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W. J. CALDWELL

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AIR WASHER AND DEHUMIDIFIER

Original Filed April 25, 1930

Fig. 1.

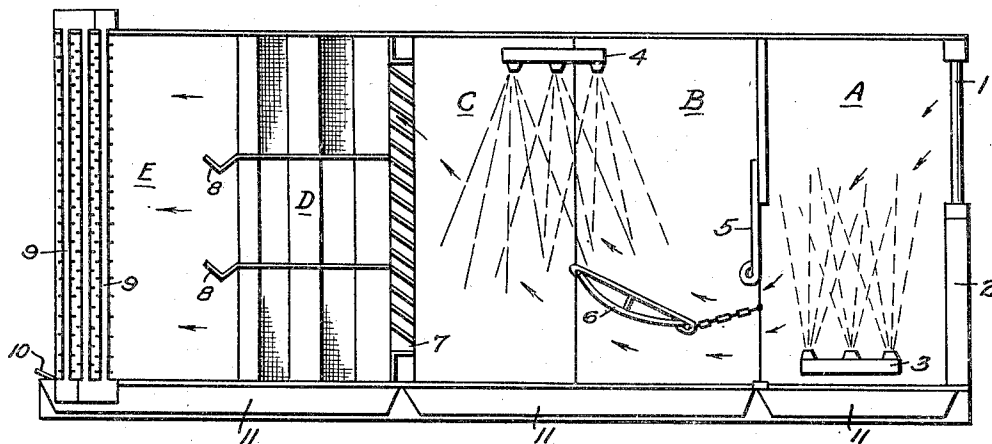


Fig. 2.

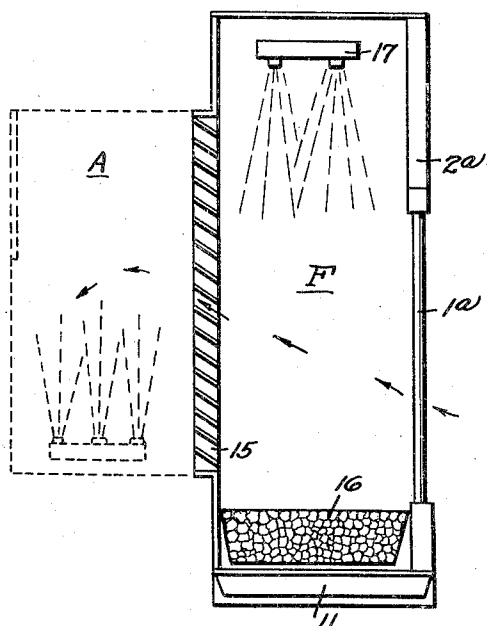


Fig. 3.

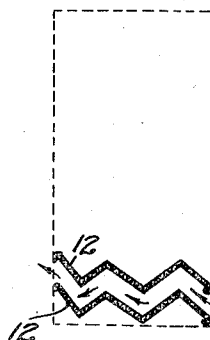


Fig. 4.



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UNITED STATES PATENT OFFICE

1,968,778

AIR WASHER AND DEHUMIDIFIER

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5 Claims. (Cl. 183—23)

My invention relates to devices for conditioning air and has for an object cleansing the air from all suspended particles of matter, from fumes and odors, and thereafter removing from the air the excess moisture carried off from the sprays used in the washing process. A further object is to condition the air, after cleansing it, with respect both to temperature and to relative humidity.

10 With the foregoing and other objects in view as will appear as the specification proceeds, my invention resides in the combination and arrangement of parts and in the details of construction described in this specification and particularly pointed out in the appended claims, it being understood that changes in the particular embodiment of my invention may be made within the scope of what is claimed without departing from the spirit of the invention. I intend no limitations other than those of the claims.

25 The use of air washers, rather than oil filters, is essential to remove fumes and odors from the air. Commercial air washers of the present time have defects which my invention is designed to overcome. I have found, for example, that it is possible to remove all free moisture from washed air by passing it, after it has left the sprays, through zig-zag passages formed by reinforced coffee bag grade of burlap or other coarse fabric or textile material, if the air is put in turbulence while travelling at the proper velocity through these passages. This is a result not found possible with the conventional metal moisture eliminators.

35 I have found, also, that by the use of aluminum fin cooling coils over which the air passes after washing and removing the free moisture therefrom, it is possible to directly expand ammonia or CO₂ or other gas in the coils, and the coils will not frost up even at temperatures twenty degrees below zero on the Fahrenheit scale. This, I believe, is due to three factors, the high specific heat of aluminum, the turbulence and high velocity of the air sweeping the moisture off the fins before it freezes, and the fact that the fins constitute 81% of the total cooling area, thus giving a unit temperature much higher than the equivalent number of feet of conventional pipe used for refrigeration, which is so readily frosted up under similar conditions.

50 The fins of aluminum are warmer than the tubing which is commonly of steel, there being a temperature gradient from the outer part of the fin to the tubing, and this permits the deposited condensation from the air to be swept off the fin

edges into a trough or gutter before it freezes. In many instances I have found that where iron or steel fins are put on the ends of the tubing to facilitate welding into place, these iron fins will frost over in a few hours while the aluminum fins will not frost up at all. The particular features of construction of these aluminum fin tubes are claimed in my Patent No. 1,893,270 dated Jan. 3, 1933.

By substantially cooling the air discharged, after washing it and removing the free moisture, I have found that it is possible to dehumidify it to almost any desired extent. This is accomplished by passing the air at proper velocity through cooling coils of aluminum fin type with water or other cooling medium flowing in the coils at a temperature lower than the air passing over the coils. The action is two fold. The air is cooled by contact with the coils and absorption of heat. The moist air striking cold coil surfaces causes the condensation of water thereon, lowering its actual water content. The water condensed is swept into troughs. The discharged air, with a decreased moisture content, then entering a room and being heated to room temperature may have a less relative humidity than when it entered the washer and dehumidifier and in any case less than when leaving the sprays.

For example, in a test on a unit using 60,000 cubic feet of air per minute and the low value of 37 gallons per minute water supply, the water entering cooling coils at 37 degrees F., leaving cooling coils at 56 degrees F., and with a spray temperature of 56 degrees F., the air entering the air washer with the temperatures 76 degrees F. (dry bulb) and 61 degrees F. (wet bulb) corresponding to a relative humidity of 41%, it was found that at the discharge from the fan after leaving the cooling coils, the wet and dry bulb temperatures were, respectively, 59 degrees F. and 64 degrees F., giving a relative humidity of 73%, but when this air is raised to the room temperature of 76 degrees F., with the same water content the relative humidity is then found to be 49%. Then, increasing the water supply through the cooling coils, with corresponding greater cooling, and greater condensation, showed relative humidity of the discharged air, when warmed to room temperature, below the 41% of entering air and possible adjustment to whatever value desired within usual commercial practise.

Finally, I have found that even with two pass washers of the high efficiency shown herein, it is possible for an occasional minute particle to work through. For factories during the finest work,

such as rolling celluloid sheets for non-shatterable windshield construction, in which the deposit of a microscopic speck of coloring matter or soot may spread and damage several square feet of product or even an entire sheet, I have devised a further spray pass which precedes the usual washers. In this a spray of saponified warm water results in immense quantities of small bubbles through which the air is passed at a lowered velocity and which removes the finest particles of suspended matter.

With this preliminary discussion, reference is made to the accompanying drawing diagrammatically illustrating a preferred embodiment of my invention. Similar reference numerals refer to similar parts throughout the several views.

Fig. 1 is a conventional side elevation shown diagrammatically of an air washer and dehumidifier unit embodying my invention, with the side plates of the unit removed.

Fig. 2 is a similar elevation of a preliminary spray section for the use of saponified water.

Fig. 3 is illustrative of a partial top view of the moisture eliminator section D of Fig. 1, with top plates removed.

Fig. 4 is a detail of the construction of the moisture eliminator walls.

In Fig. 1 it is indicated that a complete air washer and dehumidifier unit embodying my invention may be made of a series of sections designated respectively A, B, C, D, and E, in the order through which the air is to be conditioned is passed. Each section may be four or five feet in length and ten or twelve feet high and wide for, say, a capacity of 100,000 cubic feet of air per minute.

At the intake side of section A, the air may be preheated by being drawn over heating coils 1 or, when preheating is not desired, the air may be drawn through by-pass louvres 2, in order that the friction of the heating coils may be eliminated. If desired, air may be drawn through both intakes.

In section A is the first spray 3 and the admitted air travels in a direction against the spray, creating turbulence for more thorough washing. Between section A and section B is a partition or wall with a vertically sliding door 5 which may be opened to a greater or less extent to admit air from section A to section B. The second spray 4 extends into both sections B and C. Suspended between these two sections, however, is a curved splitter baffle 6 adapted to divide or split the air currents coming from section A and to divert a portion downwards more directly to the baffles 7, a large part of the air current travelling upwards through the main section of the spray 4. In this second spray pass, also, it will be noted that the air travels against the spray with resulting turbulence and more thorough washing.

Between the spray chamber C and the moisture eliminator section D is a baffle wall 7 designed to keep the spray drops from the eliminator. One of the air passages through the moisture eliminator section D is shown in plan in Fig. 3. These are of a zig zag shape, restricted in section, and formed by walls 12, 12, comprising reinforced, absorbent textile material as shown more in detail in Fig. 4.

Referring to Fig. 4, the moisture eliminator walls comprise a center reinforcement 13 and two outer layers 13, 13, all three preferably wire mesh. I have found the quarter inch mesh known in the trade as #16 hardware cloth to be satisfactory. Between the center strip of wire mesh and each outside strip are placed one or more layers

14, preferably two, of textile material, preferably burlap of the coarse grade known as coffee bag burlap, or other rough absorbent material of low cost.

The wire mesh 13, 13, not only holds the cloth and permits shaping of the wall but, also, the center strip separates the inner layers and makes a drip opening or channel for the water to trickle down to the plates and troughs 8, 8, (Fig. 1) while the outside strips of wire mesh, being rough, cause great turbulence of the air passing at high velocities through the restricted zig zag passages, facilitating the deposit of free moisture on the absorbent fabric and this moisture in due time escapes down the center channel of the wall. As indicated in Fig. 1, the moisture eliminator section D is composed of several superimposed units divided by plates ending in drip troughs 8, 8. Beneath each section of the washer and dehumidifier are pans 11, 11.

After discharge from the moisture eliminator section D, the washed air deprived of all free moisture, travels across section E and through cooling coils 9, 9, which are comprised of steel tubing with aluminum fins, as previously described. Through these tubes may be circulated any cooling medium, usually in commercial practice, low temperature water. The air cooling and striking cold coils deposits moisture on the fins, the fins forming more than three quarters of the surface, and the water condensed is swept off by the rush of air and trickles off the fins down into the gutter or trough at 10 or into the underneath pan 11. Recirculation of the water gathered by the various pans may be provided by proper piping and filtering as will be apparent to those skilled in the art.

For a higher degree of washing and water filtering of air, a section F shown in Fig. 2, may precede section A, in which case intake heating coils 1 and by-pass louvres 2 may be dispensed with in section A and corresponding intake heating coils 1a and louvres 2a may be provided on section F. Between section F and section A are provided baffles 15 through which the air travels but which shield the spray chamber of section A from the saponified spray of section F.

The spray 17 of section F is preferably of warm water saponified as with sulphanated castor oil or powdered soap. This more or less fills the chamber of section F with soap bubbles or the like, through which the entering air passes at reduced speed because of the larger cross section of this chamber, designed to permit about half the velocity of that which the air attains in section A and the other spray chambers. Passage of the air slowly through the bubbles results in complete elimination of even microscopic particles of suspended matter which is washed into trays 16 of coke or charcoal. The coke or charcoal may be removed from time to time and cleansed with superheated, high pressure steam, and used again. By keeping the coke or charcoal clean, the water in this chamber may be recirculated by merely replenishing the soap supply.

What I claim is:

1. In an air washer and dehumidifier a plurality of sprays, an air supply intake to pass the air against the stream of one of said sprays and against the stream of another of said sprays, moisture eliminators adapted and arranged to remove excess moisture from said air, baffles between said sprays and said moisture eliminator adapted and arranged to shield said moisture

eliminator, and means to dehumidify said air, substantially as described.

2. A structure as defined in claim 1 and in addition means to heat the air from said air intake and said means to dehumidify said air comprising means to cool the air discharged from said moisture eliminator.

3. In an air washer and dehumidifier a plurality of sprays, air supplying means, means to pass the air against the stream of one of said sprays and against the stream of another of said sprays, moisture eliminators adapted and arranged to remove excess moisture from said air and comprising zig-zag passages formed by a composite strip of wire mesh and burlap with the wire mesh contacting the air stream to cause positive turbulence thereof while passing through said passages, baffles between said sprays and said moisture eliminator adapted and arranged to shield said moisture eliminator, and means to dehumidify said air.

4. In an air washer and dehumidifier a plurality of sprays, air supplying means, means to pass the air against the stream of one of said

sprays and against the stream of another of said sprays, by-pass means around the second mentioned spray, moisture eliminators adapted and arranged to remove excess moisture from said air, baffles between said sprays and said moisture eliminator adapted and arranged to shield said moisture eliminator, and means to dehumidify said air.

5. In an air washer and dehumidifier a plurality of sprays in separated chambers and oppositely directed, air supplying means associated with the chambers, means to pass the air against the stream of one of said sprays and against the stream of another of said sprays, said means including a member dividing the air stream to by-pass a portion thereof around the second mentioned spray, moisture eliminators adapted and arranged to remove excess moisture from said air, baffles between said sprays and said moisture eliminator adapted and arranged to shield said moisture eliminator, and means to dehumidify said air.

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