

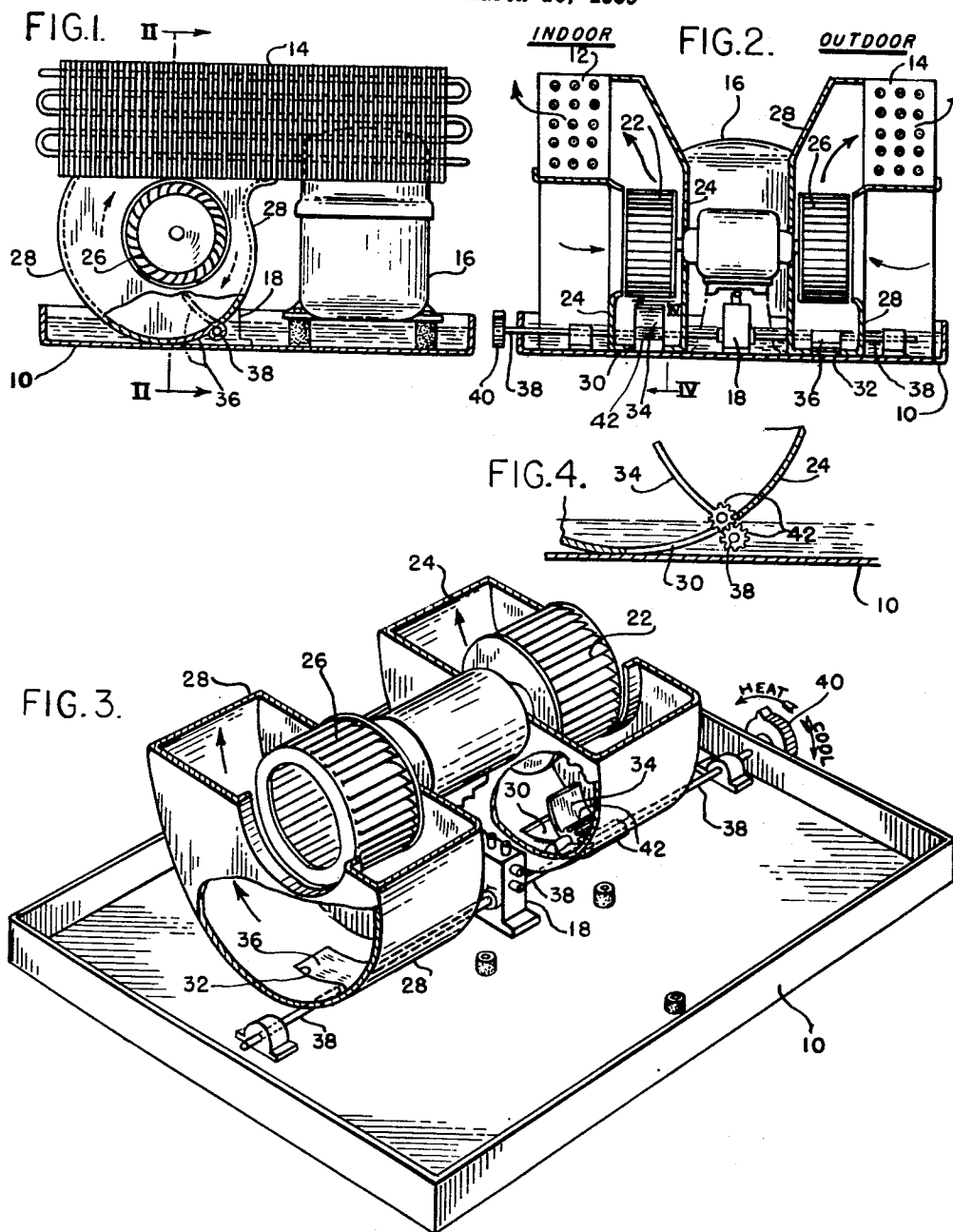
June 21, 1960

A. H. EBERHART

2,941,381

CONDENSATE DISPOSAL MEANS FOR AIR CONDITIONING APPARATUS

Filed March 16, 1959



INVENTOR

ARTHUR H. EBERHART

BY *William J. Foley*
ATTORNEY

1

2,941,381

CONDENSATE DISPOSAL MEANS FOR AIR CONDITIONING APPARATUS

Arthur H. Eberhart, East Longmeadow, Mass., assignor
to Westinghouse Electric Corporation, East Pittsburgh,
Pa., a corporation of Pennsylvania

Filed Mar. 16, 1959, Ser. No. 799,624

6 Claims. (Cl. 62-279)

This invention relates to air conditioning apparatus and more particularly to condensate disposal means for air conditioning apparatus having a reversible cycle refrigeration system.

Conventional apparatus of the type set forth includes a compressor and two, interconnected, evaporator-condenser heat exchangers. The heat exchangers have valve connections with the compressor and are selectively operable for heating and cooling an enclosure. A drip pan or sump is arranged beneath the heat exchangers in order to collect condensate from whichever heat exchanger is functioning as the evaporator. An air translating unit, such as a centrifugal fan, is provided for each heat exchanger and operates to effect flow of a stream of air over the heat exchanger with which it is associated.

Various means have been proposed in the past for disposing of the condensate collected in the drip pan. Most of them involve spraying the condensate on the warm surfaces of the condenser, where the condensate is vaporized and carried away by the air stream flowing by or contacting the condenser surfaces. The problem of condensate disposal is most complex in reversible systems where the condenser and evaporator functions of the heat exchangers are interchanged when switching the operation from heating to cooling, or vice versa. Some prior art apparatus, of the type here considered, provides for the simultaneous delivery of condensate to both heat exchangers, regardless of whether the apparatus is operating to heat or cool an enclosure, on the theory that condensate remaining unvaporized after contact with the cold evaporator will be returned to the drip pan. Such an arrangement is undesirable in the situation where the apparatus is being used to heat an enclosure and the evaporator is operating at or below freezing temperature, because condensate freezes on the evaporator surfaces and impairs its efficiency. Accordingly, it is desirable to deliver condensate to the heat exchanger acting as a condenser and not to the heat exchanger acting as an evaporator.

In carrying out the present invention, a reversible heat transfer system of the type set forth is provided with condensate disposal means comprising first and second means for lifting condensate from the drip pan onto respective heat exchangers, and means for rendering effective the lifting means associated with the heat exchanger functioning as a condenser and, at substantially the same time, rendering ineffective the lifting means associated with the heat exchanger functioning as an evaporator.

The novel condensate disposal means incorporated in the present invention includes two movable tabs each of which, when effective for lifting condensate from the drip pan, extends upwardly from the drip pan into that air stream moving toward the heat exchanger acting as a condenser. In its effective position each tab presents one broad surface to the oncoming air stream and a suction is created on the opposite or downstream surface, whereby condensate is drawn into the air stream. Each tab is also movable to an ineffective position in which there is

2

no suction or reduced pressure on the downstream surface thereof.

The various objects, features and advantages of the invention will appear more fully from the detailed description which follows, taken in connection with the accompanying drawing forming a part of this application, in which:

Fig. 1 is a rear elevational view of air conditioning apparatus embodying the invention;

Fig. 2 is a vertical sectional view of the apparatus of Fig. 1, taken along line II-II of Fig. 1 and showing portions thereof in elevation;

Fig. 3 is a rear perspective view of the apparatus, partly broken away in order to show the invention in detail; and

Fig. 4 is an enlarged, fragmentary, sectional view taken along line IV-IV of Fig. 2.

The air conditioning unit embodying the invention is of the reversible cycle type and may be positioned within an opening in an enclosure or remotely with respect to the conditioned enclosure. The outer casing has been removed to show the various parts. The apparatus comprises a horizontally disposed sump or drip pan 10 on which is supported an indoor heat exchanger 12 and an outdoor heat exchanger 14. Both heat exchangers 12 and 14 are of the finned tube type generally used in refrigerating systems and have volatile refrigerant fluid circulated therethrough. The drip pan 10 is arranged beneath the heat exchangers to receive the condensate flowing from whichever coil is acting as evaporator.

A motor-driven compressor 16 serves to compress the refrigerant and deliver it through suitable tubing (not shown) to a reversing valve 18, from whence it is serially directed through the heat exchangers and then back to the compressor. When the reversing valve 18 is set for cooling operation, the compressed, hot refrigerant is first directed to the outdoor heat exchanger 14, where it rejects heat to the outdoor air and then expands as it is conducted to the indoor heat exchanger 12 where heat is transferred from the enclosure air to the relatively cold refrigerant. The functions of the heat exchangers 12 and 14 are interchanged by movement of the reversing valve 18 to a heating position, in which hot refrigerant leaving the compressor 16 is first directed through the indoor heat exchanger 12, so as to heat the conditioning medium, then expanded to a low temperature as it is conducted to the outdoor heat exchanger 14 where the refrigerant is heated by the relatively warmer outside air. Thus, the two heat exchangers have evaporator-condenser functions.

Air for conditioning the enclosure is drawn into the apparatus by an air translating unit, such as a motor-driven centrifugal fan 22. The fan 22 has ductwork including a convolute casing 24 through which a stream of indoor air is conveyed to the indoor heat exchanger 12 from whence it is delivered to the enclosure. The outdoor portion of the unit, or right-hand portion as seen in Fig. 2, is similarly provided with a centrifugal fan 26, and duct work including a convolute casing 28 for effecting flow of a stream of outdoor air to the outdoor heat exchanger 14, and thence back to the air outside the enclosure. As shown, the fans 22 and 26 are driven by the same motor and mounted on respective motor shaft extensions which project in opposite directions from the motor housing. It follows that both fans rotate in the same direction, i.e. clockwise as shown in Fig. 1.

The convolute casings 24 and 28 each have a lower portion extending down into the drip pan 10 and are respectively provided with openings 30 and 32 at the lowermost points thereof for the purpose of admitting condensate to the interior of the casings. Associated with the air translating units are means for lifting condensate from the drip pan 10 into the stream of air flowing over

whichever heat exchanger is functioning as a condenser. The lifting means employed in the preferred embodiment of the invention herein disclosed include a pair of strips, or tabs, 34 and 36, respectively mounted in the casings 24 and 28. Each strip has a pair of oppositely facing broad surfaces and is pivotally mounted in its casing at the upstream edge of the condensate opening, 30 or 32. Each strip is movable between an erect position, wherein one broad surface is presented to the oncoming air stream, and an ineffective position, wherein the strip closes its associated opening and the same broad surface now faces transversely of the air stream.

When an air stream flows past one of the strips on opposite edges thereof a suction or reduced pressure region is created above the casing opening at the downstream-facing surface of the erect strip. This suction causes liquid condensate at the level of the openings 30 and 32 to be drawn or lifted from the pan 10 into the air stream, then carried into contact with the warm heat exchanger surface where it is evaporated; and the resultant vapor is carried off with the air stream.

Similar condensate lifting means, applied to non-reversible refrigeration systems, is disclosed in the present applicant's Patent No. 2,417,743, issued March 18, 1947, and assigned to the assignee of the present invention. But as mentioned previously, it is desirable in reversible cycle units to deliver condensate to the heat exchanger acting as a condenser and not to the heat exchanger acting as an evaporator. In accordance with this invention, the strips 34 and 36 are arranged so that one strip 34 is moved to ineffective position when the other strip 36 is moved to erect position, and the strip 34 will be moved to erect position when the strip 36 is moved to ineffective position.

As shown in Figs. 2 and 3, means are provided for selectively moving the strips 34 and 36 in the described manner as operation of the unit is changed from cooling to heating and vice versa. This means includes a shaft 38 connected directly to the reversing valve 18 and to the lower edge of the strip 36. A knob 40 is fastened to the front end of the shaft 38 so that the shaft may be manually rotated. As is the strip 36, the strip 34 is movable about its lower edge on an axis parallel thereto, but the direction of movement of the strip 34 is opposite to that of the strip 36 because it is driven through a pair of gears 42. (See Fig. 4.) Movement of strip 34 toward an inclined erect position, as shown, is halted when the strip 36 closes the opening 32. The strips 34 and 36 have the shape of curved plates so that they will conform to the shape of the fan casing when closing their respective openings 30 and 32.

The user sets the air conditioning unit for heating or cooling operation by manually moving knob 40. Selection of cooling operation positions reversing valve 18 to cause the indoor heat exchanger 12 to operate as an evaporator and the outdoor heat exchanger 14 to operate as a condenser. Simultaneously, strip 36 is raised, rendering it effective to lift condensate from the sump 10 into the air stream flowing over the outdoor heat exchanger 14. Cooling operation is generally employed during the summer when conditions of high relative humidity require the removal of moisture from the enclosure being conditioned. During cooler weather, when it is desired to heat the enclosure, conditions of low relative humidity generally exist and it is desirable to add moisture to the air within the enclosure. This is accomplished by moving the knob 40 to its "heat" position. This lowers strip 36 and raises strip 34, thereby discontinuing the disposal of condensate onto the outdoor heat exchanger 14 and causing condensate to be lifted into the enclosure air stream for passage over indoor heat exchanger 12 which is then functioning as a condenser.

It is to be understood that the present invention may be practiced by employing other condensate lifting means and various other arrangements, both manual and automatic, for lifting condensate only into that air stream

being supplied to the heat exchanger functioning as a condenser. Stated another way, the condensate is delivered to the conditioning medium only when the latter is heated and to the outside air only when the conditioning medium is cooled.

While the invention has been shown 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.

I claim:

1. In a reversible heat transfer system for an enclosure, a compressor, a pair of interconnected heat exchanger units, connections for circulating heat transfer fluid between said heat exchanger units and said compressor, means for reversing the heating and cooling functions of said heat exchanger units, a sump for accommodating condensate flowing from either of said units, means for conveying air for the enclosure over one of said units, means for conveying outside air over the other of said units, first means for lifting condensate from said sump into the air flowing over said one unit, second means for lifting condensate from said sump into the air flowing over said other unit, and means for selectively rendering said first lifting means effective and said second lifting means ineffective when said system is operative for heating said enclosure and for rendering said first lifting means ineffective and said second lifting means effective when said system is operative for cooling said enclosure.

2. In a reversible heat transfer system for an enclosure, a compressor, a pair of interconnected evaporator-condenser units, means including a valve for selectively routing a heat transfer fluid through said compressor and said units for cooling or heating said enclosure, a sump for accommodating condensate flowing from either of said units, first means for lifting condensate from said sump onto one of said units, second means for lifting condensate from said sump onto the other of said units, and means interconnecting said valve means and said first and second lifting means for rendering effective the lifting means associated with the unit which is functioning as a condenser and simultaneously rendering the other of said lifting means ineffective.

3. In a reversible heat transfer system utilizing a heat transfer fluid for heating or cooling air for conditioning an enclosure and comprising a first heat exchanger unit and means for supplying outside air thereto; a second heat exchanger unit and means for supplying air for conditioning an enclosure thereto; a compressor for said fluid; means for serially directing the fluid from said compressor through said heat exchanger units, first through said first heat exchanger unit when said conditioning air is cooled or first through said second heat exchanger unit when said conditioning air is heated; means for accumulating condensate flowing from either of said heat exchanger units; first means associated with said conditioning air supplying means for delivering condensate from said condensate accumulating means to said conditioning air; and second means associated with said outside air supplying means and connected to said fluid directing means so as to be operable for delivering condensate from said condensate accumulating means to the outside air only when the conditioning air is cooled.

4. In a reversible heat transfer system utilizing a heat transfer fluid for heating or cooling air for conditioning an enclosure and comprising a first heat exchanger unit and means for supplying outside air thereto; a second heat exchanger unit and means for supplying air for conditioning an enclosure thereto; a compressor for said fluid; means for serially directing the fluid from said compressor through said heat exchanger units, first through said first heat exchanger unit when said conditioning air is cooled or first through said second heat exchanger unit when said conditioning air is heated; means for accumulating condensate flowing from either of said heat exchanger units; first means associated with said conditioning air supplying

5

means and connected to said fluid directing means so as to be operable for delivering condensate from said condensate accumulating means to said conditioning air only when the latter is heated; and second means associated with said outside air supplying means and connected to said fluid directing means so as to be operable for delivering condensate from said condensate accumulating means to the outside air only when the conditioning air is cooled.

5. In a reversible heat transfer system utilizing a heat transfer fluid for heating or cooling air for conditioning an enclosure and comprising a first heat exchanger unit and means for supplying a stream of outside air thereto; a second heat exchanger unit and means for supplying a stream of air for conditioning an enclosure thereto; a compressor for said fluid; means for serially directing the fluid from said compressor through said heat exchanger units, first through said first heat exchanger unit when said conditioning air is cooled or first through said second heat exchanger unit when said conditioning air is heated; means disposed below said units and their respective supplying means for accumulating condensate flowing from either of said units; first means associated with said conditioning air supplying means and connected to said fluid directing means so as to be operable for lifting condensate from said condensate accumulating means into said conditioning air stream upstream of said second heat exchanger unit only when the conditioning air is heated; and second means associated with said outside air supplying means and connected to said fluid directing means so as to be operable for lifting condensate from said condensate accumulating means into the outside air stream upstream of said first heat exchanger unit only when the conditioning air is cooled.

6

6. In a reversible heat transfer system for an enclosure; a compressor; two interconnected evaporator-condenser heat exchangers having valve connections with said compressor and selectively operable for heating and cooling said enclosure; a drip pan for accumulating condensate from said heat exchangers; a centrifugal fan and a fan casing for each of said heat exchangers, each of said fans effecting flow of a stream of air through its casing, each of said casings having a portion thereof extending down into said drip pan and having an opening in said casing portion providing a passageway between the interior of said casing and the condensate in said drip pan; a tab in each casing having opposite broad surfaces and movable into erect position where it extends upwardly from said passageway and presents one broad surface to the on-coming air stream in such a manner as to create a suction or reduced pressure on the other surface of said tab, whereby liquid condensate is drawn upwardly through said passageway and entrained in said air stream when air flows past opposite edges of said tab; each of said tabs being movable to an ineffective position in which its associated opening is closed and its broad surfaces face transversely of said air stream, and means for selectively and simultaneously moving one tab to the erect position and the other tab to the ineffective position, or said one tab to the ineffective position and said other tab to the erect position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,289,035	Neeson	July 7, 1942
2,495,002	Hart	Jan. 17, 1950
2,710,510	Roseman	June 14, 1955