M. LEBLANC.

COOLING APPARATUS FOR HOUSES.

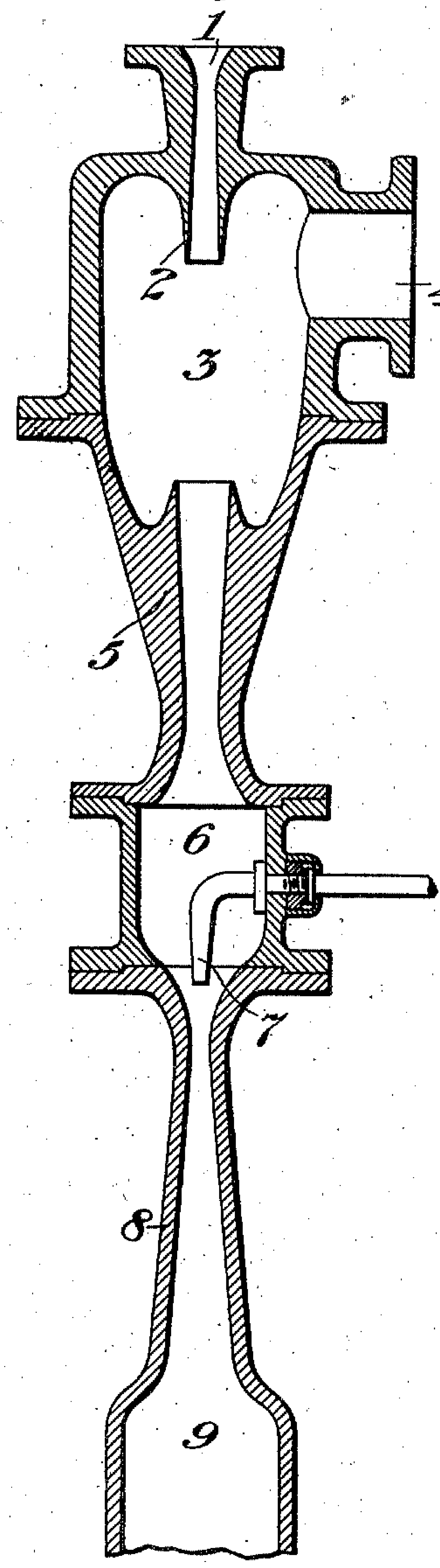
APPLICATION FILED FEB. 10, 1904.

967,024.

Patented Aug. 9, 1910.

2 SHEETS—SHEET 1.

Fig. 1



Witnesses
Chas. J. Clagett
W. H. Capel

Inventor
Maurice Leblanc
By his Attorney
Charles A. Terry

M. LEBLANC.

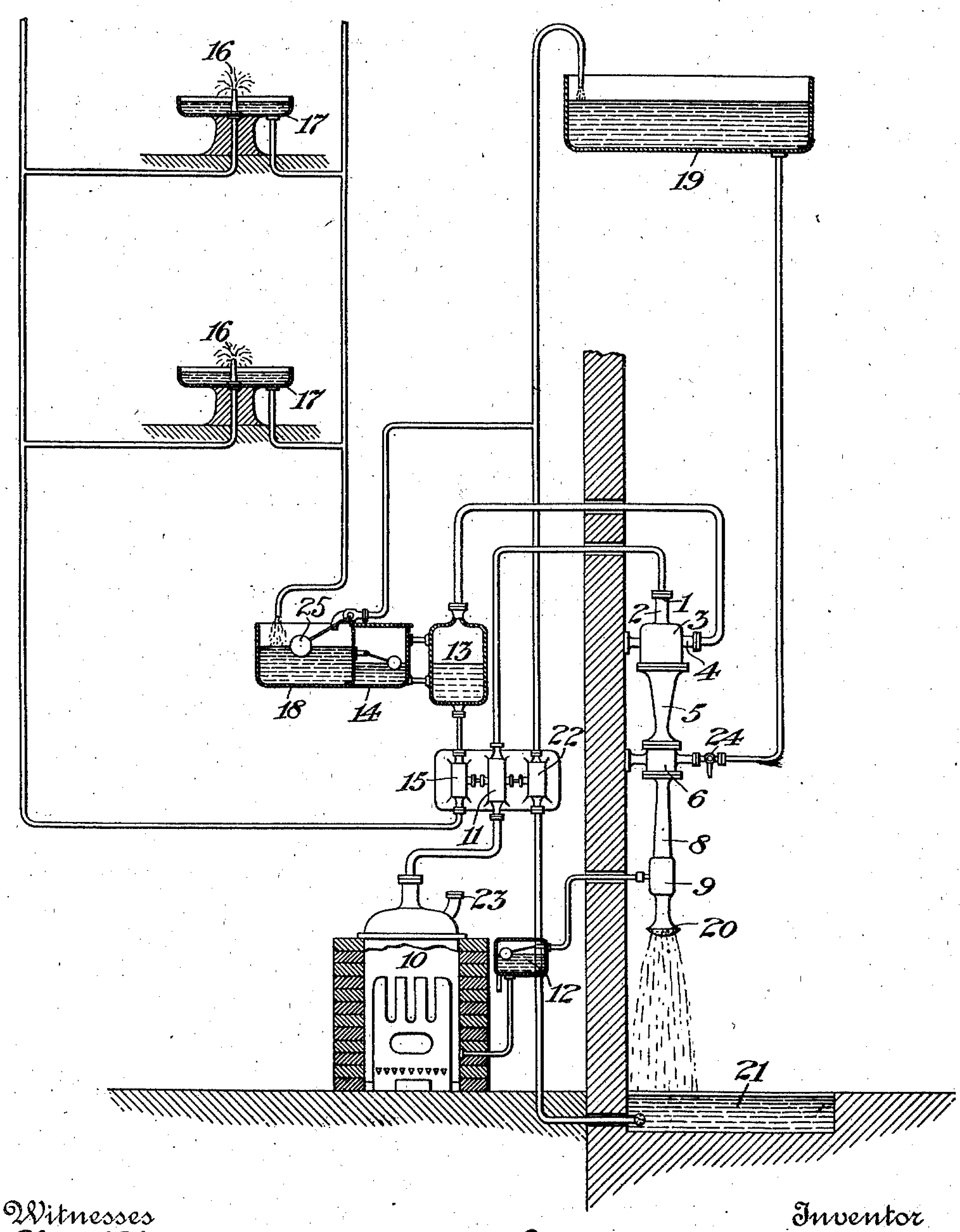
COOLING APPARATUS FOR HOUSES.

APPLICATION FILED FEB. 10, 1904.

967,024. Patented Aug. 9, 1910.

2 SHEETS—SHEET 2.

Fig. 2



Witnesses

Chas. J. Clagett

Wm. H. Capel

Inventor

Maurice Leblanc

By his Attorney

UNITED STATES PATENT OFFICE.

MAURICE LEBLANC, OF PARIS, FRANCE, ASSIGNOR TO SOCIETE ANONYME POUR L'EXPLOITATION DES PROCEDES WESTINGHOUSE-LEBLANC, OF PARIS, FRANCE.

COOLING APPARATUS FOR HOUSES.

967,024. Specification of Letters Patent. Patented Aug. 9, 1910.

Application filed February 10, 1904. Serial No. 192,908.

To all whom it may concern:

Be it known that I, MAURICE LEBLANC, a citizen of the Republic of France, and resident of Paris, France, have invented certain new and useful Improvements in Cooling Apparatus for Houses, of which the following is a specification.

This invention relates to refrigerating apparatus and more particularly to apparatus adapted to be utilized for cooling houses.

An object of this invention is the production of a simple and relatively efficient house cooling apparatus.

Experience has induced the inhabitants of hot countries, especially along the shores of the Mediterranean, to give to their houses a cubical form and to obtain light for their apartments from a central court provided with a basin having a water jet. Where cold water can be obtained, (which is but rarely) this arrangement is excellent. Again, in the hot countries while the temperature rarely exceeds 30° centigrade, it continues from one end of the year to the other and the air is saturated with moisture. The practice of having the open court and fountain, if cold water is obtainable, is not only beneficial as a means of cooling the atmosphere but it also tends to dry the same by condensing the moisture therein.

We find that a cubic meter of saturated air contains: 30.10 grams of water vapor at a temperature of 30° C. 22.30 grams of water vapor at a temperature of 25° C. 17.05 grams of water vapor at a temperature of 20° C. 12.60 grams of water vapor at a temperature of 15° C.

Supposing that saturated air at 30° were agitated by a water jet which, issuing at a temperature of 15° falls into a basin at a temperature of 15°, the air will take the temperature of 15° at its point of contact with the water and the greater part of the vapor which it contains will be condensed. On breaking contact with the water it will not contain more than 12.6 grams of water per cubic meter.

Supposing that the temperature in the house is maintained at 25°, which is a satisfactory temperature, the air which is reheated there will be comparatively dry, as it will not contain more than 12.6 grams of vapor per cubic meter while saturated air contains 22.3 grams.

In houses constructed in the European fashion basins may be arranged where jets of water at low height may fall and these may take the place of grates or fireplaces, or they may replace the hot water radiators and like them may be provided with inlet and outlet pipes.

A water jet constitutes a most efficient regulator of temperature, because the contact between the water and the air is direct and operates over an extremely large surface obtained at low cost. This allows the atmosphere to be sufficiently cooled with water at a temperature of, say, 10° centigrade, whereas if radiators were used it would be necessary to give them excessively large surface or to maintain them at a very low temperature. Both of these would render the absorption of heat units very expensive. The function of my refrigerating apparatus consists in cooling a mass of water to, say, 10° centigrade and then causing it to issue through various jets arranged in the house and returned to be cooled and again distributed.

A simple manner of cooling water is to cause it to partially evaporate in a vacuum and a steam ejector is a simple vacuum apparatus. I have found that a boiler working at 100° centigrade, that is to say, giving off vapor at atmospheric pressure, can be satisfactorily utilized to work the ejector if the same exhausts into a condenser maintained at a pressure lower than that of the atmosphere. Where only a limited quantity of water of condensation is available, I prevent its temperature from rising to any extent above that of the atmosphere by causing it to issue in a jet above a basin situated outside of the house in a shady, cool spot.

I find it advisable to provide two suction pumps, one for the water cooled by evaporation in the vacuum and one for the condensing water. As the work which the pumps have to perform is very small in comparison with the available energy absorbed by the ejector, I make use of a rotary motor, preferably constructed according to Behren's system, without distributing valves, for driving the same and cause the vapor to pass through it on its way from the boiler to the ejector. These motors, as is well known, are simple and work well but have a very low efficiency because the inlet to the steam is always open and because they are subject to great leakage. These defects, however, are of little or no consequence in the present case as the ejectors utilize all of the available energy of the steam which has not been consumed in the motor and, again, the effects of the leakage are rendered practically *nil* because the motors work on very small differences of pressure.

The efficiency of my refrigerating apparatus is largely dependent upon the efficiency of the ejector. An ejector suitable for utilization with this system is represented in Fig. 1 and in this form an inlet 1 communicates with a boiler containing water at 100° centigrade. A nozzle 2, which communicates with the orifice, leads to a chamber 3 which, in turn, by means of an inlet opening 4, communicates with a suitable tank in which it is desired to vaporize water in a vacuum. In line with nozzle 2 a diffuser 5 is arranged and which discharges into a condensing chamber 6. Condensing water is conducted under pressure into chamber 6 by means of pipe 7 which projects downwardly in line with diffuser 5 and discharges into the inlet of a second diffuser 8. The diffuser 8 opens into a chamber 9 in which a pressure somewhat higher than atmospheric pressure is maintained. The water projected into diffuser 8 tends to maintain a vacuum in chamber 6 by condensing the vapor which it contains and it carries with it the air mixed with the vapor. The pressure which the water issuing from pipe 7 tends to maintain in chamber 6 will be equal to the pressure of the vapor corresponding to the temperature of the water of condensation. This temperature will differ very little from that of the atmosphere and will be, for example, about 35° centigrade. The pressure in the chamber 6, therefore, will be equal to 0.055 of an atmosphere. Steam at atmospheric pressure is delivered at inlet 1 and passing through nozzle 2, traverses chamber 3 and enters diffuser 5 at a high velocity. In doing this it carries away the steam condensed in chamber 3 and causes an amount of vacuum in said chamber greater than that which is maintained in chamber 6 and, therefore, a lower temperature than in chamber 6. Theoretically, the efficiency of the system employing this ejector apparatus is not very good but it is extremely simple and for practical purposes good enough. It is found that such an apparatus can absorb 3300 heat units at 10° centigrade for each kilogram of coal consumed when the condensing water is 35°. The best refrigerating machines with which I am familiar cannot obtain this result because the water is not cooled directly and a condenser with an ejector can not be utilized. To attain a useful difference of temperature at 25° centigrade, it is necessary for them to develop a difference of about 40° between their refrigerator and their condenser, which more than cancels the superiority of their theoretical efficiency. Again, if it is considered that a kilogram of coal produces 7500 heat units, the absorption of one heat unit by my system would cost the same price in coal as the production of one heat unit in a heating apparatus having an efficiency of 44% and it will be found that only hot water or steam heating systems give better efficiency than this. Finally, if it be understood that the lowering of the temperature which it is necessary to secure in hot countries is less than the difference of temperature which is necessary in heating systems it will be seen that it will cost less to cool a house by my refrigerating apparatus in warm countries than to heat a house with good heating systems in cold countries.

Referring to Fig. 2: A boiler 10 is utilized for producing steam at atmospheric pressure. The steam first drives a motor 11, preferably such as described, and then passes to the inlet 1 of the ejector. The chamber 9 of the ejector communicates with the boiler by means of suitable piping and a tank containing a float valve 12, so arranged as to maintain a constant level of water in the boiler. The steam in traversing the ejector creates a vacuum in a tank 13 connected to inlet 4, which tank is filled with water and maintained at a constant level by a float 14. A pump 15 driven by motor 11 withdraws the water cooled in tank 13 and causes it to issue in jets 16, 16 suitably located in the house which it is desired to cool. The water issuing through jets 16, 16 falls into basins 17, 17 whence a return pipe conducts it into a tank 18, from which it again passes into tank 14. As the weight of water evaporated in tank 13 is necessarily greater than the weight of vapor condensed by the water jets, tank 18 would eventually become empty but the water is kept at a constant level by means of a float valve 25 in the line between tank 18 and a reservoir 19 preferably situated in the upper part of the house to be cooled. The reservoir 19, which should be situated in as cool a place as possible, is also used for furnishing the condensing water under pressure to pipe 7. The condensing water after being heated in the condensing chamber is ejected into the atmosphere through a rose head 20. It thus returns in contact with the atmosphere to its original temperature and falls into tank 21. A pump 22 also driven by motor 11 raises it from tank 21 into tank 19.

In order to start the apparatus the boiler 10 and the reservoir 19 are filled with water and a fire lighted underneath the boiler. When steam escapes freely through valve 23 the same is closed and valve 24 in the line between reservoir 19 and pipe 7 is opened. Water from the reservoir is then projected through pipe 7 and creates a vacuum in chamber 6. By this means steam is drawn into the ejector and the apparatus starts. In order to stop the apparatus it is only necessary to close the cock 24 and extinguish the fire. As the water may be used over and over again, incrustation of the boiler and tank 13 is prevented. As the water automatically added to the system in damp climates by means of the condensing action of the jets 16 will be distilled water, no trouble, such as incrustation, will be met with. In dry climates evaporation will carry away more water than that added by condensation caused by the jets and it is desirable to make up the loss with either distilled water or rain water.

Where it is possible to take advantage of a boiler already installed, it is possible to simplify the apparatus if the boiler works on a pressure considerably above atmospheric pressure, and, it is obvious that when high pressure steam is available a better efficiency will be obtained by the ejector. If the pressure is high enough the condenser may be eliminated and the ejector may exhaust directly into the atmosphere. It is preferable, however, for domestic purposes to use a boiler generating steam at atmospheric pressure.

Having thus described my invention, what I claim is:

1. In a cooling apparatus, a liquid circulating system having one or more portions thereof open to the atmosphere, a source of liquid supply, a steam generator, a fluid motor communicating with said generator, means operated by said motor for circulating liquid through said system, a vacuum chamber in said system and an ejector operated by the exhaust of said motor and tending to create a vacuum in said vacuum chamber.

2. In combination in a cooling apparatus, a water circulatory system provided with a source of water supply, a fluid-actuated motor for circulating water through said system, means for exposing the water circulating through said system to the air to be cooled and a vacuum-creating agent operated by the fluid exhausted from said motor and communicating with said system, whereby the water is cooled by forced evaporation.

3. In combination in a cooling apparatus, a water circulatory system provided with a source of water supply, means for exposing the water circulating through said system to the air to be cooled, a vacuum chamber included within said system, a motor for circulating the water through said system and a vacuum-creating agent communicating with said chamber and receiving fluid from said motor.

4. In a cooling apparatus, a source of water supply, a water circulatory system, means, included within said system, for exposing the water passing therethrough to the air to be cooled, a motor for circulating the water through said system, a fluid ejector receiving fluid from said motor and communicating with said system and a liquid ejector communicating with the exhaust of said fluid ejector whereby the water of said system is cooled by forced evaporation.

5. In a cooling apparatus, a liquid circulating system, means, included within said system, for exposing the liquid passing therethrough to the atmosphere, a fluid ejector communicating with said system and a liquid ejector communicating with the exhaust of said ejector and operating in connection therewith to cool the water of said system by forced evaporation.

Signed at Paris France this twentieth day of January A. D. 1904.

MAURICE LEBLANC.

Witnesses:
HANSON C. COXE,
JEAN COTTIER