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METHOD AND MEANS FOR ALTERING THE TEMPERATURE OF FLUIDS

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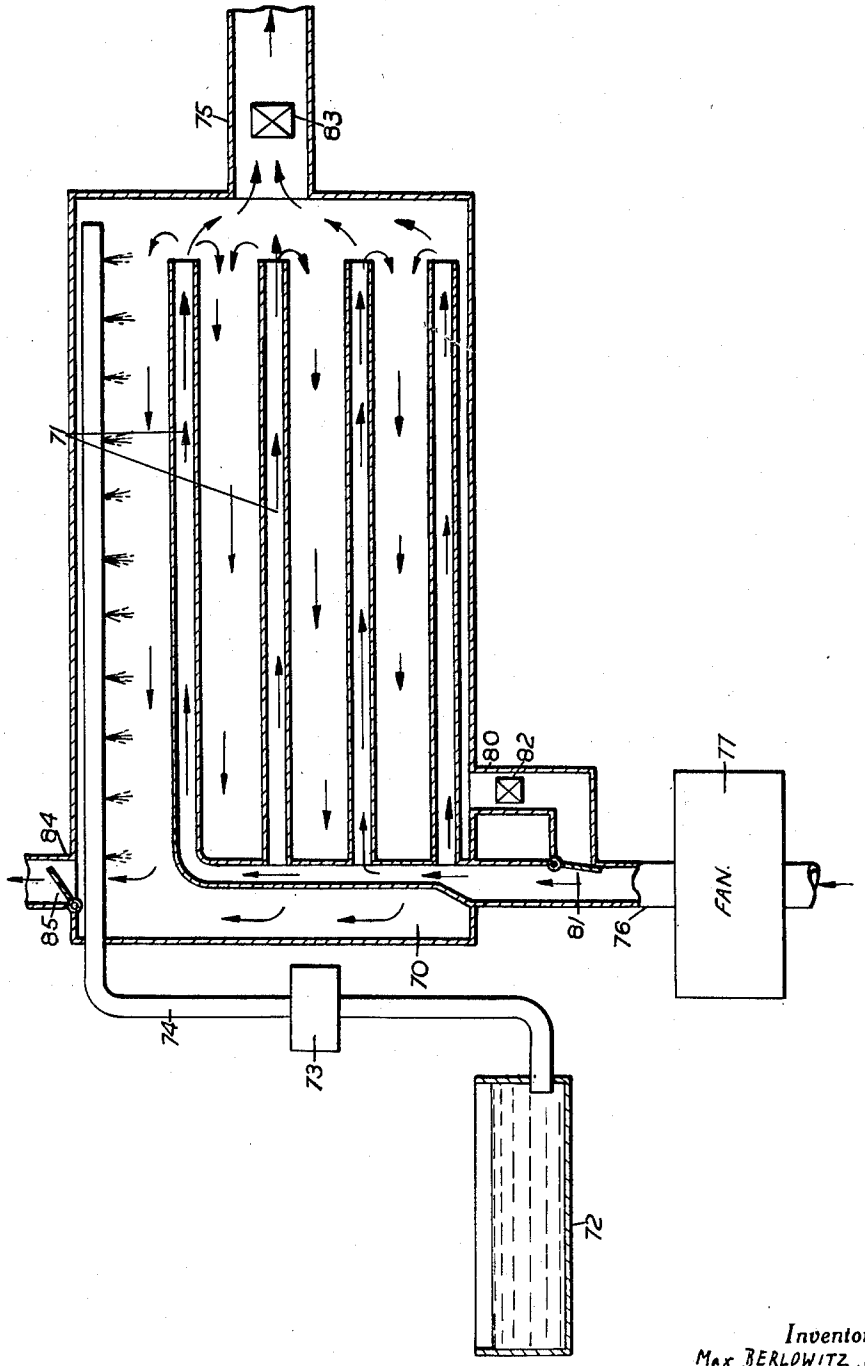

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METHOD AND MEANS FOR ALTERING THE TEMPERATURE OF FLUIDS

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8 Claims. (Cl. 261—10)

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The present invention relates to an arrangement for conditioning air.

It is an object of the invention to provide simple and inexpensive means for heating and cooling the atmosphere in an enclosure.

It is another object of the invention to provide an installation which may also act as an air washer.

Other objects and advantages of the present invention will become apparent to those skilled in the art from the following description of some embodiments of the invention when read in conjunction with the accompanying somewhat diagrammatical drawing illustrating an embodiment of the invention.

Referring now to the drawing, in a preferably horizontal vessel 70 a plurality of preferably horizontal tubes 71 are arranged side by side the interior of which forms a first channel while the space within the vessel 70 around the tubes 71 forms a second channel. From a water tank 72, water is sprayed, by means of a pump 73 and pipe 74 provided with a plurality of nozzles, into the second channel forming therein either a mist or if filling bodies are provided, a thin water film thereon. At the outlet end or discharge region of the vessel, the interior of the tubes 71 (first channel) communicates with the interior of the vessel 70, i. e. the exterior of the tubes 71 (second channel). The interior of the vessel 70 communicates at or near this region with a pipe 75 leading to the enclosure to be airconditioned. At the inlet end remote from the said discharge region, the interior of the tubes 71 communicates with a duct 76 leading to the outlet of the fan 77 or the like which delivers raw air to the duct 76 from which it may pass to the interior of the tubes 71 (first channel). The raw air may be outside air or return air from the enclosure or a mixture of both. The duct 76 communicates through a by-pass 80 with the interior of the vessel 70 around the tubes at a region near the inlet ends of the tubes 71 that is to say at a region remote from the discharge region of the vessel. A damper 81 is provided for partly or completely interrupting the communication between the duct 76 and the interior of the tubes 71 and, correspondingly, partly or completely effecting the communication between the duct 76 and the by-pass 80 or vice versa. In the by-pass 80 a preheater 82 is provided and in the pipe 75 referred to above a re-heater 83. The interior of the vessel 70 near the region where it is connected to the by-pass communicates also with the outside through a pipe line 84 which may

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be partly or completely shut or opened by a damper 85 or the like.

If it is intended to cool the enclosure, the communication between the duct 76 and the by-pass 80 is interrupted and that between the duct 76 and the interior of the tubes effected by means of the damper 81. The damper 85 is opened so that the pipe line 84 communicates with the interior of the vessel 70. Raw air is delivered from the fan 77 to the interior of the tubes 71 (first channel) and passes therethrough; part of the air passes through the pipe 75 to the enclosure to be cooled, and the remainder of the air passes around the tubes (second channel) and through the pipe line 84 to the outside. The evaporative liquid, such as water, is sprayed into the vessel 70 by means of the pump 73, evaporates in the vessel 70 and cools the air passing through the second channel, that is to say around the exterior of the tubes 71, from the discharge region to the pipe line 84. The cooled air in the second channel pre-cools the air in the first channel, that is to say the air passing through the interior of the tubes 71, by heat exchange through the walls of the tubes 71. When the pre-cooled air reaches the second channel, a further drop of temperature occurs in the second channel causing in turn, by heat exchange, a further drop of temperature in the first channel and so on, until eventually a stationary temperature will be reached which lies, at the discharge region which is the coolest region, below the wet bulb temperature of the raw air and only a few degrees above its dew point. It will be seen that the air through the first channel moves substantially in counter-flow to the air in the second channel. It should also be noted that the temperature of the air is not uniform along each of the two channels. Warm raw air enters the first channel from the duct 76, is cooled by heat exchange during its passage through the tubes 71, passes through the second channel reaching its lowermost temperature at the discharge region and is warmed again by exchange of heat with the air in the first channel. The cooled air leaving the vessel 70 through the pipe 75 is injected into the enclosure to be cooled. If it is intended to heat the enclosure the pre-heater 82 and re-heater 83 are operated, the communication between the duct 76 and the by-pass 80 is effected and that between the duct 76 and the interior of the tubes 71 is interrupted by means of the damper 81. The damper 85 is shut so as to interrupt the communication between the pipe line 84 and the interior of the vessel 70. In this case,

raw air is delivered from the fan 77 to the duct 76, thence to the by-pass 80 where it may be pre-heated. The air then passes through the vessel 70 around the tubes 71 where it is washed and moistened and reaches the enclosure through the pipe 75 where it may be re-heated, whereby humidified and heated air is delivered to the enclosure, the arrangement simply operating as a usual air washer. The desired degree of humidification may be obtained by giving the dampers 81 and 85 positions intermediate to those just described.

It should be clearly understood that the drawings are given by way of example only, and that many modifications, additions and omissions are possible without departing from the spirit of the invention.

What is claimed is:

1. An arrangement for conditioning air, comprising a vessel, means for supplying an evaporative liquid to the interior of said vessel, a plurality of tubes in said vessel, said tubes occupying substantially the entire space within said vessel and having walls made of heat conducting material, a duct common to said tubes and communicating with one end of each tube, the other end of each tube opening into the interior of said vessel at a discharge region thereof, means for supplying the total amount of raw air to be treated from outside said vessel through said duct and said tubes to the interior of said vessel, an outlet pipe communicating with the interior of said vessel at said discharge region thereof for discharging air from said vessel to an enclosure to be air-conditioned, a pipe line communicating with the interior of said vessel at another region remote from said discharge region for feeding air from said other region of said vessel into the atmosphere, a by-pass between said duct and the interior of said vessel at the said other region thereof, and means for adjusting the ratio between the amount of air supplied from said duct to said tubes and the amount of air supplied from said duct through said by-pass to the interior of said vessel.

2. An arrangement as defined in claim 1, and comprising heating means in said by-pass.

3. An arrangement as defined in claim 1, and comprising heating means in said outlet pipe.

4. An arrangement as defined in claim 1, and comprising heating means in said by-pass, and heating means in said outlet pipe.

5. An arrangement as defined in claim 1, and

comprising means for storing a liquid, the said means for supplying liquid to the interior of said vessel drawing the liquid from said storing means.

6. An arrangement as defined in claim 1, wherein the said tubes are arranged substantially horizontally.

7. An arrangement for conditioning air, comprising means for forming a first channel for a primary air current and a second channel for a secondary air current, the said means including at least one wall made of heat conducting material and separating the said channels, the said wall being arranged to allow said primary air current to contact one face and said secondary air current to contact the other face of said wall to enable an exchange of heat between the said two air currents through said wall, means for supplying an evaporative liquid to said second channel, the said channels having each an inlet and an outlet, the outlet of the first channel communicating with the inlet of the second channel, the said second channel having two discharge openings, one adjacent its inlet and the other adjacent its outlet, for connection respectively to an enclosure to be air-conditioned and to the atmosphere, and having an additional inlet adjacent its outlet, and means for adjusting the ratio between the amount of air supplied to the inlet of the first channel and the amount of air supplied to the additional inlet of the second channel.

8. An arrangement as defined in claim 7, wherein the air supplying means comprise a fan and means for adjustably connecting the delivery side of said fan to the inlet of the first channel and to the additional inlet of the second channel.

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