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AIR CONDITIONING UNIT INCLUDING CORROSION INHIBITING MEANS

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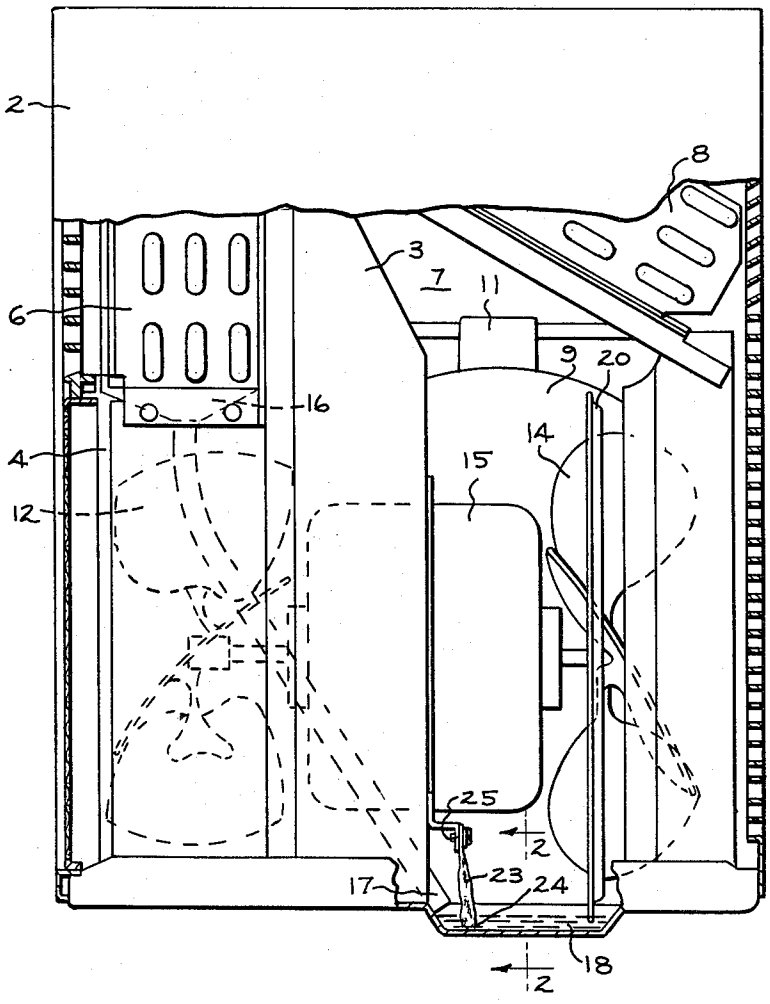
FIG. 1



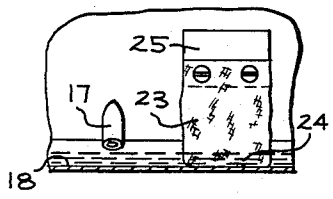


FIG. 2

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AIR CONDITIONING UNIT INCLUDING CORROSION INHIBITING MEANS

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The present invention relates to self-contained air conditioning units and is more particularly concerned with self-contained air conditioning units including means for inhibiting the corrosion of the components thereof exposed to outdoor atmosphere conditions.

Self-contained air conditioning units include two heat exchangers, one located within an inner compartment of the unit and exposed to indoor air and the other located in the outer compartment of the unit where it is exposed to the outdoor atmosphere. Fans or blowers are normally provided in the unit for circulating separate streams of air from the enclosure and the outdoors through the inner and outer compartments respectively. In simple cooling units, the refrigeration system is not reversible so that the indoor heat exchanger always operates as an evaporator and the outdoor heat exchanger as a condenser. In reversible type units, the refrigeration system is reversible so that during the heating cycle the indoor unit operates as a condenser and the outdoor unit as an evaporator. In both types of units that heat exchanger functioning as the evaporator operates at temperatures such that moisture from the air stream condenses thereon. Condensate disposal means normally provided for disposing of the condensate outside of the enclosure being conditioned generally includes means for directing the condensate onto the outdoor heat exchanger or into the air stream flowing through the outoor heat exchanger.

In many air conditioning units, the heat exchangers are made of copper or aluminum or combinations of these two metals in order to take advantage of the excellent heat conductivity properties of these metals. The operation of such units in sea coast areas have long been known to present a serious corrosion problem due to the saline atmosphere of such locations. Various attempts have been made to protect the aluminum and copper surfaces from corrosion by the saline atmosphere but none have been completely satisfactory. Corrosion resistant coatings such as organic finishes materially interfere with the heat exchange properties of the heat exchangers while factory treatments with the usual inorganic corrosion inhibitors, such as a chromate treatment, have failed to provide long term protection primarily due to the fact that the constantly recirculating condensate leaches out or washes away the chromate inhibitor in a relatively short period of time.

It is a primary object of the present invention to provide an air conditioning unit including means for continuously inhibiting corrosion of the components thereof exposed to the outdoor atmosphere.

Another object of the invention is to provide an air conditioning unit including means for disposing of the condensate onto or through the outdoor heat exchanger and means for continuously supplying a corrosion inhibitor material to that condensate.

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

In carrying out the objects of the present invention, there is provided an air conditioning unit including an indoor heat exchanger and an outdoor heat exchanger, condensate disposal means for collecting condensate and

for discharging the collected condensate onto the outdoor heat exchanger and means for continuously introducing a slightly soluble corrosion inhibitor into the condensate prior to discharge thereof onto the outdoor heat exchanger. Preferably the condensate disposal means includes means for discharging the condensate into the path of the stream of air circulating over the outdoor heat exchanger so that the corrosion inhibitor will be carried by the condensate to all of the surfaces which are contacted by the condensate.

For a better understanding of the invention reference may be made to the accompanying drawing in which:

FIGURE 1 is an elevational view, partly in section, of a self-contained air conditioner including the corrosion inhibitor arrangement of the present invention; and

FIGURE 2 is a partial view taken generally along line 2—2 of FIGURE 1.

While the invention is applicable, as previously indicated, to either a simple cooling air conditioning unit, it will be described with particularity as applied to a reverse cycle unit adapted to be utilized for both heating and cooling an enclosure.

Referring now to FIGURE 1 of the drawing there is shown an air conditioning unit comprising a casing 2 for housing the refrigeration system, fan and other components of the unit. The casing 2 is divided by means of a barrier 3 into an inner compartment 4 having mounted therein an indoor heat exchanger 6 and an outer compartment 7 containing an outdoor heat exchanger 8. The heat exchangers 6 and 8 are connected in refrigerant flow relationship with a compressor 9 also positioned in the outdoor compartment 7 by means of a reversing valve 11. The valve 11 can be selectively operated to reverse the flow of refrigerant to the heat exchangers 6 and 8 so that the indoor heat exchanger 6 operates either as the evaporator or as the condenser component of the system. Air is drawn from within the room or other enclosure and circulated by a fan 12 through the inner compartment of the air conditioner and over the heat exchanger 6. Air is drawn into the outdoor compartment 7 by means of a fan 14 for circulation through the outdoor heat exchanger 8. In the illustrated unit, both fans are driven by means of a motor 15 mounted in the barrier 3.

During operation of the unit on the cooling cycle with the heat exchanger 6 functioning as the evaporator, moisture in the air being conditioned condenses out of the air stream onto the surfaces of the heat exchanger 6 and drains downwardly into the suitable drip tray 16 from which it is delivered by a conduit 17 into a condensate collection sump 18 located in the outer compartment 7. When the unit is operated on the heating cycle, the outdoor heat exchanger 8 functions as the evaporator, so that moisture contained in the outdoor air stream condenses onto the outdoor heat exchanger and collects in the sump 18.

Various means are known for disposing of this condensate. Generally by dispersing the condensate into the air stream flowing through the outdoor compartment or spraying the condensate directly onto the outdoor heat exchanger 8. While the present invention is not limited to any particular means for thus disposing of the condensate, it will be described with specific reference to the use of a slinger ring 20 which dips into the sump and upon rotation picks up condensate from the sump 18 and sprays or throws it outwardly onto the other components within the outer compartment 7 and more specifically onto the outdoor heat exchanger 8. During operation of the unit on the cooling cycle this condensate is vaporized by the heat of the heat exchanger 8 functioning as a condenser. During the cooling cycle operation, the water thrown onto the heat exchanger 8 which is then operating as an evaporator provides additional cooling and

thereby increases the capacity of this heat exchanger and the refrigeration system. Some of the water lifted by the ring 20 may also be atomized or formed into very small droplets which are dispersed in the air stream and deposited onto the outdoor heat exchanger.

While there has been thus far described one type of air conditioner to which the present invention is particularly adapted, it will be understood that it is not limited thereto as the invention may be embodied in any self-contained air conditioning unit comprising refrigeration apparatus including indoor and outdoor heat exchangers, condensate disposal means for collecting condensate from the apparatus and for discharging the condensate onto the outdoor heat exchanger. As will now be described, the present invention is directed to means for introducing a corrosion inhibitor into the condensate prior to discharge thereof onto the outdoor heat exchanger in order to inhibit the corrosion of and thereby prolong the useful life of the outdoor heat exchanger.

During operation of the air conditioner of this general type, the condensate collected in the sump 18 is continually splashed or sprayed throughout most or all of the outdoor compartment 7 in the form of relatively small droplets. Some of these droplets are deposited on the outdoor heat exchanger 8 while others collect on other surfaces in the outdoor compartment and flow back into the sump 18. This constant wetting of the various surfaces may cause corrosion thereof and the corrosion problem is particularly troublesome as to the outdoor heat exchanger 8 which normally is made of aluminum, copper or other good heat conducting material which also happen to be particularly subject to corrosion. The corrosion problem has been found to be particularly acute in air conditioners operated in sea coast areas due to the salinity of the atmosphere in these areas. Not only does the circulating saline atmosphere in itself tend to cause corrosion of the heat exchange surfaces but the salt content of the atmosphere also becomes dissolved in the condensate to form a corrosive solution. Continued evaporation of the solution results in the gradually increasing concentration of the solution. As a result the condensate itself becomes increasingly corrosive to such an extent that in some areas it has been found that the aluminum surfaces of an outdoor heat exchanger may become completely destroyed and of no heat exchange value within one season of operation of the air conditioning unit.

In order to protect these surfaces and to provide an air conditioning unit adapted to operate satisfactorily for its entire normal or operating life, means are provided in accordance with the present invention for continuously introducing a suitable corrosion inhibitor into the condensate in order to provide continuous protection for corrodible surfaces.

More specifically there is provided a supply of corrosion inhibitor adapted to be introduced continuously into the condensate so that the condensate as it is discharged onto the corrodible surfaces of the unit will provide continued protection for these surfaces. While the supply of the corrosion inhibiting material can be placed at any point in the outdoor compartment 7 in which it will be contacted by the condensate, in the illustrated embodiment of the invention, the inhibiting means is shown as comprising a porous bag 23 of a suitable solid corrosion inhibitor, supported within the outdoor compartment 7 so that the lower end 24 thereof dips or extends into the sump 18. More specifically the bag 23 is illustrated as having its upper end supported on a bracket 25 secured to the barrier 3 and positioned so that the lower end of the bag is within the sump 18.

The bag 23 may be made of any porous material which is not affected by the corrosion inhibitor or by the condensate solution. Preferably it is composed of a relatively tightly woven cloth of nylon or the like which is sufficiently porous so that the corrosion inhibiting material contained therein will slowly leach or filter into the condensate coming in contact therewith.

While the invention is not broadly limited thereto, the preferred corrosion inhibitor is a chromate, such as zinc chromate, particularly a basic zinc chromate commercially known as zinc yellow and used frequently as a paint pigment, and more particularly the use of a slightly soluble alkaline salt such as calcium silicate mixed with zinc yellow. Zinc yellow Y–539–D, sold by E. I. du Pont de Nemours and Company, Incorporated, is an example of the type of chromate that is preferred for the reason that it has sufficient solubility to provide corrosion inhibition, yet is dissolved in the condensate so gradually that the protection obtained thereby will extend over a period of years. Although a chromate, by itself, has been found to provide excellent protection, the addition of a slightly soluble alkaline salt such as calcium silicate to the chromate inhibitor has been found to enhance the protection afforded by the chromate. It has been found that the alkalinity provided by the alkaline salt increases the solubility of the slightly soluble chromate, hence provides an additional amount of chromate ion to provide increased corrosion protection. It is possible also that the alkalinity provided by this salt maintains the proper pH for maximum corrosion inhibition by the chromate or the silicate may act to inhibit corrosion or provide synergistic corrosion protection with the chromate. It is known however, that calcium silicate enhances the protection afforded by a chromate and does so over an extended period of time. Other very slightly soluble alkaline salts may provide similar enhancement of the corrosion protection provided by a chromate.

Chromates other than zinc can also serve as corrosion inhibitors using the means described herein for continuously supplying the corrosion inhibiting material to the condensate. Any metal chromate that has a suitable degree of solubility in water under the conditions of operation of a self-contained air conditioning unit can serve to provide corrosion inhibition over an extended period of time. Chromates considered to be insoluble in water at 20° C., e.g., zinc chromate and lead chromate do, in fact, possess sufficient solubility to provide significant protection when used as described herein. Chromates with water solubilities from what is generally considered as insoluble to chromates as solubles as strontium chromate could also be used as corrosion inhibitors as described herein but the more soluble chromates would be suitable only for protecting self-contained air conditioning units for shorter periods of time than the less soluble chromates.

Though chromates are the preferred inhibitors, silicates, phosphates, carbomates and other known chemical corrosion inhibitors could conceivably be introduced into self-contained air conditioning units by the means described herein, providing only that the degree of solubility of the chemical inhibitor is sufficient to provide adequate corrosion inhibition and that it is not so soluble as to be rapidly dissolved and hence not capable of providing inhibition over an extended period of time.

Though calcium silicate is the preferred chemical to enhance the protection of a chromate when introduced into the condensate by the means described herein, aluminum silicate, magnesium carbonate or calcium carbonate may also be used.

During operation of the air conditioning unit, the condensate collecting within the sump 18 and coming in contact with the bag 23 gradually and continuously leaches the corrosion inhibitor into the condensate and the resulting solution is splashed by the slinger ring 20 or equivalent means over the metal surfaces within the outdoor compartment 7 and particularly over the surfaces of the heat exchanger 8. As a result all of the surfaces contacted by the condensate and hence all of the surfaces which are particularly subject to corrosion during oper-

ation of the air conditioning unit are provided with a continuous supply of corrosion inhibitor to provide corrosion protection for these surfaces over long periods of time.

It has also been found that the present invention provides a continued protection which is not possible by a single treatment of the surfaces by a chromate or similar treatment during manufacture of the air conditioning unit. Whereas the constantly recirculating condensate quickly leaches out or washes away any inhibitor from the factory treated aluminum surfaces in a matter of days so that thereafter the surfaces are completely uninhibited, the present invention provides a continuous renewal of the inhibitor to obtain continuous protection of the surfaces.

Tests of air conditioning units protected in accordance with the present invention have been found to exhibit substantially no detrimental corrosion of the more corrosion susceptible surfaces, such as the surfaces of an aluminum outdoor heat exchanger, over a full season of operation in sea coast locations whereas unprotected control units were found to have from 60 to 75% of their aluminum coil areas completely destroyed and of no cooling value even when factory treated with corrosion inhibiting coatings.

After one season of operation of the protected units, it was found that nylon bags originally filled with 4 ounces of zinc chromate or 4 ounces of a mixture of zinc chromate and calcium silicate contained approximately 90% of their original charge after one season of operation. This indicates that the protection offered by the present invention can be expected to extend over a period of 10 years without renewal of the supply of corrosion inhibitor.

While the invention has been particularly described with reference to an arrangement in which a corrosion inhibitor is positioned for immersion in the condensate within the sump **18**, it will be understood that it is not limited thereto. For example, the corrosion inhibitor contained in a porous nylon bag or equivalent containing means may be supported in any area within the outdoor compartment **7** where it will be contacted by the condensate dispersed into the compartment during rotation of the slinger ring **22** or equivalent splash means. It is only necessary that the corrosion inhibitor contacts the condensate to an extent such that a small but continuous amount of the inhibitor will be leached into the condensate during operation of the unit.

While there has been described what is presently considered to be a preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and it is therefore intended by the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. In an air conditioner comprising refrigeration apparatus including an indoor heat exchanger and an outdoor heat exchanger composed of a metal subject to corrosion by a saline atmosphere,

fan means for circulating a stream of outdoor air over said outdoor heat exchanger,

a sump for collecting condensate from said apparatus,

means for discharging condensate from said sump into the path of the stream of air circulating over said outdoor heat exchanger prior to contact thereof with said outdoor heat exchanger for contacting said condensate with said outdoor heat exchanger and means for supplying a corrosion inhibitor to the surfaces of said outdoor heat exchanger contacted by said condensate comprising a porous bag containing a zinc chromate corrosion inhibitor arranged in said sump for contact by said condensate for introducing said zinc chromate corrosion inhibitor into said condensate whereby corrosion of said surfaces contacted by said condensate is inhibited.

2. In an air conditioner comprising refrigeration apparatus including an indoor heat exchanger and an outdoor heat exchanger composed of a metal subject to corrosion,

fan means for circulating a stream of outdoor air over said outdoor heat exchanger,

condensate disposal means for collecting condensate from said apparatus and for discharging the condensate into the path of said stream of air prior to circulation thereof over said outdoor heat exchanger,

and means for inhibiting corrosion of said outdoor heat exchanger comprising means arranged to be contacted by said condensate for introducing a slightly soluble corrosion inhibitor comprising a mixture of zinc chromate and calcium silicate into said condensate prior to contact thereof with said outdoor heat exchanger.

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