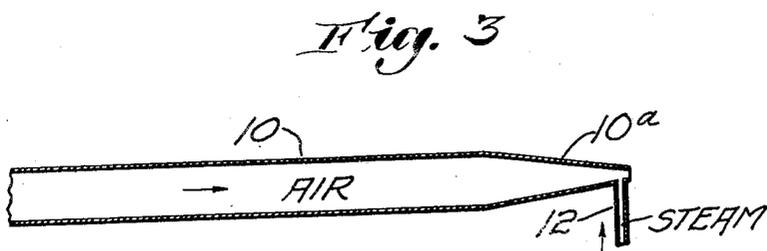
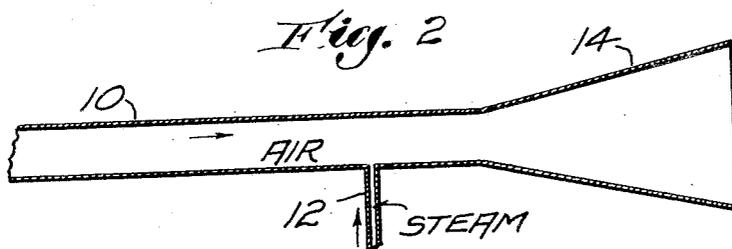
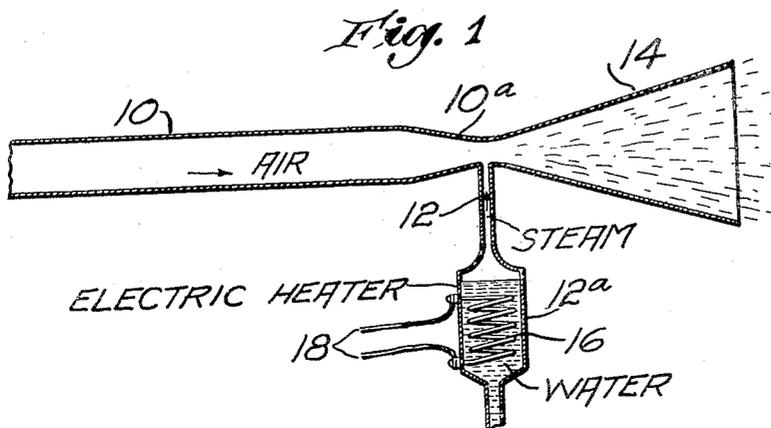


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A. J. LOEPSINGER
ART OF HUMIDIFICATION
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ALBERT J. LOEPSINGER
INVENTOR

BY
Mitchell, Chadwick & Kent
ATTORNEYS

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ALBERT J. LOEPSINGER, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO GENERAL FIRE EXTINGUISHER COMPANY, OF PROVIDENCE, RHODE ISLAND, A CORPORATION OF DELAWARE.

ART OF HUMIDIFICATION.

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This invention relates to improvements in the art of humidification. More particularly it relates to the art of maintaining or raising the humidity of the atmospheric air in a room by blowing a jet of steam into the air. This very simple method of humidifying would probably be extensively in use were it not that as heretofore practiced the condensation of the steam gives out such heat as to raise the temperature locally to an objectionable extent—an evil so serious that humidifying by steam jets is forbidden by law in some places. It is an object of the present invention to eliminate the objectionable features so that humidifying can be done by a jet of steam without sensible or undue increase of temperature of the room locally, where the steam is set free, due to its introduction and condensation.

This is accomplished by associating a discharge of air expansively with the steam, which air has previously been compressed and separated from the heat produced by its compression, so that when the de-thermalized compressed air is liberated in connection with the steam the latent heat of condensation of the steam is immediately utilized to supply the heat demanded by the expanding air and is absorbed thereby. The invention may be carried out with apparatus of various types, one suitable and simple arrangement being the provision of a nozzle, fed by a compressed air pipe and a steam pipe, by which the air and moisture are discharged so that both expand into the air of the room. Some other gas might be employed, instead of air, but air will probably be found most convenient for ordinary industrial uses. As a measure of preparation the air or whatever gas is to be used is compressed in any suitable compression apparatus. In such case a part of the work done by the compressing apparatus appears as heat, raising the temperature of the air and the surrounding container. This heat is to be rejected, so that the air which is used in the process is approximately at atmospheric temperature or lower; and the air is to be used in sufficient volume relative to the steam, so that the heat, which has been rejected and which must be reabsorbed when it expands to atmospheric pressure, approximately equals the heat which is set free by the steam in its condensation.

The condensation to which reference is thus made is that which occurs locally where the steam is released, producing the visible cloud or mist which is colloquially called "steam," which consists of very small particles of water in liquid form. As this floats away it evaporates, assuming that the relative humidity of the atmosphere is such as to absorb it, and this evaporation requires heat, so that the net addition of heat to the atmosphere by condensation of injected steam, and subtraction of heat from the atmosphere by the re-evaporation of the same, may be supposed to be theoretically equal. But in past experience the injection of such steam has produced unbearable living conditions, locally at least; and there has been undoubtedly an increment of heat due to the excess of temperature of condensation above the temperature of atmosphere which, accumulating through a period of time, makes a considerable aggregate addition of quantity of heat, to that already contained in the room; and this accumulation, at certain times of the year and under certain atmospheric conditions is very objectionable. The process and apparatus of the invention provide for the avoidance or diminution of the local increase of temperature where the condensation occurs, so that temperatures are equalized around the room; and it may provide absolutely for the neutralization of the net heat actually introduced by steam, so that in the aggregate result the total quantity of heat in the room is not affected by the humidifying apparatus or process, but only humidity is added; and the changes of temperature locally are so minimized, with aid of circulation of air and moisture, that no part of the room is thereby rendered unduly high or low in temperature.

These results are accomplished by introducing cooled compressed air whose expansion to atmospheric pressure takes heat equal to the quantity of heat which comes in with the steam as a net quantity of sensible heat. The quantity introduced by steam being known, depending upon the temperature, pressure and quantity of steam, computation will show what pressure and temperature and quantity of compressed air is requisite to absorb this heat by its expansion to atmospheric pressure and temperature. In practice the provision for expansion of this

air in the midst of the steam, which also is expanded, will cause its heat to be taken initially from that liberated by the condensation of the steam as well as from that introduced by the high sensible heat of steam, but with the dissemination of the whole through the atmosphere of the room, with evaporation of the condensed steam, the excess of heat initially observed will disappear, becoming latent heat of vaporization at atmospheric temperature.

The accompanying drawings illustrate varieties of apparatus by which this process can be practiced; and it will be understood that other arrangements also can be made. It is intended that the patent shall cover by suitable expression in the appended claims whatever patentable features exist in the invention disclosed so far as the same relates to the process or method of distributing a gas, such as the vapor of water, through a body of air such as the air of a room.

In the accompanying drawings:

Figure 1 is a side elevation of a medial section through apparatus by which the invention may be practiced; and Figures 2, 3 and 4 are similar views showing modifications of apparatus.

Referring to the drawings, a duct 10, leading from a compressor (not shown) contains a dry gas at relatively low pressure, say 10 to 15 pounds gage, of the temperature of the local atmosphere. Into this dry gas, which may be air, there is introduced through an inlet pipe 12, a current of vapor, in this instance steam, which upon intermingling with the relatively cool dry air is condensed into tiny floating particles of liquid. The resulting mixture of air and vapor particles issues through the discharge nozzle 14 into the atmosphere in the form of very fine fog.

The apparatus may be so designed and proportioned, with respect to the quantity of air and steam discharged, that the number of heat units, added, net, by introduction of the vapor will equal, very closely, the number of heat units acquired by the air in expanding from its compressed state in the duct to its normal state in the atmosphere. And such heat units as may remain in excess after the expansion is complete are taken up by the subsequent evaporation of the particles. Accordingly there is no increase in the local temperature, as has heretofore resulted when humidification has been effected through the addition of steam to the atmosphere.

In Figure 1 the duct 10 is shown as having a gradual contraction 10^a, followed by an enlargement constituting the discharge nozzle 14. The steam inlet pipe 12 is connected to the duct at the smallest part of the contraction or neck, 10^a, where the ve-

locity of the air is greatest and its side pressure is most reduced, in accordance with the law utilized in the Venturi meter. In an antecedent enlargement 12^a of this steam pipe there is a heating unit, represented as a coil 16 having electrical connections 18, and a supply of water surrounding the coil, being heated thereby to form the steam. The rapidly moving air current in the neck of the duct acts with a sort of aspirator effect to draw into itself the rising vapor and, by arranging the water supply close up to the neck, the aspiration effect can be utilized to reduce the pressure on the water to below that of atmosphere, thus lowering the boiling point, with consequent saving of the electrical current required for heating. The increased velocity of the air also produces a desired projecting effect which enables the fog to be driven well into the region to be humidified.

The contraction 10^a of the air duct is not an essential feature. It may be omitted as shown in Figure 2, where the duct 10 is illustrated as continuing at uniform size past the steam inlet 12, to the expanding discharge nozzle 14. The latter also may be dispensed with, if desired, and the apparatus be provided in the form of Figure 3, in which the contraction or neck 10^a is open to the atmosphere just beyond the junction with the steam inlet 12. Or an even more simple arrangement could be used in which, as shown in Figure 4, the contraction and nozzle are both absent and the discharge is from the open end of a uniform pipe, into which the steam is introduced just before the discharge opening is reached.

The steam may be provided by any other convenient means, as by a gas flame, or by piping from an ordinary steam boiler, with coal furnace.

I claim as my invention:

1. The art of humidification, comprising the introducing of steam into a current of compressed air whose heat of compression has been lost, which steam condenses; and projecting the mixture into the atmosphere, whereby the resulting free expansion of the compressed air absorbs heat introduced by the steam.

2. The art of humidification, comprising the compressing of air, with loss of heat produced thereby; injecting steam into said compressed air; and projecting the resulting mixture into the region to be humidified with freedom for expansion of the gas; whereby the sensible heat introduced and heat liberated by the condensation of the steam are absorbed by the expansion of the compressed air and evaporation of the condensed steam.

3. The art of humidification, comprising the compression of air with loss of heat produced thereby; moving said air toward the

region to be humidified; introducing steam to the moving air while the latter is still compressed; and then liberating the mixture of air and steam into the atmosphere whereby the sensible heat of said steam is absorbed in the expansion of the compressed air to atmospheric pressure.

4. The art of humidification, comprising the introducing of steam into a stream of moving compressed air of temperature not greater than that of the atmosphere, and then projecting the mixed air and steam into the atmosphere whereby the expansion of the air absorbs some of the liberated latent heat of condensation of the steam.

5. The art of humidification comprising the discharge, into atmosphere and in the same vicinity, of steam, and of compressed air whose heat of compression has been lost, whereby the introduction, condensation and later evaporation into atmospheric humidity of the steam simultaneously with the expansion of the compressed air effects a transfer

of heat units without increase of the atmospheric temperature.

6. The art of humidification comprising the discharge of steam and compressed air into atmosphere which is to be humidified, respectively in position to co-act on air in the same region, and severally at pressure, temperature and quantitative rate sufficient for the sensible heat introduced by the steam to be absorbed by the expansion of the air introduced, whereby approximately a constant temperature of air is maintained in the region.

7. The art of humidification wherein substantially the exact amount of heat liberated by the cooling of water introduced to the atmosphere as steam to supply humidity is withdrawn by the expanding of air introduced.

Signed at Boston, Massachusetts, this fourth day of August, 1924.

ALBERT J. LOEPSINGER.