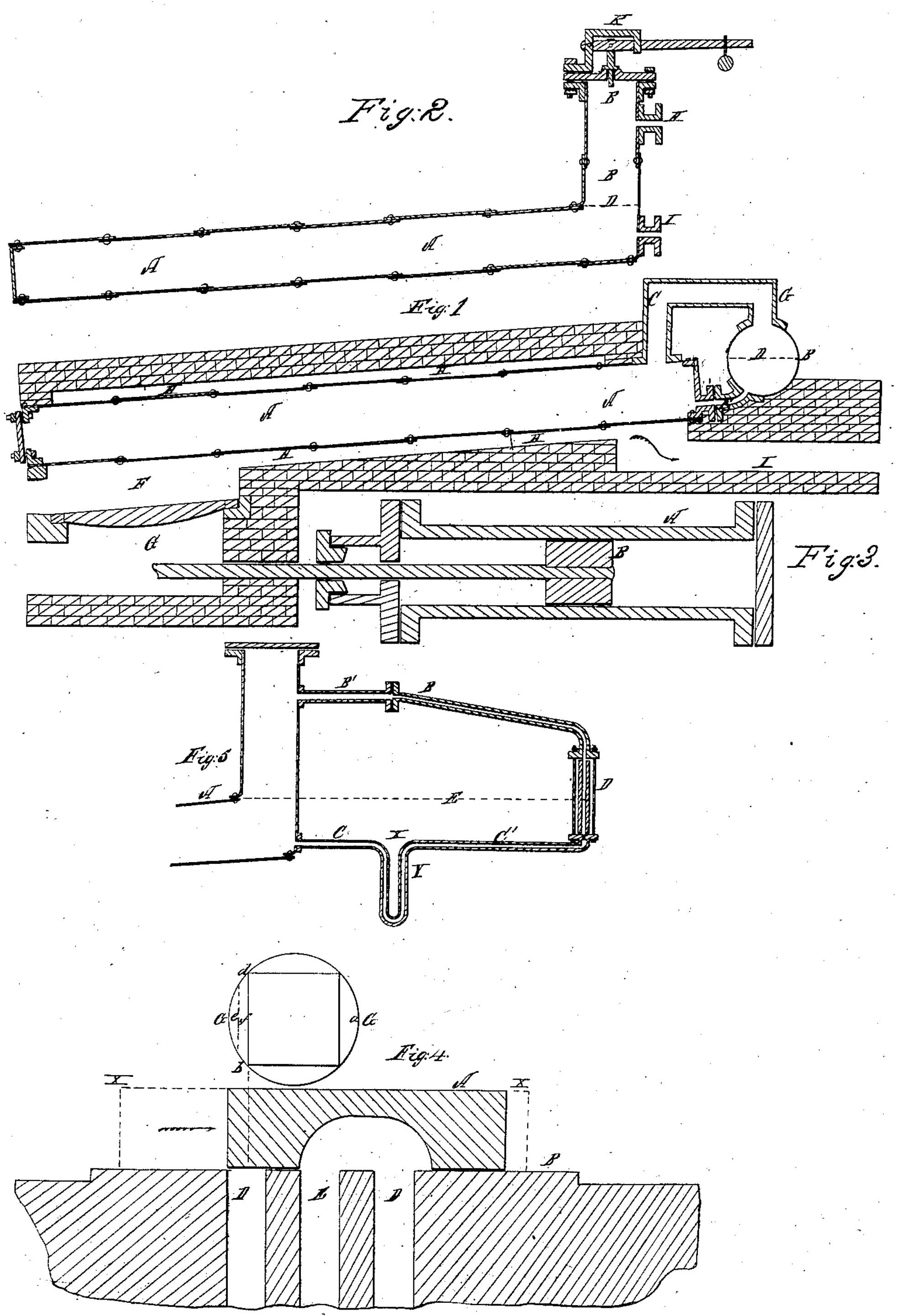
N. Bosworth,

Steam-Boiler Furnace.

No. 824. Patented July 9, 1838.



UNITED STATES PATENT OFFICE.

NATHANIEL BOSWORTH, OF PHILADELPHIA, PENNSYLVANIA.

CONSTRUCTION OF STEAM-ENGINES.

Specification of Letters Patent No. 824, dated July 9, 1838.

To all whom it may concern:

Be it known that I, NATHANIEL BOSWORTH, of the city of Philadelphia, in the State of Pennsylvania, have invented certain Improvements in the Manner of Constructing Steam-Engines; and I do hereby declare that the following is a full and exact description thereof.

My first improvement consists in the manner in which I construct and set the boiler or boilers and connect them with the pipes for the conveyance of steam, and the auxiliary parts of the engine. The boilers which I employ are of the cylindrical kind, and they are to be so set as that they may be completely surrounded by the flames and heated air from the fire, and have their whole surface, therefor, converted into a fire surface, instead of exposing one half, only, of the boiler, to the direct action of the heat as is usually the case. It is well known that, even where the best precautions are used to prevent it, a large portion of heat is lost by radification, from that part of the boiler not exposed to the fire; a loss which is entirely obviated by my plan, as the boiler is, over its whole surface, made a recipient of heat, by being constantly encompassed by a medium hotter than itself. It has been satisfactorily ascertained that this view of the subject is not a matter of theory only, but that the quantity of steam produced by the combustion of a given quantity of fuel, is much increased by this arrangement. These boilers, as they are to be entirely surrounded by the fire, are to be kept completely full of water, and are not, therefore, subject to burn out.

Figures 1 and 2 in the accompanying drawing represent the form of the boilers, and the mode of setting them, as shown in Fig. 1, two or more boilers are supposed to be used, placed side by side.

A, A, shows one of the boilers, in section. These boilers are to be so set as to form a considerable angle with the horizon, rising from their front toward their back ends, abut one inch in a foot; by which elevation the steam will be caused to escape readily from the boiler into the steam chamber or receiver at its upper end.

B, B, is the receiver, and is connected with the force pump; the dotted line D being the water line, at the level of the upper edge of the boiler; the space above D being the steam chamber.

E is a water pipe connecting the boiler with the lower part of the receiver; and C, C, a steam pipe connecting the top of the boiler with the steam chamber.

F is the fire place, and G the ash pit; H, H, the open space surrounding the boiler, and I the flue leading to the chimney. The steam pipes to conduct the steam from the receiver to the cylinder, should not enter the pipes C, C, but should, in all cases open into the top of the receiver between these pipes. When the steam chamber and connections are thus arranged, it will be found that there is a complete separation of the water from the steam which may be intermixed in passing from the boilers to the receiver.

When a single boiler only is wanted, it is to be set in the same manner as when two or more boilers are employed, but instead of the receiver which is used to connect several boilers, I make a steam chamber in the manner shown in Fig. 2 where A, A, is the boiler, and B, B a continuation thereof, rising vertically. The dotted line D, is the water line, H the steam pipe leading to the cylinder, I, the water supply pipe, and K the safety valve.

The steam cylinder, with its stuffing box, and piston, represented in Fig. 3, has nothing in it peculiar excepting the construction of the piston, which is made of metal in one piece and without packing. It may be formed of hard cast-iron, or of cast steel, and must be finished perfectly true and smooth. Its diameter is to be such that when its temperature is raised one hundred degrees above that of the cylinder, it will still pass through it readily, but leaving no sensible space between the two; when of the same temperature with the cylinder it will of course pass through it loosely. Up to a diameter of four inches I think it best to leave the piston perfectly solid, but if above this size it may be made hollow, for the purpose of decreasing its weight. Such a piston I have found to work without any apparent friction beyond that which necessarily exists in the passing of the piston rod through the stuffing box, and the most careful observation leads to the conclusion that there is not any loss of steam between the piston and the cylinder and if there is any, it has been practically proved to be so small in quantity as to be more than counterbalanced by the decreased friction, and by the other advantages resulting from the improved construction of my engine.

Fig. 4 is a representation, in section of an improved slide valve, with its seat. A is the valve, B, the valve seat. D, D induction, and E the eduction passages. The diagram C is intended to illustrate the principle upon which the valve operates. That which characterizes this valve is its being so constructed as to possess the property of shutting off the steam at a half or any other given part of the stroke, this effect resulting from the relative proportion of its respective parts, without its being complicated by any addition thereto. The ordinary value, moved by an eccentric, is usually made without reference to any particular proportion between the face of the valve and the steam passages, the eccentric being set at right angles or nearly so, to the crank, constituting what is usually termed a whole stroke valve, letting the steam on soon after passing the center on one side of the piston, the steam which caused the preceding stroke escaping simultaneously, or nearly so. The valve shown in Fig. 4, is so proportioned as to shut off at half stroke; which is effected, first, by the proportion between the valve faces and the induction passages which they alternately cover, without regard to the center passage; and secondly, by the peculiar position in which the eccentric is set to the cranks, this in the instance given, being forty five degrees from the line of the crank, instead of ninety; and as much less, or nearer to the line of the crank, when the proportion is altered so as to shut off at one third, or one fourth of the stroke.

The valve as shown in the drawing, is supposed to be moving in the direction of the arrow and to have accomplished three-fourths of its motion, measuring on the circumference of the diagram (*c*) from *a* to *b* the crank having just passed the center, and the piston being moving in the same direction with the valve, is in the act of receiving steam as will be seen by inspecting the valve. This motion of the valve being continuous will be completed on its arrival at the place of the dotted line on the right, while the motion of the eccentric will be from *b* to *c;* the motion of the valve will then be changed, and it will return to the position represented. The eccentric having moved to *d*, the steam will be shut off, and left to expand, the face of the valve passing over and covering the aperture until the piston has arrived at about seven-eighths of the stroke, when the steam will escape into the middle, or eduction passage. In this description of the motion of the valve, a lever of the first kind is supposed to form the connection between the eccentric and the valve; but this is of no consequence to the understanding of the operation provided it be borne in mind that the valve and piston are supposed to be moving in the direction of the arrow. The stroke of the piston being completed, a like effect will be produced in that which succeeds it in the opposite direction. It will be seen by inspecting the diagram C, that the steam is let on the piston during the course of one fourth of the entire circle, as from *c* to *d;* the peculiar properties of this valve being derived from the quadrature of the circle.

To arrange the valve to shut off at a third of the stroke, there needs no other change than an addition at each end of the valve, corresponding with the distance, or space, from *e* to *f*, and a slight difference in setting the eccentric a little forward, so as to permit the valve to open when the crank is on, or a little past the center. It will be observed, in this latter case, that the size of the steam passage will be diminished beyond the numerical proportion, but it is also to be recollected that the piston, when near the center, is moving at a comparatively slow rate; and the speed will be found, by calculation, or upon inspection, to be in the exact ratio of the diminution of the passage.

Fig. 5 represents my improved water indicator which shows the height of the water in the boiler, by means of a glass tube of the usual form, but so arranged as not to become heated by the steam or water of the boiler. C, C is a water pipe connecting the lower part of the boiler A with the glass indicator tube D; and B B is a tube connecting the steam chamber with the upper end of said glass tube. The water tube C, C is bent down at X, in the manner shown in the drawing, a descent being given to this bend exceeding in distance the extreme of variation in the water line of the indicator. The consequence of this is that the hot water of the boiler cannot descend so as to mingle with the water in the leg Y, and consequently the water in this leg, in the tube C, and in the glass indicator, must be kept at a temperature but little above that of the surrounding atmosphere; the only heating cause to which it is subjected being from the conducting power of the tubes; and the water produced by the condensation of the small portion of steam which first enters the tube B. The length of the tube B, as drawn in the figure, is six feet; four feet of it, next toward the glass being half an inch in diameter, and two feet of the portion B, next to the boiler, being two inches in diameter; the proportion being such that when all the atmospheric air in the portion B, is driven into the half inch tube B, the pressure will be equal to 240 lbs. to the square inch; the steam, therefore, cannot find its way into the smaller tube, and as air will not conduct heat downward into the indicator, it must remain comparatively cold, while is performs its office perfectly; there not being any apparent tendency in the steam and air to intermingle.

It will be proper to remark that what I have called the receiver differs essentially from what is usually denominated a steam drum, the office of the latter being that of a steam chamber only, while my receiver is always to contain water to the same height in which it exists in the boiler, with which it is connected for that purpose; this vessel, in my engine, receiving also the requisite water from the supply, or force pumps; its construction for the purpose of performing these respective offices, give to it a character essentially new, distinguishing it from the ordinary steam drum in a manner which must be perfectly apparent.

In the improvements above described I have had in view mainly, to attain a higher degree of speed than has hitherto been thought eligible in the reciprocating engine. It is now an admitted law in mechanics, that friction is as the time; and it is manifest, therefore, that if an engine can be so constructed as greatly to decrease the weight of its moving parts, and greatly to increase the speed with which it moves, there must, from the saving of resistance from friction, alone, be very important advantages obtained. I have succeeded in practice, in working the piston of my engine at a speed of upward of two thousand feet per minute, and have thus produced effects at least five fold greater than has ever, heretofore, been produced by engines of the same weight.

I am aware that I cannot claim the increased speed of which my engines admit, in the abstract; but I do claim it in combination with, and as resulting from, the manner in which I have constructed my engines, and especially from the peculiar construction of my piston which moves, as I verily believe, absolutely without friction.

I claim therefore—

1. The general combination and arrangement of the above described engine taken as a whole, and as distinguished from other steam engines by appropriate characteristics.

2. I claim the within described mode of constructing and setting cylindrical boilers, as represented in Fig. 1 and second, in the accompanying drawing.

3. I claim the constructing of a metallic piston, to move without friction in the manner set forth. I do not claim to be the first to have used a solid metallic piston; but I do claim to be the first who has used it so as to pass through the cylinder without friction; having been the first to ascertain that this might be done without a waste of steam.

4. I claim the manner of constructing and using the receiver, when two or more boilers are employed, as herein fully made known.

5. I claim the manner in which I have constructed my indicator and connected and combined the same with the boiler substantially as described lastly.

6. I claim the particular construction of the slide valve as set forth for cutting off the steam at any designated part of the stroke of the piston; this result being obtained by the particular proportion of its parts without resorting to any greater complexity of construction than in the ordinary whole stroke valve.

NATHL. BOSWORTH.

Witnesses:
L. BANGER,
JUDAH DOBSON.