

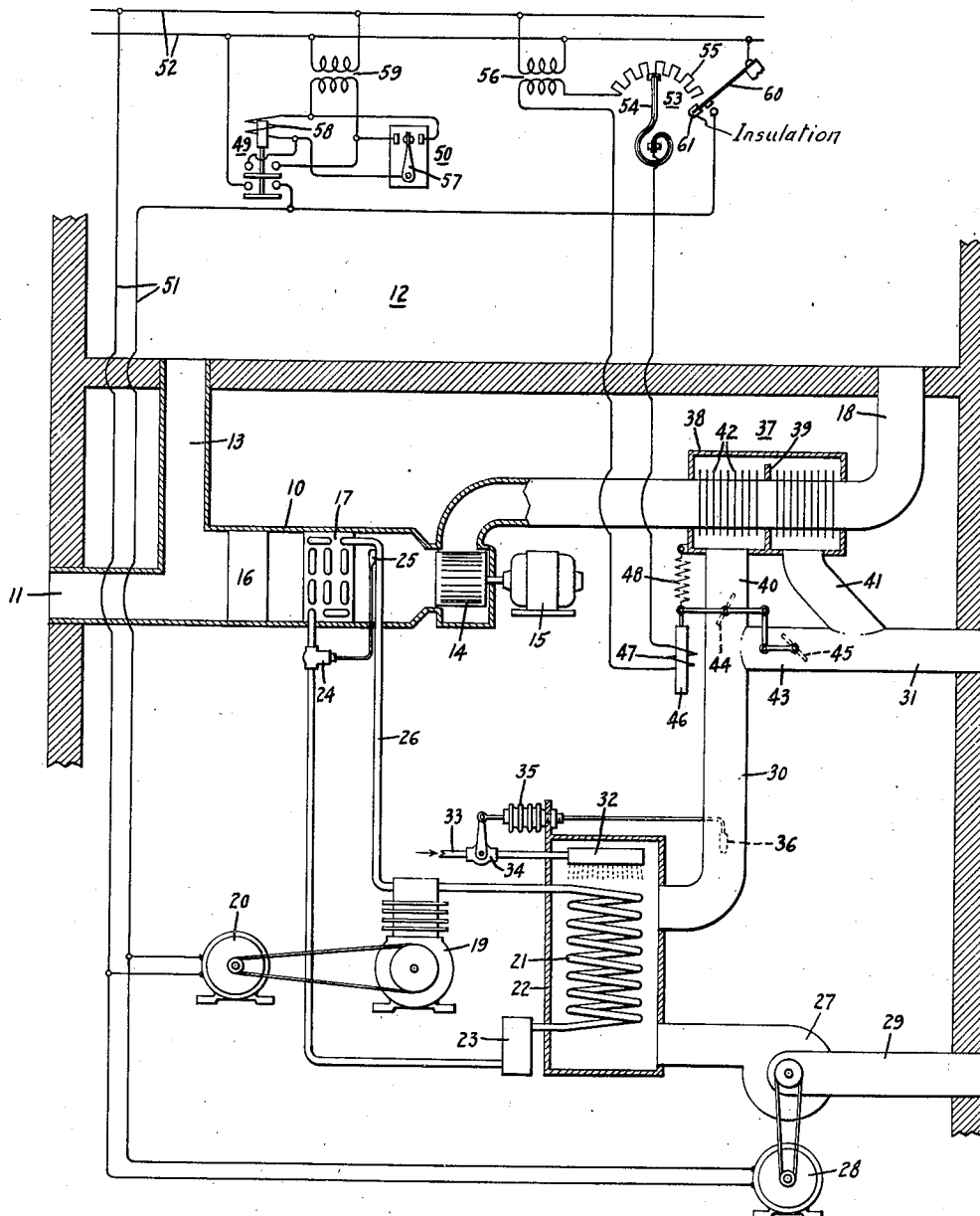
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AIR CONDITIONING SYSTEM

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AIR CONDITIONING SYSTEM

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5 Claims. (Cl. 62—6)

My invention relates to air conditioning systems, and particularly to such systems which are arranged to dehumidify the air in an enclosure to be conditioned.

5 It is an object of my invention to provide an improved air conditioning system including a refrigerating machine having an evaporative condenser and apparatus for reheating the air cooled and dehumidified by the cooling element of the refrigerating machine.

10 Further objects and advantages of my invention will become apparent as the following description proceeds, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

15 For a better understanding of my invention reference may be had to the accompanying drawing, in the single figure of which I have illustrated diagrammatically an air conditioning system embodying my invention.

Referring now to the drawing, I have shown an air conditioning system including a casing 10 arranged to receive fresh air through an inlet duct 11 and recirculated or return air from a room 12 through an inlet duct 13. Air is drawn into and circulated through the casing 10 by operation of a fan 14 driven by a motor 15, the air passing through a filter 16 and a cooling element 17. The filtered and cooled air is returned to the room or enclosure 12 through a discharge duct 18.

The cooling element 17 comprises the evaporator of a refrigerating machine including a compressor 19 driven by a motor 20 and an evaporative condenser 21 arranged in the casing 22. During the operation of the refrigerating machine, hot compressed gaseous refrigerant is discharged from the compressor 19 and enters the condensed coil 21 where it is cooled and liquefied, the liquid refrigerant collecting in a sump or receiver 23 from which it flows to the evaporator 17 through a thermostatic expansion valve 24 having a thermal element 25 responsive to the temperature of the gas discharged from the evaporator. The liquid refrigerant in the evaporator absorbs heat from the air passing through the casing 10 and is vaporized, the vaporized refrigerant being returned to the compressor 19 through a suction line 26. In order to cool the condenser 21, I provide a fan 27 driven by a motor 28 and arranged to circulate fresh air from the duct 29 through the casing and discharge it outside the building through a duct 30 and discharge connection 31. The condenser 21

is operated as an evaporative condenser, water being sprayed over the surface thereof by a spray head 32 which is supplied with water through a conduit 33. The supply of water is controlled by a valve 34 provided with a bellows 35 actuated in accordance with the temperature in the discharge duct 30 as determined by a thermal element 36.

In order to remove substantial quantities of latent heat from the air passing through the casing 10 and thereby reduce the relative humidity of the air, it is necessary to operate the evaporator 17 at low surface temperatures. This low temperature operation of the evaporator effects substantial reduction of the sensible heat of the air passing through the casing and it is, therefore, desirable to provide some arrangement for increasing the dry bulb temperature of the air before it is returned to the enclosure. Accordingly, I provide a reheater 37 arranged to heat the air returned to the enclosure from the casing 10 through the discharge duct 18. The reheater 37 is a heat interchanger and comprises a casing 38 through which the air in the duct 18 passes in heat exchange relation with the air discharged from the casing 22 of the evaporative condenser 21. Any suitable heat exchange device which provides for the flow of the two air streams in heat exchange relation without any intermingling of the streams may be employed, the arrangement shown being diagrammatic. In the illustrated embodiment the casing 38 is divided into two portions by a baffle 39 and air from the duct 30 is admitted to the casing 38 through a connection 40 and is discharged therefrom through a connection 41 to the outlet duct 31, a plurality of fins or suitable heat exchange surfaces 42 being provided to increase the effective surface of the duct 18 within the casing 38.

In order to control the reheating effect of the heat exchanger 37, I provide a by-pass duct 43 connecting the condenser discharge duct 30 and the outlet 31, and I arrange a pair of dampers 44 and 45 to proportion the amounts of air flowing through the casing 38 and the by-pass 43. The dampers 44 and 45 are linked together and actuated by a solenoid having an armature 46 and a coil 47, the pull of the solenoid being opposed by a spring 48 so that when the coil 47 is energized the dampers will take a position depending upon the degree of energization thereof.

In order to control the air conditioning system illustrated to provide dehumidification and also the desired dry bulb temperature within the enclosure 12, I provide a relay 49 actuated by a

humidostat 50 and arranged to connect supply lines 51 of the motors 20 and 28 to power supply lines 52. The refrigerating machine and evaporative condenser are thus controlled in response to the humidity of the air within the enclosure 12. In order to provide the desired amount of reheating, I control the damper operated solenoid coil 47 in response to room temperature. A thermostat 53 having a movable element 54 and a variable resistor 55 is connected to the secondary of a transformer 56 to energize the coil 47 in accordance with the temperature in the room. When the temperature in the room 12 increases the pull on the armature 46 is increased and the amount of air passing through the by-pass 43 decreased.

During the operation of the air conditioning system shown, when there is a demand for dehumidification a movable element 57 of the humidostat 50 engages its left-hand contact and connects a coil 58 of the relay 47 across the secondary of a transformer 59 thereby energizing the coil and picking up the relay. The top arm of the relay closes a holding circuit for the coil 58 and the bottom arm closes the circuit of the motors 20 and 28 thereby starting the refrigerating machine and condenser air circulating fan. The motor 15 for driving the fan 14 of the air conditioning system may be energized in any suitable manner, preferably concurrently with the motors 20 and 28. Operation of the motor 20 actuates compressor 19 to compress gaseous refrigerant withdrawn from the evaporator 17 and to discharge the hot compressed refrigerant to the compressor 21. As soon as the temperature of the air passing through the casing 22 increases to a predetermined value, the bellows 35 is actuated to supply cooling water to the sprinkler head 32. The bellows 35 and thermostatic bulb 36 are adjusted to maintain a predetermined substantially constant temperature of the air discharged from the condenser through the duct 30. The compressed refrigerant is cooled and liquified in the condenser 21, collects in the receiver 23, and is discharged therefrom in accordance with the operation of the thermostatic expansion valve 24. The liquid refrigerant in the evaporator is vaporized by the absorption of latent and sensible heat from the air passing through the casing 10 and the vaporized refrigerant is returned to the compressor through the suction line 26. The air circulated through the casing 10 by operation of the fan 14 is filtered, cooled and dehumidified and discharged through the duct 18. The moisture removed from the air in the casing 10 may be collected at the bottom of the casing and removed in any suitable manner. If the air admitted to the room through the duct 18 reduces the room temperature to a predetermined value, the thermostat 53 will operate to open the damper 44 and admit the warm air discharged from the condenser to the heat exchanger 37 thereby increasing the temperature of the air passing through the duct 18, the amount of reheating being determined by the difference between the temperature of the room and the desired temperature. Some of the moisture-laden air discharged from the condenser 22 is cooled in the heat exchanger 37. The absorption of the heat from this air by the air passing through the duct 18 will condense moisture in the heat exchanger, which moisture may be collected and removed by a suitable drain connection (not shown).

In order to provide for operation of the cool-

ing means when the humidostat 50 is satisfied and the thermostat 53 is not, I provide the thermostat 53 with an auxiliary switch 60 so that the cooling element 17 may be operated even though relay 49 is de-energized. When the movable element 54 moves over to a position at the extreme right-hand end of the resistor 55, the element 54 will engage an insulated end 61 of the switch 60, thereby moving switch 60 into its closed position to complete a circuit to the motors 20 and 28 and start the refrigerating machine and condenser air circulating fan. Thus the cooling apparatus will operate under the direct action of the thermostat 53.

While I have shown my invention in connection with an air conditioning system for comfort cooling, other applications will readily be apparent to those skilled in the art. I do not, therefore, desire my invention to be limited to the particular arrangement shown and described, and I intend in the accompanying claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An air conditioning system including a casing and means for circulating air through said casing and into an enclosure to be conditioned, means including a refrigerating machine having a cooling element for cooling and dehumidifying air circulated through said casing, said refrigerating machine having an evaporative condenser, means for circulating a stream of air over said condenser, means for circulating water over the surface of said condenser in the path of the air stream, means controlling said water circulating means for maintaining the temperature of said stream of air at the discharge end of said condenser above a predetermined minimum, and means utilizing the heat in said discharged stream of air for reheating air passed through said casing after its circulation over said cooling element and before its discharge into said enclosure.

2. An air conditioning system including a casing and means for circulating air through said casing and into an enclosure to be conditioned, means including a refrigerating machine having a cooling element for cooling and dehumidifying air circulated through said casing, said refrigerating machine having an evaporative condenser, means for circulating a stream of air over said condenser, means for circulating water over the surface of said condenser in the path of the air stream, means controlling said water circulating means for maintaining the temperature of said stream of air at the discharge end of said condenser above a predetermined minimum, means utilizing the heat in said discharged stream of air for reheating air passed through said casing after its circulation over said cooling element and before its discharge into said enclosure, and means for varying the amount of said condenser air utilized in said reheating means.

3. An air conditioning system including a casing and means for circulating air through said casing and into an enclosure to be conditioned, means including a refrigerating machine having a cooling element for cooling and dehumidifying air circulated through said casing, said refrigerating machine having an evaporative condenser, means for circulating a stream of air over said condenser, means for circulating water over the surface of said condenser in the path of the air stream, means controlling said water circulating

means for maintaining the temperature of said stream of air at the discharge end of said condenser above a predetermined minimum, means utilizing the heat in said discharged stream of air for reheating air passed through said casing after its circulation over said cooling element and before its discharge into said enclosure, means dependent upon a condition of the air in said enclosure for controlling said refrigerating machine, and means dependent upon the temperature of the air in said enclosure for varying the amount of the air discharged from said condenser and utilized by said reheating means.

4. An air conditioning system including a casing and means for circulating air through said casing and into an enclosure to be conditioned, means including a refrigerating machine having a cooling element for cooling and dehumidifying air circulated through said casing, said refrigerating machine having an evaporative condenser, means for circulating a stream of air over said condenser, means for circulating water over the surface of said condenser in the path of the air stream, means controlling said water circulating means for maintaining the temperature of said stream of air at the discharge end of said condenser above a predetermined minimum, means utilizing the heat in said discharged stream of air for reheating air passed through said casing after its circulation over said cooling element and before its discharge into said enclosure, means responsive to the relative humidity of the air in said enclosure for controlling said refrigerating machine and said condenser air circulating

means, means responsive to the temperature of the air in said enclosure for varying the amount of said condenser air stream utilized in said reheating means, and means responsive to the temperature of the air discharged from said condenser for controlling the circulation of water over said condenser.

5. An air conditioning system including a casing and means for circulating air through said casing and into an enclosure to be conditioned, means including a refrigerating machine having a cooling element for cooling and dehumidifying air circulated through said casing, said refrigerating machine having an evaporative condenser, means for circulating a stream of air over said condenser, means for circulating water over the surface of said condenser in the path of the air stream, means controlling said water circulating means for maintaining the temperature of said stream of air at the discharge end of said condenser above a predetermined minimum, means utilizing the heat in said discharged stream of air for reheating air passed through said casing after its circulation over said cooling element and before its discharge into said enclosure, means dependent upon a condition of the air in said enclosure for controlling said refrigerating machine, means dependent upon the temperature of the air in said enclosure for varying the amount of the air discharged from said condenser and utilized by said reheating means, and additional means for controlling said refrigerating machine when said condition-dependent means is satisfied.

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