

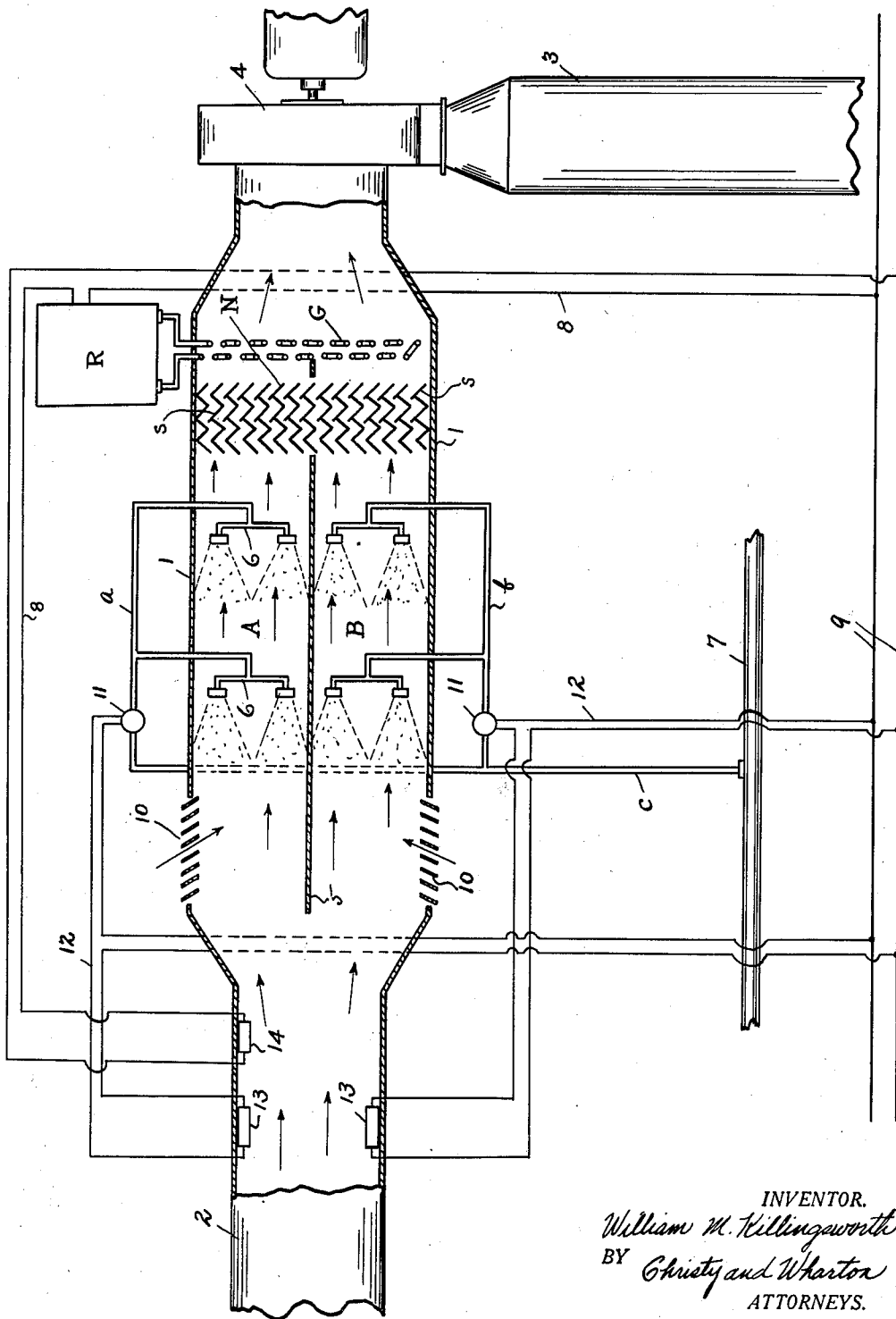
Jan. 23, 1940.

W. M. KILLINGSWORTH

2,187,905

AIR CONDITIONING

Filed March 7, 1938



INVENTOR,
William M. Killingaworth
BY Christy and Wharton
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,187,905

AIR CONDITIONING

William M. Killingsworth, Claysville, Pa., assignor
to Frazier-Simplex, Inc., a corporation of Delaware

Application March 7, 1938, Serial No. 194,236

2 Claims. (Cl. 62—176)

My invention relates to air conditioning, and consists in a method of controlling the temperature and humidity of the atmosphere within auditoria, theatres, offices, factory buildings, homes, and other rooms or regions.

The art is familiar with various methods of treating air to this end. A particularly well-known method consists in circulating a stream of air between an outlet and an inlet in the walls of the room or rooms whose atmospheric conditions are to be controlled. This circulating stream of air is passed through sprays of water, moisture-removing instrumentalities, refrigerated cooling coils and other known means for cleansing the air and establishing the desired conditions of temperature and humidity. The sprays of water and the refrigerating means are responsive in operation to known controlling devices, and the temperature and humidity of the circulating air are automatically established and maintained at such values as to provide the desired atmospheric conditions within the room or rooms.

In some cases the circulating stream of air is divided and caused to advance in multiple lines of flow, each through individually controlled means for regulating temperature and moisture content, and in most cases fresh air from the outer atmosphere is introduced to the room or rooms with the circulated and treated air. In such way more accurate control of the desired atmospheric conditions is obtained. The invention is particularly directed to refinements in this method of conditioning air, and by virtue of such refinements the desired control of the atmosphere within a room or rooms may be effected more readily and with greater precision.

In the accompanying drawing I illustrate apparatus, in which and in the operation of which my invention is realized. The drawing shows the apparatus diagrammatically, partly in plan from above and partly in horizontal section.

The apparatus illustrated is arranged in the line of air circulation between the air inlet and outlet of the room or rooms (not shown) in which the atmosphere is to be conditioned. The circulating air enters the apparatus by way of a duct 2, and, under the influence of a motor-driven fan 4, leaves by way of a duct 3.

Between the inlet and outlet ducts 2 and 3 the walls 1 of the apparatus provide a chamber in which I provide two (or more) sets of water-spraying devices, a nest of baffles, and a grid of refrigerated cooling coils, all arranged in the line of flow in the order named. The water-spraying

devices are arranged (on opposite sides of a partition 5) in two parallel sets A and B, and each set includes two nozzle units 6, 6 arranged in series. Water is fed to the nozzles from a supply line 7, through pipe c and leads a and b. Each of the baffles in nest N consists in a sheet s of metal, bent into a section of the zigzag form shown, and in assembly the zigzag sections, arranged in close lateral juxtaposition, extend vertically from the floor of the chamber to the roof. And immediately beyond the baffles the grid G of cooling coils is arranged. In known way a mechanical refrigerating unit R is arranged to maintain the coils at sub-atmospheric temperature. The refrigerating unit includes a compressor (not shown) driven by a motor—in this case an electric motor, energized through an electric circuit 8 connected to power supply lines 9.

Manifestly, by mere duplication more than one partition 5 may be provided, and the flowing air divided into more than two streams, each subject to treatment by water-spraying devices. And manifestly the inlet duct, outlet duct, fan, nest of baffles, cooling coils, and refrigerating unit may be duplicated in the system within the intent of the appended claims.

Into the stream of air flowing from duct 2, I introduce fresh air drawn from the outer atmosphere, and in this case the fresh air enters through louvers 10 included in the chamber walls 1. The stream of circulating air, including the added quantities of fresh air, is caused to flow in divided stream through the sets A and B of water sprays. The water supplied to the sprays is cool water, drawn from a natural supply, or from the delivery lines of a municipal water system, or from the sump of a water cooling system organized in known way with the air-conditioning apparatus. The cool sprays of water wash and cool the flowing air, and the degree to which the air is cooled is proportional to the quantity of water delivered by the sprays, understanding, of course, that the temperature of the supply water is at substantially constant sub-atmospheric value.

In accordance with the invention, I regulate the quantity of water supplied to each set of nozzles individually, and the regulation is effected automatically, in accordance with variations in the dry-bulb temperature of the treated air. The control of the sets of sprays is established at different temperature values.

To this end the apparatus in which the invention is practised is provided with an electrically controlled valve 11 in each of the water-supplying

leads *a* and *b* of the two sets of water sprays; each valve is by a circuit 12 connected to the power supply lines 9, and a thermostat 13 is included in each circuit 12. In this case the thermostats are arranged in the inlet duct 2, but it is to be understood that, alternately, they may be installed at some other point in the system where they will be responsive to the temperature of the air undergoing treatment. If the temperature of the air rises or falls, each thermostat 13 operates in known way to increase or decrease the electric current flowing in its circuit 12, and, when such current increases or decreases, the valve 11 operates correspondingly to increase or decrease the quantity of water discharged by the particular set of nozzles. Thus, as the temperature of the air rises or falls, water in greater or less quantities is delivered by the sprays, and the cooling effect of the sprays on the flowing air is correspondingly increased or decreased.

More specifically, the two thermostats 13, 13 are designed and adjusted to operate at different critical temperatures, by virtue of which feature the temperature of the air in the room or rooms being conditioned is accurately maintained within a narrow range of permissive temperature variation. The thermostat of the set A of water sprays is so designed and adjusted that, when the temperature of the air coming from the room is 72 degrees F., the valve controlling the supply of water to the sprays closes and cuts off the flow of water. The thermostat of the set B of sprays is in like manner set to shut off the flow of water when the temperature of such air comes to a value of 70 degrees F. If the air flowing from the room rises above 72 degrees F., the valves 11 of both sets of water sprays are opened wide and maximum quantity of water is delivered by the sprays of each stage. Both components of the divided stream of air are subjected to maximum cooling effect. When the temperature of the air drops to a value of 72 degrees, the valve 11 of sprays A closes and the water is cut off. In brief, the two thermostats operate so far as practical to hold the temperature of the air in the room to a value of between 70 and 72 degrees F., it being understood that the critical values given are exemplary only. Of course, if the temperature of the air falls and remains below the lower of the two critical values (70 degrees in this case), it merely signifies that the atmospheric temperature in the room has fallen below the point where cooling of the air is required.

Thus it is that the air-washing sprays operate to establish and maintain the desired temperature in the air of the room or rooms whose atmospheric conditions are to be controlled.

The humidity or moisture content of the air is also regulated. The air flowing in divided stream from the washing and cooling water sprays invariably contains more than the proper quantity of moisture—that is, the humidity of the air is too high. In correcting this condition, I pass both components of the divided stream of washed and cooled air first through the nest N of baffles and then through the grid G of refrigerated coils. The nest of baffles operates in usual way to remove substantially all condensed moisture carried in the streaming air, and the refrigerated grid, in suddenly cooling the flowing air, operates to condense moisture carried in vaporous state in the air. The condensed vapors precipitate to the floor of the chamber, whence they are drained away in any convenient manner.

The lower the temperature of the coils of the grid, the greater is the quantity of the included vapor that is condensed and removed from the flowing air. In order to establish and maintain the desired humidity in the room or rooms being air-conditioned, I regulate the refrigerating effect of the unit R, and the refrigerating effect in turn regulates the humidity-determining temperature of the grid coils G, through which both components of the divided stream of air flow. This regulation of refrigerating effect is obtained by means of a humidostat 14 (a known device) that, connected in series in the energizing circuit 8 of the motor-driven compressor (not shown) of the refrigerating unit R, is arranged in the inlet duct 2. When the humidity of the air flowing into the apparatus rises, the humidostat operates in known way to close the circuit 8, with the consequence and effect that the compressor motor is set in operation and the refrigerating effect of the unit R is increased; that is, the temperature of the coils of grid G reduced. Accordingly, the quantity of water vapor removed from the flowing air is increased. Alternately, when the humidity of the air falls, the humidostat operates to open the circuit 8, with the result that the operation of the compressor motor is arrested; the refrigerating effect of the unit R is decreased, the temperature of the grid coil or coils rises, and the quantity of water vapor removed from the air is decreased. In such manner the moisture content or humidity of the air under treatment is automatically regulated and maintained at desired value.

Upon flowing through the grid coil or coils G the several components of the divided stream of air are merged, and under the influence of the fan 4 are thoroughly mixed and introduced to duct 3, leading to the room or rooms whose atmosphere is to be held within specified limits of temperature and humidity. In thus regulating the temperature and humidity of the air introduced to the room, and in regulating the rate of circulation in usual way, such as by dampers or other means, the desired atmospheric conditions are established and maintained.

In the operation of the exemplary apparatus described, the method of my invention is practised. It is to be noted of my method that the temperature of the treated air is controlled primarily by a plurality of sets of water sprays, and the humidity by refrigerated coil or coils of a refrigerating unit or units. Both the fresh air and the air drawn from the room, or other region to be air-conditioned, are mixed and passed in two or more streams through the temperature-controlling and humidity-rectifying instrumentalities.

I claim as my invention:

1. The method of establishing and maintaining desired atmospheric conditions within a room, which method includes passing air drawn from the room and mixed with air drawn from the outer atmosphere in a divided stream through a plurality of sets of water sprays, regulating the water supplied to said sets of sprays individually in accordance with variations in temperature of the air whose conditions are to be controlled, leading the several components of the divided stream of air from said sprays and passing them through the refrigerated coils of a single refrigerating unit, regulating the refrigerating effect of said unit in accordance with variations in humidity of the air under control, and introducing the treated stream of air to said room.

2. The method of establishing and maintaining desired atmospheric conditions within a room, which method includes passing air drawn from the room and mixed with air drawn from the outer atmosphere in a divided stream through a plurality of sets of water sprays, regulating the quantities of water flowing from said sets of sprays individually in accordance with variations from different temperature values of the air whose conditions are to be controlled, leading the several components of the divided stream of air from said sprays and passing them through refrigerated coils, regulating the temperature of said coils in accordance with variations in humidity of the air under control, and introducing the treated stream of air to said room.

WILLIAM M. KILLINGSWORTH.