G. E. TOWER.

VALVE-GEAR FOR STEAM ENGINE.

No. 184,443. Patented Nov. 14, 1876.

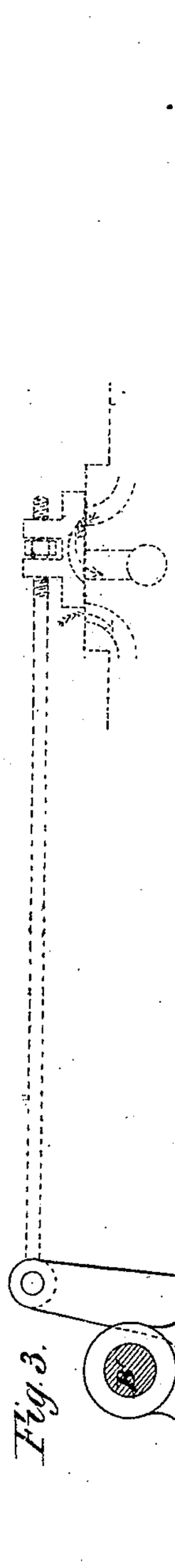
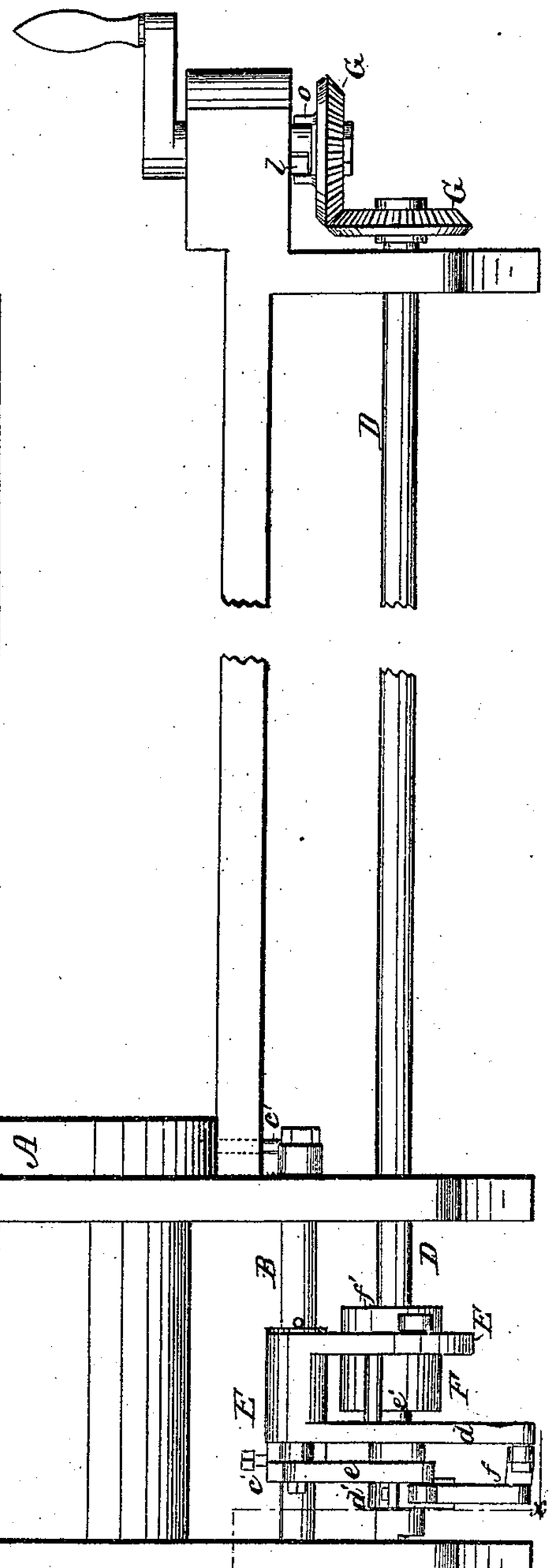


Fig. 3.

Fig. 1.

Fig. 2.

Fig. 4.



WITNESSES:

W. W. Hollingsworth

Solon C. Kemon

INVENTOR:

Geo. E. Tower

BY Munn & Co.

ATTORNEYS.

UNITED STATES PATENT OFFICE.

GEORGE E. TOWER, OF ANNAPOLIS, MARYLAND.

IMPROVEMENT IN VALVE-GEARS FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **184,443**, dated November 14, 1876; application filed May 11, 1876.

To all whom it may concern:

Be it known that I, GEORGE E. TOWER, of Annapolis, in the county of Anne Arundel and State of Maryland, have invented a new and Improved Valve-Gear for Steam and other Gas Engines; and I do hereby declare that the following is a full, clear, and exact description of the same.

My invention is designed particularly for stationary engines, but is also applicable to others.

It relates to an improved means for adjusting and working the steam-valves of an engine, whether the same be applied to the side or heads of a cylinder.

The chief feature of the invention is a shifting-lever mounted on a rotating eccentric or crank, and connected with a rocking frame, or equivalent device, which is capable of vibrating or remaining stationary during the running of the engine. When the rocker is stationary, the movement of the lever is least eccentric or irregular, and the valves cut off at about seven-tenths of the stroke; but when the lever attains its greatest eccentricity, the valves cut off at about two-tenths of the stroke. Between these limits, the movement of the valves may be regulated at will. The variation in the position and movement of the lever is, in this instance, effected by an irregular cam, whose adjustment with the rocking frame shifts the position of the point of connection between the latter and the lever, such point being stationary or vibrating in the arc of a circle, correspondingly.

The invention further relates to connecting the valves of the engine to the same rock-shaft, thus dispensing with separate gear for each valve, when desirable.

In the accompanying drawing, forming part of this specification, Figure 1 is a plan view of my valve-gear; Fig. 2, a cross-section on line *x x* of Fig. 1; Fig. 3, a sectional view, showing a modified arrangement of the valve-gear; Fig. 4, an elevation of the respective ends of the irregular cam.

The cylinder-heads A are each provided with induction and exhaust ports *a a'* and a valve, *b*. The details of construction and arrangement of the valves may be substantially such as described in Letters Patent No. 165,187, granted to me July 6, 1875. The valve-rods *c c'* are, in this instance, connected to one and the same rock-shaft B, so that the operation of the valves at the respective ends of the cylinder is regulated by one and the same valve-gear. The said shaft is preferably arranged parallel with the side of the cylinder. The rocking motion required to operate the valves *b* in the desired manner is imparted to the shaft by the gear which I will now proceed to describe.

The chief element of the same is the two-armed lever C, which is mounted loose on the eccentric or cranked portion of shaft D as a fulcrum. One of the arms is connected with a radial arm, *c''*, of the rock-shaft B, and the other arm with the arm *d* of rocker-frame E, by means of the respective links *e f*. The peculiar operation of the lever C depends upon the rotation of the driving-shaft D, and the adjustment of a shifting irregularly-formed cam, F, thereon with reference to the rocker-frame E.

The latter is mounted on the rock-shaft B as a fulcrum, and provided with friction-rollers, which bear against the periphery of the cam. The end *e'* of the cam next the lever C is circular, from which point its form gradually changes or becomes more and more irregular up to the other end, *f'*, which is approximately heart-shaped. The cam has a spline connection with the shaft D, and is thus caused to rotate therewith, while adapted to slide freely toward and from the rocker-frame E.

The adjustment of the cam may be effected by hand, or by any approved mechanical agent—as, for instance, the governor of the engine. When the cam is so adjusted that the friction-wheels of the rocker-frame bear upon its circular end *e'*, it is evident the rocker-frame will remain stationary, and hence the position of the point of connection between it and the lever C will also remain immovable. In such relation of parts the valves are so operated that the engine works nearly full stroke, the cut-off being effected at about seven-tenths of the stroke. If, however, the cam be adjusted to its opposite limit, so that the friction-rollers work in contact with the other or irregular end, *i*, of the cam, it is obvious the motion of the lever C will correspond,

and attain its greatest eccentricity, causing the valves to cut off very quickly, or at about two-tenths of the piston-stroke. Between these limits, the movement of the lever, and adjustment of the valves consequent thereon, may, of course, be varied at will, by changing the position of the cam with reference to the rocker-frame.

The shaft D rotates continually during the operation of the engine, being suitably geared therewith.

The lever has a compound movement—to wit, a vibratory movement proper on its fulcrum toward and from the valve-shaft B, a circular motion of its head *d'* around the fulcrum, and a circular or elliptical motion of the termini of its respective arms.

The movement of the head of the lever on its fulcrum is, of course, invariable; but the motion of the lever otherwise is varied at will, and, as previously intimated, such variation effects the change in the position of the valves of the engine required to enable them to cut off at any desired part of the stroke of the piston, ranging from two to seven tenths.

It will be noted that the chief characteristic of the operation of the lever C results from one of its arms being hung on a pivot, which is either fixed or movable—fixed, as when the rocker-frame is stationary, in consequence of bearing on the circular head of the cam, or movable, as when the rocker-frame is vibrated in the arc of a circle by contact with the irregular surface of the cam.

Whatever be the movement of the lever consequent upon the adjustment of the cam, the valves are so operated that the lead, exhaust, and travel are always the same.

To reverse the engine it is, of course, indispensable to change the position of the valves with reference to the crank, in order to give the proper lead. This result may be effected by forming a recess, *o*, in one side of the hub of one of the bevel-gears G, and providing the shaft of the wheel with a lug or arm, *l*, which bears against one side or the other of the recess *o*, according as the engine is running forward or back. The recess enables the gear to rotate about one-quarter without affecting the crank. The shaft is rotated that distance, to change the position of the lead of the valves, by means of a spanner or other equivalent device applied to the end *m*.

I do not restrict myself to the particular construction, arrangement, and means of connection of the valve-lever and rocker-frame above described. For example, as shown in Fig. 3, the rocker-frame may be pivoted on a fixed point, B', and extend below the main shaft D', having in such case a slot-and-pin connection with the valve-gear. In this instance the lever is in the form of an eccentric strap, with arms extended on opposite sides of the shaft. The eccentric F', which is substituted for the crank shown in Fig. 1, is, of course, fast on the shaft, and rotates with it, the slot and pin allowing the vertical movement of the strap or lever, due to the throw of the eccentric, but not allowing a side movement of its lower end, except at such times as the lower arm of the rocker-frame E' is moved by the action of the cam F' on the friction-rollers.

The lever is shown connected with the ordinary slide-valve of an engine, and as the gear stands the valve is at its extreme throw to the right, leaving the steam-port nearest the main shaft full open. Now, if the shaft is turned to the right the action of the cam carries the lower arm of the rocker-frame and the eccentric strap or lever to the right, and the upper arm of the latter to the left, sufficiently far to draw the valve over the open port and cut off the steam. When the shaft has made a half-turn the valve is, of course, at its opposite extreme, and is acted upon by the gear in a similar manner, but in an opposite direction.

In place of the rocker-frame I may employ a carriage, such as described in my Patent No. 165,187, for shifting the valve-lever.

It is obvious that an eccentric may be substituted for the cam for shifting the position of the point on which the valve-lever is pivoted.

What I claim is—

1. The combination, with the valve or valves of a steam-engine, of the shifting-lever C, mounted upon an eccentric or crank making complete rotations, and also pivoted on a movable point, whose position may be changed by suitable mechanism for varying the movement of the valves, the movement of the lever being such as is due to the eccentric alone, or a resultant of the movement of the eccentric and the shifting of said point, as described.

2. The combination of the rock-shaft B, connected to the valves at its respective ends by means of arms, a rocker-frame, pivoted on a fixed point, the shaft D, the valve-lever mounted thereon, and a cam or eccentric for actuating the rocker-frame, substantially as shown and described.

3. The combination, with the valve-operating lever, of a rocking frame or reciprocating carriage, and the sliding or adjustable cam, having the irregular form and variable throw, as shown and described.

4. The rock-shaft B, the rocker-frame mounted thereon, the parallel shaft D, and the valve-lever mounted thereon, and the sliding rotating irregular cam, connected, combined, and arranged with the valves and cylinder, as shown and described.

GEO. E. TOWER.

Witnesses:

AMOS W. HART,

CHAS. A. PETTIT.