Jan. 21, 1958 C. A. V. PRIEST 2,820,353

HUMIDITY AND TEMPERATURE REGULATING AIR CONDITIONER

Filed Sept. 19, 1955

Fig. 1

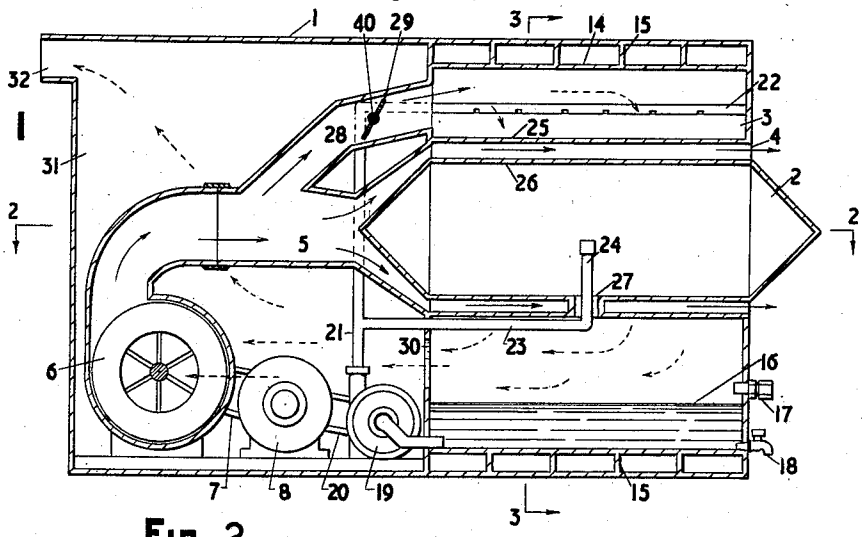


Fig. 2

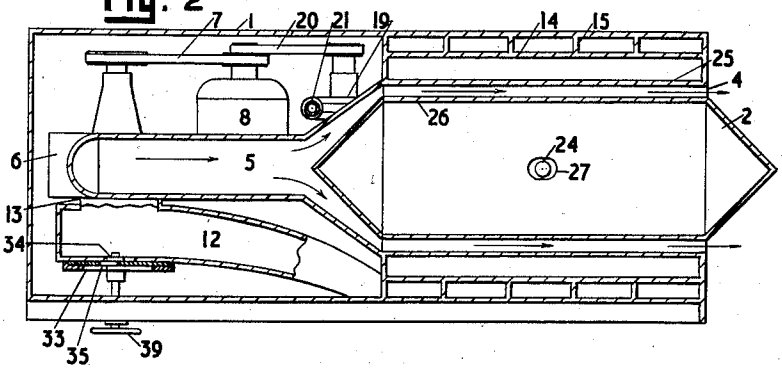
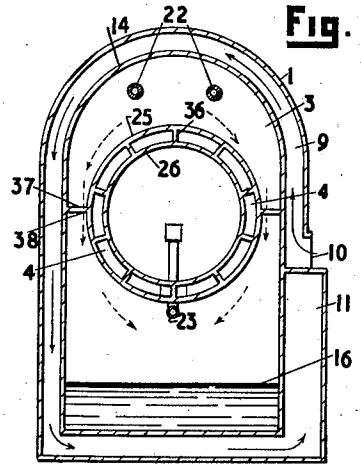


Fig. 3



United States Patent Office 2,820,353 Patented Jan. 21, 1958

2,820,353

HUMIDITY AND TEMPERATURE REGULATING AIR CONDITIONER

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Application September 19, 1955, Serial No. 535,213

4 Claims. (Cl. 62—139)

This invention relates to a humidity and temperature regulating air conditioner which has been designed specifically to allow air passing through the conditioner to have its temperature varied and which will also permit the humidity of such air to be regulated as required.

The objects of the present invention are to provide an arrangement in which a coolant such as water can be used to cool the air but without communication between the coolant and the treated air so that dry air can be passed through, means being however provided to allow the humidity of such air to be varied by introducing water vapour in the required proportion.

The invention comprises air ducts leading to and from a blower, and an evaporation chamber having its walls common with at least one of the ducts and means to spray water on to the walls of the evaporation chamber, means being provided to control the quantity of air flowing through the evaporation chamber.

According to one embodiment the ducts comprise a precooler duct and a heat exchange duct with a blower arranged between them so that air will be drawn through the precooler duct and discharged through the heat exchange duct, an evaporation chamber being disposed between the said ducts and having walls common therewith so that water sprayed on to the walls in the evaporation chamber by a pump will be evaporated by air which passes in a controlled quantity from the blower through the evaporation chamber and will regulate the amount of evaporation, means being provided to feed a controlled quantity of moisture into the blower to control the humidity. The heat exchange chamber may form the inner wall of the heat exchange duct, the interior walls of this chamber preferably also being washed with cold water from the spray-line and are thereby enabled to absorb heat from the air flowing over their outer surface.

In order that the invention may be more fully appreciated an embodiment will now be described with reference to the accompanying drawings in which:

Fig. 1 is a longitudinal section of the unit,

Fig. 2 is a section of same on line 2—2 of Fig. 1 but with part of the main air transfer duct sectioned, and

Fig. 3 is a section on line 3—3 of Fig. 1.

A main outer housing **1** carries in it an inner heat transfer chamber **2** which is surrounded by an outer evaporation chamber **3** to form therebetween an annular heat exchanger **4**.

The heat exchanger **4** communicates with an air channel **5** through which air is fed to the annular air heat exchanger **4** from a blower **6** driven through a belt **7** from a motor **8**.

Surrounding the evaporation chamber **3** is the air precooler duct **9** which has its inlet at **10** and as shown more particularly in Fig. 3 extends over the outer wall of the evaporation chamber **3** and down beneath same to terminate in a larger portion **11** which in turn opens into a transfer duct **12** leading to the intake **13** of the blower **6** so that air may enter the opening at **10** and pass around the precooler duct **9** to be cooled by contact with the outer wall **14** of the evaporation chamber.

The wall **14** is connected by a series of webs **15** to the outer housing **1** to give greater heat transfer and thus greater cooling of the air being drawn through the duct **9** into the blower **6**.

The lower part of the evaporation chamber **3** forms a sump **16** in which the water used for the cooling is carried, an inlet **17** allowing the supply to be maintained and an outlet **18** allowing draining when required.

The water for the heat exchange chamber **2** and the evaporation chamber **3** is drawn from this sump **16** by a pump **19** driven by a belt **20** from the motor **8**, the pump having its outlet tube **21** connected to a pair of spray-lines **22** disposed in the evaporation chamber **3**, the pipe **21** also having a branch **23** connected thereto leading to a spray-line **24** disposed inside of the heat exchange chamber **2**.

In this way water from the sump **16** is forced into the pipe **21** and issues through apertures in the spray-lines **22** and **24** to keep the inside of the wall **14** of the evaporation chamber **3** wet as well as the outside wall **25** of the heat exchange duct **4** and the inner wall **26** of that duct.

As the air from the channel **5** is forced through the heat exchange duct **4** and flows over the walls **25** and **26** it is cooled by the cold water continuously sprayed over their other sides and gravitating to the sump to be recirculated by the pump **19**.

The spray line **24** passes through an aperture **27** which aperture serves also as a drain of water from the inside of the heat exchange chamber **2** back to the sump **16**.

An air bleed channel **28** with a control valve **29** allows a regulated proportion of the air from the channel **5** to enter the evaporation chamber **3**, this allowing good control of evaporation by allowing the amount of air flowing through the chamber to be selected. The air passes out of the evaporation chamber **3** through an opening **30** into the humid air chamber **31**. In the drawing this is shown as housing the blower **6**, the pump **19** and the motor **8**, but their components could be elsewhere positioned. Openings must of course be provided to give access to the blower, pump and motor.

Air from this chamber **31** may flow out through the outlet **32** and be led away to atmosphere outside of the building, but the air transfer duct **12** is provided with a slotted valve disc **33** forming the humidity control, which disc **33** is associated with a wall of the duct **12** which has slots **34** so arranged that as the disc is set, slots **35** in the valve disc **33** can be brought into register with the slots **34** in the wall of the duct **12** to thereby allow moist air from the chamber **31** to be drawn into the blower **6** through the end of the duct **12**. In this way the moist air can be mixed with the dry air normally passing through the blower **6** and an effective humidity control thus results, the valve **29** thus controlling the amount of air which is available for the humid air chamber **31** but also controlling the rate of evaporation by the amount of air circulating through the evaporation chamber **3**, surplus air flowing through this valve **29** being led away to outside of the building through the outlet **32**, but the fan can draw in through the registering slots **34** and **35** any required quantity of this humid air to be fed through the heat exchange duct **4** and thus into the building being air conditioned.

Spacers **36** between the walls **25** and **26** support the heat transfer chamber **2** and also serve to increase heat transfer, while a horizontal partition **37** extending from the wall **14** to the wall **25** spaces this within the unit and also regulates air and water flow from the upper part of the evaporation chamber **3** to the lower part thereof the partition **37** having apertures **38** therethrough.

It will be realised that modifications of the foregoing can be effected, for instance the air bleed channel **28**

could lead into the lower part of the outer evaporating chamber and the air could flow into the humid air chamber 31 at the top, or the actual construction and shape of the various chambers can be materially changed, and of course the outlet of the heat exchange duct 4 can be taken to a duct which may lead away to an area to be air conditioned instead of opening as shown.

The water inlet 17 may be provided with automatic level control means such as a float valve and the driving motor 8 could be external of the unit if such was thought advisable, particularly if the heat of the motor is to be kept out of the chamber 31. The warm air from the motor may otherwise be led away to any desired point. Heat insulation material may be used where required.

The humidity control valve disc 33 will of course be provided with an external control 39 by means of which it can be set, while the shaft of the control valve 29 is similarly provided with operating means disposed outside of the housing 1, suitable air seals being provided where these pass through the housing 1.

Where the conditioner is to operate in humid climates the water delivery line 21 to the heat transfer chamber 2 and evaporation chamber 3 may be first passed through a radiator coil mounted inside of the air transfer duct 12 so that the air flowing to the intake of the blower 6 will have to pass over this surface.

In operation water is placed into the sump 16 and the blower 6 and pump 8 are set in motion.

The pump forces water through the pipe 21 to the spray lines 22 and line 24 in the evaporation chamber 3 and the heat exchange chamber 2, washing the walls and gravitating back to the sump 16.

The blower 6 creates a suction in the air transfer duct 12 which causes air to enter at the inlet 10 of the air precooler duct 9 and flows around the wall 14 of the evaporation chamber 3 to be finally drawn into the air transfer duct 12 and thus the blower 6.

The air is blown through the channel 5 into and through the heat exchange duct but a proportion flows through the air bleed channel 28 and valve 29 into the outer evaporation chamber 3, it passing along its upper portion and down at the end furthest from the blower and back along the lower portion of the chamber 3 into the humid air chamber 31.

During its passage through the evaporation chamber 3 the air absorbs water in the form of vapour and the temperature of the water and air is thus reduced to provide a latent heat of vaporisation for the water being taken up by the air.

As the temperature of the circulating water is reduced, it absorbs heat from the walls of the evaporation chamber 3 which in turn absorb it from the air passing through the precooler duct 9 and the heat exchange duct 4.

The heat absorbed by the water is continually given up to provide the latent heat of vaporisation for the water being taken up by the air.

The air entering the humid air chamber is cold and damp and when it is desired that the humidity of the conditioned air should not be increased the humidity control valve disc 33 is kept closed and the chamber 31 exhausts through the outlet 32 to a duct leading away from the room.

Under such conditions the cooling of the conditioned air is accomplished mainly as it passes over the surfaces of the walls 14, 25 and 26 of the air precooler duct 9 and the heat exchange duct 2.

When it is desired to increase the humidity of the conditioned air the valve 33 is opened to the required degree to allow the air from the evaporation chamber 3 to flow into the blower 6 and thus mingle with the air circulating from the room through the unit.

What I claim is:

1. A humidity and temperature regulating air conditioner comprising an air pre-cooler duct and an evaporation chamber and a heat exchange duct all arranged consecutively around a heat exchange chamber, a blower with its intake end connected with said air pre-cooler duct and its outlet end connected with said heat exchange duct, an air bleed channel between the outlet of said blower and said evaporation chamber, air flow control means in said air bleed duct, a humid air chamber connected with said evaporation chamber to receive the air therefrom, air flow control valve means between said humid air chamber and the inlet of said blower, and spray means in said evaporation chamber and said heat exchange chamber.

2. A humidity and temperature regulating air conditioner comprising a central heat exchange chamber, a heat exchange duct around said central chamber, an evaporation chamber around said heat exchange chamber, an air pre-cooler duct around said evaporation chamber, a blower with its intake end connected with said air pre-cooler duct and its outlet end connected with said heat exchange duct, an air bleed channel between the outlet of the said blower and said evaporation chamber, air flow control means in said air bleed duct, a humid air chamber connected with said evaporation chamber to receive air therefrom, air flow control valve means between said humid air chamber and the inlet of said blower, and water spray means in said evaporation chamber and said heat exchange chamber.

3. A humidity and temperature regulating air conditioner comprising an air pre-cooler duct and an evaporation chamber and a heat exchange duct all arranged consecutively around a heat exchange chamber, a humid air chamber at one end of the just said assembly, a blower in the same humid air chamber with its intake end connected with said air pre-cooler duct and its outlet end connected with said heat exchange duct, driving means for the blower in said humid air chamber, an air bleed channel between the outlet of said blower and said evaporation chamber, air flow control means in said air bleed duct, connecting means between the said humid air chamber and said evaporation chamber to allow flow of air from the evaporation chamber to the humid air chamber, air flow control valve means between said humid air chamber and the inlet of said blower, spray means in said evaporation chamber and said heat exchange chamber, a sump in the bottom of the evaporation chamber, a pump in said humid air chamber, means connecting the inlet to said pump with the said sump, and means to connect the pump outlet with said spray means.

4. A humidity and temperature regulating air conditioner comprising a central heat exchange chamber, a heat exchange duct around said central chamber, an evaporation chamber around said heat exchange chamber, an air pre-cooler duct around said evaporation chamber, a blower with its intake end connected with said air pre-cooler duct and its outlet end connected with said heat exchange duct, an air bleed channel between the outlet of the said blower and said evaporation chamber, air flow control means in said air bleed duct, a humid air chamber connected with said evaporation chamber to receive air therefrom, air flow control valve means between said humid air chamber and the inlet of said blower, water spray means in said evaporation chamber and said heat exchange chamber, a pump to supply water to said spray means, a sump to collect water from said evaporation chamber and said heat exchange chamber, and means connecting said pump inlet to said sump.

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