G. E. TOWER.

Valve-Gear.

No. 165,186. Patented July 6, 1875.

Fig. 1.

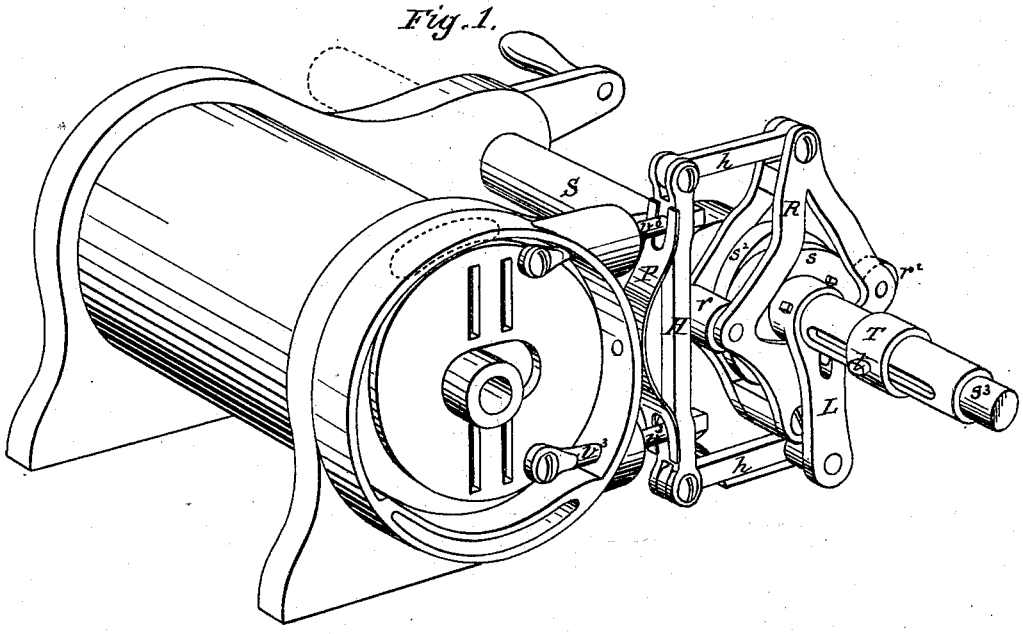


Fig. 2.

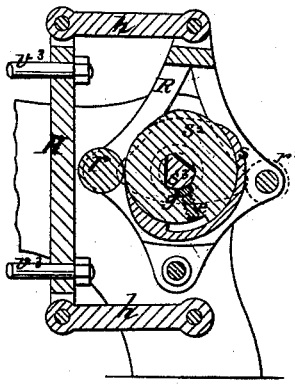


Fig. 3.

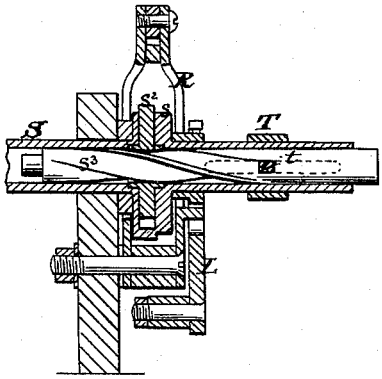
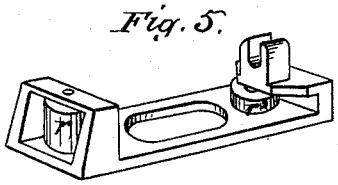


Fig. 4.

Fig. 5.



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UNITED STATES PATENT OFFICE.

GEORGE E. TOWER, OF ANNAPOLIS, MARYLAND, ASSIGNOR OF ONE-EIGHTH HIS RIGHT TO ELI P. WETHERWAX, OF WEST SANDLAKE, NEW YORK.

IMPROVEMENT IN VALVE-GEARS.

Specification forming part of Letters Patent No. **165,186**, dated July 6, 1875; application filed April 27, 1875.

To all whom it may concern:

Be it known that I, GEORGE E. TOWER, of the city of Annapolis, in the county of Anne Arundel and State of Maryland, have invented certain Improvements in Valve-Gear for Steam and other Engines, of which the following is a specification:

This invention is in part the same as that constituting a part of the invention shown in my pending application for improvements in steam and other engines filed November 20, 1874, but in order to enlarge the scope of its application, a modification, hereinafter described, has been introduced, by which it can be better applied to engines and valves of varying design and size, though it is specially suited for actuating the valve shown and claimed in that application, for by the conjoint action of that valve and this valve-gear the steam can be variably cut off with a large range of expansion without changing the lead of the valve as to either the entrance to or exit from the cylinder of the steam, and without altering the width of opening of any of the ports, which is not the case with ordinary slide-valves, moved by either the ordinary cams or eccentrics, nor with my said valve, were it moved by either ordinary cam or eccentric action. In the drawing forming part of this specification the valve there shown is introduced merely for the sake of illustration, to show the connection of the valve-rod or rods with any suitable valve. In this invention a rocker-frame carrying differential rollers has been substituted for the reciprocating carriage carrying the same rollers shown in my application above mentioned, and also shown in Figure 5 of the drawing accompanying this application. This rocker-frame, its use, and the parts and combination of parts constituting this invention, will now be described.

The object of using this rocker-frame is to multiply the throw of the cams within it by means of its leverage, by which arrangement, with the same diameter of cams or eccentrics, a shorter point of cutting off the steam can be obtained, and space between the cylinder and center of cam-shaft also be saved, by reason of no increased diameter of cams or eccentrics. But with large engines, the reciprocating carriage might be preferable to the rocker-frame, for, their steam-ports requiring but little width, the travel of the valves would be correspondingly short. In the figures of the drawing, R is the rocker-frame to which the valve-rods v^3 are attached; but it is obvious that a single rod and link could be used at the end of the rocker-frame opposite its point of oscillation, by direct attachment to the frame instead of the cross-bar H, attached thereto by links, and to which the two valve-rods v^3 are attached, as seen in the drawing, and for which a central valve-rod may be substituted if desired. But with a large valve it is obvious that space is saved by using two valve-rods, as the room required for their stuffing-boxes can be taken from space out of the line of action of the cams and rollers. But where the cross-bar is interposed between the rocker-frame and the valve-rod or rods it is evident that provision must be made for preserving its parallelism or rectilinear reciprocating motion. This is effected by means of the auxiliary arm L, which is fitted loosely upon the shaft S for a bearing, and which shaft revolves through its eye in one end, while its other end is attached to one of the links *h* by a pin or bolt, and it is also connected to the rocker-frame at another point in the manner now to be described. In the drawing this auxiliary arm L is connected to the rocker-frame by means of a slot and pin, which slot and pin, provided of course with suitable bearing-brasses, may be respectively in either the frame or the auxiliary arm; but it is also evident that, instead of a slot and pin, the arm and frame may be connected by putting a pin in each, and connecting said pins by a short link or rod. It is easily seen that the auxiliary arm L will thus preserve the parallelism of the cross-bar H, when moved, by forming with the links *h h* a parallel motion for the rocker-frame, just as when a reciprocating carriage is used its parallelism is preserved by the well-known means of

guides. The valve-gear for but one end of the cylinder is shown in the drawing, but it is understood, of course, that said gear is the same at both ends of the cylinder. The rocker-frame being provided with the differential-rollers r r^2, the longer of these, r^2, receives the motion and wear of both of the cams s s^2, and the shorter roller r that of the full-stroke cam s only, s^2, being the cut-off cam. These rollers, it is true, might be made of equal length, but their extremities would nevertheless require to be placed in different planes.

The operation of this valve-gear is as follows: S is an intermediate rotary shaft, such as is commonly used for actuating either cams or eccentrics, and taking its motion from the main shaft of the engine. This shaft may be mounted with its axis in any plane best suited to actuate the valves of the engine, and itself be actuated by miter gearing or by any other suitable means for transmitting to it motion from the main shaft. The cam s, secured to the shaft S, performs the functions of an ordinary full-stroke cam; nevertheless it is of peculiar construction. It is in reality a double or two-part cam, supporting within it the cut-off cam s^2. An ordinary cam, whether for full stroke or cut-off, is always in contact with the connections operating the valve, whereas the cam s has a portion of its rear face cut away, which gives it a necessary conformation for allowing it to escape contact with roller r, when said roller is advanced by the action of the cut-off cam s^2, which, when in action, advances the roller r by reason of the advance of the frame or carriage when the cam s^2 acts upon roller r^2.

The cam s^2 is a cut-off cam, contained within the cam s, and provided with a hollow hub, longer than its face. It is partially rotated by the spiral rod s^3, reciprocating axially through its center, which thus protrudes it beyond the face of cam s, and causes the rocker-frame or reciprocating carriage and connections to close the main valve at any desired point of the stroke of the piston after the commencement of its stroke, thus causing the main valve to act as a cut-off valve for the entering steam, but allowing, at the same time, free exit from the cylinder for the exhaust steam.

In case eccentrics are used instead of cams, they would be placed side by side, instead of one within the other. The spiral rod s^3 is inserted within the shaft S, which is bored out to receive it far enough to allow for its axial movement in operating the cut-off cams at both ends of the cylinder. This spiral rod s^3 has a cross-section whose contour is three-sided, and formed of lines either straight or curved, as may be desired. The object of making the spiral rod three-sided will be hereinafter explained; but a spiral rod having a section of any suitable shape may be used without departing from the principle, here applied, of actuating the cut-off cam by a spiral rod passing within and through the intermediate shaft S. This spiral rod is itself directly actuated by the sliding collar T, which is connected to it by the pin or key t, traveling in a slot in shaft S, as is clearly seen in the drawing. The revolution of shaft S, therefore, causes cam s^2 to revolve, through the intervention of the pin t in the sliding collar T, and this collar itself may either be moved by hand longitudinally on shaft S, and be secured at any fixed point, and thus set cam s^2 to cut off, at any desired point, by the action upon it of the spiral rod, or it may be connected by any suitable device to a governor, and thus, by the action of the governor, be caused to traverse on the shaft S, and automatically and momentarily, if necessary, change the point of cutting off the steam through the joint action of cam s^2 and the governor.

The spring P, interposed between the cross-bar H and the steam-chest, performs an important office, hereinafter mentioned, besides that of taking up lost motion due to wear in the joints of the valve-gear, and thereby preventing noise and jars.

I am aware that springs and weights have been used to prevent valves from hanging up or sticking in their seats, and also with rollers to keep them in contact with cams; but I am not aware that springs have been used in connection with governors to obviate a defect likely to be made manifest when connected to cut-off valves instead of to throttle-valves.

In rolling-mills and in other machinery sudden obstructions are liable to be presented to the movement of the engine after the cut off of the steam has been effected by the governor. In such case the governor can no longer act to reopen the cut-off valve before the completion of the stroke; hence the engine is liable to stop immediately. This difficulty, however, is obviated in my valve-gear by the use of the spring P, interposed between the steam-chest and the cross-bar or sliding carriage. A weighted lever might, however, if desired, be used instead of the spring, and the use of either of which in a small engine might dispense with the use of the roller r, for the valve would then make the return-stroke by the action of either of them, instead of by the action of the cam s upon the roller r; but should the engine be in danger of stopping, through the closing of the cut-off valve by the governor, the reaction of the spring P, or an equivalent weighted lever, will instantly cause the cut-off valve to reopen and afford the necessary steam to move the piston to the end of its stroke, when the valve-gear will operate for the return-stroke.

The object of making the spiral rod s^3 three-sided in cross-section is this: It will be observed that the cut-off cam s^2 has a pocket formed in one side of its interior bearing-surface, which conforms generally with the perimeter of the spiral rod. This pocket is filled by the step or shoe g, which is set up or adjusted by the screw e. By this device any lost

motion due to the wear of both the cam and the rod can be taken up, and thus noise and jars be prevented.

Having thus fully described this valve-gear as of my invention, I claim—

1. The combination, with the hollow rotary cam-shaft S, of the collar T and its pin *t*, and a spiral rod within said shaft, and rotated by it by means of said collar and pin, said rod being bounded longitudinally by helicoidal faces, and neither helically grooved or threaded, nor longitudinally toothed, whereby rotary motion is transmitted by said rod to the cut-off cam of the engine, in the manner substantially as described and set forth.

2. The combination of a spiral rod, s^3, contained within the hollow rotary cam-shaft S, with the cut-off cam s^2, sliding collar T, and pin *t*, and any suitable adjusting device for said collar, whereby said cam is adjusted to cut off the steam in proportion to the work to be performed, in the manner substantially as described and set forth.

3. The combination of the three-sided spiral rod s^3, gib or step *g*, and adjusting-screw *e* with the hub of an eccentric, wheel, or cam, whereby the rod is allowed a longitudinal spiral motion through said hub, and provision is made for tightening the hub on the rod, in the manner substantially as described and set forth.

4. The combination of the three sided spiral rod s^3 and cut-off cam s^2, provided with the adjusting device *e g*, whereby provision is made for the wear of the cam and the rod, in the manner substantially as described and set forth.

5. The combination of the differential rollers $r\ r^2$, mounted in a suitable rocker or carriage, with the cams $s\ s^2$, whereby motion is transmitted from both cams by the longer roller, and from the full-stroke cam only, by the shorter roller, in the manner and for the purpose substantially as described and set forth.

6. The combination of a full-stroke cam, having a portion of one side of its rear face cut away, a cut-off cam contained within it, and the rollers $r\ r^2$, of different depths, mounted in a suitable rocker or carriage, whereby allowance is made for the contact and clearance of said cams and rollers, in the manner and for the purposes substantially as described and set forth.

7. The combination, with the cross-bar H and rocker R, of the vibrating auxiliary arm L, connected to said rocker by any suitable device, whereby the parallelism of the cross-bar is preserved, in the manner substantially as described and set forth.

8. The combination, with a cut-off valve, of the cross-bar H, the cut-off cam s^2, and the elliptic spring P interposed between said bar and the steam-chest, whereby the valve is reopened, if required, after cutting off the steam before the end of the stroke, and lost motion in the joints of the valve-gear taken up, in the manner substantially as described and set forth.

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