2 Sheets—Sheet 1.

W. WELLS.

LOCOMOTIVE ENGINE.

No. 186,285. Patented Jan. 16, 1877.

Plate I.

Fig. 1

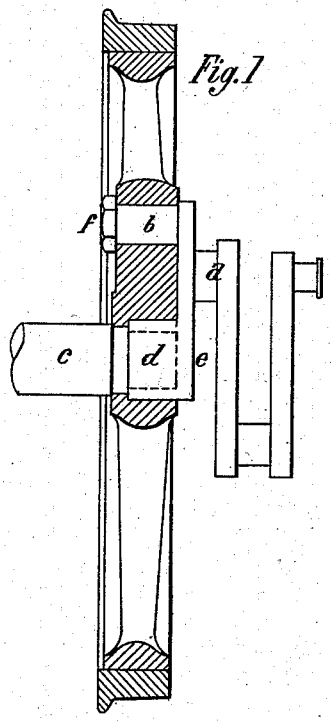


Fig. 2

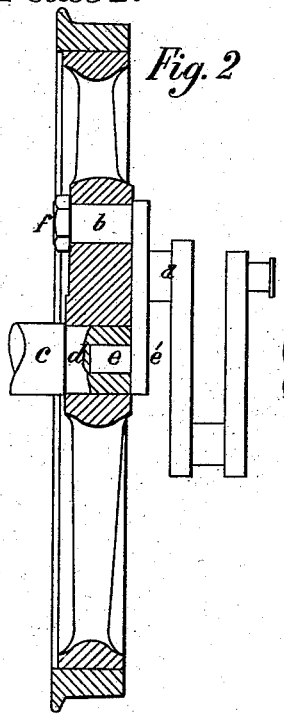


Fig. 3

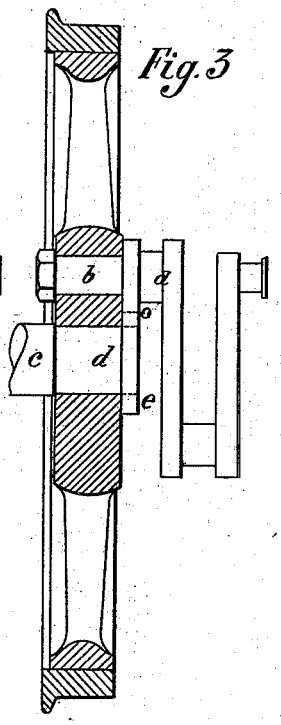


Fig. 6

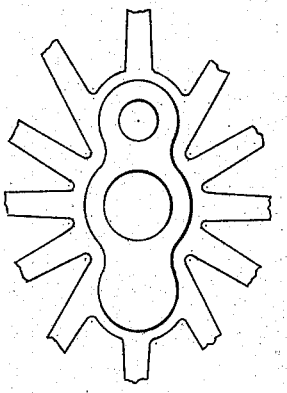


Fig. 4

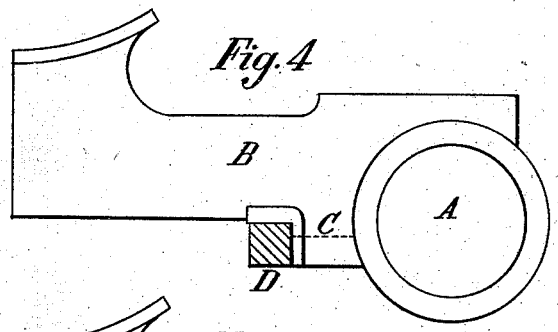
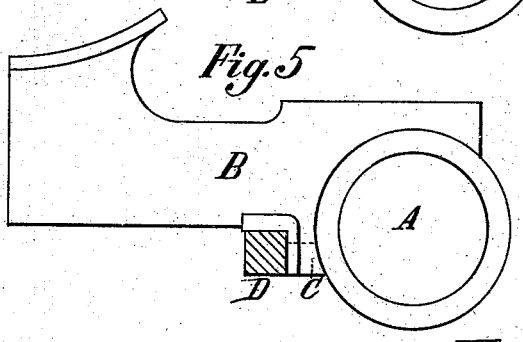


Fig. 5



Witnesses.
Chester R. Wells,
A. Fielding.

Inventor,
Wallace Wells.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

2 Sheets—Sheet 2.

W. WELLS.

LOCOMOTIVE ENGINE.

No. 186,285. Patented Jan. 16, 1877.

Fig. 1

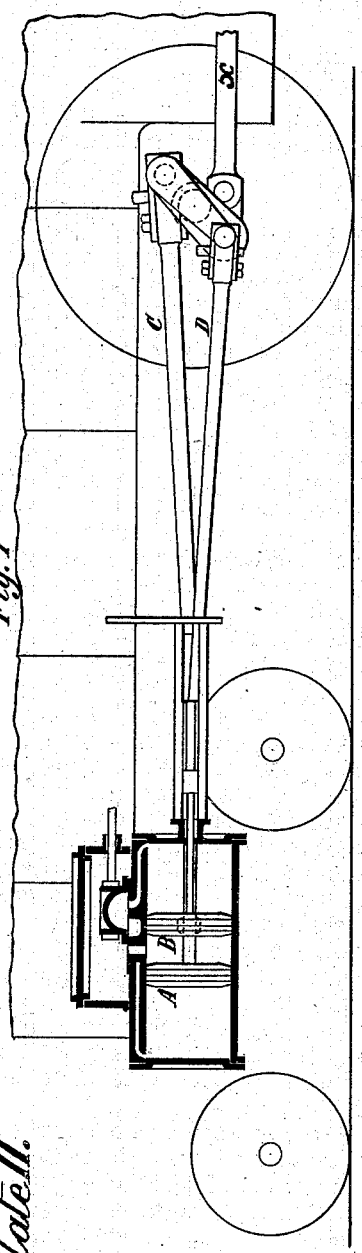


Fig. 2

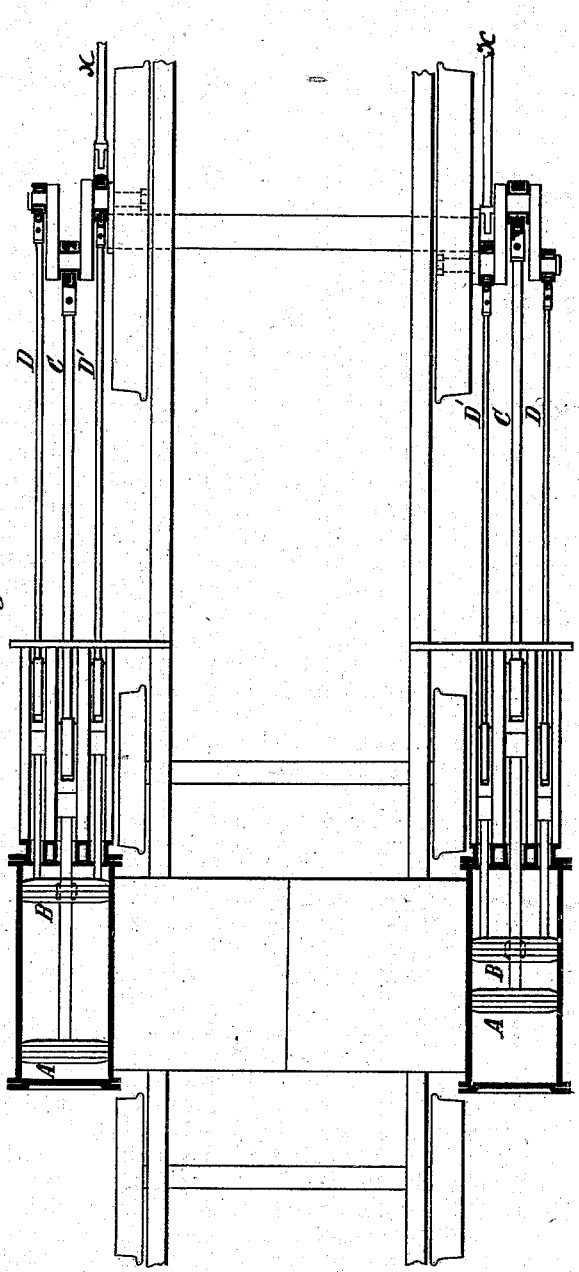


Plate II.

Witnesses.
Justin R Wells.
A. Fielding

Inventor.
Wallace Wells.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WALLACE WELLS, OF BROOKLYN, NEW YORK, ASSIGNOR TO WELLS' BALANCE ENGINE COMPANY, OF STAMFORD, CONNECTICUT.

IMPROVEMENT IN LOCOMOTIVE-ENGINES.

Specification forming part of Letters Patent No. **186,285**, dated January 16, 1877; application filed June 22, 1876.

To all whom it may concern:

Be it known that I, WALLACE WELLS, of Brooklyn, in the State of New York, have invented certain new and useful Improvements in Locomotive-Engines, and that the following, taken in connection with the drawings, is a full, clear, and exact description thereof.

In the drawings, Figure 1, Plate 2, is a side elevation, partly in section, of parts of a locomotive-engine containing my invention. Fig. 2, Plate 2, is a plan, partly in section, of the same parts, with the boiler wholly removed. Figs. 1, 2, and 3 of Plate 1 are vertical sections, partly in elevation, of a locomotive driving-wheel with a crank applied thereto. Figs. 4 and 5 of Plate 1 are sketches, showing the position of a cylinder of an ordinary engine and my improved engine; and Fig. 6 of Plate 1 is an elevation, representing the manner in which I intend sometimes to construct the hub of a driving-wheel.

My invention consists, chiefly, in combining two double-piston engines with the driving-wheels and axle of a locomotive-engine, in the manner substantially as hereinafter described; and consists, also, in certain subsidiary inventions, as hereafter set forth.

My invention may be applied to engines having two, four, or six—in fact, any number of—driving-wheels, and when I say combining engines with the driving-wheels, I mean that pair of drivers to which the cranks are attached.

The engines I employ as elements of my combination are double-piston engines—that is, engines having two pistons in the same cylinder, and three piston-rods and three connecting-rods, all the piston-rods passing out of the same end of the cylinder, two of them being secured to one piston, and one of them—the central rod—to the other piston. These engines are substantially such as are described in Letters Patent of the United States granted to me September 11, 1860.

In order to carry out my invention, I locate the cylinders in the usual place of outside connected cylinders, except that the axis of the cylinder is a little (a few inches) farther out from the longitudinal center line of the engine than usual. Fig. 5, Plate 2, shows the position of an ordinary outside connected cylinder, A representing the cylinder, B the saddle, and D the framing, while Fig. 4 of the same plate shows the position of the outside connected cylinders in my engine. Observation of the dotted lines *c* will show the amount of change in position from the old to the new arrangement. These cylinders, as before stated, have each two pistons, three piston-rods, and three connecting-rods, (see Figs. 1 and 2, Plate 2,) and also proper stuffing-boxes, guides, or slides, brasses, stub-ends, &c., and a valve and ports, constructed so as to admit and exhaust the steam properly. I prefer the arrangement of valve and ports shown in the drawings at Fig. 1, Plate 2. In this arrangement the steam and exhaust passage leading from one end of the cylinder is twisted around the exhaust-passage leading to the exhaust-pipe, so that the former connects with the steam and exhaust passage from the other end of the cylinder. Both of these steam and exhaust passages connect, therefore, with the same port in the valve-seat, so that when the valve is in the position shown in the figure, steam may exhaust from both ends of the cylinder through the same port into the valve-cup, and when the valve is at the other end of its stroke steam may enter through the same port in the valve-seat and flow through the passages leading to opposite ends of the cylinder. In consequence of this peculiar arrangement and connection of passages, I can employ an ordinary short slide-valve in a double-piston engine.

Although I prefer the short slide-valve, I wish it to be understood that I intend to use other forms of valve and other arrangements of steam and exhaust passages.

Each of these engines is combined with the driving-wheels and their axle by means of a three-throw crank, arranged outside of the driving-wheels, care being taken that the cranks are so arranged with reference to each other that the pistons of one engine shall be in the center of their stroke, and in position to do their best work, when the pistons of the other engine are at one end or the other of their stroke. Or, in other words, the cranks must be so arranged that the pistons of one engine have their cranks on centers, while the

pistons of the other engines have their cranks in the half-stroke position.

Various plans of attaching these three-throw cranks to the driving-wheels will be hereafter described; but the cranks may be made and secured to the wheels in any way known to mechanics, provided that they are arranged with reference to each other as heretofore stated. By properly proportioning each part of the crank, including the pins, the crank as a whole may be so made that equal parts of its weight will lie on each side of the center of the driving-wheel, and by making the center connecting-rod C of the same weight as both of the connecting-rods D D, Figs. 1 and 2, Plate 1, the connecting-rods of each wheel will balance each other, or the cranks and connecting-rods may be both made slightly out of balance, provided the error in balance of the one is compensated for by the error in balance of the other. I prefer to balance the cranks exactly, and also to balance the connecting-rods exactly, as I thus secure not only a balance of weights, but a balance of momentums of the parts; but I wish it to be understood that inferior results may be secured by a construction which will not balance these parts, and which will necessitate the use of counter-balances in the wheel, such as are usually employed.

Consideration of this description and the drawings will lead to the following conclusions, viz: that the weights and momentums of the moving parts may be exactly balanced for each wheel. Thus the connecting-rod of each wheel balance in their forward and backward and up and down motions not only in weight, but in speed and extent, of their motions. The same is true of the cranks of each wheel, and the same of the forward and backward motions of the pistons and piston-rods, provided care is taken that one piston with its two rods and cross-heads is of the same weight as the other piston with its single piston-rod and cross-head. In addition to these results there will be little or no force exerted to move either end of the axle to or from the engine that is acting on that end, because, when the single connecting-rod is trying to drive the axle away from the cylinder, the two connecting-rods are striving to pull the axle toward the cylinder. In ordinary locomotives this effort of the engines at times either to pull the axle bodily to or away from the cylinder, and at other times to push one end of the axle away from its cylinder, while the other end is being pulled toward its cylinder, keeps a constant strain upon the boxes, increases friction and wear, and is generally considered to be the great source of unsteadiness of locomotives.

It may be further stated that all locomotive driving-wheels support the engine through the intervention of springs; consequently the axles and cranks thereto attached are constantly moving up and down with reference to the center-line of the cylinder, and the centers of the axles are only momentarily in line with the center-line of the cylinder, even when those center-lines are, in modern fashion, in the horizontal plane which passes through the center of the driving-wheels. In such engines, during their revolutions, both connecting-rods are sometimes tending to move both ends of the shaft downward, and at other times one connecting-rod is striving to move its end of the shaft downward, while the other connecting-rod is striving to move its end of the shaft upward. As there are springs, this motion actually takes place, and the boiler and engine proper are consequently kept in a state of oscillation, owing to the compression and expansion of the springs, due to this action of the engine.

My invention remedies this defect, by reason of the fact that the two outside connecting-rods of each engine always tend to throw the shaft in exactly the opposite direction to that in which the central connecting-rod tends to shove it.

There is, therefore, in my locomotive no tendency either to contract the springs or to permit them to expand, much less a tendency to contract the springs on one side, while the other is permitted to expand, as is the case in ordinary locomotive-engines.

The advantages of my invention, therefore, may be summed up as insuring a greater extent of steadiness of motion, as obviating friction and wear to a certain extent, and, as a consequence thereof, the use of less fuel and steam to do the same work.

I have not hitherto spoken of the connecting-links, (as at *x x x*, Figs. 1 and 2, Plate 2,) which connect one pair of drivers with other pairs of drivers in the same engine. Each of them may be counterbalanced either by weights in the drivers or partly by a weight in the driver farthest from the engine, and partly by adding weight in the right place either to the crank or the central connecting-rod, or both. I prefer to balance half their weight by the center connecting-rods, as I thus, to a certain extent, balance their momentum as well as their weight.

I intend to apply my invention to locomotives already built, using the old valve-gear and driving-wheels, and, in case of using the old driving-wheels, have contrived a plan for constructing the crank and attaching it to the wheels, two modifications of which are represented on Plate 1. In both these modifications the three-throw crank has its crank-pin nearest the wheel attached to a wide flat plate, *e'*, which extends from the outside of the old crank-pin hole to or beyond the axle of the driver. This plate is, by preference, forged in one piece, with a pin, *b*, which passes through the old pin-hole, and is secured there by a nut, *f*, the fit between the pin and hole being a tight one. The other end of this wide plate has either a socket, as in Fig. 1, or a pin, as in Fig. 2, forged upon it, and this socket or pin is forced, by means of a press,

into a recess fitted to receive it, this recess being bored out either in the axle or the hub, or partly in both. This construction fastens the crank securely, preventing it from being twisted, as it might be if secured to the wheel at one point only.

As I intend, when altering old locomotives, that the length of stroke of each piston should be about half the length of stroke of the old single-piston engine, the crank-pin *a* will be nearer the center of the wheel than the old crank-pin.

With new locomotives or new drivers I prefer to make the hubs elliptical, (see Fig. 6, Plate 1,) to extend the axle outside of the face of the wheel, and to bore out the wide plate to fit the projecting end of the axle. (See Fig. 3, Plate 1.)

It will be seen that these modifications all have the same feature, viz., that the inner crank-pin is attached to a plate, which latter is attached at both ends to the driving-wheel.

Although I have thus described preferred ways of attaching the three throw-cranks to the drivers, I wish it understood that I intend to use cranks attached or constructed in other ways, so long as they are three-throw, are outside of the drivers, and arranged on the opposite drivers relatively, as before described.

I claim as of my own invention—

1. The combination of two cylinders, each provided with two pistons, and three piston-rods, and three connecting-rods, with two driving-wheels and their axle, by means of two three-throw cranks, arranged outside of the drivers, and in such relation to each other as herein described, the combination being and acting substantially as herein set forth.

2. In combination with a short slide-valve and two pistons in one cylinder, the construction of passages and ports, as described, whereby an ordinary short slide-valve acts to admit and exhaust steam properly in a double-piston engine.

3. The construction, substantially as herein described, whereby a three-throw crank is attached to the face of a driving-wheel, the distinguishing peculiarity of said construction being that the crank-pin nearest the wheel is secured to a plate which is secured at both ends to the driving-wheel, substantially as herein set forth.

WALLACE WELLS.

In the presence of—

C. A. SEWARD,

THOS. F. KRAJEWSKI,