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CENTRIFUGAL DEHUMIDIFIER

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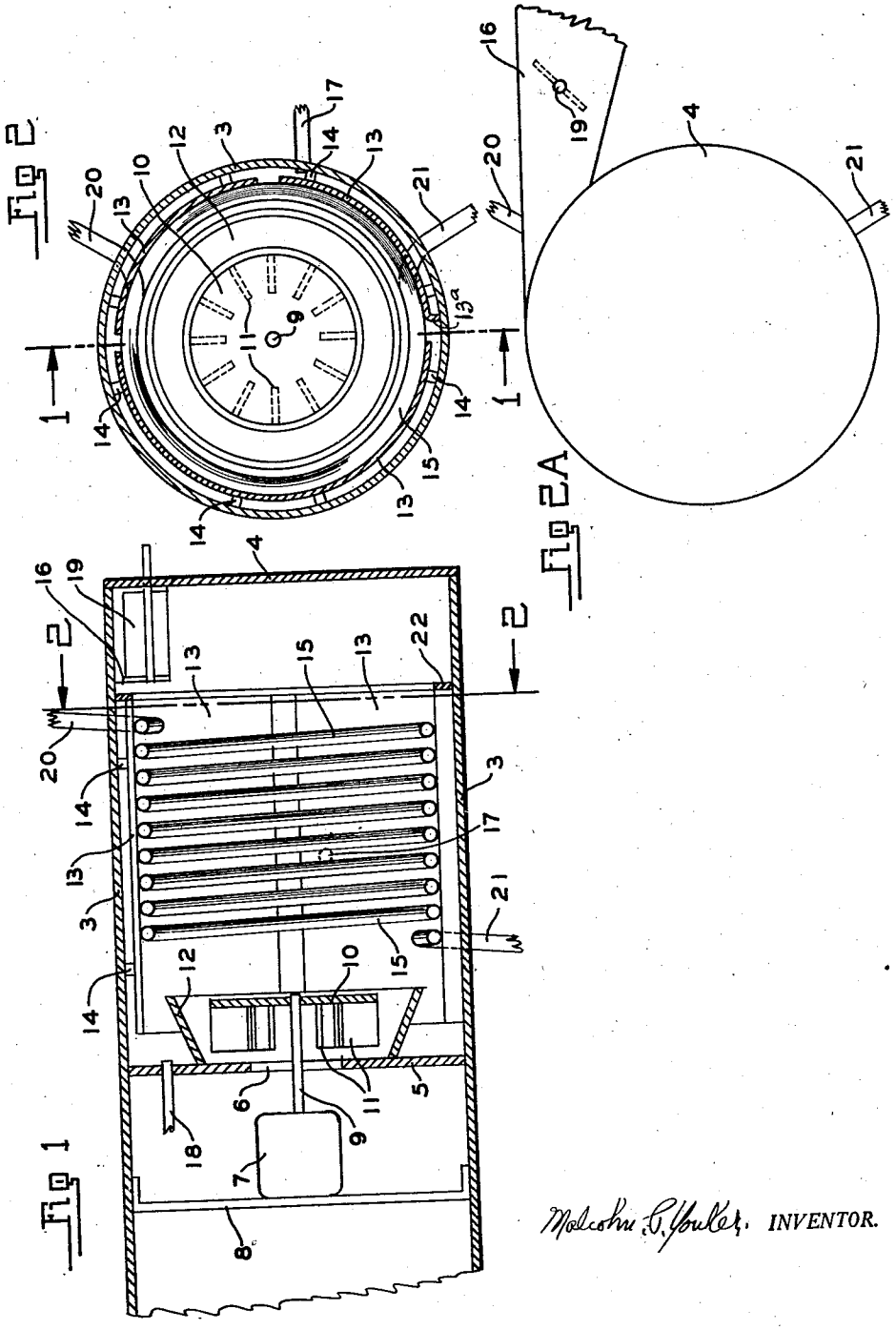

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CENTRIFUGAL DEHUMIDIFIER

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6 Claims. (Cl. 62—140)

My new invention relates to the heating and cooling of the atmosphere of inhabited quarters, and in particular, relates to the removal of excess water from such air during the process of cooling.

Conventional apparatus commonly used for heating and cooling air does not provide counter-current heat exchange between the cooling or heating medium and the air, also such equipment does not provide for the complete removal of excess water contained in the air which is cooled. By my new invention counter-current heat exchange is effected between the heating or cooling medium, and the air treated, and of marked importance, excellent means for removing excess water from air which is cooled is provided by my new invention. The advantageous manner by which these accomplishments are obtained, and likewise other accomplishments, will be made apparent in the following specification taken in connection with the accompanying drawing.

Figure 1 illustrates a horizontal cross-section taken through the apparatus on line 1—1 of Fig. 2, looking down on the device.

Figure 2 illustrates a cross-section taken along the vertical plane 2—2 through Figure 1.

Figure 2-A illustrates the closed end of the apparatus in elevation.

Referring to the drawing, the numeral 3 designates a horizontal metal cylinder, one end of which is closed by a circular metal plate 4, which is perpendicular to the axis of cylinder 3. A circular plate 5, in the center of which is a circular orifice 6, and the outer edge of which is attached to the cylinder 3, is disposed within and perpendicular to the axis of cylinder 3. A motor 7 is disposed within cylinder 3 and rigidly held in place by a supporting bar 8, the extremities of which are attached to cylinder 3. The motor drive shaft 9 is disposed along the axis of cylinder 3 and extends through the orifice 6. A centrifugal blowing wheel is made up of a circular plate 10, to which are attached blades 11, and which is attached to the extremity of shaft 9. The plate 10 is disposed in a plane perpendicular to the axis of the cylinder 3, and the blades 11 are disposed perpendicular to the plate 10 in planes which are radial with respect to shaft 9. The fan blades 11 are so disposed as to fit neatly and close with respect to plate 5. A metal sheet 12 is formed in the shape of the surface of a frustrum of a cone, the small end of which is attached to plate 5 concentric with orifice 6. The plate 12 projects from plate 5 to a point beyond plate 10. Plate 12 may be omitted, in which case the pipe coil 15 will be extended to plate 5. Separator plates 13 are formed in the shape of a segment of a cylinder, and are attached to each other and to cylinder 3 by means of bolts 14, which also serve to maintain an opening between these separator plates themselves and also between them and the cylinder 3, except that one longitudinal edge 13a of one separator plate is turned outwardly at an angle to contact cylinder 3. A pipe coil 15, the extremities 20 and 21 of which project through separator plates 13 and cylinder 3, and between the individual coils of which there is an opening, is disposed parallel to and within the separator plates 13 and the cylinder 3. A conduit 16 is tangentially connected into cylinder 3, the wall of the cylinder 3 being partially cut away to afford free communication between the inside of cylinder 3 and the inside of conduit 16. Drain pipes 17 and 18 pierce the cylinder 3 and the plate 5 respectively and lead away from the apparatus. A damper 19 is disosed within conduit 16. A dam ring 22 is provided to prevent flow of water from the space between cylinder 3 and separator plates 13. Suitable conduits may be connected to the open end of cylinder 3 and the open end of conduit 16 through which air may be led to and from the apparatus.

For the purpose of cooling air the apparatus will be operated as follows:

A refrigerating medium will be delivered through the pipe coil 15. The motor 7 will be utilized to rotate the centrifugal blower, thus causing air to flow through the orifice 6 to the blower and thence between the blades 11. Air which will flow between the blades 11 will be delivered from their outer extremities while rotating at high velocity and this air, while still rotating at high velocity, will strike the plate 12 and will be deflected thereby and will flow therefrom while still rotating at high velocity in the direction toward the plate 4, and upon reaching the closed end of the cylinder 3, while still rotating, this air will flow therefrom through the tangential conduit 16. Air which will pass through that part of the cylinder in which is disposed the pipe coil 15 will contact this pipe coil while rotating at high velocity, and will, by such contact be cooled and, as a result of such cooling, water will be precipitated from this air in the form of a very fine mist and, as a result of the rapid rotation of the air so cooled, the water mist formed therein will, by centrifugal force, be thrown against the separator plates 13 and will flow through the opening between these

separator plates and thence to the bottom of the cylinder 3 and thence therefrom through the drain pipe 17. When the unit is horizontally disposed, drain pipe 17 is located in the lower side of the cylinder 3. A second drain pipe 18 is provided in the circular plate 5 for the removal of water in the event the cylinder 3 is vertically disposed. Through the manipulation of the damper 19 the quantity of air delivered through the cylinder 3 will be regulated. In case a variable boiling point refrigerant is utilized, such refrigerant will preferably be delivered into pipe coil 15 through extremity 20 and away from pipe coil 15 through extremity 21 in order that counter-current heat exchange between the air and the refrigerant may be obtained. In case a constant boiling point refrigerant is utilized, such refrigerant preferably will be delivered into the pipe coil 15 through extremity 21 and therefrom through extremity 20. It should be noted that by this apparatus air which is to be cooled will be contacted with a cold metal surface at very high velocity which will materially assist in obtaining heat exchange. It should be particularly noted that air which is being cooled is at the same time rotating at high velocity, and that as a result of such a state of motion any water precipitated in the air will be immediately thrown therefrom by centrifugal force and will be separately recovered.

For the purpose of heating air my new apparatus will be operated as has been outlined above for the purpose of cooling air, except a heating medium, such as hot water or vapor, will be delivered through the pipe coil 15, and that, of course, no precipitation of water will take place in the air heated. In case the heating medium should consist of a hot liquid or the vapor of a variable boiling point liquid, I will preferably deliver such heating medium into the pipe coil 15 through extremity 20 and away from pipe coil 15 through extremity 21 in order that counter-current heat exchange may be obtained. the damper 19 will be utilized to regulate the quantity of air passed through the cylinder 3 to thus secure regulation of the temperature to which such air is heated. Decreasing the amount of air delivered through the cylinder 3 will increase the final temperature of such air and vice versa.

It should be particularly noted that the energy supplied to the motor 7 is simultaneously utilized to accomplish the purposes of transporting air, changing the temperature of air and centrifuging precipitated water from air. The apparatus, therefore, obtains economy in that three desirable purposes are simultaneously accomplished through the expenditure of less energy than would be required to separately accomplish the three purposes.

The diameter of the pipe coil 15 is such that the outer surface of the coil is in contact with separator plates 13, therefore, air delivered from the blower will not flow through the opening between the separate pipe coils but will be restricted to flow through the cylindrical passageway formed by the pipe coils as a whole. The air which will flow through this passageway, formed by the pipe coil 15, will, at the same time, be rotating at high velocity. The dam ring 22 and the edge of one of plates 13, which is turned to contact cylinder 3, will effectually prevent flow of air through the space between plates 13 and cylinder 3. Rotation of the centrifugal blower will preferably be in the direction such that air delivered from it will flow along the screw formed by the pipe coil.

While I have described in detail one specific form of my new apparatus, it should be understood that I do not propose to limit myself to the details shown, but intend to claim broadly all of the new and novel features which are inherent in my invention.

I claim:

1. Apparatus for cooling and dehumidifying air, comprising a casing, inlet and outlet openings in said casing, a longitudinally disposed separator shell spaced inwardly from the walls of the casing, cooling means within the confines of said shell, a centrifugal blower adjacent said inlet opening arranged to whirl a current of air over said cooling means and against the inner surface of said shell, openings in said shell to permit condensate to escape from said shell into the space surrounding the latter, and means for draining said separated condensate from said space.

2. Apparatus for cooling and dehumidifying air, comprising a cylindrical casing, air inlet and outlet openings in said casing, a longitudinally disposed separator shell spaced inwardly from said casing, a condensate chamber surrounding said shell, cooling coils within the confines of said shell, a centrifugal blower adjacent said inlet opening arranged to whirl a current of air over said cooling coils and against the inner surface of said shell, whereby said current of air will be cooled and the water of condensation deposited on said shell, openings in said shell to permit said condensate to escape into said condensate chamber, means for preventing the escape of condensate from said chamber into said air outlet opening, and means for draining the collected condensate from said chamber.

3. Apparatus for cooling and dehumidifying air, comprising a cylindrical casing, air inlet and outlet openings in said casing, a series of longitudinally disposed baffles in said casing, spaced inwardly from the latter, a condensate chamber surrounding said baffles, said baffles being spaced from one another to provide openings in communication with said condensate chamber, cooling coils within the confines of said baffles, a centrifugal blower adjacent said air inlet opening arranged to whirl a current of air over said cooling coils and against said baffles, whereby said current of air is cooled and the water of condensation collected in said condensate chamber, a stop ring interposed between said casing and said baffles adjacent said air outlet opening, for preventing the escape of condensate from said chamber to said outlet, and means for draining said separated condensate from said chamber.

4. Apparatus as claimed in claim 3 wherein the longitudinal edge of one of said baffles is turned outwardly against the inner wall of said casing.

5. Apparatus for cooling and dehumidifying air, comprising a cylindrical casing, an air inlet opening in said casing, a series of longitudinally disposed baffles in said casing, spaced inwardly from the latter, a condensate chamber surrounding said baffles, said baffles being spaced from one another to provide radial openings in communication with said condensate chamber, cooling coils within the confines of said baffles, a centrifugal blower adjacent said air inlet opening arranged to whirl a current of air over said coils and against said baffles, whereby said current of air is cooled and water of condensation

collected in said condensate chamber, a tangential air outlet opening in said casing, a stop ring interposed between said casing and said baffles adjacent said tangential outlet, for preventing the escape of condensate from said chamber to said outlet, and means for draining said separated condensate from said chamber.

6. Apparatus for cooling and dehumidifying air, comprising a cylindrical casing, an air inlet opening in one end of said casing, a longitudinally disposed separator shell spaced inwardly from said casing, a condensate chamber surrounding said shell, cooling coils within the confines of said shell, a centrifugal blower adjacent said inlet opening arranged to whirl a current of air over said cooling coils and against the inner surface of said shell, whereby said current of air will be cooled and water of condensation deposited on said shell, openings in said shell to permit said condensate to enter said condensate chamber, a tangential outlet opening in said casing, means adjacent said outlet for preventing the escape of condensate from said chamber into said outlet, and means for draining the collected condensate from said chamber.

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