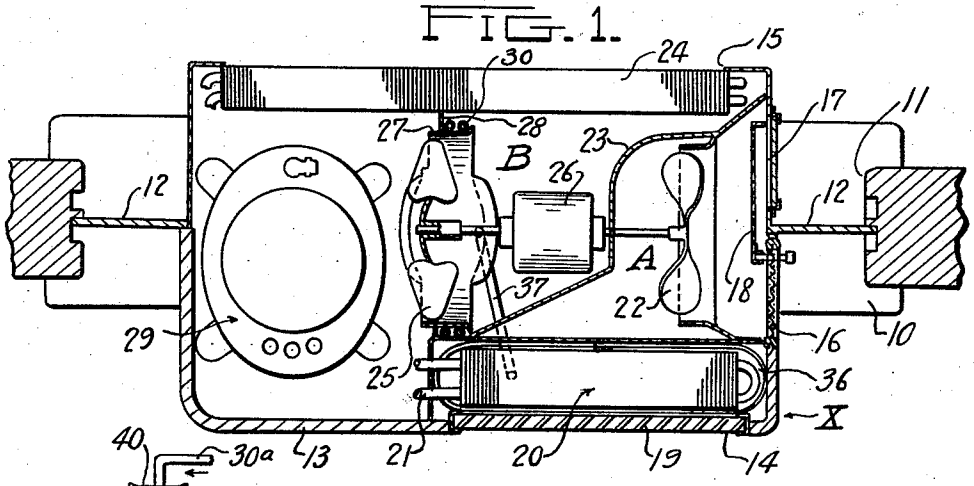
May 16, 1944. M. C. TERRY ET AL 2,349,059

CONDENSATE REMOVAL

Filed April 23, 1940

FIG. 1.



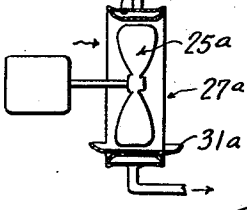


FIG. 6.

FIG. 2.

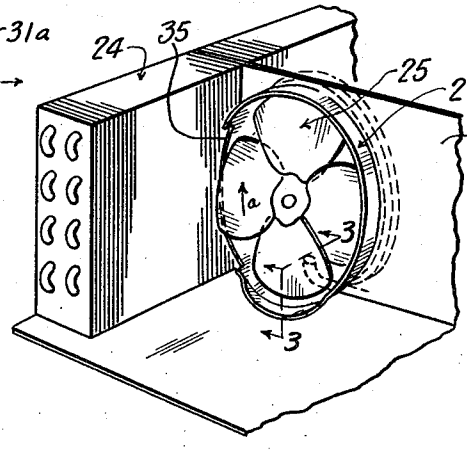


FIG. 3.

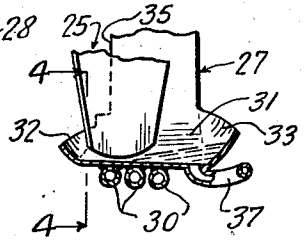


FIG. 4.

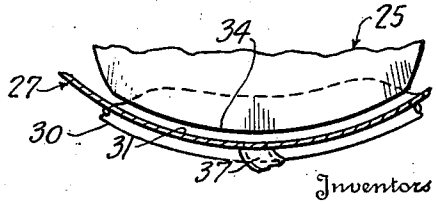
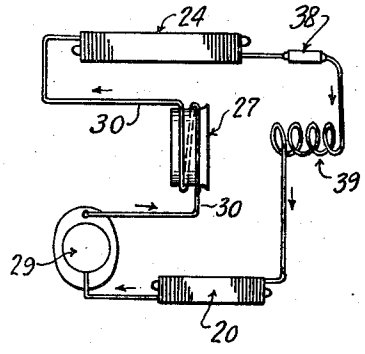


FIG. 5.



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UNITED STATES PATENT OFFICE

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CONDENSATE REMOVAL

Matson C. Terry and Paul Komroff, Toledo, Ohio, assignors, by mesne assignments, to Matson C. Terry, Washington, D. C.

Application April 23, 1940, Serial No. 331,082

6 Claims. (Cl. 62—140)

This invention relates to air conditioning apparatus, but more particularly to apparatus of this character employing a compressor, a condenser and an evaporator and in which condensate forms on the evaporator when the apparatus is used for cooling purposes.

An object of this invention is to produce a new and improved means for removing or disposing of condensate which collects on the evaporator by employing the heat generated in the operation of the apparatus for efficiently evaporating the condensate.

Another object is to utilize the condenser fan and the heat generated in the operation of the apparatus for effectively disposing of condensate from the evaporator.

A further object is to enable the condenser fan to throw the condensate from the evaporator against a casing or shroud which has been heated by means of the hot gases discharged from the compressor thereby causing the condensate to be evaporated and taking advantage of the cool condensate for cooling the gas discharged or forced from the compressor before it is introduced into the condenser.

A still further object is to provide the condenser fan shroud with an apertured or relieved portion so that the fan blades recurrently dipping into a pool of condensate will throw the same through the relieved or apertured portion toward the condenser.

A still further object is to provide means for conducting the condensate from the evaporator to a trough into which the condenser fan dips during its operation, thereby to throw the condensate in comminuted form against the casing or shroud surrounding the fan, and conducting the hot gas from the compressor to the shroud so that it is in thermal contact with the shroud, thereby to dispose of the condensate by evaporation and also to employ the cooling influence of the condensate to cool the hot gas delivered from the compressor to the condenser.

A still further object is to provide means whereby the condenser fan which dips into a pool of condensate delivered thereto from the evaporator may throw a portion of the condensate toward the condenser and into contact therewith, particularly in the event that the pool of condensate becomes excessively large.

Other objects and advantages of the invention will hereinafter appear, and, for purposes of illustration but not of limitation, the invention is shown by way of illustration on the accompanying drawing in which

Figure 1 is a transverse horizontal sectional view of an air conditioning unit for installation in a window and showing the unit in place on a window sill;

Figure 2 is a fragmentary perspective view of the condenser and the condenser fan with its shroud showing the condensate trough and the cut-out in a portion of the fan shroud through which condensate may be thrown against the condenser;

Figure 3 is an enlarged fragmentary sectional view on the line 3—3 of Figure 2;

Figure 4 is an enlarged sectional view on the line 4—4 of Figure 3;

Figure 5 is a diagrammatic plan view of the air cooling mechanism and a preferred refrigerant circuit arrangement, showing tubing surrounding the condenser fan shroud; and

Figure 6 is a vertical sectional view of an alternate form of shroud or casing for the condenser fan, in which a single large channel is provided for the gas forced from the compressor to the condenser.

The illustrated embodiment of the invention comprises an air conditioning unit X which is adapted to be mounted in a window opening. As shown, the unit X is mounted on a window sill 10 within a window opening 11 so that a portion of the unit projects outside of the window frame and a portion inside of the room. It will be understood that in installing the unit X in a conventional double-hung window, the window is first raised and then the unit mounted in the desired position, the space between opposite sides of the unit and the window frame being closed in any suitable manner as by panels 12, which are suitably mounted in position. The unit X is not limited to installations in double-hung windows, but may also be installed in a casement type of window by mounting the entire unit inside the window, and removing panes of glass opposite the rear of the unit X.

The air conditioning unit X comprises a cabinet 13 which is closed except for a front outlet opening 14 for introducing air into the room, a rear opening 15 which opens to the outside of the room, and side openings 16 and 17 arranged respectively on the inside and outside of the room. The openings 16 and 17 are controlled in any suitable manner such as by a suitable slide damper 18 which enables outside air or inside air or a mixture of outside and inside air to be introduced into the evaporator chamber as will hereinafter appear. Disposed in rear of the front opening 14, which in this instance is provided with a series of louvers 19, is an evaporator 20 made up of a series of coils 21. Air is forced through the evaporator 20 by a fan 22 having its axis disposed longitudinally of the housing 13. The fan 22 is adapted to draw air into the housing 13 through the openings 16 or 17, or some air can be drawn into both of these openings according to the position of adjustment of the slide damper 18.

The inside of the casing 13 is divided into two compartments by a partition 23 which extends from a point intermediate the front wall of the

casing in an irregular diagonal manner toward one side wall of the casing. The partition 23 forms an evaporator chamber A and a condenser chamber B. Covering the opening 15 and extending substantially the entire length of the casing is a condenser unit 24 which is made up of a series of finned tubing. A condenser fan 25 is adapted to draw in outside air through one portion of the condenser 24 and discharge air from the inside of the chamber B through another portion of the condenser 24. The fans 22 and 25 are driven by a common electric motor 26 which is disposed within the condenser chamber B, the evaporator fan 22 being mounted on one end of the shaft of the motor 26 and the condenser fan 25 being mounted on the opposite end of this shaft.

It will be observed that the condenser fan 25 is enclosed within a tubular casing or shroud 27, and is arranged in the region of the central portion of the condenser 24. The shroud 27 is carried by a vertically disposed panel 28 which extends from a forward portion of the partition 23 to the condenser 24. The construction and arrangement of parts is such that the condenser fan 25 operates to draw in air from the outside through the right-hand portion of the condenser 24 and discharge air from the interior of the condenser chamber B through the left-hand portion of the condenser to the outside. It will be observed that in this instance the right-hand portion of the condenser 24 or that portion through which air is drawn into the condenser chamber B is somewhat larger than the left-hand portion, or that portion through which air is discharged from the condenser chamber. The purpose of this arrangement is to effect a higher air discharge velocity to prevent the heated discharged air from recirculating back through the condenser. Also arranged within the condenser chamber B and in advance of the fan 25 is a motor compressor unit 29, this arrangement being desirable since the action of the condenser fan 25 not only operates to cool the condenser 24 but also carries away heat from the motor compressor unit 29.

The casing or shroud 27 for the condenser fan 25 is preferably of sheet metal of relatively light gauge and of high heat conductivity. As shown, the shroud 27 is in the form of an annulus. A portion projects forwardly of the panel or partition 28 but the larger portion of the shroud projects rearwardly thereof or into that portion of the condenser chamber occupied by the fan motor 26. Encircling the rear end portion of the shroud 27 is a tube 30 which leads from the discharge end of the motor-compressor unit 29 and extends to the condenser 24. It will be manifest that the refrigerant gas under high pressure and temperature is conducted from the discharge end of the motor driven compressor to the coil of tubing which encircles or is wrapped around the shroud 27 with which the tubing is in intimate thermal contact. The coil of tubing surrounding the shroud may be secured or bonded thereto in any suitable manner as by soldering, brazing or tinning. Since this gas not only contains the heat of compression but also is superheated, as will be readily understood by those skilled in this art, a relatively large amount of heat is conveyed to the shroud.

Formed in the lower portion of the shroud 27 is an enlarged receptacle 31 for receiving condensate from the evaporator 20, as will hereinafter appear. Upwardly inclined lips 32 and 33 are arranged at the front and rear portions respectively of the receptacle 31. As indicated on Figure 3, the lip 33 is higher than the lip 32 and the fan 25 is disposed closer to the lip 32. This forms a larger trough or container for the condensate in rear of the fan 25 than at the front portion thereof. Although in the form shown, the coil of tubing is in intimate thermal contact with both the shroud and trough, the coil may thermally contact only the shroud or the trough by restricting the extent to which the coil embraces one portion or the other.

In practice it is found that in the operation of the fan, rotating in the direction of the arrow *a*, the condensate is forced to the rearward portion of the receptacle by a back draft of air and the receptacle 31 is accordingly formed in this manner. In this instance, the blades of the fan 25 are relatively wide at the outer end portions thereof, and as best shown on Figure 4, the outer edge 34 of each of the fan blades is shaped to conform substantially with the contour of the inner wall of the shroud 27. The edge portion 34 is spaced a slight distance from the inner wall of the shroud in order to minimize back draft and in order to dip well into the condensate in the receptacle 31. A portion of the shroud 27 on the side adjacent the condenser 24 is relieved or cut away as indicated at 35, and in the rotation of the fan 25, at least a portion of each of the blades travels opposite the cut-out portion 35. If desired, removal of the condensate may be obtained by forcing same in spray form against the condenser through the relieved portion 35 without the necessity of employing the heat from the refrigerant gas for evaporation purposes. Moisture which collects on the evaporator 20 drops into a trough 36, and from the trough 36 the condensate flows by gravity through a conduit 37 to the receptacle 31 in the shroud 27.

In operation it will be understood that the superheated gases from the motor compressor unit 29 are forced through the tube 30 which winds about the shroud 27 before it reaches the condenser 24. Since the tube 30 is in heat exchange relationship with the shroud 27, the shroud, as well as the receptacle or trough 31, will become heated, and the fan blades of the condenser fan 25 dipping into the pool of condensate in the receptacle 31, will throw the condensate in comminuted form against the inner walls of the shroud. The contour of the shroud is such that unevaporated condensate thrown thereagainst by the fan will flow by gravity back to the receptacle or trough 31. Some of the condensate will thus be evaporated and excess will return to the receptacle 31, and relatively small amount, if any, will be thrown outside of the shroud 27. Obviously, this arrangement not only has the advantage of disposing of the condensate but also reduces the temperature of the gas before it reaches the condenser 24. In the event that an exceedingly large amount of condensate collects in the receptacle 31, the fan blades will throw the unevaporated portion of it against the condenser 24 through the space formed by the cut-out 35. Ordinarily, the throwing of a fine spray of the condensate against the inner walls of the shroud 27 will be sufficient to dispose of the condensate from the evaporator 20, and it will only be under exceptional conditions that such a large amount of condensate will collect in the receptacle 31 for the fan blades to throw it out through the cut-out portion 35.

Therefore, the cut-out or relieved portion **35** is important primarily when an exceedingly large amount of condensate reaches the receptacle **31**. The refrigerant gas, substantially cooled by the evaporative action of the condensate, as above pointed out, passes to the condenser **24** and then through the remainder of the cycle in the conventional manner, **38** indicating a dryer and strainer and **39** a restrictor or capillary tube, the purposes for which will be readily understood by those skilled in this art. It is to be understood that any form of refrigerant control valve with its associated parts may be substituted for the restrictor tube without in any way interfering with the effectiveness of the condensate removal means herein described or claimed. The substitution of other types and forms of compressor, condenser and evaporator units may also be made without adversely affecting the performance of the condensate removal means herein described.

In the alternate form shown on Figure 6, the shroud **27*a*** for the condenser fan **25*a*** is formed with an annular cavity **40** through which the super-heated gas passes from the motor compressor unit delivered through the tube **30*a***. The shroud **27*a*** is provided with a trough **31*a*** the purpose and functions of which are the same as trough **31** described above. Thus, in this instance the annular cavity **40** takes the place of the coil of tubing **30** wrapped around the shroud in accordance with the structure above described. A greater amount of heat would be created on the inner wall of the shroud **27*a*** by the use of the cavity **40** than in the previously described embodiment due to the reduced temperature gradient between the hot refrigerant gas and the condensate.

It is to be understood that numerous changes in details of construction, arrangement and operation may be effected without departing from the spirit of the invention especially as defined in the appended claims.

What we claim is:

1. Refrigerating apparatus comprising an evaporator, a condenser, a compressor adapted to deliver heated refrigerant gas to said condenser, an annular shroud arranged at substantially right angles to said condenser and in close juxtaposition thereto, a trough associated with said shroud for receiving condensate from said evaporator, a condenser fan fitting said shroud and arranged to dip into the condensate in said shroud and throw same in spray form against the walls of the shroud, a relieved portion on the side of the shroud adjacent the condenser for enabling the fan to throw a spray of condensate against the condenser in case an excessive amount of condensate collects in said trough, and means for causing the heated gas refrigerant to thermally contact the shroud for heating same, thereby to evaporate condensate thrown thereagainst by the fan.

2. Refrigerating apparatus comprising a casing, a partition dividing said casing into an evaporator chamber and a condenser chamber, an evaporator in the evaporator chamber, a condenser in the condenser chamber, a wall disposed at substantially right angles to said condenser and separating the condenser chamber into two portions, an annular shroud constructed of heat conducting material, a fan within said shroud for drawing in air through one portion of the condenser and forcing it out through the other portion, said fan having relatively wide blades, a trough in the lower portion of the shroud into which said fan blades recurrently dip, means to conduct condensate from said evaporator to said trough, a compressor adapted to deliver heated refrigerant gas to said condenser, and a conduit leading from said compressor to said condenser and having a portion encircling said shroud thereby to be in intimate thermal contact therewith.

3. Refrigerating apparatus comprising a casing, a partition dividing said casing into an evaporator chamber and a condenser chamber, an evaporator in the evaporator chamber, a condenser in the condenser chamber, a wall disposed at substantially right angles to said condenser and separating the condenser chamber into two portions, an annular shroud, a fan within said shroud for drawing in air through one portion of the condenser and forcing it out through the other portion, a relieved portion on the side of the shroud adjacent said condenser, a trough in the lower portion of the shroud into which the fan blades recurrently dip, and means to conduct condensate from said evaporator to said trough, whereby spray of condensate formed by said fan is thrown through said relieved portion against the condenser.

4. Refrigerating apparatus comprising a cooling coil, a condensing coil, a propellor type fan in the region of said condensing coil, an annulus enclosing said fan, a trough formed in the lower portion of said annulus and into which said fan is arranged to dip, means to conduct condensate from said cooling coil to said trough to enable said fan to throw condensate from the trough against said annulus, and a cut away portion in that portion of said annulus adjacent said condensing coil to enable condensate to be thrown by said fan through said cut away portion and against said condensing coil.

5. Refrigerating apparatus comprising a casing, a partition dividing said casing into an evaporator chamber and a condenser chamber, an evaporator in the evaporator chamber, a condenser in the condenser chamber, an apertured wall disposed at substantially right angles to said condenser, an annular shroud constructed of heat conducting material and fitting the aperture of said wall, a fan within said shroud for passing air through the condenser, a compressor within said condenser chamber and arranged in the path of the air stream from said fan, a trough in the lower portion of the shroud into which a portion of said fan dips, means to conduct condensate from said evaporator to said trough, and a conduit for hot compressed gases leading from said compressor to said condenser, a portion of said conduit encircling said shroud thereby to be in intimate thermal contact therewith.

6. Refrigerating apparatus comprising a cooling coil, a condensing coil, a fan in the region of said condensing coil, a shroud surrounding said fan, a trough formed in the lower portion of said shroud and into which the blades of said fan are arranged to dip, means to conduct condensate from said cooling coil to said trough to enable said fan to throw condensate from the trough against said shroud, and a cut-away portion in that portion of the shroud adjacent said condensing coil to enable condensate to be thrown by said fan through said cut-away portion and against said condensing coil.

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