(No Model.)

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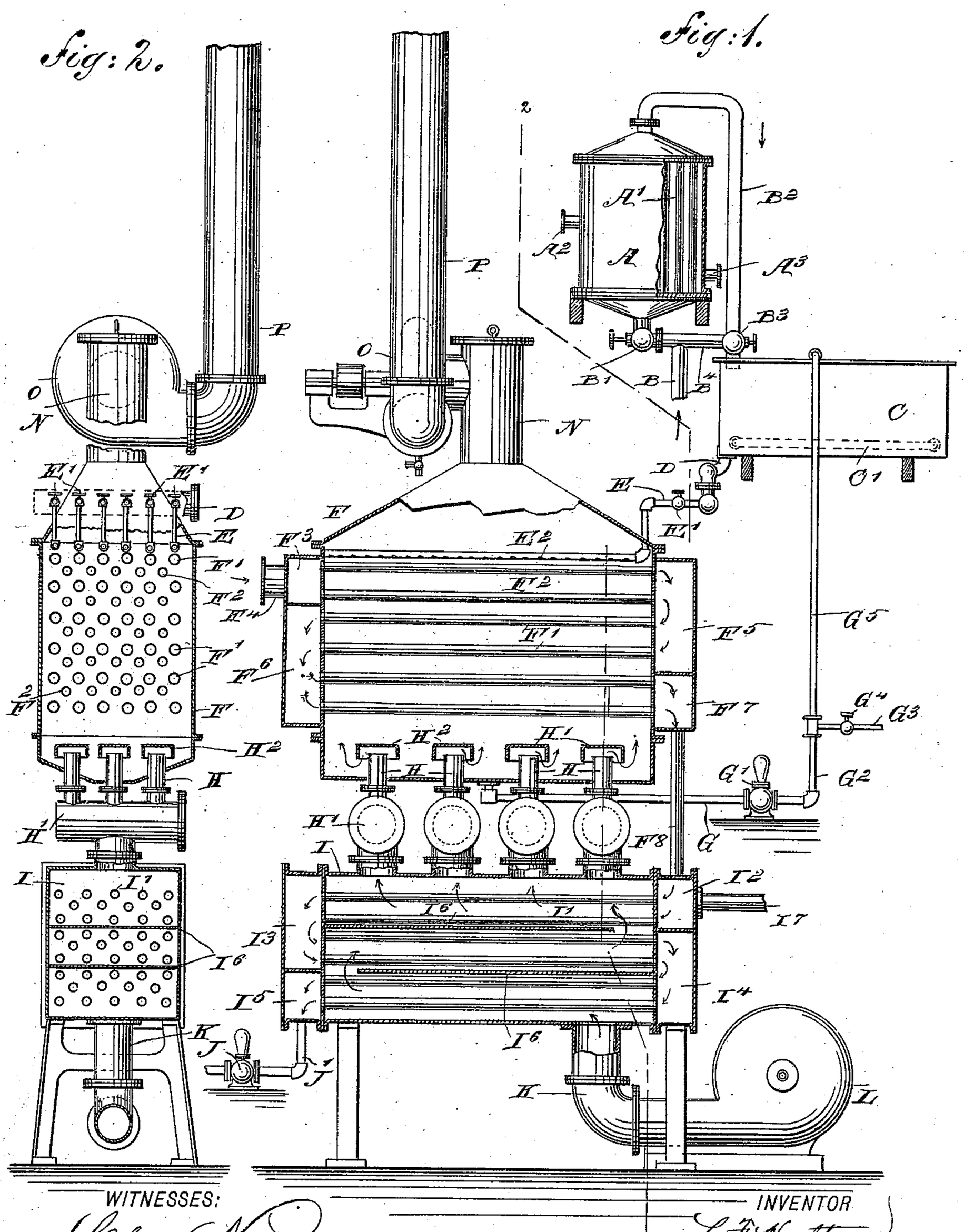
APPARATUS FOR EVAPORATING LIQUIDS.

No. 546,530. Patented Sept. 17, 1895.

Fig: 2.

Fig: 1.



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APPARATUS FOR EVAPORATING LIQUIDS.

SPECIFICATION forming part of Letters Patent No. 546,530, dated September 17, 1895.

Application filed July 12, 1894. Serial No. 517,346. (No model.)

To all whom it may concern:

Be it known that I, LEON FRANCOIS HAUBTMAN, of New Orleans, in the parish of Orleans and State of Louisiana, have invented a new and Improved Apparatus for Evaporating Liquids, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved apparatus for evaporating water and saccharine solutions or other liquids in a very simple and inexpensive manner.

The invention consists of certain parts and details and combinations of the same, as will be fully described hereinafter, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in both the figures.

Figure 1 is a sectional side elevation of the apparatus, and Fig. 2 is a transverse section of the same on the line 2 2 of Fig. 1.

It is a well known fact that air, taken at a certain temperature and superheated, is capable of absorbing a certain quantity of moisture, in proportion to the difference of temperature between the normal temperature of the air when entering the superheater and the temperature at which the air is on leaving the superheater. In the apparatus presently to be described, the superheated air can absorb all the moisture contained in the liquid to be concentrated by simply causing the hot air to come in direct contact with a flowing liquid at a hotter temperature, the liquid flowing in an opposite direction to the movement of the air, so that the latter comes in contact with the liquid under a certain pressure and creates a current opposite to the current of the liquid.

The apparatus as illustrated in the drawings is provided with a steam-heater A, of any approved construction and provided at its bottom with a liquid-inlet pipe B, connected with a suitable source of liquid-supply and provided with a valve B′ to regulate the flow of the liquid to and through the heater A. The latter is provided with the usual pipes A′, around which circulates the steam, entering the vessel at A^2 and leaving the same at A^3. The liquid in passing through the pipes A′ is heated to a considerable temperature, and finally passes from the upper end of the vessel A into a discharge-pipe B^2, discharging into a heating-tank C, provided with a steam-coil C′ for heating the liquid to about its boiling-point.

The pipe B^2 is connected by a branch pipe B^4 with the inlet-pipe B, and a valve B^3 as arranged in the joint of the branch pipe B^4 and the pipe B^2, so that the liquid may be passed directly from the pipe B into the tank C, instead of first passing through the heater A. The tank C is provided with a discharge-pipe D, extending transversely and provided with a series of smaller pipes E, each containing a valve E′ and extending into the upper part of an evaporator F, as plainly shown in the drawings. Each pipe within the evaporator is formed with perforations or slots E^2 for the escape of the liquid in jets or sprays, the liquid passing over pipes F′ and F^2, arranged in the evaporator F in such a manner that the flow of liquid is continuously broken, causing the liquid to pass in a zigzag line toward the bottom of the evaporator, to be taken from there by a pipe G and circulating-pump G′ to be discharged, through the pipes G^2 and G^3, into the tank for the concentrated liquid. The pipe G^3 is provided with a valve G^4 and is connected by the pipe G^5 with the tank C, so that the liquid, instead of being passed to the tank for the concentrated liquid, may be returned by the pipe G^5 into the tank C, previously described.

Through the pipes or flues F′ and F^2 circulates steam, entering the chamber F^3 arranged on one side of the evaporator F, and connected by a pipe F^4 with a suitable source of steam-supply. On the opposite side of the evaporator F is arranged a second chamber F^5, into which discharge the uppermost pipes F′ and F^2, the said chamber also causing the steam to pass through the next lowermost pipes F′ and F^2 to a chamber F^6, arranged below the chamber F^3 on the evaporator F. This chamber F^6 connects with the lowermost pipes F′ and F^2, which latter discharge on the opposite side of the evaporator into a chamber F^7, located below the chamber F^5. Thus the steam completely circulates through the several

heating-pipes or flues F′ and F² to heat the liquid flowing over the said pipes in very thin streams or jets.

Into the lower end of the evaporator F extend the air-pipes H, connected in sets with manifolds H′, connected with an air-heater I for heating the compressed air discharged into the said air-heater before it passes through the manifolds H′ and pipes H into the lower end of the evaporator F.

A short distance above the upper end of each pipe H is arranged a hood or protector H² to prevent the downflowing liquid from flowing into the said pipes, at the same time spreading the air passing from the pipes H into the evaporator. The air-heater I is provided with steam-pipes I′, of which the uppermost is connected at one end with the steam-inlet chamber I², connected by a pipe F⁸ with the last chamber F⁷ of the evaporator F.

The pipes I′ discharge, on the left side of the air-heater I, into a chamber I³, connected with the middle pipes I′, discharging into a chamber I⁴, located below the chamber I² and connected with the lowermost pipes I′, discharging into the chamber I⁵, arranged below the chamber I³ and connected by a pipe J′ with a condensed-water pump J, of any approved construction, to cause the rapid circulation of the steam through the pipes and chambers in the air-heater I. The latter is also provided with partitions I⁶, for causing a circulation of the air from the bottom upward, as indicated by the arrows in Fig. 1. Into the lower end of the air-heater I discharges a pipe K, connected with the discharge end of a blower L for forcing air under pressure into and through the air-heater I and the evaporator F. The top of the evaporator F is provided with an outlet-pipe or flue N, connected with a suction-fan O, discharging into a chimney P, leading to the outside.

The operation is as follows: When first starting the apparatus, the valve G⁴ in the pipe G³ is closed and the pumps G′ and J, as well as the blower L and exhaust-fan O, are set in motion and the liquid is forced through the pipe B into and through the heater A, to be heated to a certain extent and to be finally discharged into the tank C, to be subjected to a further heating so as to bring the liquid to or nearly to the boiling-point. The liquid then flows through the pipes D and E out of the perforations E², from which it passes in jets or sprays over the pipes or flues F′ and F², and at the same time heated air under pressure travels in an upward direction within the evaporator F, so as to take up all the moisture contained in the downwardly-flowing liquid. The exhaust-fan O removes the moistened air as quickly as possible from the evaporator F, while the liquid gathering in the bottom of the evaporator is pumped by the pump G′ and pipes G² and G⁵ back into the the tank C, to be treated over again in the manner above described. When it is desired to obtain a specified density of the liquid concentrated, then this process is repeated until the proper degree is reached, after which the valve G⁴ is opened to permit the concentrated liquid to flow through the pipe G³ to the tank for the concentrated liquid.

It will be seen that the superheated air passing through the evaporator absorbs a large quantity of the moisture contained in the liquid flowing down in little sheets over the pipes or flues F′ and F², and consequently the liquid is concentrated in a very short time and at a comparatively low cost.

This system of concentrating liquors does away with all the extensive use of costly vacuo-pumps, and, furthermore, does not require any water-sprayer, such as is used in boiling *in vacuo*, while by the absorption of moisture it evaporates the liquor to a high density under a very low degree of heat.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. An apparatus for evaporating liquids, comprising an evaporator provided with heating flues or pipes for the passage of a heating medium, perforated pipes for discharging the liquid over the said pipes or flues in the evaporator, air pipes connected with the said evaporator, to pass a current of air through the evaporator to bring the air in contact with the liquid, an air heater into which air is discharged and heated to pass through the said air pipes into said evaporator, and a blower for forcing air in and through the said heater, substantially as shown and described.

2. An apparatus for evaporating liquids, comprising an evaporator provided with heating flues or pipes for the passage of a heating medium, perforated pipes for discharging the liquid over the said pipes or flues, air pipes connected with the said evaporator to pass a current of air through the evaporator to bring the air in contact with the liquid, and a circulating pump connected with the bottom of the said evaporator and adapted to discharge into a tank containing the liquid, substantially as shown and described.

3. In an evaporator, the combination with a casing provided with heating flues and a perforated pipe above the flues, of an air heater arranged below the casing, pipes leading from the air heater up through the bottom of the said casing, and a blower connected with the air heater, substantially as described.

4. In an evaporator, the combination with a casing having end chambers and provided with flues communicating with the said chambers, of a second casing communicating with the first named casing and provided with end chambers and flues communicating with the end chambers, a pipe connecting one lower and upper chamber of the two casings, and a blower connected with the second casing, substantially as described.

5. An evaporator, comprising a steam heater, a heating tank connected with the

heater, a casing provided with flues and perforated pipes, said perforated pipes being connected with the heating tank, an air heater below the casing, pipes leading into the bottom of the casing, and manifolds connected with the air heater and with which the pipes leading into the casing are connected in sets, substantially as described.

6. An evaporator, comprising a steam heater, a heating tank connected with the steam heater, an evaporator connected with the tank and provided with heating tubes and a perforated pipe above the said tubes, an air heater connected with the bottom of the evaporator, and a blower connected with the air heater, substantially as herein shown and described.

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