Clifford N. White.

Inventor:
Malcolm L. Harris,
By Charles J. Brown,
Atty.

(No Model.) 2 Sheets—Sheet 2.

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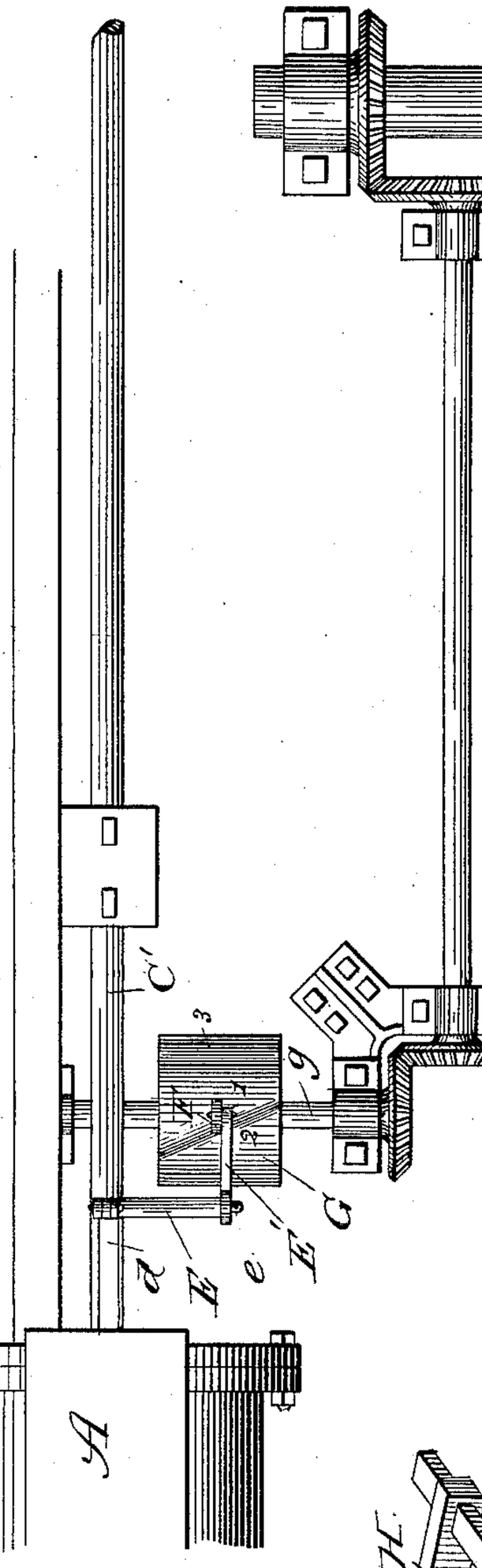

Fig. 3.

Fig. 6.

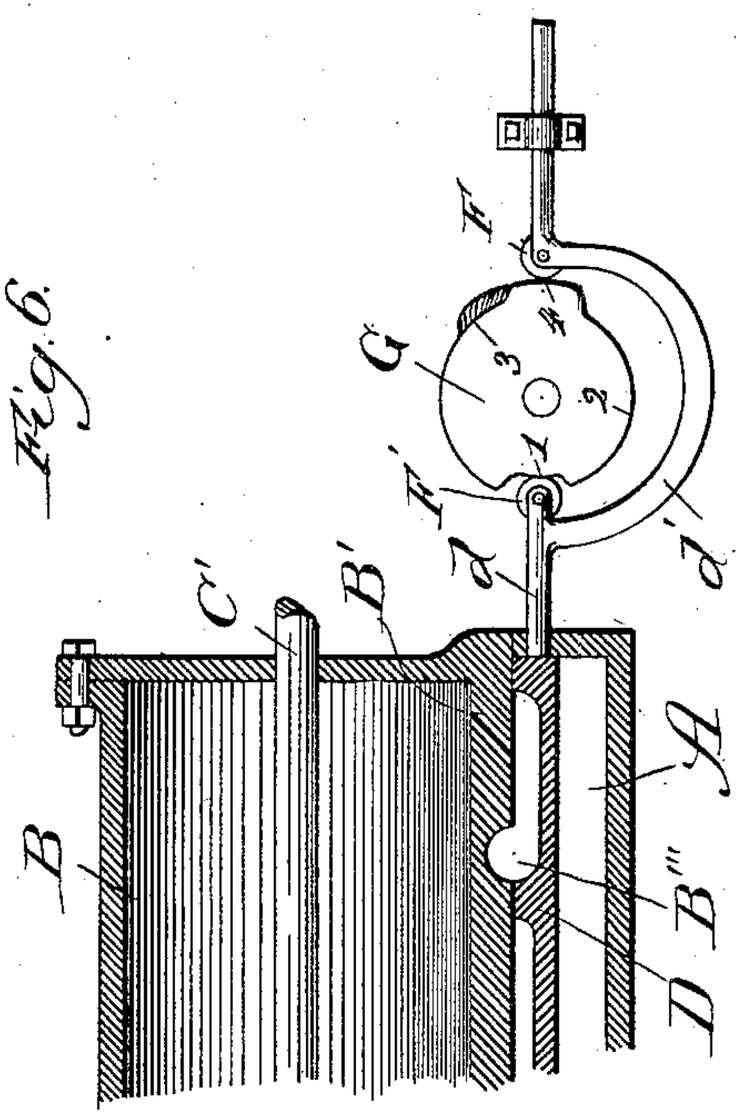

Fig. 4.

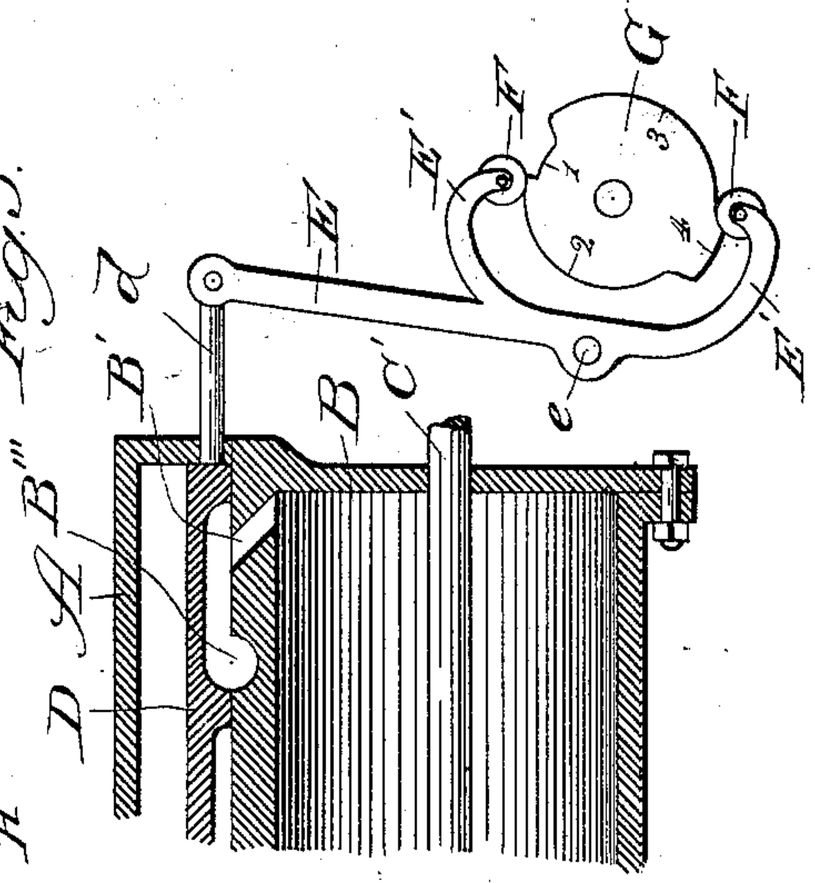

Fig. 5.

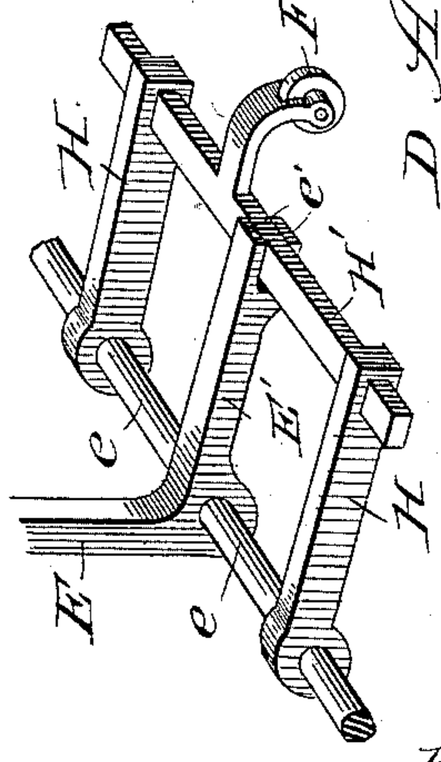

Fig. 7.

Witnesses:
Chas. E. Gaylord.
Clifford M. White.

Inventor:
Malcolm L. Harris,
By Charles J. Brown
Att'y

UNITED STATES PATENT OFFICE.

MALCOLM L. HARRIS, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO TRUMAN W. MILLER, OF SAME PLACE.

VALVE-ACTUATING DEVICE.

SPECIFICATION forming part of Letters Patent No. 415,671, dated November 19, 1889.

Application filed September 24, 1888. Serial No. 286,150. (No model.)

To all whom it may concern:

Be it known that I, MALCOLM L. HARRIS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Valves and Valve-Actuating Devices, of which the following is a full and complete description.

My invention relates to that class of valves and valve-actuating devices whereby there is secured a variable cut-off of the steam admitted to the cylinder of the engine to which such valves and valve-actuating devices are attached, such valves and valve-actuating devices being, when desired, controlled and regulated by an automatic governor; and the object of my invention is to obtain a single slide-valve which, when operated by the valve-actuating device invented by me and herein described, shall perform all the functions heretofore obtained from four valves, the said valve-actuating device being rapid and positive in its action, automatic in its working when attached to a governor, as described, simple in construction, and less liable to derangement in its working or from accident than those heretofore made.

I have illustrated my invention by the drawings accompanying and forming a part of this specification, in which—

Figure 1 is a sectional view of the steam-chest and steam-cylinder of an engine, a slide-valve controlling the admission of steam to said cylinder and from said cylinder to the exhaust-ports thereof, and an elevation of my valve-actuating device attached to said slide-valve. In this figure the several parts of the valve-actuating device are in such relative position that the steam-way, or passage for steam from the steam-chest to one end of the steam-cylinder, is represented as open, and also the exhaust-port at the other end of said steam-cylinder. Fig. 2 is a like sectional view of said steam-chest, steam-cylinder, and slide-valve, and an elevation of my valve-actuating device attached to said slide-valve, with the several parts of my valve-actuating device in such relative position that the steam-way from the steam-chest to said cylinder is closed, the exhaust-port at the other end thereof being open, as in Fig. 1. Fig. 3 is a plan view of my valve and valve-actuating device attached to an ordinary engine-cylinder. Fig. 4 is a perspective of a double cam which may be used in my device. This cam is single in all engines where it is not desired to reverse the admission of steam to the steam-cylinder while the engine is in motion. In Fig. 3 this cam is illustrated and is represented as single. Fig. 5 is an elevation of a portion of my device constructed to give positive motion to the slide-valve in each direction. Fig. 6 is an elevation of a portion of my device secured directly to the rod extending from the slide-valve through the wall of the steam-chest.

In the construction illustrated in Figs. 1 and 2 a "dash-pot," so called, or other equivalent means, is required to move the slide-valve toward the right; but in the modified form illustrated in Figs. 5 and 6 no dash-pot or other device is necessary, positive movement of the slide-valve being secured by the revolution of the said cam G, as hereinafter described.

Fig. 7 is a perspective view of a modified form of a portion of my device.

In Fig. 3 the revolving cam G, actuating the parts connected thereto and to the slide-valve, may be slid longitudinally on the shaft upon which it is mounted, in the manner hereinafter fully described, and by such sliding of said cam the steam passing into the steam-cylinder from the steam-chest may be cut off at any desired portion of the travel of the piston in said cylinder; but in the construction illustrated in Fig. 7 the said revolving cam is secured rigidly to the shaft thereof, and the friction-pulley resting thereon or in contact therewith may be moved longitudinally over and along the said revolving cam, thereby causing a variation in the travel of the piston while steam is being admitted to the cylinder, and the "variable cut-off," as it is termed, is thus secured.

Like letters and figures refer to like parts throughout the several views.

A is the steam-chest, and B the steam-cylinder, of an engine.

B′ and B″ are the ports of the cylinder, and B‴ B⁗ are exhaust-ports.

C is the piston, and C′ the piston-rod.

D is a slide-valve.

d is a rod extending from slide-valve D through the wall of the steam-chest A. Motion is communicated to slide-valve D by rod *d*.

E E′ is a bell-crank pivoted at *e*. Arm E of bell-crank E E′ is secured to rod *d*, and friction-pulley F, at the end of arm E′, rests against or in contact with cam G. This bell-crank E E′ is actuated by cam G as said cam is rotated in the movement of the engine. The surface of said cam G has four circumferential faces at varying distances from the axis of said cam. These several faces are numbered 1, 2, 3, and 4, respectively. Face 1 is nearest to the axis of said cam, face 2 a greater distance therefrom, and faces 3 and 4 a like further distance therefrom, respectively. Each of said faces 1, 2, 3, and 4 is so shaped that when friction roller or pulley F is in contact with any one thereof no movement of bell-crank E E′ is caused by the rotation of the said cam; but when any one of said faces passes from under said friction-pulley F and another of said faces goes thereunder a graduated movement in said bell-crank E E′ will result therefrom.

By reference to Fig. 1 it will be observed that friction-pulley F is resting against face 1 of cam G, and as said face is the nearest to the axis of said cam no further downward motion in friction-pulley F can occur. If said cam G is rotated to the right by the movement of the engine, as indicated by the arrow in Figs. 1 and 2, as face 2 goes under friction-pulley F the said friction-pulley is raised, say, one step, and a horizontal movement of, say, one space is thereby given rod *d* and slide-valve D. The said slide-valve D thereby assumes the position illustrated in Fig. 2, port B″ being closed and port B′ connected with exhaust-port B‴, allowing free passage for any steam in said cylinder at the right-hand end thereof to pass through said exhaust-port from said cylinder. Further rotation of said cam G will cause no further movement in bell-crank E E′ until face 2 passes from under friction-pulley F and face 4 goes thereunder, when said bell-crank will be turned two more steps and a corresponding horizontal movement given slide-valve D. In slide-valve D thus moving two spaces farther to the left from the position illustrated in Fig. 2 a direct steam way or passage will be opened between steam-cylinder B at the extreme right end thereof and steam-chest A through port B′, while at the same time port B″ will be placed in connection or communication with exhaust-port B⁗. As face 4 passes from under the friction-pulley F and face 3 goes thereunder, arm E′ of bell-crank E E′ will drop, or go one step nearer the axis of said cam G, and slide-valve D will thus be caused to assume a position whereby port B′ is closed, port B″, however, still remaining in communication with exhaust-port B⁗. Finally, as cam G completes a revolution, and at the same instant that the piston completes a full stroke and return, and as face 3 passes from under the friction-pulley F, face 1 again comes under said friction-pulley and arm E′ drops two steps into its original position, and slide-valve D again assumes the position illustrated in Fig. 1, in which port B′ is in communication with exhaust-port B‴, and a free way for steam made between the steam chest and cylinder B through port B″.

In Fig. 5 two arms E′ E′ are indicated, each of said arms having a friction-pulley F thereon, adapted to come in contact with cam G on opposite sides thereof. By this arrangement it is evident that arm E of said bell-crank E E′ is moved positively both to the right and to the left, while in the construction illustrated in Figs. 1 and 2, for instance, it is necessary to connect a dash-pot or other equivalent to said bell-crank E E′ in such manner that arm E of said bell-crank is moved thereby to the right whenever cam G will permit such movement.

In Fig. 6 is illustrated an arrangement of parts in my invention whereby motion is given rod *d* by cam G acting directly on friction-pulleys placed on said arm *d*, and without the intervention of bell-crank E E′.

From an inspection of Figs. 3 and 4 it will be noted that the line separating face 1 from face 2 on cam G is not parallel with the axis of said cam, and that from this construction the amount of rotation in said cam G, without movement thereby of arm E′ of bell-crank E E′, is greater or less when friction-pulley F is at one end of said cam than the amount of rotation of said cam, which is permitted without movement of said bell-crank when the friction-pulley is at the other end thereof; and by an inspection of Figs. 1, 2, 5, and 6 it will be seen that the line separating faces 4 and 3 is placed at the same angle with the axis of said cam as is the line last above described between faces 1 and 2. If, therefore, cam G be moved from one end to the other of shaft *g* (cam G rotating with said shaft *g*) underneath pulley F, a variation in the cut-off of the steam admitted to the steam-cylinder will thereby be produced. This variation in the cut-off will also be produced if the friction-pulley F be moved from end to end of said cam G, while said cam is rigidly secured to and rotates with shaft *g*, and in Fig. 7 of the drawings I have illustrated a method of thus sliding said friction-pulley F.

In Fig. 7, H H are arms placed loosely on shaft *e* and connected together at their free ends by bar H′. Arm E′ has a slot or other equivalent device at its free end, through which bar H′ passes. Friction-pulley F is placed on bar H′.

In Fig. 4, as hereinbefore stated, I have illustrated a double cam. This cam need be used only in engines wherein it is desired to quickly reverse the motion of the engine while in motion. With the single cam illustrated in Fig. 3 the engine may be run in

either direction, the only change required being that cam G must be placed end for end on shaft *g* when the direction of the running of the engine is to be changed.

Whatever governor is employed with my device it is merely necessary to cause cam G to automatically slide on shaft *g*, or, if preferred, to cause friction-pulley F to automatically move from one end to the other of said cam G, in order to vary the cut-off, and thus maintain an even or comparatively even rate of speed in the engine, and for this purpose any suitable governor may be used.

The operation of my invention is: Assuming the several parts of my device and of the engine to be in the position illustrated in Fig. 1, if steam be admitted to the steam-chest it will pass through port B″ into the steam-cylinder B and piston C moved thereby. As the piston moves, cam G is rotated, and when face 2, as in Fig. 2, goes under friction-pulley F slide-valve D moves one space forward, closing port B″ against the admission of more steam to the cylinder. Exhaust-port B‴ is open in both the instances just given—that is to say, when friction-pulley F is in contact with faces 1 and 2 of cam G—and any steam in that end of the cylinder may escape therefrom. As piston C continues to travel in cylinder B the steam therein, forcing said piston onward, may and does expand in said cylinder; and when the piston has reached or nearly reached the end of its movement to the right face 4 goes under friction-pulley F, and slide-valve D moves two spaces farther to the left and to its extreme left point of travel, thus uncovering port B″ and opening communication between the said port B″ and exhaust-port B⁗, at the same time uncovering port B′ and opening communication between said port and the steam-chest A. Steam may enter from said steam-chest into the steam-cylinder through said port B′, and as the piston C is moved to the left by said steam the steam at the other end of said cylinder may escape through port B″ and exhaust-port B⁗. When piston C has traveled on its return or to the left such distance that cam G has been revolved a sufficient distance to cause face 4 to pass from under friction-pulley F and face 3 to go thereunder, the slide-valve D will be moved thereby one space to the right, thus covering port B′, preventing the further admission of steam, and as the port B″ will still remain in communication with exhaust-port B⁗ the steam will continue to escape from the left-hand end of said cylinder until the piston has reached or nearly reached the extreme point of travel to the left, at which time face 3 will pass from under friction-pulley and face 1 again go thereunder, when slide-valve will again assume the position illustrated in Fig. 1, and a repetition of the above-described operation will be had.

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

1. The combination of a slide-valve adapted to alternately completely cover the induction-port of an engine-cylinder and simultaneously completely uncover the exhaust-port thereof at the opposite end of such cylinder, with a cam having four concentric peripheral faces, each concentric face having a different radius from the others, one of the lines dividing any one of said faces from the adjacent faces being parallel with the axis of said cam and the other of said lines being diagonal therewith, and the said cam connected with the slide-valve in such manner that the rotating or sliding into position of any given point on any one of said four faces will determine the position of said slide-valve, all substantially as described.

2. The combination of a slide-valve adapted to alternately completely cover the induction-port of an engine-cylinder and simultaneously completely uncover the exhaust-port thereof, with a cam having four concentric faces on the circumference thereof, each concentric face having a different radius from the others, one of the lines dividing any one of said faces from the adjacent faces being parallel with the axis of said cam and the other of said dividing-lines being diagonal therewith, a pivoted rocking bar or bell-crank connected at one end thereof to the said slide-valve and adapted at the other end thereof to come in contact with any given point on said faces of said cam, whereby the position of said slide-valve is determined by the movement of said cam and said point in contact therewith, all substantially as described.

3. Slide-valve D, adapted to alternately completely cover ports B′ B″ and simultaneously completely uncover exhaust-port B‴ B⁗ at the opposite end of engine-cylinder B, in combination with cam G, having faces 1 2 3 4 thereon, with different radii, said cam being actuated by the movement of said engine, and rocking bar or bell-crank E E′, adapted to transmit motion from said cam to said slide-valve as said cam is rotated, and means whereby any given point on said cam may be brought in contact with the end of said rocking bar resting against said cam, whereby a variable cut-off of the steam entering the said cylinder and actuating the said engine may be obtained, all substantially as described.

MALCOLM L. HARRIS.

Witnesses:
CHARLES T. BROWN,
NICHOLAS MERRICK.