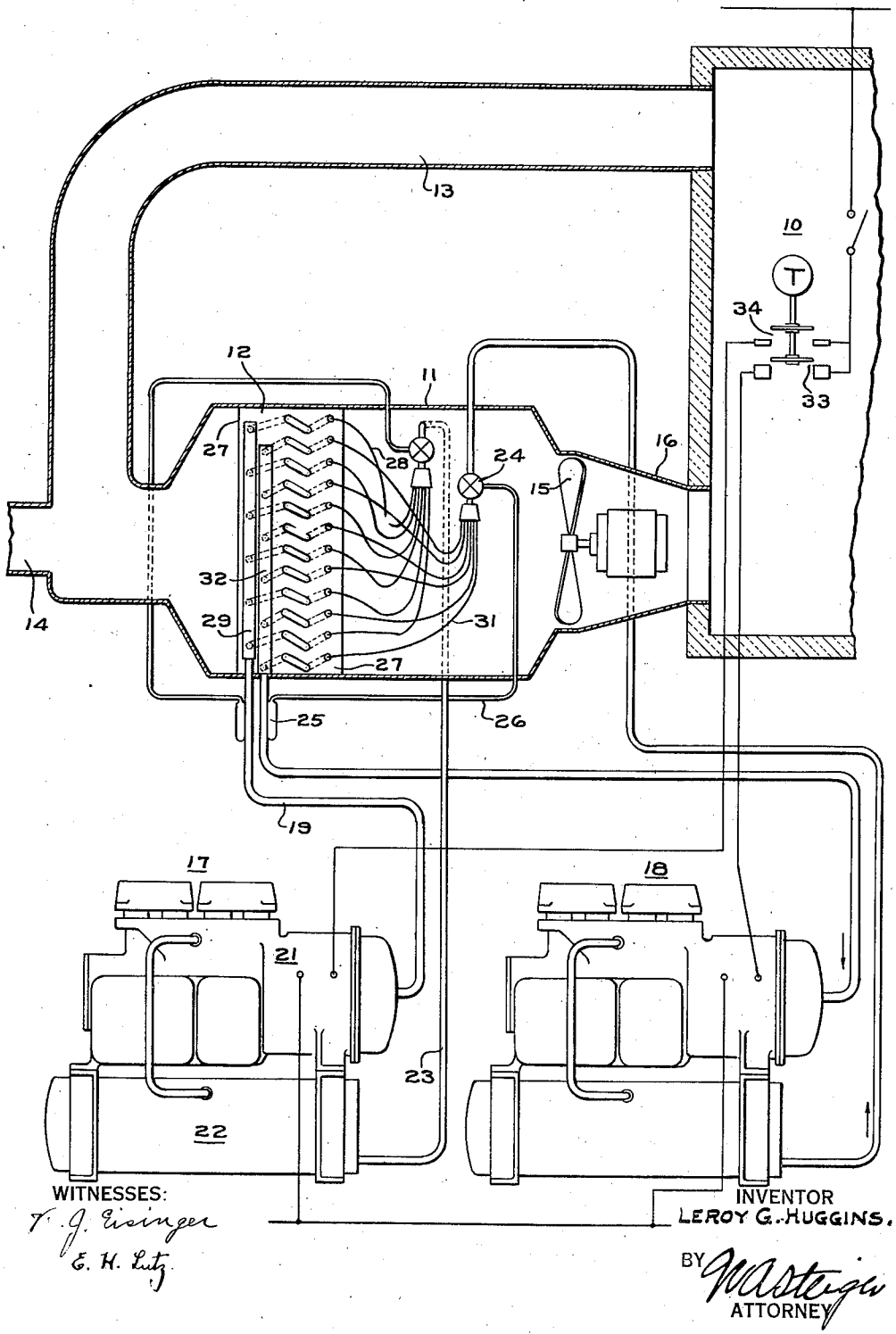
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AIR CONDITIONING APPARATUS

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AIR CONDITIONING APPARATUS

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My invention relates to air conditioning apparatus, more particularly to air cooling and dehumidifying apparatus, and it has for an object to provide improved apparatus.

A further object is to provide improved air cooling and dehumidifying apparatus for partial load operation.

A more particular object is to provide an evaporator structure wherein the supply of refrigerant may be reduced for partial load operation and wherein the entire extended heat transfer surface is utilized at partial load.

In accordance with my invention, I provide first and second groups of cooling tubes, the tubes of one group being arranged in alternate relation to the tubes of the other group. A common set of fins or plates extending across and in heat conducting contact with the tubes of the two groups provides extended heat transfer surface for the tubes of the two groups. When flow of cooling fluid is effected through one group of tubes only, then the portions of the fins adjacent the inactive tubes provide increased heat transfer surface for the active tubes.

The above recited and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawing forming a part of this application, in which:

The single figure is a diagrammatic view of air cooling and dehumidifying apparatus in accordance with my invention.

Referring to the drawing in detail, I show an enclosure 10 which is to be provided with cooled and dehumidified air. An air conditioning chamber 11 contains the novel evaporator structure 12. A portion of the air supplied to the chamber 11 is withdrawn from the enclosure 10 through a duct 13 and another portion is drawn from outdoors through a duct 14. The air admitted to the chamber 11 passes over the evaporator structure 12 and is then drawn by the motor driven fan 15 through a duct 16 to the enclosure 10.

The evaporator structure 12 is common to and provides evaporator surface for two refrigerant circuits indicated generally at 17 and 18, respectively. Each refrigerant circuit is generally of conventional form including in addition to portions of the evaporator structure 12, a suction conduit 19, a motor compressor unit 21, a condenser 22, a liquid refrigerant supply line 23, and a thermostatic expansion valve 24. The latter is of the conventional type known by this name, operating in response to the superheat of the vaporized refrigerant entering the associated suction conduit and including a thermostatic bulb 25 in contact with the suction conduit and connected to the valve through a tube 26.

The evaporator structure 12 includes a plurality of evaporator coils, each coil comprising a plurality of tubes (four being shown) arranged in a substantially horizontal row and connected in series. The several coils are arranged in a vertical row, or in superposed relation. All of the tubes extend through a common set of fins or plates 27 and are arranged in heat conducting contact therewith, so that the plates or fins provide extended heat transfer surface for the tubes. The odd numbered coils, counting from the top, are connected to the refrigerant circuit 17, liquid refrigerant being supplied to the inlet ends of the coils through distributor tubes 28 which are sometimes also referred to as capillary tubes, and the vaporized refrigerant is discharged to a suction header 29. The even numbered coils, counting from the top, are connected in the refrigerant circuit 18, refrigerant being supplied in a similar manner through distributor tubes 31 and the vaporized refrigerant being conveyed to the suction conduit through a suction header 32.

The apparatus is controlled by a two-step thermostat T which is responsive to the temperature of the air in the enclosure 10. It is provided with a set of contacts 33 which are closed to initiate operation of the apparatus providing the refrigerant circuit 18 upon increase in temperature beyond a predetermined value such as 80° F. and with a second set of contacts 34 which are closed to initiate operation of the apparatus providing the refrigerant circuit 17 upon increase beyond a slightly higher predetermined temperature, such as 81° F. It is to be understood that the illustration of the control is diagrammatic and that anyone skilled in the art may readily provide suitable relays, etc., which are commonly provided, the diagram shown being entirely sufficient to enable anyone skilled in the art to understand and practice the invention.

Operation

In response to a relatively high cooling load of the enclosure 10, represented by a temperature above 81° F., the thermostat T closes both sets of contacts so as to render both refrigerant circuits active. In this case, liquid refrigerant is supplied to all of the evaporator coils through the tubes 28 and 31 and the vaporized refrigerant is discharged to the headers 29 and 32. The air passing over the tubes and fins is cooled and dehumidified thereby before being delivered

to the enclosure 10. The cooling and dehumidifying of the air is effected in this case in a conventional manner, substantially the same as if all of the coils were connected to a common refrigerant circuit or if the two refrigerant circuits were provided with two separate evaporators arranged in parallel with respect to the flow of air. It will be apparent, however, that the refrigerant circuits are separate, the refrigerant of one circuit does not intermingle with the refrigerant of the other circuit.

If the temperature in the enclosure 10 drops to a value between 80° and 81°, indicating a reduced cooling load, the thermostat T opens the contacts 34, so that operation of the apparatus providing the refrigerant circuit 17 is terminated. Consequently, the odd numbered coils no lonegr receive refrigerant and are inactive. The even numbered coils connected to the refrigerant circuit 18 continue to receive refrigerant and to effect cooling and dehumidifying of air. It will be noted that the portions of the fins 27 surrounding the tubes of the first group are integral with the portions surrounding the tubes of the second group and are adjacent to such portions, being alternated therewith. Consequently, the portions of the fins adjacent the inactive tubes of the first group are cooled by heat conduction to the tubes of the second group, and thus they provide increased heat transfer surface for the tubes of the second group.

In this case, all of the air flowing over the evaporator is cooled, since the entire fin surface is cooled by the refrigerant circuit that remains in operation. The degree of cooling is not as great because of the reduction in refrigerating apparatus that is in operation.

It will be apparent, therefore, that I have provided an evaporator structure wherein the extended heat transfer surface of inactive evaporator coils is utilized to increase the heat transfer surface of evaporator coils that remain inactive. This arrangement greatly increases the economy of operation at partial load, inasmuch as operation of the refrigerant circuit varies with the amount of heat transfer surface that is provided. The amount of such surface is ordinarily limited by cost.

While I have shown two separate compressors connected to the two groups of tubes, it is to be understood that there may be provided instead any suitable compressor apparatus whereby operation of sufficient compressor capacity may be effected for operation of both groups of tubes or operation of reduced compressor capacity may be effected for operation of one group of tubes only.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In air cooling apparatus, the combination of first and second groups of tubes, means for supplying cooling fluid, means operable automatically for selectively admitting cooling fluid from said supply means to the second group of tubes or admitting cooling fluid from said supply means to the first group only, heat transfer plates or fins common to and arranged in heat conducting relation with tubes of both groups, the tubes of the first group being interspersed among the tubes of the second group, whereby the portions of the plates adjacent the tubes of the second group provide extended heat transfer surfaces for said tubes when cooling fluid is supplied thereto and serve as additional extended heat transfer surfaces for the tubes of the first group when cooling fluid is supplied to the first group only.

2. In air cooling apparatus, the combination of a cooling coil unit comprising a plurality of coils arranged in a bank, a common set of fins or heat transfer plates extending across said coils and arranged in heat conducting contact therewith, a first cooling fluid inlet common to alternate coils of said unit, a group of refrigerant distributor tubes respectively connecting said alternate coils to said first inlet, a second cooling fluid inlet common to the intervening alternate coils of said unit, and a second group of refrigerant distributor tubes respectively connecting said last-mentioned coils to said second inlet.

3. In air cooling apparatus, the combination of first and second groups of tubes, heat transfer plates or fins common to and arranged in heat conducting relation with tubes of both groups, the tubes of the first group being interspersed among the tubes of the second group, compressor means connected to said first and second groups of tubes, and means for selectively supplying liquid refrigerant to both groups of tubes and effecting operation of sufficient capacity of said compressor means for both groups of tubes or supplying liquid refrigerant to one group of tubes only and effecting operation of reduced capacity of said compressor means suitable for said one group of tubes.

4. In air conditioning apparatus, the combination of a plurality of heat transfer plates or fins arranged in spaced, parallel relation, a plurality of tubes extending through said plates and arranged in heat conducting contact therewith, first means for circulating cooling fluid through one group of said tubes, second means for circulating cooling fluid through another group of said tubes, the tubes of said first and second groups being interspersed among each other, and means for selectively rendering one only or both of said circulating means effective.

5. In air conditioning apparatus, the combination of an evaporator coil unit comprising a plurality of coils arranged in a bank, a common set of fins or heat transfer plates extending across said coils and arranged in heat transfer relation thereto, first means including a first refrigerant compressor for circulating refrigerant through alternate coils of said structure, and second means including a second refrigerant compressor for circulating refrigerant through the intervening alternate coils.

6. In air cooling apparatus for an enclosure, the combination of a cooling coil structure comprising a plurality of coils arranged in a bank, a common set of fins or heat transfer plates extending across said coils and arranged in heat conducting contact therewith, means for effecting forced circulation of air over said coil structure and into the enclosure, and means operable automatically in response to the temperature of the air in the enclosure for supplying cooling fluid to alternate coils only or supplying cooling fluid to intervening alternate coils.

7. In air conditioning apparatus for an enclosure, the combination of a cooling coil struc-

ture comprising a plurality of coils arranged in a bank, a common set of fins or heat transfer plates extending across said coils and arranged in heat transfer relation thereto, first means for circulating cooling fluid through alternate coils of said structure, and second means for circulating fluid through the intervening alternate coils, and means for automatically rendering one or both of said supply means effective in response to the temperature of the air in the enclosure.

8. In air cooling apparatus for an enclosure, the combination of first and second refrigerating systems including first and second groups of evaporator tubes, respectively, heat transfer plates or fins common to and arranged in heat conducting contact with tubes of both groups, the tubes of the first group being interspersed among the tubes of the second group, and means for conveying air over said tubes and fins to the enclosure.

9. In air cooling apparatus for an enclosure, the combination of first and second refrigerating systems including first and second groups of evaporator tubes, respectively, heat transfer plates or fins common to and arranged in heat conducting contact with tubes of both groups, the tubes of the first group being interspersed among the tubes of the second group, means for conveying air over said tubes and fins to the enclosure, and means responsive to the temperature of the air in the enclosure for selectively operating one only or both of said refrigerating systems.

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