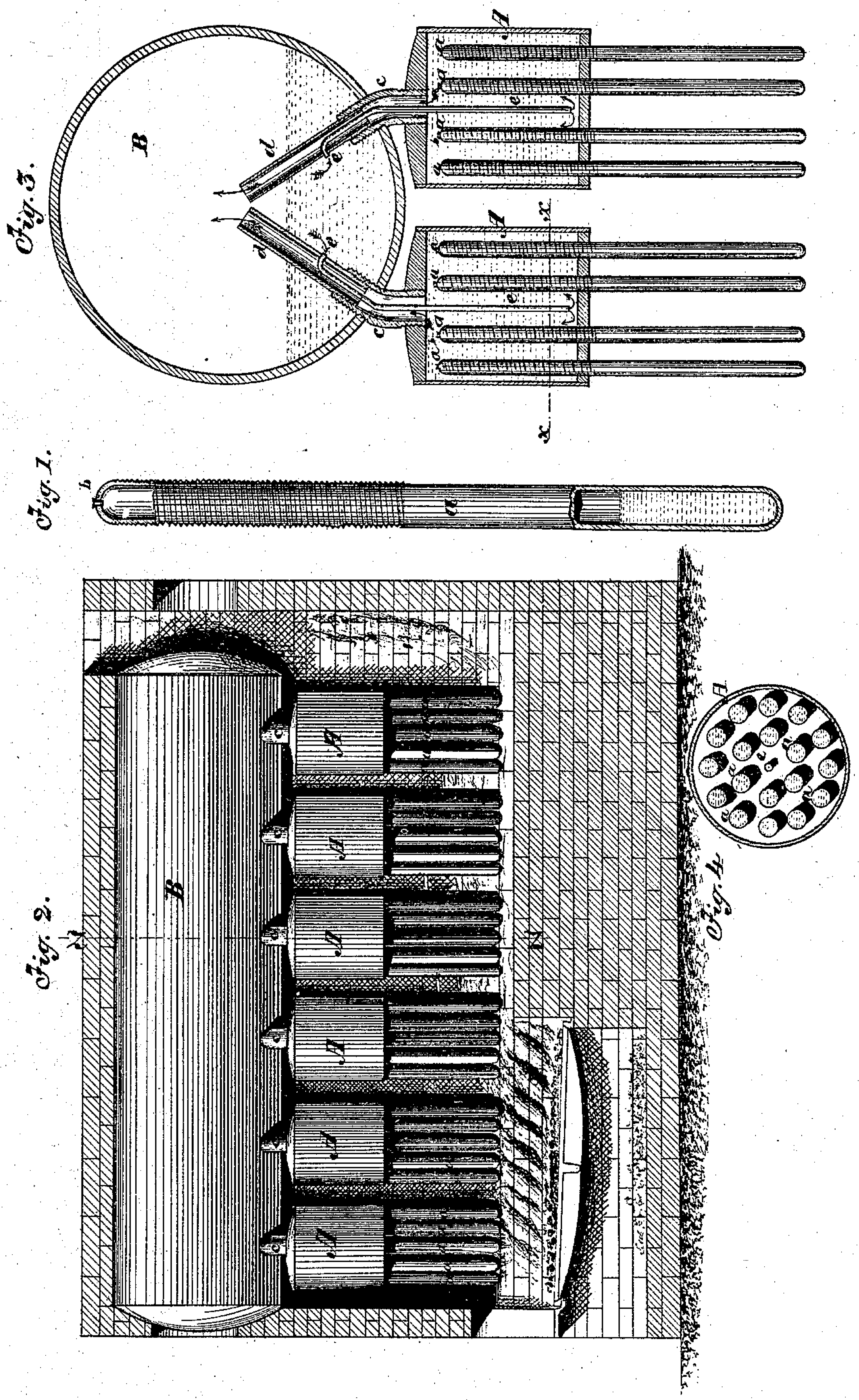
N. H. BARBOUR.

Steam Generator.

No. 105,626. Patented July 26, 1870.



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STEAM-GENERATOR.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, NELSON H. BARBOUR, of New York, in the county and State of New York, have invented a new and improved Steam-Generator; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing which forms a part of this specification.

This invention relates to a method of generating steam upon a new principle, that is to say, by means of a vacuum-chamber. The construction of the apparatus may be modified, but I prefer small metal tubes, hermetically closed, into which a small quantity of water or other liquid is introduced, the air therein being wholly or partially exhausted, leaving more or less of a vacuum or a vacuous space within the tubes above the water which they contain. The tubes have their upper ends inserted in a vessel containing water, and their lower ends placed over a fire, like the tubes in that class of boilers known as drop-tube steam boilers. The heat acts on the lower ends of the tubes, and converts the water they contain into steam, which fills the vacuum-space above and transmits its heat by condensation to the water surrounding their upper ends, converting it into steam. But in order that my invention may be fully understood, I shall now proceed more particularly to describe the manner of performing the same, and for that purpose shall refer to the several figures in the accompanying drawing, the same letters of reference indicating corresponding parts in all the figures.

Figure 1 is a side view of a single vacuum tube, a portion of the side at each end being removed to show the water and the vacuous space above it within the tube.

Figure 2 is a side elevation of a series of evaporators, A A, each containing a number of vacuum-tubes, *a a*, and connected with a water-reservoir, B, placed above, the whole being set in a furnace.

Figure 3 is a vertical section taken in the line *z z*, fig. 2, through the center of a pair of evaporators, A A, showing upon an enlarged scale the arrangement of the vacuum-tubes *a a* and the steam and water-pipes connecting the evaporators with the reservoir B.

Figure 4 is a transverse section of a single evaporator, A, taken in the line *x x*, fig. 3, showing how the vacuum-tubes *a a* are arranged in the evaporator.

The vacuum-tube *a* is made of copper or iron tubing; for ordinary purposes the tube is about eighteen inches long and three-eighths of an inch in inside diameter. Both ends of the tube are hermetically closed by brazing or welding, after which a small hole is drilled into one end; the tube is then moderately heated to rarefy the air in its interior, and, while the tube is hot, it is plunged into water, which rushes into the small hole and partly fills the tube with water. The tube is then again heated until steam is generated and the air within is expelled, when the hole in the end of the tube is promptly plugged with a metal pin, *b*, fig. 1; the pin is driven or screwed in tight and brazed to close the hole hermetically. The tube will then contain a small quantity of water occupying a part of the chamber, and the rest of the space will be a partial vacuum, that is to say, will be a space containing no fixed gas. And, if the tube has had the air properly exhausted, and contain a sufficient quantity of water, it will ring as if the liquid were a piece of metal, when it is held vertically and jerked up and down, so that the water shall fall suddenly from the upper to the lower end.

The metallic sound thus produced by the water in a vacuum is the practical test of the perfect construction of the tube, showing that it contains the necessary quantity of water, and that the air has been properly exhausted from it.

The quantity of water is not fixed, but, as a rule, the tube should contain enough to fill the vacuous space with steam, while a portion of the water still remains at the lower end of the tube, whatever may be the temperature to which it is exposed.

On the upper end of the tube, in which is the pin *b*, is cut a screw-thread, to screw the tube through the bottom of the evaporator A, until its end reaches nearly to the top on the inside. The evaporator A is a cylindrical cast-iron or coffer-vessel, usually made about six inches long and five inches in diameter. The number of tubes in an evaporator will vary as required.

The evaporators A A may be arranged in pairs, as seen in fig. 3, transversely under a water-reservoir, B, which is an iron or copper cylinder of any desired dimensions.

They are secured to the reservoir by necks or nipples *c c*, which may be made of malleable cast-iron, and are screwed into the top of the evaporator A and through the bottom of the reservoir B.

A pipe or nozzle, *d*, is screwed into the end of the nipple *c* within the reservoir B, and is long enough for the end to project above the water level and discharge steam into the steam space in the reservoir.

A feed-pipe, *e*, passes down through the nipple *c*, reaching nearly to the bottom of the evaporator A; it opens through the lower end of the nozzle *d* into the reservoir B.

The reservoir B and the evaporators A A are set in a furnace, as shown in fig. 2, with a portion of the vacuum-tubes *a a* projecting into the fire-box, while

others occupy the flue. The feed-pipe *e* supplies the evaporators A A with water from the reservoir B.

The water within the tubes is converted into steam, which fills the vacuum-chambers within them, and, whatever may be the temperature to which the lower ends of the tubes are exposed, the heat will be transmitted to the water within the evaporator A by the steam with perfect safety to the tubes; they will not be injured by the hottest fire, so long as the upper ends of the tubes are partially surrounded with water.

The steam within the vacuum-tubes is condensed at their upper ends, which are in contact with the water in the evaporators, and transmits the heat as rapidly as it can be absorbed by the lower ends of the tubes in the fire.

The heat thus transmitted by the steam in the vacuum tubes *a a* to the water in the evaporator A converts it into steam, which escapes through the nipple *c* and the nozzle *d* into the steam space of the water reservoir B.

The pressure of the steam is greater within the evaporator A, where evaporation takes place, than in the reservoir B, and the water is kept down in the evaporator to the level due to that excess of pressure; hence, the water cannot rise from the evaporator through the nipple *c* to the interior of the nozzle *d* after steam has been raised and while the generator continues in operation. The steam thus escapes from the evaporating surfaces directly through the nozzle *d* into the steam-space of the water-reservoir B without passing through water. The steam, consequently, is "dry," or true steam, and, in this respect, differs from the steam made in ordinary boilers, which passes from the evaporating surfaces through the water before it can escape into the steam-chamber.

The steam within the vacuum tubes *a a* parts with its heat to the water within the evaporator A, as rapidly as it is absorbed from the fire, because its condensation is not impeded or obstructed; for when condensation of steam takes place in a vacuum, nothing intervenes between the steam and the condensing surface of the metal.

The temperature of the evaporating surfaces of the tubes will thus always be maintained, under the action of the most intense fire, at that point which is the most effective in generating steam, that is to say, at that degree just below the point at which water, in contact with metal, assumes the spheroidal condition; hence maximum results are attained in my improved steam-generator.

It will be observed that the vacuum-tubes, being placed in a vertical position, present fire-surfaces at right angles to the current of the products of combustion, and hence the heat is most effectively applied, and may be wholly utilized before it escapes.

The evaporator A, with its group of vacuum-tubes *a a*, constitute a unit, and it is only necessary to multiply units for steam-generators of any required capacity.

Having thus described the nature of my invention, and the manner of performing the same, I wish it to be understood that I do not limit myself to the precise details of construction and arrangement hereinbefore described with reference to the accompanying drawing, as these may be variously modified without departing from the principle and nature of my invention; but

What I claim, and desire to be secured to me by Letters Patent, is—

1. A tube or chamber hermetically closed, containing water or other liquid, from over which the air, or a portion of it, has been exhausted, leaving more or less of a vacuum therein, constructed and operating substantially as and for the purpose herein specified.

2. The evaporator A, in combination with the vacuum tubes *a a*, constructed and operating substantially as described.

3. The combination of the evaporator A and the steam and water-reservoir B, constructed and operating substantially as herein described.

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Witnesses:

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