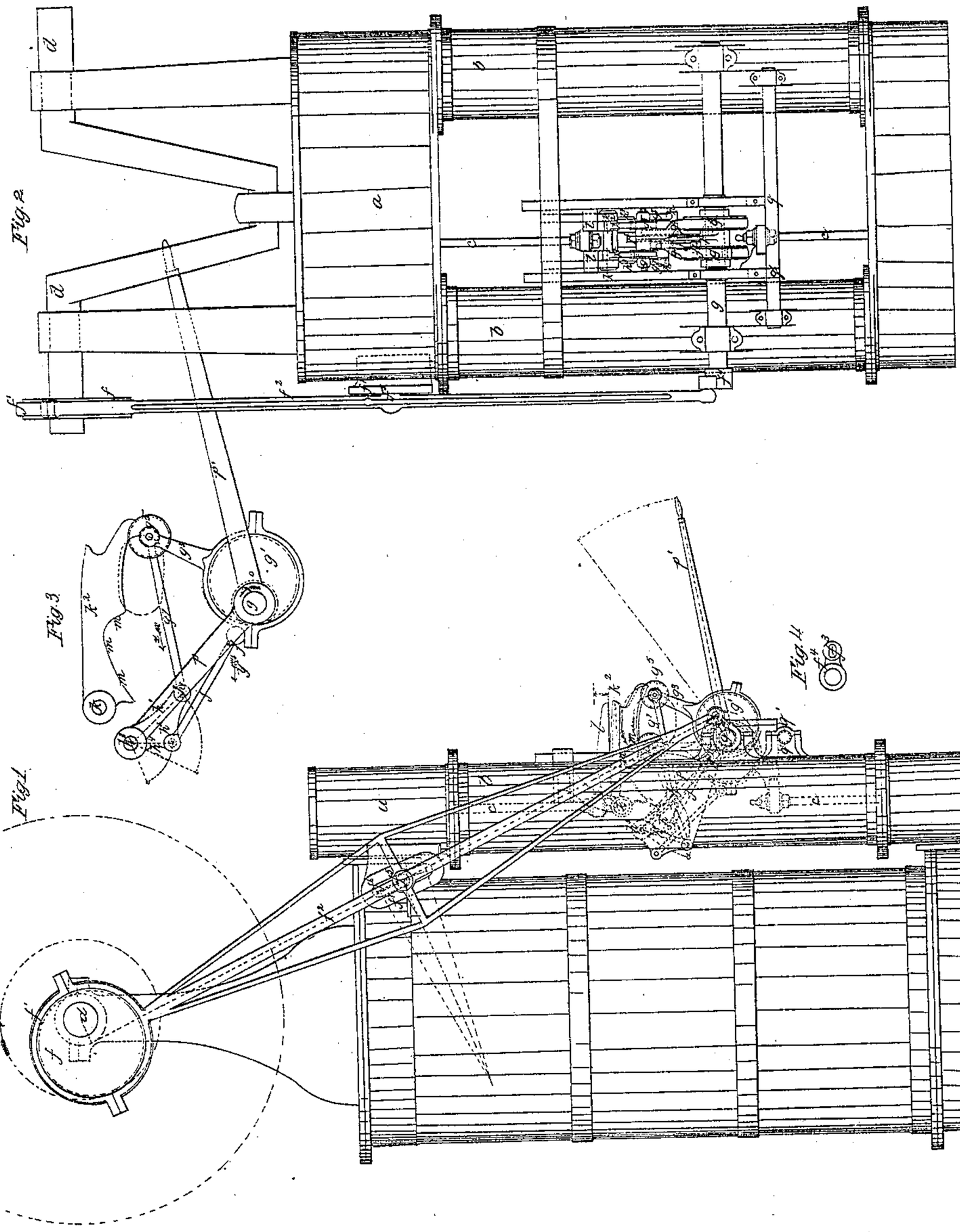
H. Winter,

Steam-Engine Valve Gear.

No. 14,978. Patented May 27, 1856.



UNITED STATES PATENT OFFICE.

HERMAN WINTER, OF NEW YORK, N. Y.

VALVE-GEAR FOR STEAM-ENGINES.

Specification of Letters Patent No. 14,978, dated May 27, 1856.

To all whom it may concern:

Be it known that I, HERMAN WINTER, machinist, of the city, county, and State of New York, have invented a new and Improved Valve-Gear for Steam-Engines, and that the following specification, taken in connection with the drawings, is a full, clear, and exact description thereof.

In the drawings Figure 1 is a side elevation of a cylinder and its appendages together with its shaft in the position the latter occupies in a steeple engine with my valve gear fitted thereto shown in the position both of lifting and lowering a valve. Fig. 2 is a front elevation of the same parts. Fig. 3 is a detail elevation on a large scale of the valve gear proper detached from its supports, but with all the parts in proper relative position. Fig. 4 is a detail side elevation of the small crank on the secondary shaft.

The same parts are referred to by the same letters in all the figures, the parts which are in position to lower a valve in Fig. 1 not being lettered so as to avoid confusion.

My valve gear is of that class in which the valves receive their motion from a revolving shaft moving with the same speed as the main shaft of the engine, various varieties of which have already been applied to use. In such valve gear the secondary shaft or that which actuates the valves has been driven by a cord, or a pitch chain, or by a series of cog wheels and shafts; and the cams keyed on that shaft for the purpose of lifting and lowering the valves have in various ways been so arranged that the time during which a valve is raised might be varied so that the period of cut off could be changed. Two great objections, one of them almost insuperable, have prevented the general introduction of such gear. The first is that cords will stretch and contract, pitch chains elongate by use, and cogs in course of time will wear; any of these changes alters the relative angular position of the main and secondary shafts and thus varies the lead of the valves. In such valve gear, moreover, there is a want of range in the variability of the cut off arising from the fact that no method of changing the shape of the cams has yet been used by which the length of the lifting part could be altered to such an extent as is necessary to give that range in the period of cutting off which is at the present day demanded both in land and marine engines.

The object of my invention is to remedy these defects and produce a good rotating valve gear and to this end the nature of the first part of my invention consists in giving motion to the secondary shaft by means of an eccentric and a crank or its equivalent connected by means of a rotating lever properly governed the whole acting and combined substantially as hereinafter set forth.

The nature of the second part of my invention consists in lifting and lowering valves by means of eccentrics or cranks keyed upon a revolving shaft and operating through the intervention of levers or rods driving a reciprocating motion from such eccentrics and forced to vibrate in the plane in which they reciprocate either by a stop or a positive motion the whole acting jointly, substantially in the manner and for the purposes hereinafter described.

The nature of the third part of my invention consists in a method of vibrating the rods or levers above referred to by a positive motion derived from some convenient part of the engine through the intervention of rods and a bell crank or their equivalents substantially as herein specified, and the nature of the fourth part of my invention consists in changing the period of cut off by changing the position of the center of vibration of the reciprocating rods or by altering the distance through which they vibrate substantially in the manner hereinafter specified, and the nature of the last part of my invention consists in altering the period of cut off by changing the position of the pivots of a bell crank substantially as hereinafter described.

My valve gear may be applied to any of the usual forms of engines and may actuate any of the usual kinds of valves so long as the valve governing one steam port is independent of that which governs the other in its motions, and provided such valves are shut by their own weight or by the force of a weight or spring applied to them. In the drawings, however, are represented the chests and side pipes pertaining to an ordinary arrangement of puppet valves and by their aid I will proceed to describe my gear.

At *a a* are represented the valve chests, at *b b* the side pipes, and at *c c* the valve stems,

while the main shaft of the engine is shown at *d*. Upon this shaft is secured an ordinary eccentric *f* with a strap *f'*, to which is attached the rotating lever f^2, the other end thereof being by means of a proper slot f^3 and a pin connected to a crank f^4, forged upon or attached to the secondary shaft *g*. This lever is provided at its center with a pin f^5, which rests in a slot f^6, formed in an ear or stud f^7, which may be attached to any convenient firm support such as the engine frame. As the main shaft revolves with its eccentric that end of the revolving lever attached thereto describes a circle equal to the throw of the eccentric and its center pin vibrates back and forth in the slot above named which governs the lever, causing its center to move in a right line or nearly so. The other end of the rotating lever describes a reëntering curve not exactly circular but closely approximating to it, and would if the joint between it and the crank were as close as usual probably remove the crank shaft from its journals. But the crank has a slightly elongated slot (see Fig. 4) for the reception of the pin on the rotating lever and thus accommodates itself, to the irregular curve described by the end of the rotating lever; and the secondary shaft therefore revolves turn for turn with the main shaft but in an opposite direction. It is true that during a single revolution it does not always revolve with the same angular velocity as the main shaft, but such irregularity is beneficial rather than hurtful, as advantage may be taken of it to lift the valves more speedily. This contrivance as a whole it will also be perceived cannot under any amount of wear of the parts become so disorganized as to effect materially the isochronism of the revolutions of the two shafts and thus alter practically the lead on the valves.

Upon the secondary shaft *g* are keyed two eccentrics g' g^2, each provided with straps as usual, and attached thereto are rods g^3 g^4, carrying friction rollers g^5 g^6. At or near the ends of these rods are fastened by proper joints radius bars g^7 g^8, which are jointed at *h* to one of the arms *h'* of bell cranks h^2, pivoted at h^3. To the other arms h^4 of these cranks are pivoted links *j* connected by a proper joint to the eccentric straps at *j'*. The pivot of the bell crank may be stationary or variable at the pleasure of the engineer. As the secondary shaft revolves both eccentrics revolve with it in the direction shown by arrow *z* and the rods g^3 g^4 reciprocate up and down to an extent equal to the throw of the eccentrics. But when the rods are at the center of their upward motion that part of the strap at *j'* commences to move in the direction of the arrow *y*. The link *j* moves in a similar direction; the bell crank oscillates and the radius bar g^7 or g^8 pulls the head of the rods g^3 g^4 over in the direction of arrow *x* until these rods have risen to their highest point and descended again half way or nearly so. At that time the links, bell cranks and radius bars come to rest and then commence to move in directions opposite to those just described, thereby vibrating the friction pulleys in a direction opposite to that indicated by the arrow *x* and continuing to do so until the rods (g^3 g^4) rise to half their lift, when the system of links, bell cranks and radius bars again cease to move for a moment. The rods are thus vibrated in the plane of their reciprocation and the rollers attached thereto describe an irregular oval. Above each friction roller and resting thereon is pivoted at *k k* a loose toe k^2 k^2, and these toes rise and fall as the rods g^3 g^4 are raised and lowered. Above each toe is the foot *l l* of one of the valves attached firmly to the stems *c c* of the upper and lower valves. Each loose toe is curved upward, as shown at *m m m*, and the greatest depth of the concavity should be about equal to the lift of the valves. The eccentrics are keyed upon the shaft in such positions as to give the proper lead, and each loose toe is so set that it begins to act upon the lifter toe when the eccentric rods have been lifted to about half the extent to which they reciprocate.

As the rods reciprocate upward they raise the loose toes, which at the proper time and in their turn act on the footstalks *l l*, lifting them and their attached valves. But as the valves rise the friction pulleys are drawn over as before explained until they reach the concavities, whose inclined faces then commence to slide down over the rollers, thus lowering the toes and consequently the valves while the rollers vibrate in the direction of arrow *x*. This lowering may take place even while the roller is rising, and a cut off at less than half stroke can consequently be effected. The same effect would take place if the roller acted directly upon the under surface of a properly curved foot stalk without the intervention of a loose toe, but there would in that event be a slight shock when the roller struck the foot *l* and commenced to lift the valve. This shock would be harmless in small engines, but might be hurtful in large ones. The loose toe is therefore introduced not as a necessary adjunct to the apparatus, but merely as a convenient auxiliary. It will further be seen that the apparatus described would make a useful full stroke valve gear without the concavities (at *m*) in the loose toes or in the feet if loose toes were not used, and it is also evident that the motion for vibrating the reciprocating rods might be obtained from various moving parts of the engine and through the intervention of various trains of mechanical movements with-

out departing from my invention so long as the vibration took place at the proper time and was of the proper extent. Moreover I intend at times to effect this vibration by a stop instead of by a positive motion. For instance I slot the reciprocating rod and locate therein a pin fastened either to a stationary part of the engine or to one that moves as a valve stem moves—and then the rotating motion imparted by the eccentrics to one end of the reciprocating rods will through the intervention of the pin and slot cause the upper end which carries the roller to traverse in an irregular oval curve as it does when acted upon by a radius bar etc., as before described. Cranks may be substituted for the small eccentrics upon the secondary shaft and a long radius bar properly attached may be substituted for the pin and slot which govern the rotating lever and the friction rollers may be dispensed with.

By looking at the loose toes it will be seen that their lower faces are curved from the extremities to the edge of the concavities in a circle whose center lies at the point *o* and which is struck when the toes are in the position when they commence to lift a valve. It follows from this construction that the lead will not be altered by changing the center of vibration of the reciprocating rods or the distance through which the rollers vibrate so that they act on different parts of the toe at the same period of the stroke.

In the arrangement herein described for vibrating the reciprocating rods by a positive motion the apparatus for altering the period of cut off consists of a radius bar *p* upon which the bell cranks are pivoted, while its other extremity is pivoted upon the revolving shaft. To this bar is attached firmly a handle *p'*, which serves to move it or hold it in place, the handle being provided with a clamp screw or some similar contrivance. When this radius bar is turned upon its center the center of the bell crank will be shifted and if moved away from the loose toe the roller will enter the concavity sooner and the cut off take place at an earlier period, but if the bell crank center be shifted toward the toe the roller will be retarded in reaching the concavity and the valve will remain open for a longer period of time. The center of the bell crank may be thus changed, thereby altering the center of vibration of the rods or levers so as to alter the period of cut off within any reasonable limits, and many other ways of holding and changing the bell crank centers have been devised by me and may suggest themselves to others, but they will be equivalent means so long as they perform substantially the office herein allotted to the radius rod and its handle. I also intend at times to vary the point of cut off by means of turnbuckles or their equivalents so placed as to alter the effective length of the radius rod or the link attached to the bell cranks or by means of screws and slides or their equivalents so applied as to alter the position of the pivot pins and consequently the effective length of the bell crank arms. The use of any of these means will change either the extent of vibration of the reciprocating rods or the position of the center of their vibration or both, and thus vary the period of cut off, while they will not alter the lead that being fixed invariably by the peculiar shape of the lower faces of the loose toe. A governor may in various ways be applied to the handle *p'* or its equivalent so as to alter the period of cut off.

In this specification I have made no mention of the exhaust valves or the means by which they may be actuated. They may receive their motion from any usual mechanism or from eccentrics and rods on the secondary shaft similar to those which actuate the steam valves or from cams keyed upon that shaft, which latter is the method that I prefer.

In order to unhook the engine I divide the secondary shaft at some point between its crank and the valve-lifting eccentrics and connect the two parts by a clutch coupling; when the clutch is thrown out the secondary shaft will cease to revolve and the valves may then be worked by hand through the aid of an ordinary starting bar applied to a trip shaft such as *q* having short toes *q' q'*.

Having thus described my apparatus for raising and lowering steam valves and cutting off at different periods of the stroke I claim therein as of my own invention and desire to secure by Letters Patent—

1. An eccentric on the main shaft, a lever properly governed and connected therewith, and a crank upon a secondary shaft, the whole in combination and connected each to each substantially in the manner and for the purpose herein set forth.

2. I claim an eccentric or its equivalent upon a revolving shaft, in combination with a rod or lever connected therewith receiving a reciprocating motion from the eccentric and a vibrating motion substantially in the manner specified, whereby valves of steam engines may be raised and lowered substantially as herein described.

3. I claim forcing rods or levers caused to reciprocate as specified, to vibrate in the plane of their reciprocation by a positive motion derived from some convenient part of the engine through the intervention of bell-cranks, radius-bars, and links or their equivalents connected and acting substantially as herein set forth.

4. I claim changing the center of rotation of reciprocating vibrating levers, or altering the distance through which they vibrate

substantially in the manner described, in combination, with a toe or foot curved substantially in the manner described whereby the period of cut-off may be raised as herein specified.

5. I claim altering the position of the pivots of a bell crank provided with a link and radius bar substantially in the manner set forth herein whereby the period of cut off may be varied at the pleasure of the attendant.

In testimony whereof I have hereunto subscribed my name in the city of New York, on this 22nd day of April, A. D. 1856.

HERMAN WINTER.

In presence of—

GEO. W. QUINTARD,

MIERS CORYELL.