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3,427,005

PRECOOLER

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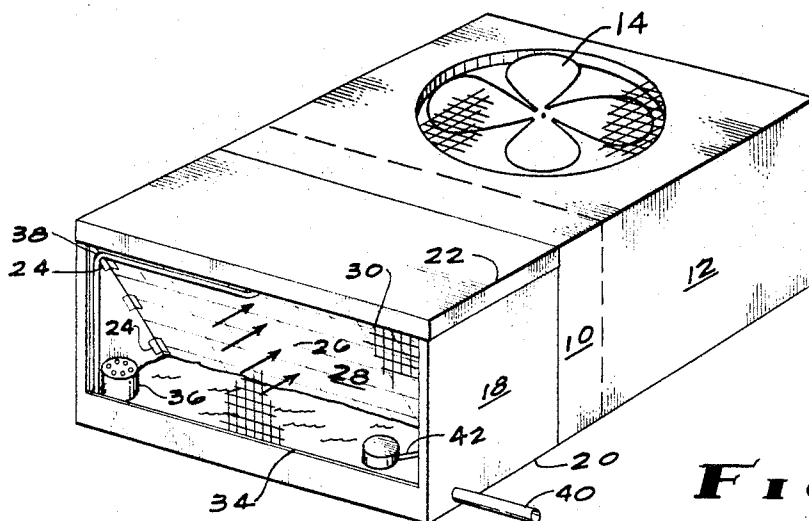


FIG. 1

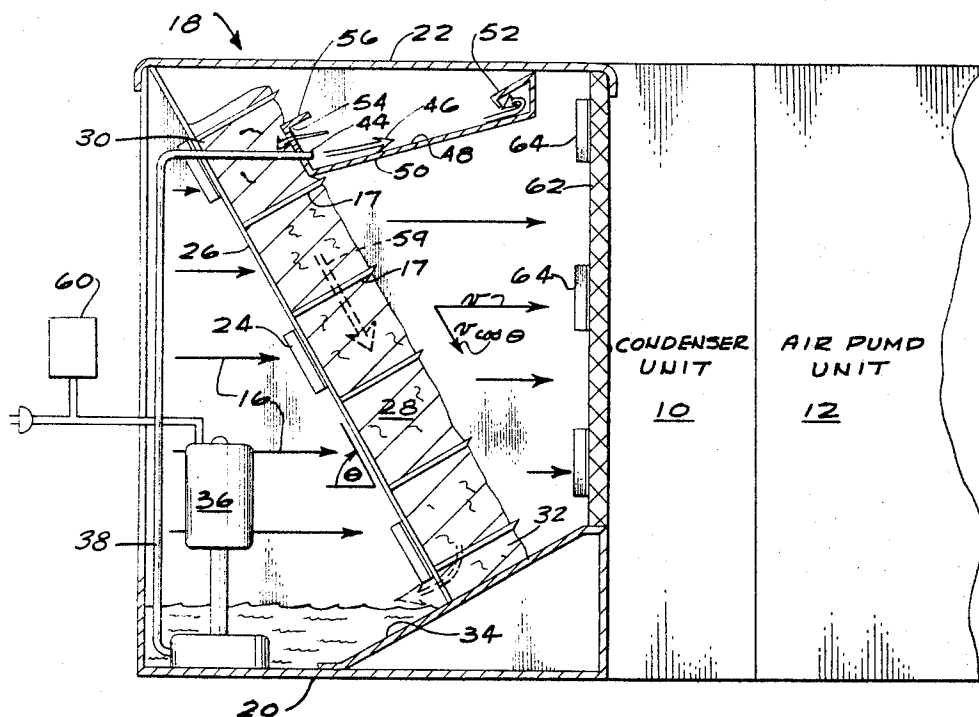


FIG. 2

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3,427,005 PRECOOLER

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U.S. Cl. 261-26
Int. Cl. B01d 47/02

6 Claims

ABSTRACT OF THE DISCLOSURE

A system for precooling the air which is drawn over the condenser heat exchanger coils of refrigeration apparatus. An evaporator pad of aspen wood excelsior is disposed in front of the air intake port for the refrigeration system's condenser coil cooling heat exchanger system. The air flow is substantially horizontal and the pad is disposed across the flow at an angle of 50 to 70 degrees from the horizontal with the lower edge of the pad being downstream in the air flow with respect to the upper edge. Means for flooding the evaporator pad with a relatively very high magnitude of flow of cooling and washing water which flows downwardly across the width of the pad due to the combined forces of gravity and the strong draft of the cooling air the velocity of which has a component downwardly along the face of the sloped pad. The flooding water is recirculated from a receiving sump which is resupplied through conventional float valve means. A thermostatic control automatically stops the water flow when the ambient dry bulb temperature is relatively cool.

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my earlier filed co-pending application, Ser. No. 440,029 filed Mar. 15, 1965, now abandoned and entitled Precooler.

BACKGROUND OF THE INVENTION

In modern refrigeration systems for cooling dwelling and commercial spaces or industrial buildings or the like, it is typically the practice to embody a low vapor pressure, high specific heat coolant fluid for pumping heat from the space and discharging it to the external environment. The refrigerant in liquid form takes up heat from the space as latent heat of vaporization. The vapor is then pumped to a cooled condenser coil where its heat of vaporization is absorbed in heat exchange relation with air or liquid passing over the external surfaces of the condenser coils. The condensed refrigerant is then pumped back to the space for another cycle of cooling.

Generally, the condenser coils are disposed somewhat remotely from the space to be cooled and, usually, heat is removed from them by a draft of ambient air which effectively pumps the heat into the environmental atmosphere. The thermodynamic efficiency of this heat exchange process is substantially proportionate to the temperature difference between the condenser and the coolant air. Unfortunately the temperature of the coolant air is generally highest at the time of heaviest load on the refrigeration system, namely, the hottest portions of those rays when refrigeration is most needed or desired. The result is typically, severe straining of the system as by excessive head pressure in the compressor and, often, burn-out of compressors and loaders. In addition, electrical loading is greatly increased as a manifestation of the lower efficiency particularly at the time of maximum required cooling.

In recognition, in part, of these and other related problems, practitioners in the prior art have attempted to pro-

vide solutions through such approaches as massively increasing the heat flow from the condenser to the coolant air either by enlarging its size or by vastly increasing the flow of coolant air thereover. However, neither approach is adequately effective when the ambient air is in the range of 100 to 125 degrees Fahrenheit, as is typical in the southwestern portions of the United States; and both approaches require excessive expense in the initial cost of the system or in its operation or both.

Another approach has been to spray the condenser coils with water or water vapor. This technique significantly increases the thermodynamic efficiency of the condenser heat extraction process, however, the severe scaling by salts and liming of the coils creates a servicing problem so formidable as to preclude this approach as being not generally practical since it is unquestionably essential, for adequate heat exchange, therefrom, that the coils be clean and free of non-metallic materials.

Other approaches have been suggested and developed in the prior art; however, of those known, they either exhibit one or more of the above disadvantages or are so complex and costly as to preclude their use in practical and low cost systems.

Accordingly, it is an object of the present invention to provide precooler apparatus for the air current flowing over the condenser component of a refrigeration system which is not subject to the above and other limitations and disadvantages of the prior art.

It is another object to provide such apparatus which increases the thermodynamic heat exchange efficiency of a refrigeration system and prevents burn-out of compressors and motors and reduces electrical loading as well as other operating and maintenance costs.

It is another object to provide such apparatus which provides a full flow of condenser cooling air thereover the temperature of which approaches ambient wet bulb temperature.

It is another object to provide such apparatus which is versatile and may be readily and quickly adapted to cooperate with conventional air-conditioning systems of all designs.

It is another object to provide such apparatus which increases the useful life of a refrigeration air-conditioning system.

It is another object to provide such apparatus which is low in cost in its initial manufacture, installation and servicing.

It is another object to provide such apparatus in which all working parts are replaceable standard items of commerce.

It is another object to provide such apparatus which utilizes a very small sump reservoir the contents of which are cooled substantially to wet bulb temperature substantially immediately after operation is initiated.

It is another object to provide such apparatus which is substantially self-cleansing and which maintains the condenser coils and all other structure associated therewith substantially clean, dry, and free of all foreign matter.

It is another object to provide such apparatus which is compact, rugged, and reliable over a very long service life.

It is another object to provide such apparatus which automatically secures itself from operation when the ambient environmental air is sufficiently cooled to preclude undue loading of the refrigeration system.

SUMMARY OF THE INVENTION

Very briefly, these and other objects are achieved in a precooler system which includes an evaporator pad and rack means for holding the pad at an inclined disposition across the horizontal flow of coolant air being drawn

through and over the condenser coils of the refrigeration air conditioning system. The angle of inclination of the pad is approximately 50 to 70 degrees from the horizontal and is inclined with its top portion upstream or away from the condenser coil structure.

Flooding and washing means are provided for flowing a relatively large volume of water downwardly over the evaporator pad and into a small collector sump disposed therebelow.

The downward flow of the flooding water over the pad is aided by the horizontal current of air through the pad which has a significant component of velocity in the downwardly inclined direction of the face of the pad. Accordingly, the air flow, instead of being purely orthogonal to the water flow, and tending only to withdraw it from the face of the pad and consequently onto the external surfaces of the condenser apparatus, actually aids the water flow in the desired direction and the usual tendency to draw the water off the pad in the direction normal thereto, is, in large measure, compensated by gravity.

The resulting heavy flow of water along the pad not only cools the air flow therethrough to substantially ambient wet bulb temperature, but also precludes lime and salt deposits thereon. It also thoroughly precleans the air flowing over the condenser coils whereby they are kept clean from foreign matter such as dust and the like.

Further details of these and other novel features including means for achieving the water flow as well as for automatically securing it as well as additional objects and advantages of the invention and its operation will become apparent and be best understood from a consideration of the following description when taken in connection with the accompanying drawing which is presented by way of illustrative example only and in which:

BRIEF DESCRIPTION OF THE DRAWING

FIGURE 1 is a simplified perspective view of precooler apparatus constructed in accordance with the principles of the present invention; and

FIGURE 2 is a longitudinal sectional view thereof.

With specific reference now to the figures in more detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and structural concepts of the invention. In this regard no attempt has been made to show structural particulars of the apparatus in more detail than is necessary for a fundamental understanding of the invention. The description taken with the drawing will make it apparent to those skilled in the mechanical and air-conditioning arts how the several forms of the invention may be applied in practice. Specifically, the detailed showing is not to be taken as a limitation on the scope of the invention which is defined by the appended claims forming, along with the drawing, a part of this specification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the example of FIGURE 1, a portion of a refrigeration air-conditioning system is illustrated which includes an air cooled condenser unit 10 and an air pump unit 12, which utilizes a driven blower element 14 to create a flow of coolant air indicated by the cooled input vectors 16 and the warmed exhaust vectors 16'. The resultant air flow is through the precooler 18, over and through the coils and fins (not shown) of the condenser unit 10, through the unit 12, and out past the blower 14.

The precooler includes a body 20 and a lid 22 removable for pad replacement access and service. The sides of the precooler body 20 are provided with pad rack brackets 24 for holding an evaporator pad wire rack 26

which, in turn holds the aspen-wood evaporator pad 28 across the horizontal flow of coolant air 16. The pad is disposed at an angle inclined with its upper portion 30 tilted away from the condenser unit 10, or upstream in the path 16, relative to its lower edge 32.

The bottom portion of the precooler body 20 is formed to provide a water receiving sump 34 from which a flooding flow of water is drawn by the recirculating pump 36 through a duct 38 to the upper reaches of the pad 28. Make-up water is supplied to the sump 34 through a supply line 40 controlled by a float valve mechanism 42.

Referring to FIGURE 2, the precooler body 20 is again shown as supporting the pad rack 26 and its pad retainer fingers 17 on the brackets 24 in a manner whereby the evaporator pad 28 is disposed across the path of the input air flow 16. Note that the top portion 30 of the pad 28 is inclined upstream or away from the condenser unit 10 with respect to its lower portion 32. The angle θ of inclination, measured from the horizontal, is in the range of approximately 50 to 70 degrees. Upon removal of the lid portion 22, the rack 26 and the pad 28 may be readily slid upwardly along the line of the bracket 24 for easy replacement of the pad.

The recirculating pump 36 draws water from the sump 34 and drives it through the duct 38 to its termination nozzle 44 which ejects the flooding water, indicated at 46, rearwardly along the forwardly downwardly sloping bottom portion 48 of a water distribution tray member 50. The rear of the tray member 50 is terminated by a retaining and deflecting panel portion 52 which returns the water 46 forwardly toward a perforated dispensing plate portion 54 which also includes a deflecting lip member 56. The flooding water may be dispensed through the foramins 58 in the plate 54 or may simply flow over the top thereof and onto the pad 28. In either event, the water 46 is adequately distributed laterally along the plate 54 after it has traversed the bottom portion 48 twice, the rear deflector system 52, and the deflecting lip member 56.

The pump 36, in this example, has a flow rate capability of at least approximately 5, or the order thereof, gallons per minute, and the area of the aspen-wood pad 28 is approximately 10 to 12 square feet. Of particular note, the capacity of the collector sump 34 is of the order of 3 gallons or approximately one half minute's flow of the pad flooding system. This relationship has been found to provide almost immediate lowering of the sump water temperature to nearly ambient wet bulb temperature when the pump 36 is turned on in the presence of the air flow 16.

This type and magnitude of flow of water through the pad 28 continually washes it, precludes dry spots which would lime and foul and, most importantly, lowers the temperature of the air flow 16 to approximately the ambient wet bulb point. If this were attempted without the indicated slope θ of the pad 28, considerable water deleterious to the operation thereof would be pulled off the back surface of the pad 28 and deposited on the condenser elements.

In accordance with the principles of the present invention, however, the slope of the pad causes the velocity v of the air flow 16 to have a component $v \cos \theta$ which actually aids, in cooperation with gravity, to pull the flood 59 of water along the length of the pad 28 and down into the collecting sump 34. To preclude further any foreign matter such as dry aspen particles or shreds due to operation without energization of the pump 36, due to its automatic cut-off by the thermostat control 60 when the atmospheric temperature is sufficiently low e.g. in morning, evening, or night periods, or due to deterioration or decay of the pad, an auxiliary filter 62 may be provided, as shown, at the input to the condenser unit 10 and retained there removably as, for example by a set of brackets 64 affixed to the body 20.

What is claimed is:

1. A cooling apparatus for use in cooperation with a stream of airflow and water whereby said water is evaporated to cool said airflow, comprising:

an evaporator pad, having an upper portion for carrying said water, said pad being open to pass said airflow;

means for transversely supporting said evaporator pad in said stream of airflow with the upper edge of said evaporator pad displaced upstream to said airflow to position said pad at an angle offset from the axis of said stream of airflow of approximately 50 to 70 degrees, whereby said stream of airflow opposes gravitational forces on said evaporator pad;

a water-collecting sump to provide a reservoir to receive water from said pad; and

means for directing said water from said sump to be dispensed in a concentrated flow to flood said pad by downward flow, including a shallow tray portion disposed behind said upper portion of said pad and extending laterally across substantially the entire width thereof, said shallow tray portion having a bottom portion inclined towards said pad, said shallow tray portion having a forward lower edge and an upper rear edge, said trough further including a forward, dispensing plate portion affixed to the forward, lower edge of said shallow tray portion, said dispensing plate portion being disposed contiguously to said upper portion of said pad means and a rearwardly disposed deflecting portion terminating the upper, rear edge of said shallow tray portion in an overhanging forwardly deflecting relation therewith, said deflecting portion being of the character to receive a high velocity, rearwardly directed waterflow, retaining it within said shallow tray portion, and returning it along said forwardly inclined bottom portion towards said forward dispensing plate portion.

2. A cooling apparatus according to claim 1 further in-

cluding a blower means for providing said stream of airflow to said evaporator pad.

3. A cooling apparatus according to claim 1 further including means to cut off the flow of water from said sump means in accordance with an ambient environmental temperature, including thermostatic means for sensing said temperature.

4. A cooling apparatus according to claim 1 which further includes recirculating duct means interconnecting said collecting sump and said distributing trough, said duct means including a terminating nozzle portion carried by said forward dispensing plate portion in a rearwardly ejecting relation into said tray portion.

5. A cooling apparatus according to claim 4 which further includes recirculating pump means interposed serially in said duct means for returning water from said collecting sump to said distributing trough.

6. A cooling apparatus according to claim 5 in which said recirculating pump means is electric and further includes thermostatic pump control means for controlling said pump means responsive to predetermined temperatures of the ambient environmental atmosphere.

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U.S. Cl. X.R.

261—29, 97, 140; 62—305