M. M. Forney,

Locomotive.

No. 52,406. Patented Feb. 6, 1866.

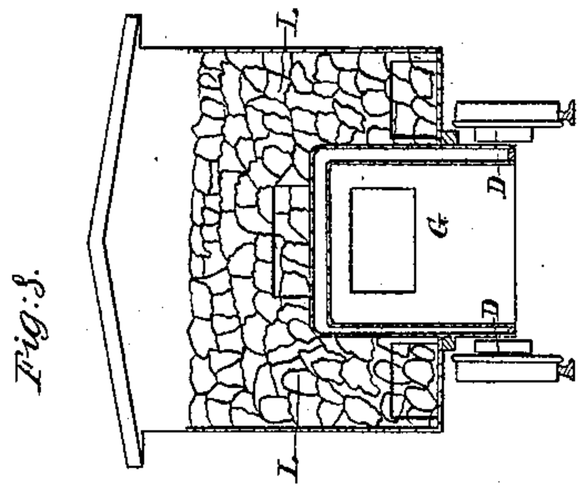

Fig. 3.

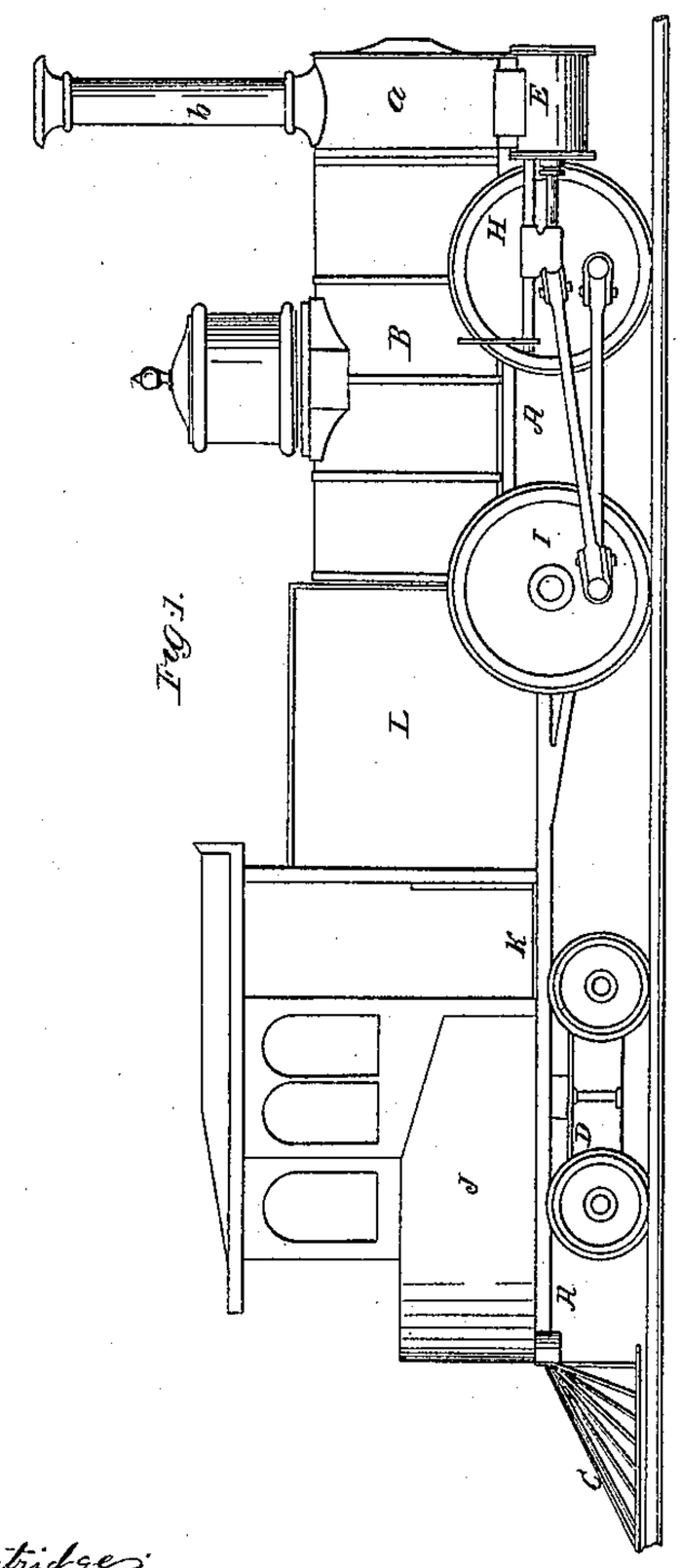

Fig. 1.

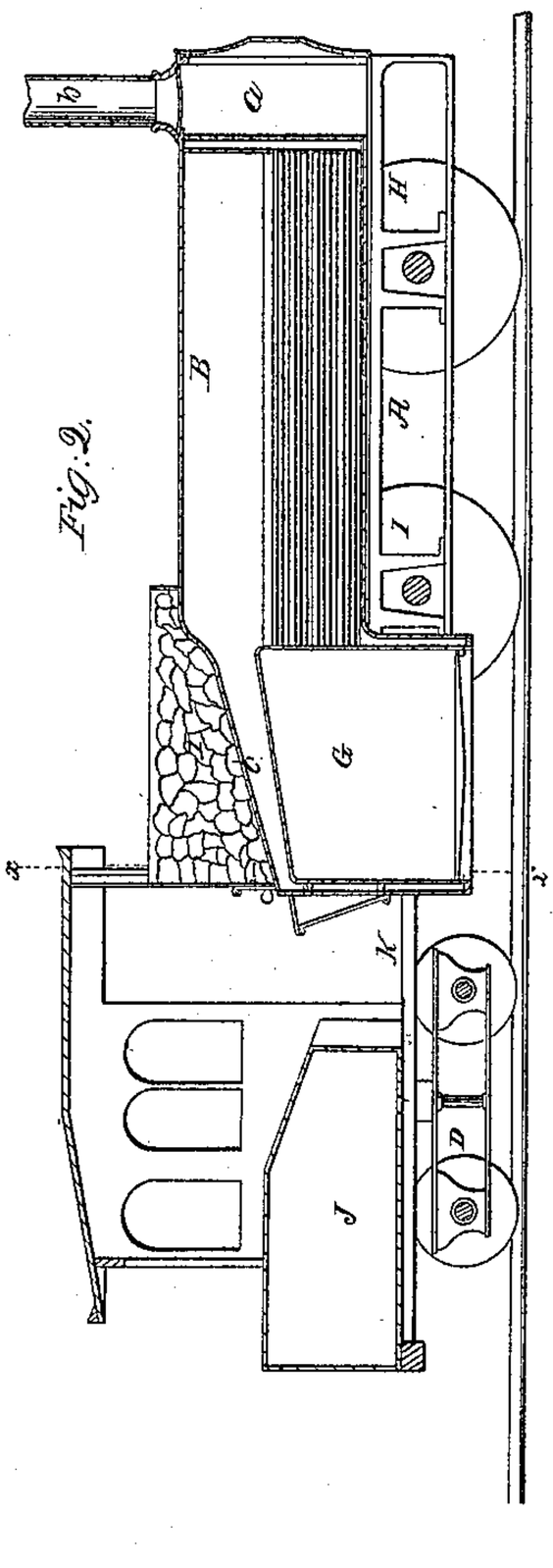

Fig. 2.

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UNITED STATES PATENT OFFICE.

M. N. FORNEY, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN LOCOMOTIVES.

Specification forming part of Letters Patent No. **52,406,** dated February 6, 1866.

To all whom it may concern:

Be it known that I, MATHIAS N. FORNEY, formerly of Baltimore, in the county of Baltimore, in the State of Maryland, but now of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Locomotives; and I do hereby declare that the following amended specification, taken in connection with the accompanying drawings, is a full, clear, and exact description thereof.

I will proceed first to point out the defects in existing locomotives which my invention is designed to remedy.

Previous to my invention locomotives have been generally so constructed as to carry only a part of the weight of the engine and boiler upon the driving-wheels, the remainder being thrown upon a bogie or truck, the wheels of which are not connected with the driving-wheels, and consequently do not aid in propelling the locomotive, but are useful only as a support. To keep this truck steady it is found necessary to throw upon it a considerable share of the weight. It usually bears about one-third of the weight of the engine and boiler, leaving only two-thirds to be supported by the drivers. This construction, as is now universally admitted, is attended with a very serious loss of power. The locomotive is able to draw loads solely by the friction of the driving-wheels upon the track, and as that friction is measured by the weight upon the driving-wheels, it follows as a matter of course that whatever diminishes the weight diminishes also the friction, and therefore the power, in the same, or nearly the same, proportion.

In spite of this objection, however, this same guiding-truck or bogie is so important that its use cannot well be dispensed with, and hence, as above stated, nearly all engines at the present day are so constructed. Its great importance consists in its guiding the locomotive round curves or over irregularities in the track, acting in this respect almost precisely as the forward wheels and axle of a wagon on a common road. But though by far the greater number of locomotives are built with this guiding-truck, this is not universally the case. There are certain classes of engines without this truck, and in which, consequently, the whole weight is borne upon the drivers.

The first are those with only two pairs of driving-wheels. In these there is a remarkable increase of power in proportion to the weight over engines of the ordinary construction; but at the same time the base of support of the wheels upon the rails is made so small and the motion becomes, consequently, so unsteady, owing to this cause and to the want of anything to serve as a guide, that the wear of the locomotive and rails, as also the liability of being thrown off the track, are greatly increased. The larger the engine and the greater the velocity the greater these objections become, so that, in fact, only comparatively small engines of this description—that is, engines with all the weight on two pairs of driving-wheels—are now known to be used at all.

The second class of locomotives without a truck are those with three or more pairs of driving-wheels. In these we have a larger base of support, and consequently greater steadiness, so far as that alone is concerned; but in turning curves these engines are even worse than the others. The wheels, being all attached immovably, or very nearly so, to the same rigid frame, with very little play allowed, cannot accommodate themselves with any freedom to the curves. The consequences are a great increase in the wear of the engine and rails, a constant tendency to mount the track, and a very considerable loss of power.

Various attempts have been made to overcome these difficulties by giving more play to the drivers; but none of them can be said to have been successful. Accordingly it is now almost universally conceded that nothing is gained by any of the above modes of construction for ordinary purposes, and by far the greater number of locomotives continue to be built, as before, with small truck-wheels carrying a large part of the weight.

The object, then, of my invention is to produce a locomotive possessing the advantages and free from the disadvantages of all the above modes of construction, or, in other words, a locomotive in which the whole weight of the engine and boiler, and, if required, a part of the water or fuel, may be carried on the driving-wheels, whether two pairs or more, thus securing the greatest possible amount of power, and which shall at the same time possess the advantages of a guiding-truck, as above set forth.

No locomotive possessing these combined advantages has yet, so far as I can learn, ever been constructed. They have either been without a guiding-truck or else the truck has been made to bear a large share of the weight.

To enable others skilled in the art to make and use my invention, I now proceed to describe its construction and operation.

Figure 1 is a side view of a locomotive according to my invention. Fig. 2 is a central vertical longitudinal section of the same. Fig. 3 is a transverse vertical section of the same in the plane indicated by the line *x x* of Fig. 2.

The same letters indicate the same parts in all the figures.

I begin by throwing the whole weight of the engine and boiler, together with a considerable part of the fuel, upon the driving-wheels, as shown in the drawings, thus securing a great increase of power. This may be done with any number of wheels, my invention being as applicable to three or more pairs as to two; but two pairs are what I have chosen to illustrate in the drawings, and are what I consider best in practice.

In order to attain the end just referred to, and also the others proposed in my invention, in the fullest and most perfect manner, it becomes necessary to make an entirely new arrangement of the different parts of the locomotive, which is done as follows:

A common locomotive-boiler with horizontal tubes is used. The driving-wheels are between the fire-box and smoke-box, and the cylinders are fastened to the latter, so that their weight, with that of their necessary attachments, may balance the weight of the fire-box. By no other arrangement can the weight be so conveniently and equally distributed on the driving-wheels. I then extend the frame of the engine A beyond the fire-box, so as to project far enough to receive the water-tank, a fuel-bin, or both, if necessary, and I support the end of the frame thus extended by a truck, which, of course, bears the weight of the water or fuel, or both, as the case may be.

In the drawings, A is the rigid frame. B is the boiler; *a*, the smoke-box; *b*, the smoke-stack. C is the fender; D, the guiding-truck or bogie; E, the cylinders; I I, the main driving-wheels; G, the fire-box; H H, a second pair of driving-wheels coupled with the main ones. J is the water-tank on the forward end of the frame A. K is the engineer's stand in front of the boiler, and between it and the tank J. L is a fuel-bin covering the top and sides of the fire-box. The top of the fire-box slopes down, as shown at C, Fig. 2, from the cylindrical portion of the boiler toward the fire-door, or is otherwise depressed below the top of the cylindrical portion of the boiler, to make more room for fuel.

Instead of the fuel-bin being arranged over and at the sides of the fire-box and the water-tank arranged at the front end of the frame A, the position of the two may, if expedient, be reversed. In practice, however, I prefer the arrangement here indicated.

Several important distinctions between the construction just described and that ordinarily adopted may here be noted.

First, the relative position of the truck and drivers is the same in both, but the position of the boiler is reversed. In engines of the ordinary construction the smoke box and stack are at the front end when the locomotive is moving, as usual, with the truck ahead. In my plan, on the contrary, the fire-box is in front and the smoke-stack and smoke-box are in the rear. This is conceived to be a great advantage, because the draft is thereby turned in the opposite direction to the motion of the locomotive, and thus greatly increased. Less power will therefore be required for this purpose from the blast, and consequently the exhaust-orifices can be enlarged, thereby reducing the back-pressure on the piston, and in this way economizing steam and fuel.

Second, the engineer's platform being by this arrangement in front of the boiler, he has from this position a full view of the road, unobstructed by the smoke-stack, dome, sand-box, &c., and is also free from the annoyance of the steam and smoke, which, in his ordinary position is often a very serious inconvenience.

Third, the position of the foot-board between the truck and drivers is the steadiest part of the locomotive when in motion.

Fourth, the cab, with the exception of an opening to rake coal from the fuel-bin into the hopper, may be closed up tight on all sides, which cannot be done when the coal has to be brought from a separate tender to the engine. In this way the fireman and engineer can be protected from excessive cold and rain, while in warm weather, the fire and boiler being behind, the heat is carried away from the cab, instead of into it, as usual.

Fifth, in order to obtain the fullest advantage from the tender as a guiding-truck, the whole combination is so arranged and constructed as to have the tender run before the engine, instead of following it, as in the ordinary mode of construction. By this arrangement the tender is the first to enter curves, and the engine naturally and smoothly follows, whereas if the engine went first the driving-wheels would be compelled to encounter the principal resistance, and the difficulties of turning the curve would thus be greatly increased. This becomes perfectly plain by reference to a common wagon. Nothing is easier than to turn it when moving with the vibrating axle in front. When drawn backward, however, it can be turned only with great difficulty. The first and second of the advantages above specified may be obtained, perhaps, as well by running an engine backward; but in running an engine backward the truck is, of course, thrown behind, and all the advantage of that is lost so far as its guiding the engine is concerned. Locomotives, in fact, as heretofore constructed, are not meant to

run backward, and cannot be run backward without many and serious inconveniences, so that in practice that mode is never adopted except for short distances and on accidental occasions, whereas in engines of my construction that is the natural mode of running, or, rather, what would be running backward in another is simply running forward in mine.

Sixth, but by far the most important advantage claimed for my invention, and that to which all the others are merely incidental, is the great saving in weight and consequent saving in the first cost of locomotives. I find on careful estimates that this saving will amount to fully one-third of the total weight of the locomotive—in other words, an engine of my construction will perform as much work as an engine of the ordinary construction weighing fifty per cent. more. This is due to several causes, as, first, by my construction, as already shown, a separate tender is dispensed with. Here is a very important saving both in the first cost and in the expense of repairs. Second, the top of the fire-box is inclined, as explained before. This construction is the cheapest, strongest, and lightest known. The water-space over the crown-sheet is made about the same in depth as on the sides, and thus the top of the inner and outer fire-boxes can be stayed with screw-bolts, as is customary, on the sides. In this way all the heavy crown-bars and equally heavy and expensive braces can be dispensed with.

Another advantage from this construction that may as well be mentioned here is the convenient arrangement thus provided for carrying the fuel. The coal, owing to this inclination of the fire-box, can be very easily raked into a hopper placed at the furnace-door, and from that into the fire-box; or, as already explained, the water may be carried above the fire-box, if desired, instead of the fuel. But the most important cause of the great saving in weight and expense above mentioned is to be found in the fact that, all the weight of the engine and boiler and a considerable part of the fuel being thrown upon the driving-wheels, so much power is thereby gained that it is possible to reduce by nearly one-third the size and weight of the engine, and it shall still do as much work as one of the ordinary size.

In these various ways a saving is effected, as above stated, of fully one-third the total weight, or about thirty thousand pounds in a locomotive of the ordinary size; and, further, the locomotive being thirty thousand pounds lighter, the same weight may be added to the train which it draws.

The following additional particulars may perhaps make the details of construction more easy of comprehension:

In a locomomotive of the usual construction there are four driving-wheels, each bearing a weight of about ten thousand pounds, and a truck bearing a weight of about twenty-two thousand. The tender will weigh, with fuel and water, forty thousand pounds, making a total of one hundred and two thousand pounds. In my locomotive I propose to carry eleven thousand pounds on each of the four driving-wheels and twenty-seven thousand pounds on the truck, making a total of seventy-one thousand pounds, or thirty-one thousand pounds less than the other, while at the same time it will be seen I have four thousand pounds more on the driving-wheels, which give about ten per cent. more adhesion. Of this weight I estimate the fuel, water, &c., to be about thirty-two thousand pounds, the truck or tender included, while the engine, boiler, and connections will make up the remaining thirty-nine thousand. The proportions in which this weight shall be divided depend much on the purpose for which the locomotive is intended and on the judgment of the builder or user of the machine.

The particular style or mode of construction which I think, on the whole, best fitted to secure the end proposed is as follows:

Besides inclining the fire-box in the manner above shown, I also shorten the waist of the boiler about two feet and use tubes of a corresponding length. To compensate for this loss of heating-surface I decrease the diameter of the flues in the same proportion, in order that the relative amount of heating-surface to the volume of air that passes through them may still remain the same. The number of tubes will thus be correspondingly increased.

I also use driving-wheels of small diameter, which are lighter in themselves than larger ones, and the stroke of the piston remaining the same, it has, of course, more power, and is subjected to less strain in turning the wheels. Consequently both the pistons and their connections may be made smaller and lighter.

The truck not being under the smoke-box, as is usual, the steam-chest and valve can be placed on the side of the cylinder, thereby dispensing with the rocking shaft and its connections.

In describing my particular invention I have been obliged to describe at the same time a great deal that is not new and to which I make no claim, for the reason that much of the advantage of my invention might be lost if a different arrangement were adopted in any material part. Many of the advantages above specified are incident to my invention without being a part of it.

To distinguish what is new from what is old I would say, therefore, that I do not claim the inclined fire-box, nor the reversed draft, nor the shortening of the boiler, nor the arrangement of the parts of the engine and boiler in relation to each other, nor, in short, any one of the devices above enumerated, except so far as expressly included in the statement of claim.

The nature of the first part of my invention consists in arranging a fuel-bin or water-tank, in combination with an inclined or depressed fire-box, so as to carry a large part of the fuel or water, as the case may be, upon the driv-

ing-wheels, thereby securing these three advantages, viz: first, relieving the tender, which would otherwise be burdened too heavily, of a considerable part of its load; secondly, obtaining a convenient receptacle for fuel, if fuel instead of water is carried there, as I advise; and thirdly, increasing the tractive power of the locomotive by increasing the hold of the drivers upon the rails.

The nature of the second part of my invention consists in combining a locomotive in which the whole weight of the engine and boiler is thrown upon the driving-wheels with a tender or truck for carrying the water or fuel, or both, by means of a rigid frame, the whole combination being so arranged and constructed as to have the tender run before the engine instead of following it, and thus serve the purpose of the ordinary guiding-truck in turning curves or passing irregularities in the track.

What I claim, then, as my invention, and desire to secure by Letters Patent, is as follows:

1. The combination, and only the combination, of a fuel-bin or water-tank with a depressed or inclined fire-box in locomotives, arranged and operating in the manner and for the purposes hereinabove substantially set forth.

2. The combination, and only the combination, of these three elements: first, a locomotive having all the weight of the engine and boiler upon the driving-wheels; second, a guiding or leading truck or tender for carrying the water or fuel, or both, or so much of them as is not carried as above shown; and, third, a rigid frame connecting the locomotive and tender, all arranged and operating substantially as above set forth.

In testimony whereof I have hereto signed my name, in the city of Chicago, this 4th day of January A. D. 1864.

MATHIAS N. FORNEY.

Witnesses:
GEORGE PAYSON,
C. M. HAWLEY.