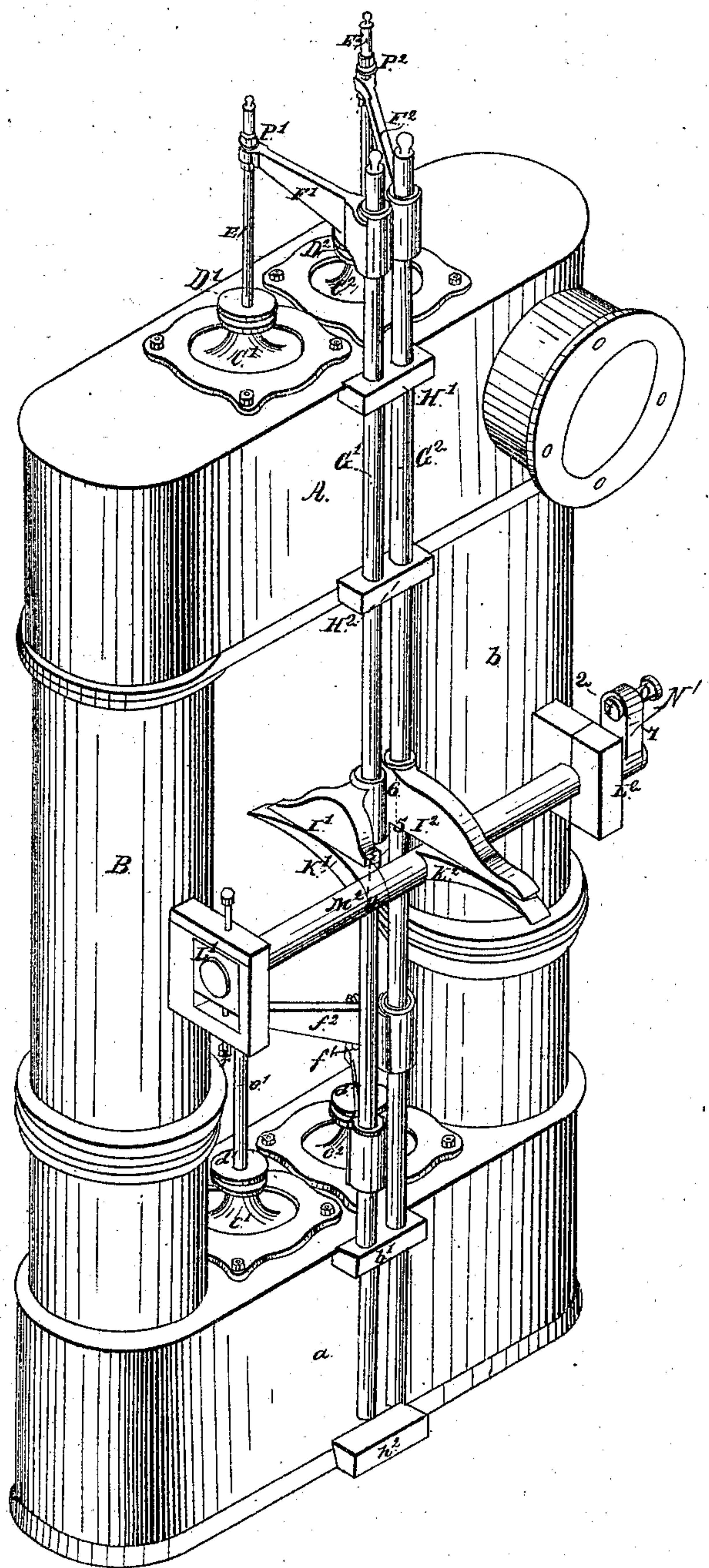


*F. E. Sickels,*  
*Steam-Engine Valve-Gear.*  
*N<sup>o</sup> 3,802.      Patented Oct. 19, 1844.*

*Fig. 1.*





# UNITED STATES PATENT OFFICE.

FREDERICK E. SICKELS, OF NEW YORK, N. Y.

## METHOD OF OPENING AND CLOSING VALVES OF STEAM-ENGINES.

Specification forming part of Letters Patent No. 3,802, dated October 19, 1844; Reissued January 1, 1861, Nos. 1,112 and 1,113.

*To all whom it may concern:*

Be it known that I, FREDERICK ELSWORTH SICKELS, of the city of New York, in the State of New York, have invented a new and useful improvement on apparatus for opening and closing steam and exhaust valves of steam-engines, so that the steam will act with greater practical efficiency than it would without the improvement herein-  
after particularly described, it being of such a nature as to be easily and advantageously arranged for and applied to variously-arranged steam-engines.

Figure 1 is a drawing of the steam-chest, side-pipes, and the apparatus immediately connected with and used to work the steam and exhaust-valves of steam engines, as generally arranged for low-pressure, double-valve steam engines, excepting such parts as are altered for the purpose of showing my improvement, hereinafter described.

In the accompanying drawing A,  $\alpha$ , is the steam-chest; B,  $b$ , are the side-pipes; C', C<sup>2</sup>  $c'$ ,  $c^2$ , are the bonnets on the steam-chest; D' D<sup>2</sup>  $d'$ ,  $d^2$ , are the stuffing-boxes for valve-stems; E', E<sup>2</sup>  $e'$ ,  $e^2$  are the valve-stems; F', F<sup>2</sup>  $f'$ ,  $f^2$ , are the lifters; G', G<sup>2</sup>, are the lifting-rods; H', H<sup>2</sup>  $h'$ ,  $h^2$ , are the bearings for lifting-rods; I', I<sup>2</sup> are the feet on lifting-rods; K', K<sup>2</sup> are the toes on rock-shaft; L', L<sup>2</sup>, are the bearings for rock-shaft; M, is the rock-shaft; N, is the rock-shaft arm; P', P<sup>2</sup> are the upper valve-nuts on the upper steam and exhaust-valve-stems the lower ones being similar, but not represented in the drawing; O is the rock-shaft pin to which the eccentric-rod is connected.

I will now describe the usual combination and arrangement together with the usual mode of operating the heretofore mentioned parts, in connection with the accompanying drawing, for the purpose of hereinafter, more particularly showing the distinction between the usual mode, and my mode of and improvement in, arranging and combining them, so as to produce new and useful results.

As the pin O, moves in the direction, from 7 toward 2, the toe K<sup>2</sup> acts upon the foot, I<sup>2</sup>, and causes it to rise, thereby opening the upper steam and lower exhaust-valves, the valve-stem-nuts being so placed on the valve-stems, as to cause the valves to open at the same time, or nearly so, the lifters  
commence to move. And by the movement

of the pin O returning in the direction from 2, toward 7, the foot I<sup>2</sup> lowers, causing the upper steam, and lower exhaust-valves to close, this taking place while the engine is completing one half its stroke, after which continuing the motion of the pin O, in the direction from 2 toward 7, the toes K', K<sup>2</sup> being so placed upon the rock-shaft M, in connection with the feet I', I<sup>2</sup>, that the toe K', comes in contact with the foot I', and causes it to rise, and the upper exhaust and lower steam-valves to open, the valve-stem-nuts being placed (as before described) on the other valve-stems. And by the movement of the pin O, in the direction from 7 toward 2, returning, the toe, K' acts upon the foot I' allowing it to lower, and allows the upper exhaust, and lower steam-valves to close, this taking place while the engine is completing the other half stroke. The pin O being moved by the agency of the eccentric of the engine. It will be seen therefore from the foregoing description of the usual mode of opening and closing the steam and exhaust-valves of steam engines, that while one lifting-rod with its feet, lifters, and valves, attached, is in motion the other lifting-rod, with its attachments remain stationary.

I will now describe the nature of my improvement; which consists in so regulating the period of the movements of the valves, as to leave the piston free to complete each stroke, also to give any desirable lead to the exhaust-valves, and allow the piston to be in equilibria near the completion of its stroke (it not being absolutely necessary if desirable, to give a lead to the steam-valves as heretofore,) which is effected by opening the lower exhaust-valve, before the end of the upward stroke of the piston, and before the upper exhaust-valve is closed, and opening the upper exhaust-valve, before the end of the downward stroke of the piston, and before the lower exhaust-valve is closed, the steam-valve being opened without a lead, and after the exhaust-valve on the corresponding end of the cylinder has been closed.

My improvement further consists, in a peculiar arrangement of the toes on the rock-shaft, feet on the lifting-rods, and the connection of the lifters with the valve-stems, to carry into effect the above stated improvement.



The toes  $K'$ ,  $K^2$  are so placed as represented in the drawing, in connection with the feet  $I'$ ,  $I^2$ , so that, before the toe  $K^2$  has ceased to act upon the foot,  $I^2$ , the other toe  $K'$ , commences the raising of its foot  $I'$ , and so that before the toe  $K'$  has ceased to lower its foot,  $I'$ , the other toe  $K^2$  has commenced to raise its foot  $I^2$ , as by the moving of the rock-shaft-pin  $O$  in the direction from 7 toward 2, the foot  $I'$  will commence to descend in the direction from 3 toward 4, and the foot,  $I^2$  to raise in the direction from 5 toward 6, then, by a further motion of the pin  $O$ , in the direction from 7 toward 2, after the toe  $K'$  has allowed the foot  $I'$  to complete its descent, the toe  $K^2$ , continues to raise the foot  $I^2$ , then by the motion of the pin,  $O$  in the direction from 2 toward 7, in returning, after the toe  $K^2$ , has allowed the foot  $I^2$  to lower some distance, and during the progress of the foot  $I^2$  downward, the toe  $K'$  commences to act, and raises the foot  $I'$ , this taking place during one half the revolution of the engine; by a further motion of the pin  $O$  in the direction from 2 toward 7, the toe  $K'$  continues to raise the foot  $I'$ , after the toe  $K^2$  has allowed the foot  $I^2$  to complete its descent, then, by the motion of the pin  $O$  in the direction from 7 toward 2, in returning, the toe  $K'$  allows the foot  $I'$  to descend, and after the foot  $I'$  has descended some distance, and is yet on its downward motion, the toe  $K^2$  comes in contact with, and commences to raise the foot  $I^2$ , this taking place during the other half revolution of the engine, the descent of one toe and one foot while the other is rising, takes place at or near the center of the engine the pin  $O$ , being moved by the eccentric of the engine in the direction from 7 toward 2, as shown in the drawing, and also in the direction from 2 toward 7, in returning.

The nuts, attached to the stems of the steam-valves are so arranged as to be adjustable, and allow a slip of the lifters, operating thereon, of an inch more or less, and to be equal, or nearly so, to the rise of the toes above the upper surface of the rock-shaft.

Having thus far explained my improved combination and arrangement of the relative position of the toes and feet, and also the effect which such combination has upon the motion of the toes and feet, I now will explain my improved combination of the relative position of the toes and feet and their connection with the steam and exhaust-valves, and the improved effect which the whole of my combination and arrangement has upon the operation of such valves, and the more efficient working of steam-engines.

As the pin  $O$  moves in the direction from 7 toward 2, and while the toe  $K^2$ , acts upon the foot  $I^2$ , and raises it with the lower ex-

haust-valve, and while the toe  $K'$ , allows the foot  $I'$ , with the upper exhaust-valve to lower, the upper steam-valve remains unmoved in consequence of the position and arrangement of the valve-stem-nut,  $P^2$ , and the lifter,  $F^2$ , as shown in the drawing, the under surface of the upper valve-stem-nut  $P^2$ , being placed so far above the lifter, which acts upon it, as the toe  $I^2$  raises, while the toe  $I'$  is descending, by continuing the motion of the pin  $O$ , in the direction from 7 toward 2, when the foot  $I'$  has finished its motion, and the upper exhaust-valve closes the upper steam-valve opens, in consequence of the lifter  $F^2$  being brought in contact with the valve-stem-nut  $P^2$ , then by the motion of the pin  $O$  in the direction from 2 toward 7, in returning, and as the upper steam-valve closes, the toe,  $K'$ , comes in contact with the foot  $I'$  raising it, at the same time opening the upper exhaust-valve, this taking place during half the revolution of the engine, and by continuing the motion of the pin  $O$ , in the direction from 2 toward 7, and as the toe  $K^2$  allows the foot  $I^2$  to lower, and the lower exhaust-valve to close, the toe  $K'$  continuing to raise the foot  $I'$ , continues the rise of the upper exhaust-valve, causing the lower steam-valve to open, as the lifter,  $f'$  acts upon the nut on the stem of the lower steam-valve, in the same manner as the upper lifter  $F^2$  acts upon the nut  $p^2$  on the stem of the upper steam-valve, as hereinbefore described, and by continuing the motion of the pin  $O$  in the direction from 2 toward 7, the toe  $K'$  continues to raise the foot  $I'$  with the upper exhaust and lower steam-valves, then in returning, in the direction from 7 toward 2, it permits the upper exhaust and lower steam-valves to lower, and as the lower steam valve shuts, the lower exhaust-valve opens, in consequence of the action of the toe  $K^2$  on the foot  $I^2$ , and the connection of these valves as hereinbefore mentioned, this taking place during the other half revolution of the engine.

$L$ , is a movable bearing, supporting one end of the rock-shaft  $M$ , which is operated upon by screws  $R$ ,  $r$ , so as to raise or lower the rock-shaft, so as to vary or suspend the operation of my improved combination and arrangement, hereinbefore described.

I have herein first described the usual mode of opening and closing steam and exhaust-valves of steam engines, and lastly described my improved combination and arrangement and its mode of action. I have also in this specification, described my improved combination and arrangement of the apparatus for opening and closing steam and exhaust-valves in steam engines as represented in the accompanying drawing, being aware that there are various ways by which my combination can be applied to



suit the differently arranged engines now in use, all of which ways will involve the same mechanical principles.

The movable bearing in the drawing for  
5 modifying or suspending the operation of my improved combination, can be made to raise and lower by means of a lever attached to it, so as to be readily worked by the engineer when desired.

10 In engines having separate rock-shafts to open and close each valve, a variation of the length of the connection between the respective rock shafts, combined with the slip between the connections, working the steam-  
15 valves, would constitute, and be one method, of carrying out my improved combination; another mode is, by placing pieces or cams upon the toes, or rock-shafts without toes, or by modifying the shape of the feet upon  
20 the lifting-rod, by placing cams thereon or otherwise, so as to operate in connection with the other parts described in the drawing.

In engines having one rock-shaft to work  
25 the steam-valves, and another to work the exhaust-valves, my improved combination would be produced, by altering the position of the toes on the rock-shaft, working the exhaust-valves, so as to be similar to the  
30 toes and rock-shaft shown in the drawing, thereby causing the toes on the rock-shaft, working the steam-valves to operate them at the same time the steam-valves open, with my combination and arrangement attached  
35 to the engine.

By means of my combination and improvement in the relative position of the toes on the rock-shaft, with the nuts on the valve-stems of the steam-valves, and their  
40 relative position to the valves, as herein set forth, any desirable lead may be given to the exhaust-valves, without the piston of the steam-cylinder being subjected to any opposing force or difficulty in consequence thereof,  
45 which effect cannot be produced by any device heretofore known or used, besides, both exhaust-valves may together be open for a desirable moment of time, so that the piston of the steam cylinder shall be in equilibrio,  
50 when it shall nearly have completed its stroke, thereby, being enabled to shut a portion of the steam being exhausted into the steam-chest nearest the piston, that it may be used in combination with steam emitted  
55 from the boiler, to drive the piston the return stroke.

By the use of my combination the unequal application of force to the paddle wheels, which communicates a sudden and  
60 alternate impetus as well as much tremulous motion to the steamer, and which has more

or less tendency to shake the engine out of line, will be in a great measure, if not wholly, overcome.

Having thus fully described the nature of 65 my improvement, in the combination of the toes attached to the rock-shaft, with the nuts attached to the stems of the steam-valves, and the relative use of the toes above the upper surface of the rock-shaft, starting at 70 the connecting point even with the upper surface, and the slip of the lifters upon the steam-valve-stems, with the peculiar and relative operation of the valves for admitting to, and exhausting steam from, the cyl- 75 inders of steam engines in a more efficient and practical manner than by any means heretofore known or used, causing various parts of the engine to perform with much greater facility, thereby, increasing speed or, 80 saving steam and fuel.

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

1. My improvement in the periods of the movements of the valves, by which they are 85 opened and closed relatively to each other, and to the movement of the piston, by means of which, the piston completes each stroke in equilibrio, or nearly so without admitting steam against the movement of the 90 piston by a lead to the steam-valve; which is effected as before stated by opening the lower exhaust-valve, before the end of the upward stroke of the piston, and before the upper exhaust-valve is closed, and opening 95 the upper exhaust-valve, before the end of the downward stroke of the piston, and before the lower exhaust-valve is closed; the movement of the steam-valve being so regulated as to admit steam to the cylinder, only 100 after the exhaust valve on the corresponding end of the cylinder has been closed.

2. I also claim as my next improvement and as a means of carrying into effect my first, and essential improvement, the ar- 105 rangement of the toes on the rock-shaft, in such manner relatively to the location and form of the feet or the lifting-rods, that at the middle, or nearly so, of the rocking motion of the rock-shaft, both lifting-rods, 110 with their exhaust-valves, shall be partly up, as herein described; and I also claim in combination with this arrangement the slip of the lifters on the steam-valve-stems, as described, to insure the closing of the ex- 115 haust-valves before the opening of the steam-valves on the corresponding ends of the cylinder as herein described.

FREDERICK ELSWORTH SICKELS.

Witnesses:

ALFRED SCOTT,

WM. M. B. SICKELS.