J. Armstrong.

Sectional Steam Boiler.

No. 79,094. Patented June 23, 1868.

Fig. 1.

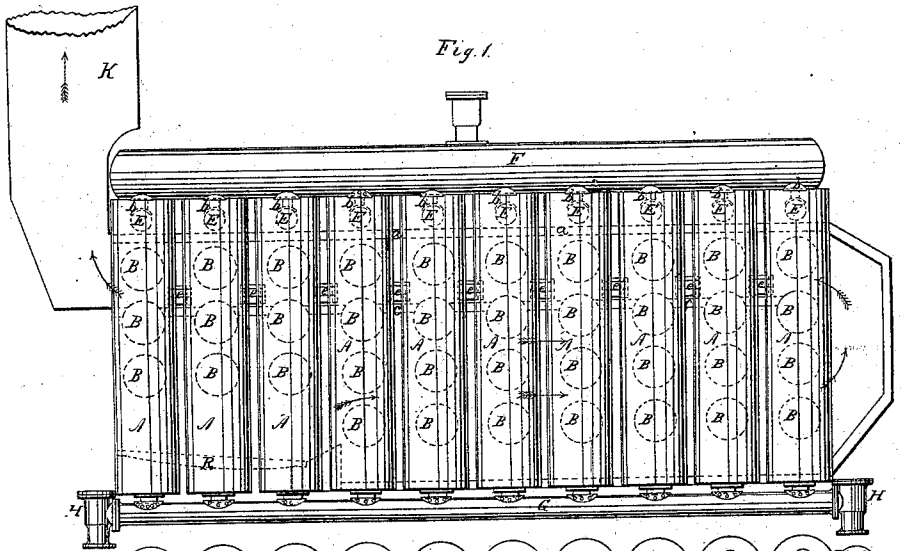


Fig. 2.

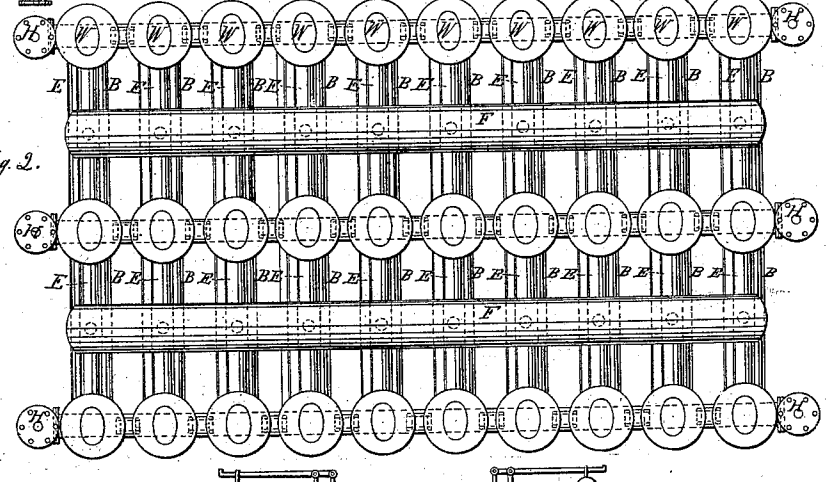
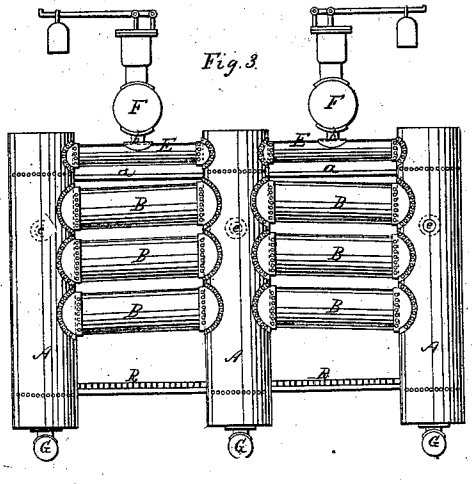


Fig. 3.



Witnesses;
Lyman Stanford
Rufus R. Rhodes

Inventor;
Jno Armstrong

UNITED STATES PATENT OFFICE.

JOHN ARMSTRONG, OF NEW ORLEANS, LOUISIANA.

IMPROVEMENT IN STEAM-GENERATORS.

Specification forming part of Letters Patent No. **79,094**, dated June 23, 1868.

To all whom it may concern:

Be it known that I, JOHN ARMSTRONG, of the city of New Orleans, parish of Orleans, and State of Louisiana, have invented a certain new and useful Improved Steam-Boiler, which, for purposes of distinction, I call an "Improved Skeleton Boiler;" and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the annexed drawings, making a part of this specification, in which—

Figure 1, Plate 1, is a side elevation; Fig. 2, Plate 2, a plan or top view, and Fig. 3, Plate 3, a front elevation.

Before I proceed to describe my invention or to indicate its mode of operation, it is proper to premise that in its construction or creation my great object has been to increase the fire-surface of a boiler of any given water-containing capacity, and correlatively the evaporation and vaporization of the water within it, with a reduced consumption of fuel; or, to state my design in other words, to make a boiler, of any given water-containing capacity, which will generate more steam with less fuel, be more easily manufactured and repaired, and far stronger, and therefore less liable to explode, while at the same time occupying less space and securing a more perfect equilibrium of pressure and heat throughout every part of it than any other boiler that has heretofore been devised, and which, furthermore, if such condition be requisite, shall be readily portable from one locality or situation to another in sections, and, therefore, in light and easily-handled form. To accomplish these obviously highly-beneficial and economic ends I have contrived a boiler in which two or more lines or sets of perpendicular tubes or flues are connected together by a system of transverse or cross flues of smaller diameter, that while approximating to a horizontal position are yet sufficiently inclined, or lower at one end than the other, to prevent the deposition and lodgment therein of saline or other sediment, and which is also provided, in addition to the ordinary steam-chamber or space in which the evolution takes place above the water-line, with capacious steam-drums, that are placed above the same for containing the steam and rarefying and drying the same, as well as to interpose an effectual guard or preventive against the danger of foaming, and also with clearing-pipes to discharge such extraneous or foreign matter, of a solid or partially-solid form, as may be carried into the boiler with the water or be created afterward by the boiling of the same and precipitated by its gravity into the lower parts or extremities of the vertical tubes and thence into the said pipes, thus preventing the formation of an incrustation upon the inner surfaces of the boiler, or the establishment of obstructions anywhere therein, to stop or check the due circulation of the water or to endanger the integrity of the boiler from the action of the fire. I employ in connection with the clearing-pipes ordinary valves—such as are used in all boilers for a similar purpose—so that it will be perceived that independently thereof my invention consists of a novel combination and arrangement of perpendicular and lateral or cross tubes, the latter being slightly inclined from a true horizontal line in connection with inferior or sub-situated clearing-pipes and superior or elevated steam-drums, the whole constituting a compact and symmetrical skeleton formation that presents an enormous measure of fire-surface with a commensurate capability of evaporation under self-evident conditions of safety and economy; but my invention will be better and more quickly understood by referring to the drawings, on which the same letters denote the same parts at all the figures.

On the drawings, A A A are the perpendicular tubes, and B B B the lateral or cross flues, which, it will be seen on inspection of Fig. 3, are slightly inclined from a true horizontal line, or so placed as to be lower at one end than the other, thus insuring a certain though gradual movement, it may be, of any deposit of sediment that may be made therein, down the inclination into the vertical tubes, from which it passes into the clearing-pipes, to be discharged by the blow-off valves or cocks. The connection between the vertical and the cross tubes may be secured by flanged sleeves riveted to the extremities of the latter and to the shell of the former around the openings cut through it, to establish a communication between the two, as shown at Fig. 3, or by any other usual and sufficient means known to persons skilled in the art to which my invention belongs.

As a general thing, or for ordinary purposes,

in constructing my boiler I propose to have three lines of vertical tubes, in each of which there are ten or more tubes; but obviously this is a matter of detail in no wise affecting the principle of my invention, and any number of lines and a greater or less number of tubes in each line may be used if circumstances should require modification. So, also, it is proper to state, while I do not confine myself to any given number of cross-flues, I should, for ordinary purposes, prefer to have four between every two of the vertical tubes, excepting just over the grate-bars, where, in order to give sufficient space for the fuel, the number is reduced to three, as shown on the drawings.

The relative diameters of the vertical and cross tubes should be about as twenty-four is to fifteen—that is to say, if the vertical tubes are to be twenty-four inches in diameter the cross-flues should be about fifteen inches; but, manifestly, any slight deviation from these proportions would not affect in the slightest degree either the design or the operation of my invention. By having the cross-flues relatively thus reduced in diameter it will be observed that an open space quite wide enough to enable a man to stand in it and work is secured between every two sets of them throughout the whole length of the boiler, and consequently that it will be easy to repair any part of the boiler that might get out of order without taking it apart. The water-line should be just above the top of the upper cross-flue and just above the horizontal cover *a*, which may consist of a plate of iron, through which the vertical tubes pass in closely-fitting openings, re-enforced by placing on it fire-brick or some other non-radiating substance, such as is usually employed in making steam-boiler furnaces. The water extending above this cover or plate, and the fire and flame being confined below it, no part of the boiler can ever be unduly heated or burned.

The space for the steam in the boiler proper is, it will be seen, in the top or upper extremity of each vertical flue, which present, in fact, multiple steam-drums above the water-line and in the connecting steam-pipes E, through which a circulation of the steam is established throughout every part of the boiler in which it is evolved or generated. Above these pipes E, and connecting with them by the short vertical pipes *b*, are the steam-drums proper, (marked F,) from which the steam passes directly to the cylinder or cylinders. The drums F are constructed and calculated with exact reference to the evaporating capacity of the boiler and to the withdrawing power of the cylinders, and being raised considerably above the boiler no foaming of the water nor consequent too rapid reduction of the same can ever possibly take place. These drums, as shown on the drawings, are merely illustrations, for they may manifestly be of any other suitable form and occupy any other suitable relation that convenience may dictate and produce precisely the same effect.

Underneath each line of vertical tubes, and connecting directly by means of a short pipe with each tube, are the clearing-pipes G, which are provided at both their extremities, as shown, with blow-off valves or cocks H, which may be, as before intimated, of any usual and approved construction.

The covering-plate *a* is the top of the furnace, which, as a whole, it will be remarked, is coextensive with the water-containing parts of the boiler, and *c* is a division-plate that is placed below it, in order to establish two reverse currents of the heat and flame, as shown by the arrows at Fig. 1, and to extend the draft to double the length of the boiler.

The apron J provides for an open space at the rear end of the boiler, that leads from the open furnace-space below plate *c* into the space that is above it, which latter constitutes the return-flue of the furnace that connects with and leads into the chimney or smoke-stack K.

In the same or very nearly the same plane with the lower extremities of the vertical tubes A the plate *d* is placed, and this plate constitutes the bottom of the furnace. The plate *c* is so placed as to be about twice the distance from the bottom plate, *d*, that it is from the covering-plate *a*, so as to reduce the return-flue—that is to say, the space above the intermediate plate, *c*, to half or less than half the vertical dimensions of the space below said plate.

The plates *a*, *c*, and *d* are permanently and firmly secured to the boiler, and each of them encircles every tube so closely that no flame can pass through either of them. They moreover extend a few inches outside each of the external line of tubes, in order to connect with the side walls of the furnace, which are thus removed for the purpose of creating a flame-space between the said walls and the said outer lines of tubes, and thus to effect a complete envelopment of every tube in the boiler by the flame, and secure an equal and uniform heat in every part of the boiler by an equal exposure of every part of its surface to the action of the fire.

Bridge-supports are fixed transversely across the boiler for the grates R in any proper manner, so that the said grates can be laid substantially as shown on the drawings.

To steady the vertical tubes and insure an upper longitudinal circulation of the water through them, small sectional pipes or chock-joints *e* may be introduced, as shown, at a point just below the line of the lower surfaces of the upper or top line of cross-flues B.

Every part of my boiler in which water is contained being completely enveloped in flame, and every part being circular, it is plainly manifest that the largest possible extent of fire-surface is presented by it, and hence that the greatest possible evaporation must necessarily result, and at the same time the greatest possible strength is secured as to every one of its parts. It will be furthermore observed that should any part or section of the

boiler explode no extended damage can take place, as in the case of boilers of ordinary construction, and that in consequence of the existence, as before stated, of considerable space between each tier or system of cross-flues, in the event of any injury to any part of the boiler the same may be easily and quickly repaired. Man-holes W, which are covered and closed by man-heads (not shown on the drawings) in any usual manner, are made in the top of each vertical tube A, in order that the same may be easily entered and cleaned.

I am well aware that James Howard and T. Bonsfield have recently patented an improved boiler in which a set of vertical tubes are connected together by means of single horizontal cast-iron tubes that are placed at the lower extremities of the former; but my invention is wholly different in every essential particular. Especially is it different in that it is made throughout of wrought-iron and is homogeneous in all its parts, and that it presents more than three times the fire-surface of the said boiler. I therefore disclaim any pretension to any part of Howard and Bonsfield's boiler, as well as to their method of uniting the parts.

I would state that I am aware that the employment or use of horizontal flues for connecting two or more lines or series of upright tubes or boilers is not new; and I am also aware that inclined pipes or flues have been used to connect vertical tubes or boilers. These, therefore, I do not claim irrespective of the arrangement described; but,

Having thus described my invention, what I do claim, and desire to secure by Letters Patent, is—

The central line or set of vertical tubes, A, in combination with the outer lines or sets of tubes, and with the system of oppositely-inclined connecting flues B, arranged in the manner and for the purpose set forth.

JNO. ARMSTRONG.

Witnesses:
LYMAN HARDING,
RUFUS R. RHODES.