I. W. Forbes,

Steam Engine Valve Gear,

No. 98,754. Patented Jan. 11, 1870.

Fig. 1.

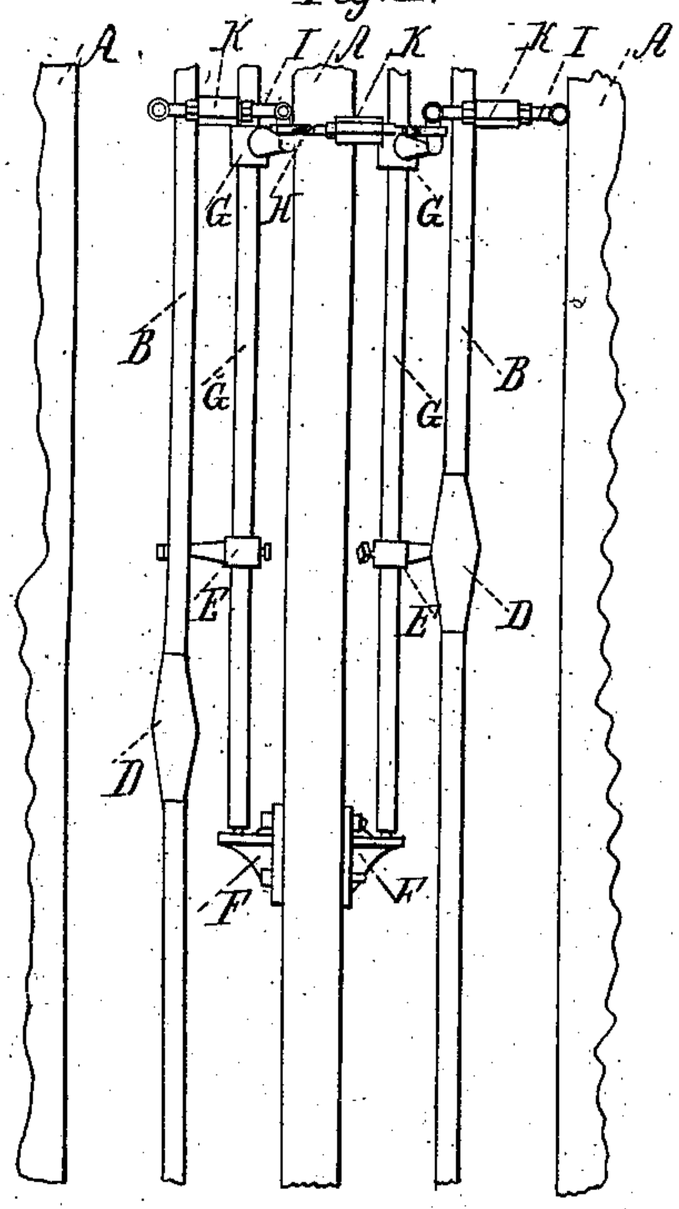


Fig. 2.

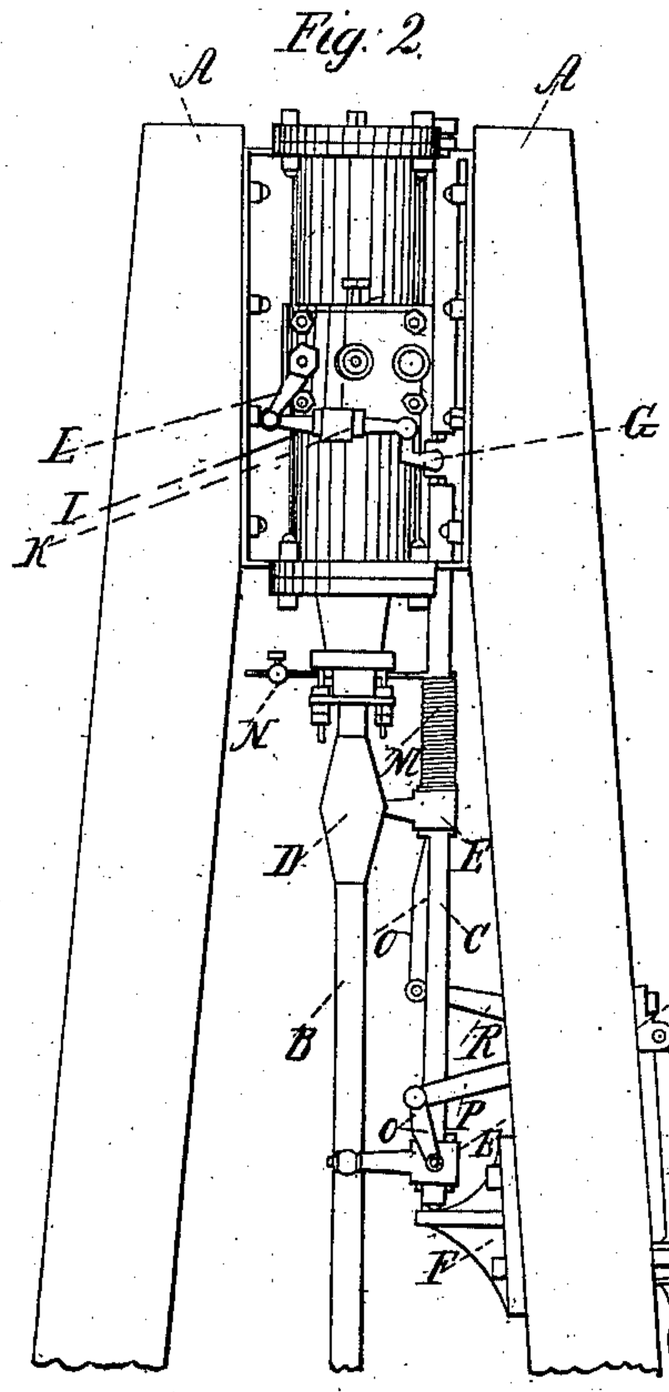


Fig. 8

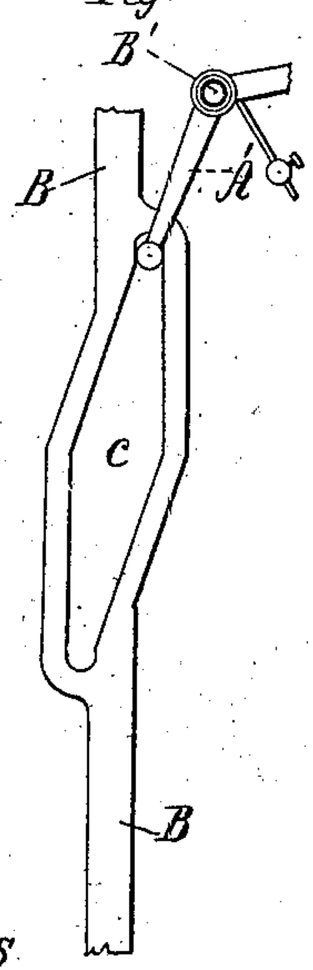


Fig. 3.

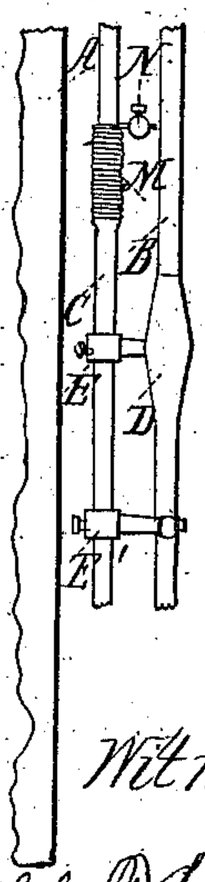


Fig. 4.

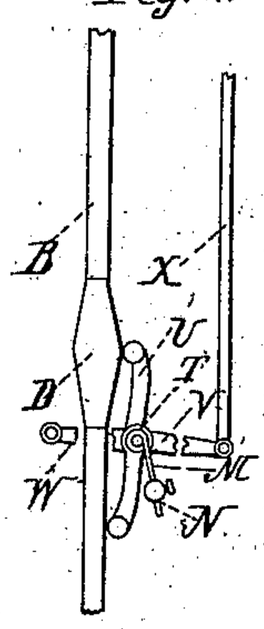


Fig. 5.

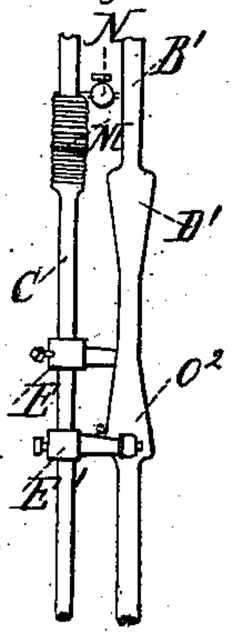


Fig. 7

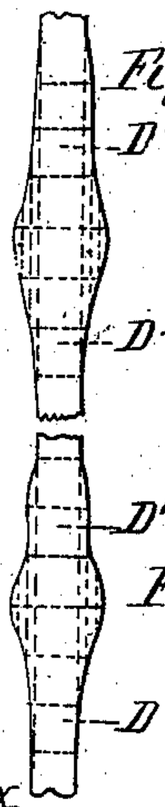
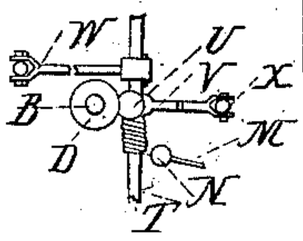


Fig. 6.

Fig. 4 A



Witnesses;

Phil. D. Lainer

Adolphe Rocke

Inventor;

I. W. Forbes

United States Patent Office.

ISAAC W. FORBES, OF LA PORTE, INDIANA.

Letters Patent No. 98,754, *dated January* 11, 1870; *antedated December* 14, 1869.

IMPROVEMENT IN STEAM-ENGINE VALVE-GEAR.

The Schedule referred to in these Letters Patent and making part of the same

To all whom it may concern:

Be it known that I, ISAAC W. FORBES, of La Porte, county of La Porte, and in the State of Indiana, have invented new and useful Improvements in Valve-Gear; and I do hereby declare that the following is a full, clear, and exact description thereof, sufficient to enable others skilled in the art to which my invention appertains, to make and use the same, reference being had to the accompanying drawings, making a part of this specification, in which—

Figure 1 is a portion of a double engine, having the valve-gear applied thereto.

Figure 2 is a frout elevation of a portion of a single engine, with the valve-gearing applied thereto, and adjustable arms, for producing variable valve-motion.

Figures 3 to 8 are views of modifications.

Similar letters of reference indicate corresponding parts in the several figures.

My invention consists of gearing, and appliances by which the valves of engines are operated by the action of the piston-rod, with or without rotary motion.

In the drawings—

A represents supports or standards for the working parts of the engine.

B represents piston-rods, on which are formed inclined projections or surfaces D, which come in contact with levers E, secured to rock-shaft C, mounted on steps or bearings F, which are supported on standard A.

G G are arms, keyed on to the rock-shaft, the outer ends of which are attached to adjustable connecting-rods I I by ball-and-socket joints.

These arms are connected together by rod H, the straps of which pass around the arms with keys and bolts, with an adjustable sleeve-nut, K, and right and left-hand screws, which fit into the two inner ends of the connecting-rod H, for the purpose of lengthening or shortening the same, with jam-nuts at each end, for holding it in position.

The arms G may be attached, at their outer end, to the valve-connections.

The connecting-rods I I are adjusted, in a manner similar to the rod H, by nuts K.

In fig. 2, the rock-shaft C has two levers or arms, E E′, for the purpose of producing variable motion, as may be required.

The ends of these arms are on opposite sides of piston B. The piston, moving between the said levers, vibrates the rock-shaft, and produces the valve-motion.

The arms may be moved together, or apart, or in any manner requisite for producing the required valve-motion, by the connections O O′, with adjustable levers R R and P P, which are pivoted at S to standard A.

The upper arm, G, is secured to the rock-shaft, and, by means of connecting-rod I, nut K, and arm L, of the rock-shaft cf valve, motion is communicated to the valve.

A coiled spring, M, is placed on the rock-shaft C, and on an extension of one of its ends is hung a momentum-ball, N.

The object of the spring and ball is to hold the end of levers E E′ to the piston-rod, until the stroke is produced, the inertia of said spring holding the rock-shaft to its position until the blow is completed, and assisting, at the same time, in changing the valve.

If the incline does not move the arms a sufficient distance, the ball N may be carried in or out, as required.

Instead of this momentum spring-lever and ball, a lever may be keyed to the rock-shaft, and having a tube partially filled with quicksilver or liquid, said tube fastened at right angles to the levers.

S′ represents a guide for the levers P R, having spring-catches, which drop into notches or recesses, in order to hold the levers in position. The guide may be graduated on its face, in order to indicate the length of stroke.

Fig. 3 shows a modification of fig. 2. The inclines D operate the valve similarly to those in the latter figure. The arms are made fast to the rock-shaft by means of set-screws or other fastenings, and always move the valve to take steam, when the middle of the incline comes to the centre of the heads of the arms when the piston makes full stroke; and whatever distance the stroke requires to be, the arms should be placed at such distances apart, and the levers so shaped as to give the required valve-motion by the motion produced from the incline. The valve can be moved in reverse order, by merely placing the heads of the arms upon the opposite side of the piston-rod to those shown in the drawings.

In fig. 4, the coil-spring has one end fastened to the rock-shaft, whose momentum and inertia perform the same office as that in figs. 2 and 3.

An opening is made in the ball N, and through it passes the other end of the spring, which is retained in position by a set-screw or other device.

U represents a double-armed lever, which is secured to its rock-shaft, and its ends work against the inclines on the piston-rod.

An arm, V, extends horizontally, and at right angles from lever U, which forms part of the same lever, and may be attached to a connecting-rod, X, extending to the valve-connections, with arm W keyed fast to the rock-shaft, and by the side of the piston-rod a sufficient distance to allow the same to pass, extending in the opposite direction from that of arm V, to which the valve-connections may be connected, which will move the valve in the opposite direction than when connected to arm V.

Figure 4ª is a top view of the fig. 4.

Fig. 5 shows the inclines D^1 D^2 on piston-rod, constructed somewhat differently from those previously described.

The rock-shaft arms or levers E E′ are placed closer together, in relation to the inclines and the length of required stroke, the ends of the levers working each side of the piston-rod, hence each side of the inclines, and being separated the same distance as the length of one incline.

Figs. 6 and 7 represent different inclines, whereby I produce different methods of producing different valve-motions by dissimilar curved inclines.

Fig. 8 is another modification of the inclines on the piston-rod. Said inclines form recesses or a mortise through the piston-rod, to receive one end or ends of a lever, A′, on a fulcrum, B′, and the other end may be connected, through intermediate parts, to the valve, and produce the required motion thereof.

It will be seen that this invention consists in having inclines upon the outside or inside of the piston-rod, which, coming into contact with an arm or arms attached to a rock-shaft or rock-shafts, parallel to the piston-rod, or otherwise, carries the heads of the arms out or in, thereby communicating motion to the rock-shaft or rock-shafts, which, in turn, communicate motion to levers and arms connected with the rock-shaft or rock-shafts, and finally act upon the rock-shaft or stem which moves the valve.

The advantage of the invention consists in producing valve-motion from the playing of the piston-rod itself, and that either with or without the use of a rotary motion.

There are different modes of operating the principles of the invention, and different results are obtained, according to the mode of operation adopted; that is to say, either a regular or a varied motion of the valves may be effected, as desired, according to the appliances of the valve-gear that may be used. And, again, different mechanical effects are achieved from the steam-engines or machines on which the valves operated, or may be used according as the valves are moved either with a regular or with a varied motion.

This valve-gearing may, as regards the use of some of its appliances, namely, in respect to the use of one or more arms, in connection with the rock-shaft, be distinguished into two principal methods, the independent and the dependent.

The independent method is so called, because the valve of the engine is moved without foreign aid from another engine, and is applicable to the case of a single engine working by itself, its valve being moved in either direction, or up or down, by the action of the piston-rod itself, and the valve-gear, in which two arms are used, in conjunction with rock-shaft of each engine; whereas the dependent method, applicable to the case of two or more, or a series of engines, working together, the piston-rod and valve-gear of each engine of the series moves the valve of its own engine, one way only, and that either upon its inward or outward stroke, as the case may require, depending upon its neighboring piston and gear to move the valve in the other direction, and, in that case, only one arm being necessarily attached to the rock-shaft of each engine.

Fig. 1 illustrates the dependent method. It shows a portion of piston-rods and valve-gearing, applicable to a double engine. There are inclines upon each piston-rod, for the purpose of producing valve-motion, in connection with rock-shafts C C, and arms for the purpose of producing an oscillating motion to said rock-shafts C C. Upon each motion of the piston in the cylinder, the incline moves the head of the arm E to the extreme point; hence, it moves its rock-shaft C, and moves its neighboring rock-shaft, with arm E, at the same time against its piston-rod, by the means of the adjustable connecting-rod H, connecting the two rock-shafts together. It opens its own valve, to exhaust at the proper time, and to receive steam at the opposite end, for driving the piston back, at the same time opening the neighboring valve at the proper time, to exhaust and to take in steam at the opposite end, for driving its piston in, thus working alternately.

The adjustable centre connecting-rod H unites the two arms G G′ of the rock-shafts C C. This connecting-rod should be divided in the centre with a right and left-hand thread, to receive an adjustable sleeve-nut, with corresponding threads in the same. By this means, arms E E may be thrown in their proper position, and, if required, the pistons are free to revolve, or they may be held stationary, if necessary.

When it becomes necessary to make the piston-rod shorter or more convenient, to produce the desired effect, then, instead of placing the inclines upon the piston-rod, a rod may extend through the opposite end of the cylinder, with the inclines upon that, for producing the same effect as the incline upon the piston-rod. The inclines are turned upon the piston-rod, and form part of the same.

Levers or arms E E and levers or arms G G should be firmly secured to rock-shaft C C, which may be done by set-screws, keys, or bolts. The heads of arms E E should be eccentric, and made of raw hide or sole-leather.

By removing centre connecting-rod H, thus separating the connection of valve-gear, and placing duplicate arms E E in rock-shaft C C, (as in fig. 3,) the engines then become separate and independent of each other.

This method is very useful for producing valve-motion of engines, where a circular or revolving motion is not required, especially for pumps and stamp-mills, upright saws, &c.

There may be two rock-shafts, with but one arm on each shaft, but both should be on the same side of the piston-rod, and the same distance apart as is required by the stroke, but connected together the same as in fig. 1, in which case there need not be eccentric heads on the levers E E, as they will be regulated by the adjustable connecting-rod.

Fig. 2 illustrates the independent method, and with variable motion. Where there is no opposing obstruction, a length of stroke is produced, according to the manner in which the heads of arms E and E′ are placed.

These arms are moved at will, by means of their connection with adjustable levers R R and P P, for producing any required stroke of the piston, consistent with its dimensions. Upon the motion of the piston-rod either in or out of the cylinder, the inclines come in contact with the heads of lever E or E′, moving them out to the extreme point of the incline, hence, opening the valve, to exhaust at the proper time, previous to taking in a head at the opposite end, by which means steam is taken in, and the piston is at once reversed. That process of moving the valve is produced at each stroke of the piston, either in or out.

This method varies slightly from that in fig. 3, as by it the arms E and E′ are fixed to the rock-shaft C, and are not movable upon the same, while the piston is in motion, but these are moved, whatever distance apart the strokes are designed to be. A variable motion may be produced by the assistance of the momentum and inertia of the ball and spring-lever, but not to such an extent as in fig. 2.

The rock-shaft C has one or more grooves, extending between the arms E E′, in which key the hubs of those arms play, and hold the arms and rock-shaft in their proper place.

Figs. 3, 4, 5, and 8, all show the independent mode. The valve-gearing in fig. 4 differs slightly from that in the previous figures. Lever U lying lengthwise to the piston-rod, the two heads work against the same,

being hinged in the centre to its rock-shaft. The inclines working between these two heads, throw out the head, with which they come in contact, moving the opposite in at the same time, thereby moving an arm, extending out at right angles with the arms of those heads, to which valve-connection is attached, and producing a valve-motion by the play of the piston-rod and valve-gear, the heads being the same distance apart as the stroke of the piston requires. These heads should be eccentric, and constructed of sole-leather or raw hide, so that when they wear, the bolts may be slackened and the heads turned, to overcome the lost motion, and then tightened, to hold them in their position.

In fig. 5, the inclines vary from those in the previous figures, but the rock-shaft and arms E and E′ are the same as in fig. 3, but are placed closer together on the rock-shaft, being the same distance apart as the length of one incline, and at opposite sides to the piston-rod, designed for arm E to hold the same relation to the required motion of the valve, in relation to the cut-off, expansion, and receiving of steam.

Figs. 6 and 7 show the variation that may be employed at the ends. A different kind of incline is represented in fig. 8. In this illustration, the inclines are separated, and the ends of the levers work between, instead of outside, as described in other figures. In this case, the inclines and lever-heads are so shaped as to give the proper motion to the valve.

In fig. 8, the piston-rod cannot revolve, but in the other figure, the piston-rod may revolve, if necessary, which is very essential for quartz-mills, rock-drills, &c.

The rock-shaft C may, if necessary, be employed as an oscillating-valve stem, thereby dispensing with the intermediate connections.

Having described my invention,

What I claim as new, and desire to secure by Letters Patent, is—

1. The rock-shaft or rock-shafts C, in combination with the incline or inclines D, substantially as described.

2. The arms E, in combination with the rock-shaft or rock-shafts, and the incline or inclines, substantially as described.

3. The lever E, on the rock-shaft C, in combination with the levers R P, substantially as described.

4. The spring M and momentum-ball N, in connection with the rock-shaft, substantially as described.

The above signed by me, this day of August, 1869.

I. W. FORBES.

Witnesses:

PHIL. F. LARNER,

ADOLPHE ROEB.