No. 700,080. Patented May 13, 1902.

S. G. PHILLIPS.

STEAM HEATING APPARATUS.

(Application filed Aug. 10, 1898.)

(No Model.) 2 Sheets—Sheet 1.

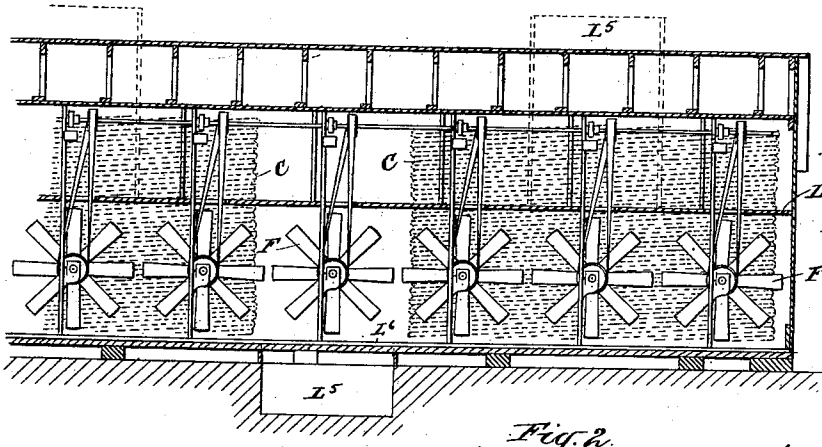


Fig. 1.
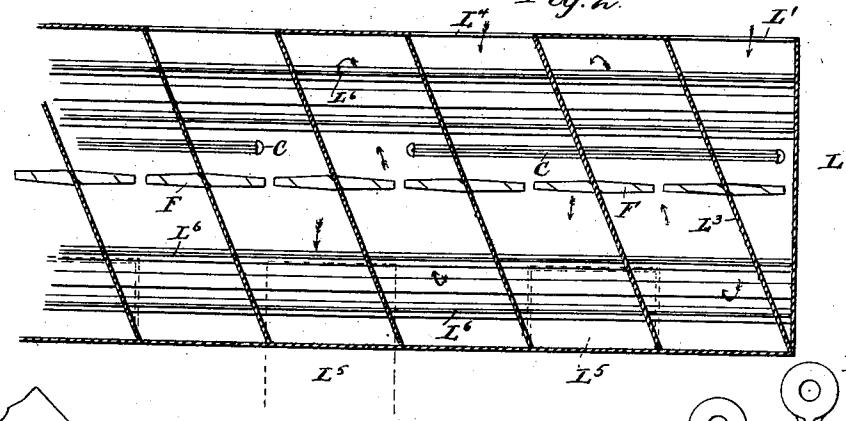


Fig. 2.

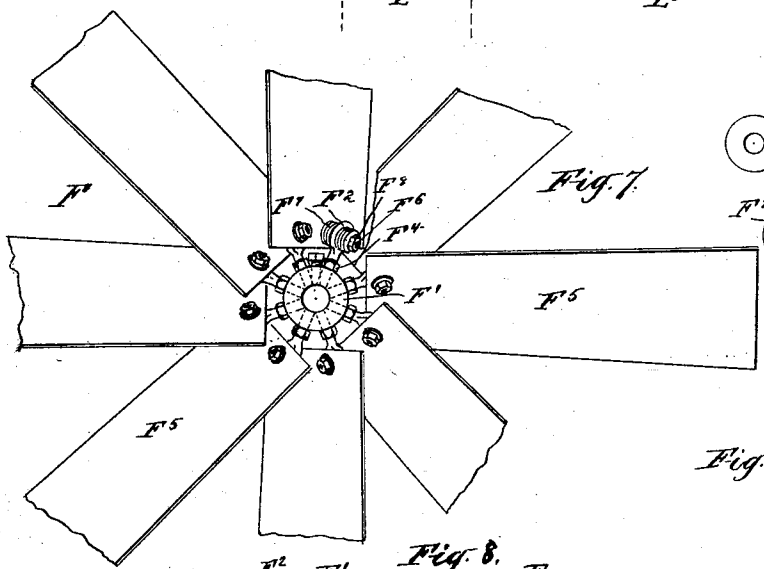


Fig. 7.

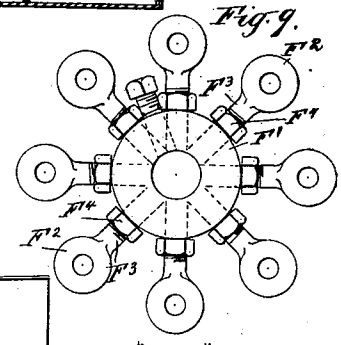


Fig. 9.

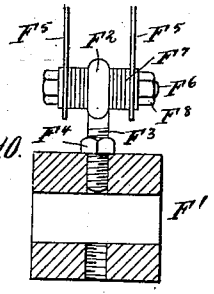


Fig. 10.

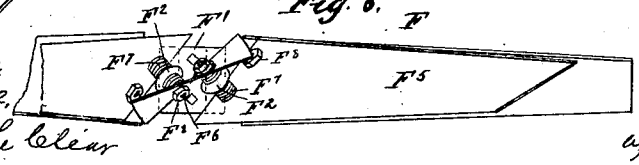


Fig. 8.

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L. R. Le Clear

Inventor:
Simeon B. Phillips
by his attorney
Charles K. Searle.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 700,080. Patented May 13, 1902.

S. G. PHILLIPS.

STEAM HEATING APPARATUS.

(Application filed Aug. 10, 1898.)

(No Model.) 2 Sheets—Sheet 2.

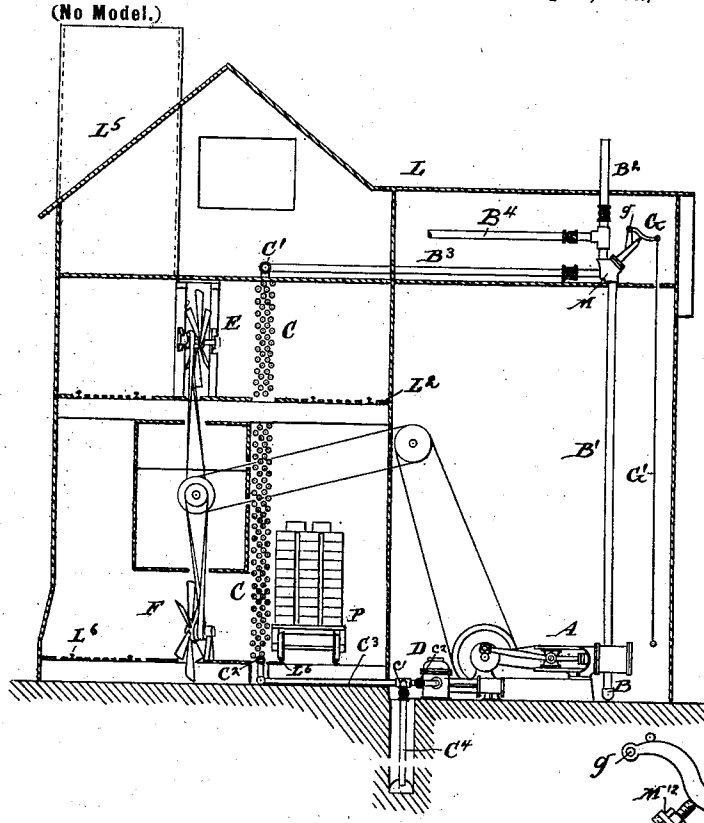


Fig. 3.

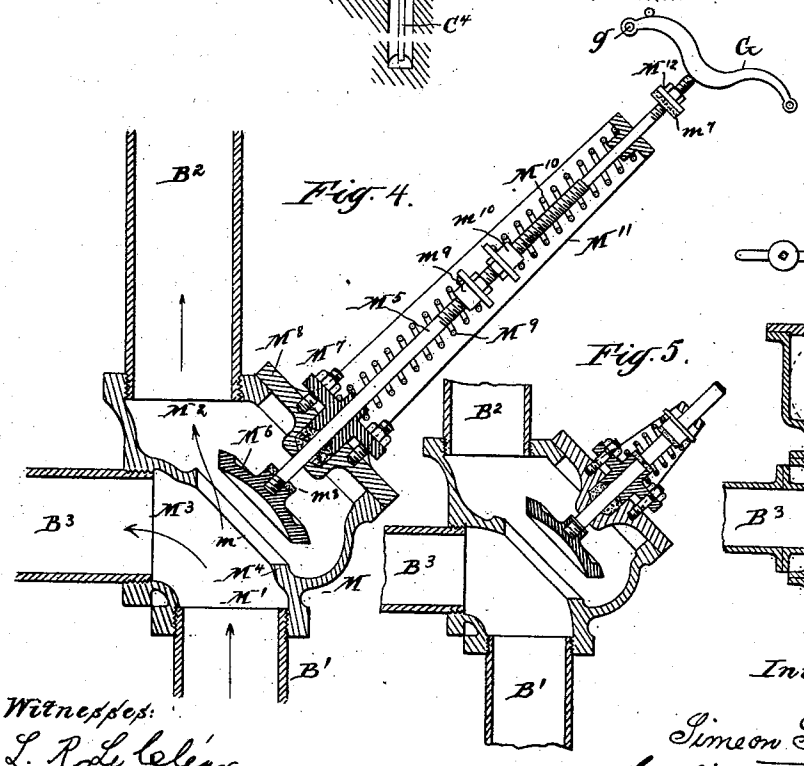


Fig. 4.

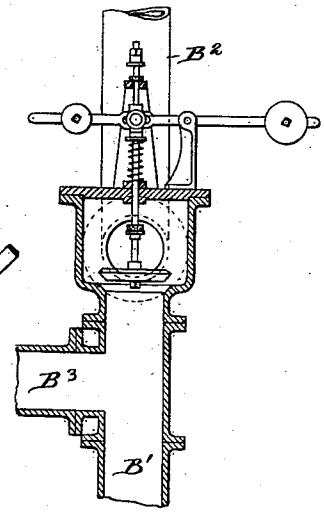


Fig. 6.

Fig. 5.

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Inventor:
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

SIMEON G. PHILLIPS, OF RAHWAY, NEW JERSEY.

STEAM HEATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 700,080, dated May 13, 1902.

Application filed August 10, 1898. Serial No. 688,258. (No model.)

To all whom it may concern:

Be it known that I, SIMEON G. PHILLIPS, a citizen of the United States, residing at Rahway, Union county, in the State of New Jersey, have invented a certain new and useful Improvement in Steam Heating Apparatus, of which the following is a specification.

The invention relates to means for utilizing the exhaust-steam from an engine in raising the temperature of large volumes of air to be used in heating or drying operations, and has for its object greater economy and increased efficiency in working.

I have devised an apparatus in which the exhaust-steam from an engine received in a system of radiator-coils of great superficial area and considerable height may be rapidly condensed by large volumes of cool air directed upon the radiators in a series of independent currents by fans driven by the engine, the partial vacuum thus produced materially aiding the latter, while the air thus heated is utilized in drying or analogous operations.

As I have carried out the invention it consists of a series of vertical radiator-coils arranged within a suitable inclosure or building having a series of air-inlet openings and discharge-passages and a number of fans in such relation thereto as to receive cool air from without, circulate it spirally between the coils, and discharge it while hot, but before the temperature rises too high to effect condensation, the succeeding fans receiving a fresh cool supply, which is similarly traversed and discharged. Large volumes of cool air in independent currents are in this manner passed through the radiators, and the height of the latter with low drainage, either with or without the aid of an air-pump, insures a partial vacuum on the exhaust side of the engine.

The invention also consists in the arrangement of a relief-valve in the exhaust-pipe, whereby any excess of exhaust-steam may escape without producing back pressure, and in an improved construction of fan for driving the air-currents.

It also consists in certain details of construction and arrangement of parts to be hereinafter described.

The accompanying drawings form a part of this specification and show the invention as carried out in practice.

Figure 1 is a vertical section through a building adapted to dry bricks or similar articles and equipped in accordance with this invention. Fig. 2 is a corresponding plan view. Fig. 3 is a cross-section on a somewhat-larger scale, corresponding, essentially, with the preceding figures, but differing in certain details. Fig. 4 is a vertical section showing the relief-valve on a larger scale, and Figs. 5 and 6 are similar views showing modifications of the valve. Fig. 7 is a face view of one of my improved fans, and Fig. 8 is a corresponding edge view. Fig. 9 is a face view of a portion on a larger scale. Fig. 10 is a vertical section through the same parts.

Similar letters of reference indicate like parts in all the figures.

I have shown the invention applied to a drier particularly adapted for drying bricks or other articles of wet clay before burning.

A is a high-pressure steam-engine, which may be of any ordinary or approved type, receiving steam from a boiler. (Not represented.) The exhaust is led downwardly through a pipe B and thence horizontally to a vertical pipe B′, extending upwardly within the building L and connecting through a lateral branch B^3 to a header C′ at the top of the radiators C C. The latter are preferably in connecting-sections arranged longitudinally of the building along its center and extending nearly its full height and are built with special regard to great superficial area, so as to serve with large volumes of moving air at a low temperature in heating the air for drying and other purposes and also to serve together as a condenser for the exhaust-steam received from the engine through the branch B^3. The several runs of pipe forming each section are arranged at a considerable incline to insure rapid drainage and are joined at a low point in the building to a header C^2, similar to that at the top, and drained through the pipe C^3 by means of the air-pump D or through the branch C^4, leading directly to a sewer or other outlet and controlled by the valves c' c^2, so arranged in the pipes C^3 C^4 that the air-pump may be cut off when desired and the partial vacuum maintained in the radiator-sections by the column of water descending

by gravity through the lower header and escaping to the drain.

F F are fans arranged, as shown, in series at one side of the line of radiators and adapted to circulate air between the coils of the latter. They are driven by belts from a counter-shaft driven by the engine. The air is received from outside through the opening L′ and is drawn through the lower portion of the radiator to the first fan below the deck or floor L^2 and forced upward through a suitable opening above the deck, thence by the guides L^3 diagonally across and forward through the upper portion of the radiator, thence downward and again through the lower portion of the radiator at a point farther forward to the second fan F, and thence discharged. The third fan receives cool outside air through the opening L^4, traverses it, as before, to the fourth fan, and discharges it, and so on through the entire length of the building or so much of it as may be desired or found expedient for the work to be performed. I have shown the air from the first pair of fans discharged upward through the passage L^5 to be led away for heating purposes and that from the second pair as passing downward to the underground passage, similarly marked, to be led to the boiler-room and finally discharged into the furnace below the grate-bars. The bricks or other articles to be dried are cross-piled upon cars P, running on tracks L^6 on each side of the radiator and adapted to be slowly pushed through the building from end to end across the spiral paths of the several currents of air.

The construction of the fans F is peculiar, especially adapting them to serve in traversing the air through this apparatus. Each consists of a central boss or hub F′, in which is secured a circumferentially-arranged single series of eyes F^2, having screw-threaded shanks F^3 and check-nuts F^4, to which are secured the blades F^5, of sheet-steel sufficiently pliable to allow bending when in position. Each eye receives a bolt F^6, passing through two adjacent blades near the advance edge of one and rear edge of the other, as shown, (see Figs. 7 and 8,) and holds them securely, but separated to the desired distance, by means of the removable washers F^7. Thus each blade is secured in an inclined position to two eyes and may be adjusted to any angle desired by simply turning the latter and making the necessary addition or subtraction in the number of washers before the check-nuts F^4 are set and the nuts F^8 tightened. I prefer to increase the angle of inclination in each second fan, and thus accelerate the movement of the current which has already been put in rapid motion by the first, and by making the blades of pliable sheet-steel or other suitable material I am able to set their outer ends to any desired angle by simply bending or twisting them by hand after they are in position to be run. Experiments demonstrate that the centrifugal force of the blades when in rapid motion is sufficient to hold the blades at the given angle. This is especially true of the second fans, to which the air is delivered in rapidly-moving currents, and the work performed in merely accelerating the speed is correspondingly slight. Thus constructed the blades may be easily adjusted in such relation to the rate of revolution as to drive the large volumes of cool air required through the radiator under all conditions.

My experiments indicate that with sufficient height, radiating-surface, and cross-sectional area in the coils under favorable conditions of drainage and low temperature of air all the steam may be condensed so rapidly that back pressure on the engine is avoided and its efficiency considerably increased by the partial vacuum produced; but in order to avoid back pressure when the volume of exhaust increases for any reason I provide a lightly-loaded relief-valve M at a convenient point in the exhaust-pipe B′ and allow the excess to lift the valve and escape through the pipe B^2. I have shown the relief-valve mounted in the angle formed at the junction of the pipe B′ and the branch B^3. It is a puppet-valve arranged obliquely, the seat m being in a partition M^1, extending from the lower opening M′ in the casing to the opening M^3, in which the branch pipe B^3 is engaged. M^2 is an opening communicating with the interior of the casing M beyond the partition. It receives the vertical pipe B^2, leading through the roof of the building and open to the atmosphere. The extended valve-stem M^5, carrying the valve-disk M^6, is screw-threaded nearly the entire length and passes through a stuffing-box M^7, very loosely packed on the bonnet M^8. It receives two helical springs M^9 and M^{10} and their adjusting-nuts and passes through an opening in a guide-yoke M^{11}, secured to the bonnet. The spring M^9 abuts against the gland of the stuffing-box below and under the nut m^9 above, exerting a lifting force on the valve-stem, tending to keep the valve always open. The spring M^{10} bears against the under face of the yoke M^{11} and the adjusting-nut m^{10} below, tending to seat the valve. By turning the nuts m^9 m^{10} the disk M^6 may be set to stand normally at the required distance above the seat and still be very sensitive to slight currents tending to lift or seat it. A washer m^8, of felt or rubber, encircling the valve-stem between the disk and bonnet, softens the impact of a sudden lift, and a similar washer m^7 above the yoke M^{11} is struck by the under surface of the nut on the reverse movement and prevents hammering upon the valve-seat. The curved oblique partition M^4 allows the steam to flow easily from the pipe B′ to the branch B^3 and leaves a nearly-direct path for the easy escape of the surplus.

A lever G, turning on the pivot g, bears against the end of the valve-stem and is operated by a cord G′, attached to its free end and reaching the engine-room. By pulling

upon the cord the engineer may close the valve when desired, and especially in starting the flow of steam to the radiator.

The exhaust-steam passing upward through the pipe B′ is drawn through the branch B^3 to the radiator-coils and rapidly condensed, as before described, the valve M standing normally open and allowing any excess of steam above that drawn by the radiator to escape easily in a nearly-direct line past the valve-disk and through the pipe B^2 to the external atmosphere.

I have observed in the plant erected that the vacuum is maintained in the coils and in the exhaust side of the engine-cylinder while steam was escaping in considerable quantities from the open end of the pipe B^2, due, I believe, to the momentum of the ascending column of steam in the pipe B′ carrying the surplus past the valve to the atmosphere when the steam in the cylinder was following further and larger quantities were exhausted at the end of the stroke than the radiator could condense. In that plant is used an Allis-Corliss engine, sixteen-and-one-half-inch piston, twenty-six-inch stroke. At the time of testing the boiler-pressure was eighty pounds and the engine making eighty revolutions. The exhaust-pipe, corresponding to B′ B^2, is six inches in diameter and the branch pipe (B^3) five inches, the radiator containing three thousand linear feet of one-inch pipe.

With the relief-valve nearly closed and the engine developing twenty-five horse-power the gage showed five inches vacuum, (mercury,) and two gallons of water per minute passed into the drain. The air-pump was cut off and not used. On increasing the load the horse-power developed correspondingly increased to about fifty. The relief-valve was held wide open and the air-pump connected and started to faster remove the water of condensation. The gage then showed eighteen inches of vacuum, and surplus steam was blowing away from the open end of the exhaust-pipe (B^2) above the roof.

A portion of the heated air after serving in absorbing moisture from the articles to be dried may be utilized to advantage by admitting it to the boiler-furnace beneath the grate-bars to promote combustion.

In the plant above referred to the vacuum maintained in the radiator increases the efficiency of the engine to an extent more than equaling the power expended in driving the fans, and therefore reduces the cost of drying very materially.

I attach importance to the low-drainage feature as offering, when circumstances will permit, an efficient substitute for the air-pump, allowing the latter to be dispensed with, thus saving in the first cost and expense of operating.

My experiments indicate that where the discharge end of the pipe C^4 is sufficiently below the radiator the gravity of the descending column of water acting upon the mingled water, steam, and air in the serpentine runs forming the elevator will draw down and discharge the imprisoned air at intervals, and thus maintain the vacuum.

Modifications may be made in the construction of the relief-valve and in the arrangement of other portions of the apparatus. The number of radiator-sections and fans may be increased and the height varied. My experiments indicate that the best results will be obtained with a radiator thirty-two feet or more in height.

Fig. 5 shows a simpler form of the relief-valve in which nice adjustments are dispensed with. It will serve successfully; but the form shown in the preceding figures is deemed preferable.

Fig. 6 shows an upright form in which the sensitive qualities are retained and adjustments made by sliding weights supported on opposite ends of a lever. In this form the passage for escaping steam is slightly obstructed by an elbow.

Instead of exhausting through the pipe B^2 directly into the air I can lead such steam through the branch B^4 to an auxiliary drier or utilize it for heating or other purposes.

In Fig. 3 I have shown the fans set at an angle and an auxiliary series upon the deck L^2. The apparatus may be thus constructed, if desired; but the single series arranged as in Figs. 1 and 2 is believed to be all that is generally necessary.

Instead of two fans between each air inlet and discharge the sets may be made up of three or more, causing the air to spiral through a longer traverse before escaping, and each succeeding fan may have the angle of its blades correspondingly increased to drive the current faster, or, if the condition demands it—as, for instance, in preparing or tempering the clay for safer drying—the blades may be set to lessen the speed of the air-currents throughout the whole or a portion of the inclosure.

The obliquity of the guides L^3 may be varied, as indicated by dotted lines in Fig. 2.

In situations where the supply of exhaust-steam is nearly constant and the capacity of the radiator sufficient to easily condense it at ordinary temperatures the relief-valve may be dispensed with and its place taken by a simple valve controlling the pipe B^2, so as to close when desired in starting the flow to the radiator.

I do not in this application claim the condensing feature of the apparatus nor the peculiar construction of fan employed, both being made the subject of separate applications for Letters Patent, the condenser filed September 27, 1899, Serial No. 731,856, and the fan filed September 27, 1899, Serial No. 731,855.

I claim—

1. In a drying apparatus, an inclosure having a series of inlet-openings and discharge-passages, a series of vertical radiator-coils ar-

ranged within the inclosure, and a series of fans arranged to receive cold air from without, circulate it in independent currents spirally between the coils and discharge it while hot but before the temperature rises too high to effect condensation, and thereby insuring a partial vacuum on the exhaust side of the engine, as set forth.

2. In a drying apparatus a series of vertical radiator-coils, an inclosure therefor having a series of inlet-openings and discharge-passages, a series of fans arranged to receive cold air from without, circulate it in independent currents spirally between the coils and discharge it while hot but before the temperature rises too high to effect condensation, whereby a partial vacuum on the exhaust side of the engine is insured, obliquely-disposed partitions in said inclosure, and tracks upon opposite sides of the fan and coils, substantially as shown and described.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

SIMEON G. PHILLIPS.

Witnesses:

FRANK H. TRUSSLER,

FRANK BOLAND.