No. 682,340. Patented Sept. 10, 1901.

S. G. PHILLIPS.

CONDENSER.

(Application filed Sept. 27, 1899.)

(No Model.) 2 Sheets—Sheet 1.

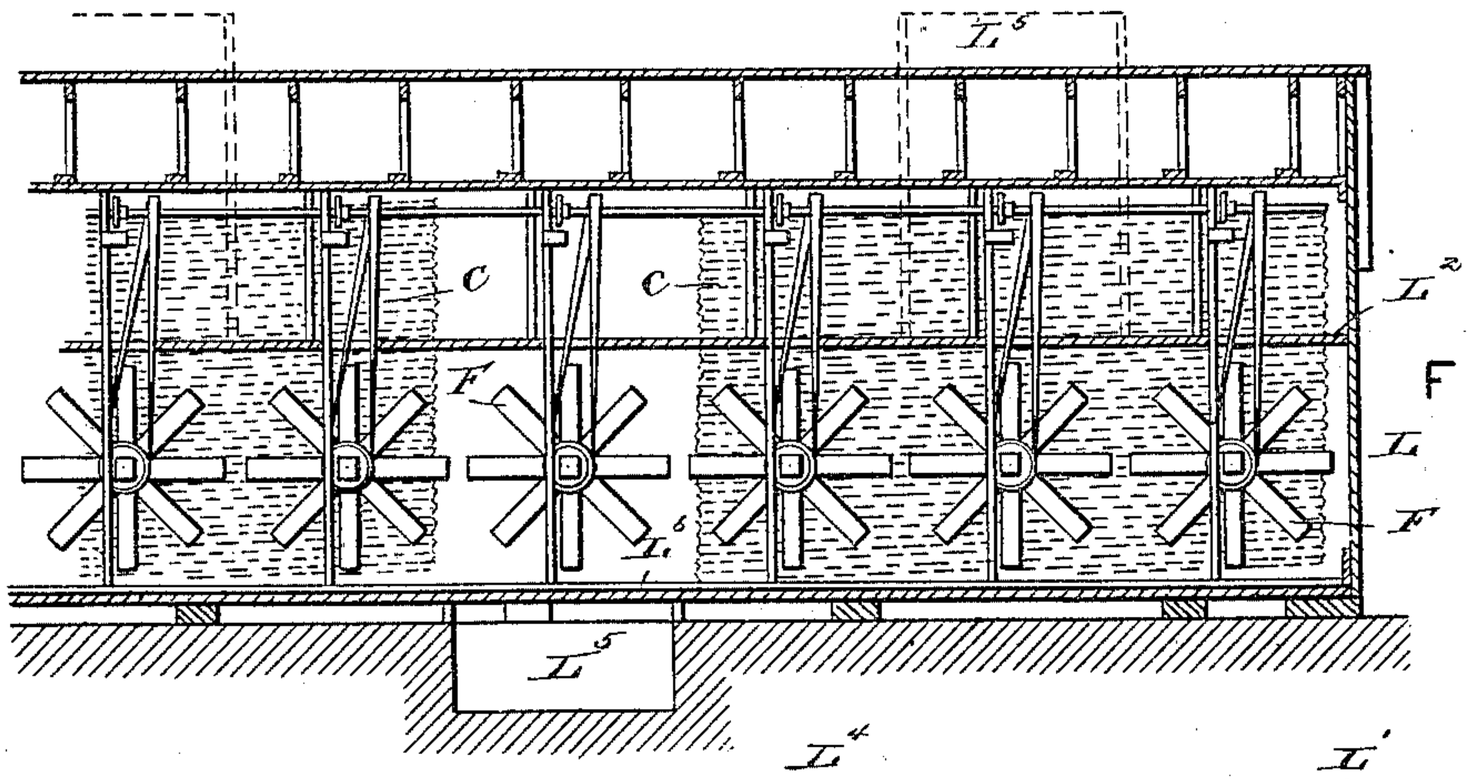

FIG. 1.

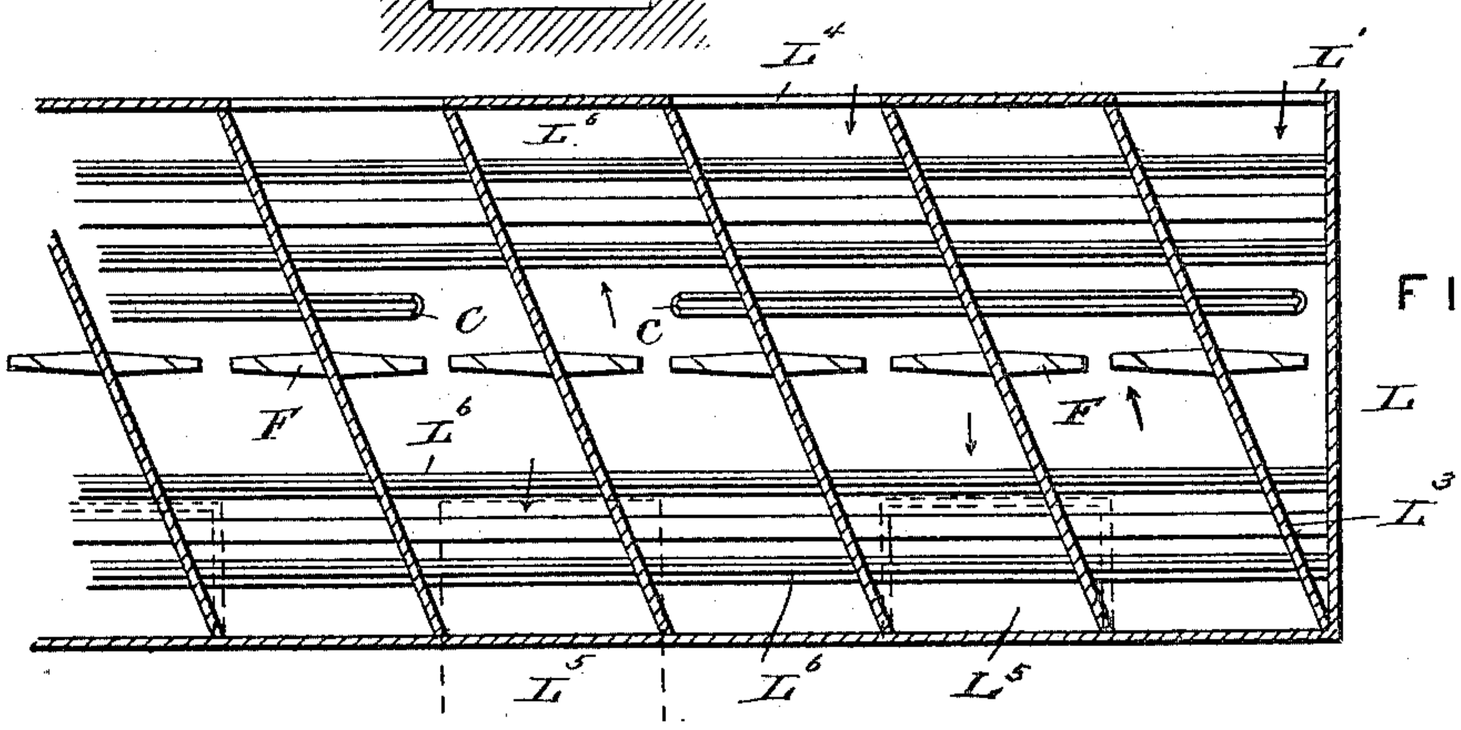

FIG. 2.

Witnesses

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FIG. 3.

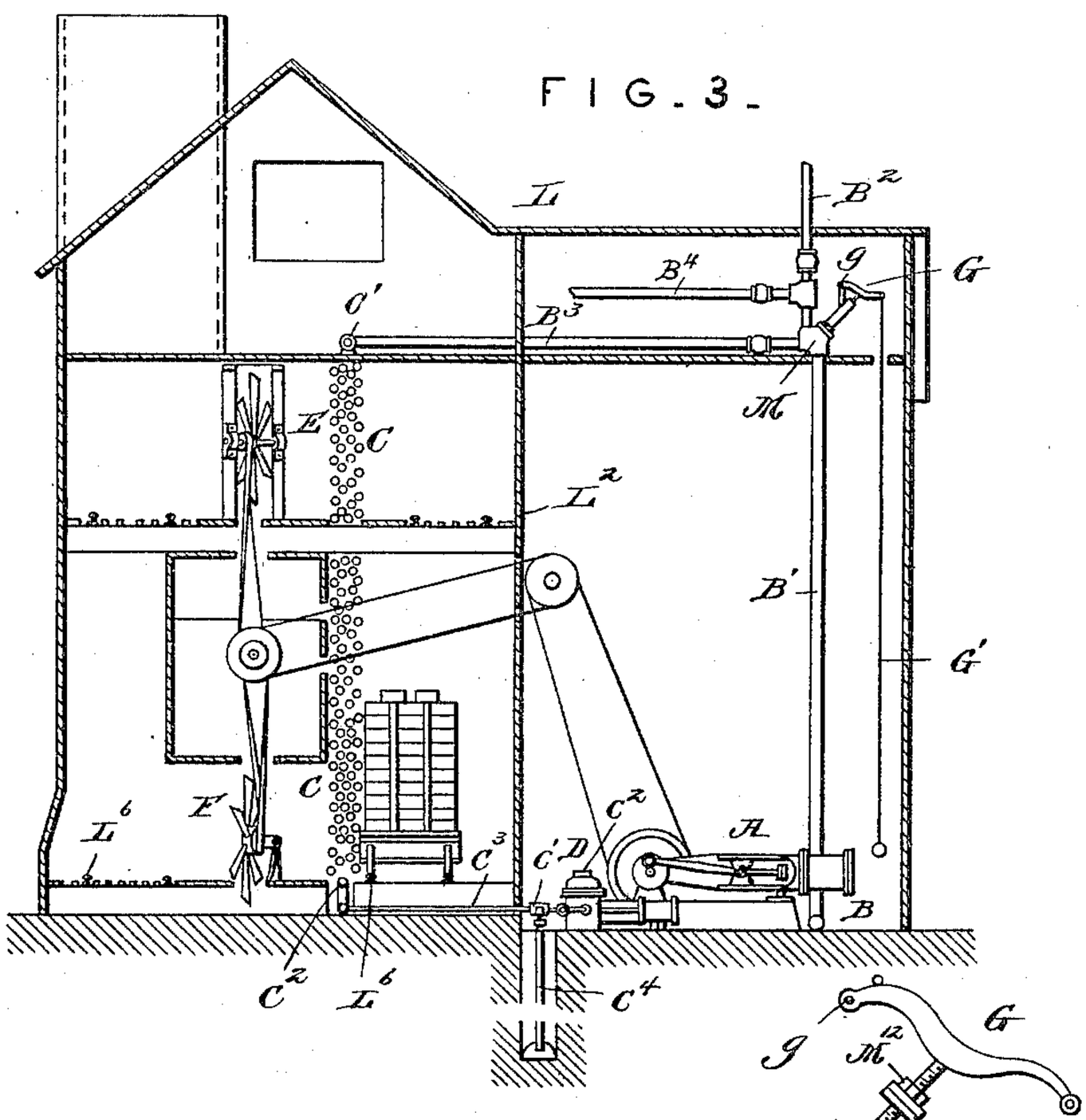

FIG. 4.

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UNITED STATES PATENT OFFICE.

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CONDENSER.

SPECIFICATION forming part of Letters Patent No. 682,340, dated September 10, 1901.

Application filed September 27, 1899. Serial No. 731,856. (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 Condensers, of which the following is a specification.

This invention relates to means for condensing the exhaust-steam from engines by bathing the coils through which the steam is led in currents of cool air supplied by fans or analogous agents.

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 may be 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 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.

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 down-

ward 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.

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 a preferred form of 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^4, 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 condenses, 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.

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 of operating. My experiments indicate that where the discharge end of the pipe C^1 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. 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. 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 conditions demand 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 the 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 patent claim the heating and drying feature of the invention nor the peculiar construction of fan employed, both being made the subjects of separate applications, the heater filed August 10, 1898, Serial No. 688,258, and the fan filed September 27, 1899, Serial No. 731,856.

I claim—

1. A system of radiator-coils, an engine having the exhaust therefrom received in said coils, means driven by the engine and disposed in series at one side of said radiator for supplying cool air to the exterior of said coils, and means for utilizing such air when heated thereby, and means for removing the water of condensation from the interior of said coils so as to induce a partial vacuum in said system and thereby increase the efficiency of the engine, all combined and arranged to serve substantially as and for the purposes herein specified.

2. An inclosure having a series of air-inlet openings and discharge passages, a system of radiator-coils, an engine having its exhaust received in said coils, a series of fans driven by the engine and arranged to draw cool air in independent currents through said openings, circulate it through said coils and the articles to be dried and diagonally across and back from one fan to the next and discharge the heated air through said passages, and means for removing the water of condensation from the interior of said coils so as to induce a partial vacuum in said system and thereby increase the efficiency of the engine, all combined and arranged to serve substantially as and for the purposes herein specified.

3. A system of radiator-coils, an engine having the exhaust therefrom received in said coils, means driven by the engine for supplying cool air to the exterior of said coils, and means for utilizing the air thus heated, means for drawing said air diagonally across and back, means for carrying and exposing material to the spiral paths of the several currents of air, means for removing the water of condensation from the interior of said coils so as to induce a partial vacuum therein and thereby increase the efficiency of the engine, an open connection from the exhaust-passage of the engine to the atmosphere, and a valve controlling such connection whereby back pressure on the engine is avoided, all combined and arranged to serve substantially as herein specified.

4. An open pipe receiving the exhaust from an engine, a branch pipe therefrom leading to a system of radiator-coils, in combination with the latter and a drain-pipe therefrom, of a depth to inclose a column of the water of condensation sufficient by its gravity to drain and maintain a partial vacuum therein, and valves controlling said open and branch pipes, whereby a portion of the exhaust-steam may be driven to said coils and a portion escape freely, all substantially as herein specified.

5. A pipe receiving the exhaust-steam from an engine, a branch pipe therefrom, a relief-valve located at the junction of said pipes and an escape-pipe leading from the valve, a deep drain-pipe of a depth to inclose a column of the water of condensation sufficient by its gravity to drain the radiator and maintain a partial vacuum therein, in combination with the connected radiator-coils and means as fans for supplying cool air to said coils, all substantially as herein specified.

6. A pipe receiving exhaust-steam from an engine, a branch pipe therefrom, a relief-valve located at the junction of said pipes, and an escape-pipe leading from the valve, a deep drain-pipe of a depth to inclose a column of the water of condensation sufficient by its gravity to drain the radiator and maintain a partial vacuum therein, in combination with each other and with the radiator-coils connected at the upper ends to said branch pipe, an air-pump connected to the lower portion thereof, and means as the fans for supplying cool air to said coils, all substantially as herein specified.

7. The relief-valve, comprising the casing

M, oblique partition M^4 having the valve-seat *m* therein, the valve-disk M^6, stem M^5, yoke M^{11}, springs M^9 and M^{10}, and their adjusting means, in combination with each other and with the exhaust-pipe B′ connected to the nozzle M′, and the branch pipe B^3 connected to the nozzle M^3 below said partition, and the escape-pipe B^2 connected to the nozzle M^2 above the partition, arranged to allow steam from the exhaust-pipe to flow directly to the escape-pipe when said valve-disk lifts, all substantially as herein specified.

8. A system of radiator-coils, an engine having the exhaust therefrom received in said coils, means driven by the engine for supplying cool air to the exterior of said coils from one side of the coils and passing it diagonally back and forth across the inclosure, and means for utilizing the air thus heated, means as a deep drain-pipe for removing the water of condensation from the interior of said system so as to induce a partial vacuum therein and thereby increase the efficiency of the engine, and an open connection from the exhaust-passage of the engine to the atmosphere whereby back pressure on the engine due to non-condensation of the exhaust is avoided, all combined and arranged to serve substantially as and for the purposes herein specified.

9. The inclosure L having the air-inlet openings and discharge-passages, the system of radiator-coils C, and fans F, the engine A driving said fans and exhausting into said coils, means for removing the water of condensation from the latter, and means as the tracks L^6 and cars P carrying and exposing the articles to be dried, all combined and arranged to serve substantially as and for the purposes herein specified.

10. The inclosure having air-inlet openings and air-discharge passages, the system of radiator-coils C, and series of fans F adapted to induce independent currents of air through said openings and passages and circulate them through said coils and spirally of said inclosure, the engine A driving said fans, a pipe B B′ B^2 leading the exhaust-steam from the engine, a branch B^3 leading it to the said system, the relief-valve M located at the junction of said branch with said pipe, means as the air-pump D for removing the water of condensation from said system, and means as the tracks L^6 and cars P for carrying and exposing the articles to be dried to said currents, all combined and arranged to serve substantially as herein specified.

11. An inclosure having a series of air-inlet openings and discharge-passages, a system of radiator-coils, an engine having its exhaust-steam received in said coils, a series of fans driven by the engine and arranged to draw cool air through said openings, circulate it through said coils and the articles to be dried, and discharge the heated air through said passages, in combination with a deep drain-pipe as C^4 serving to inclose a column of the water of condensation sufficient by its gravity to drain the radiator and maintain a partial vacuum therein, all substantially as herein specified.

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

SIMEON G. PHILLIPS.

Witnesses:
CHARLES R. SEARLE,
GEO. W. CASE, Jr.