May 19, 1953 W. F. BORGERD 2,638,757

CEILING MOUNTED AIR-CONDITIONING APPARATUS

Filed May 5, 1951

FIG. 1.

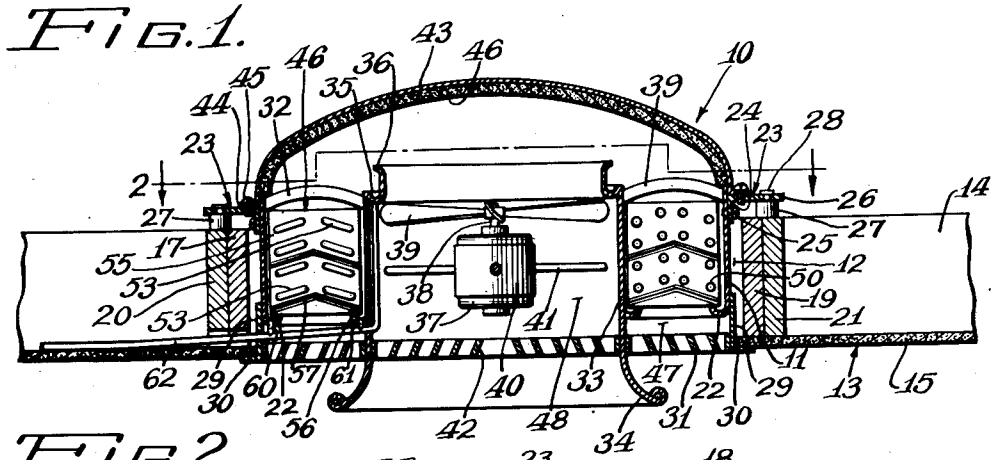


FIG. 2.

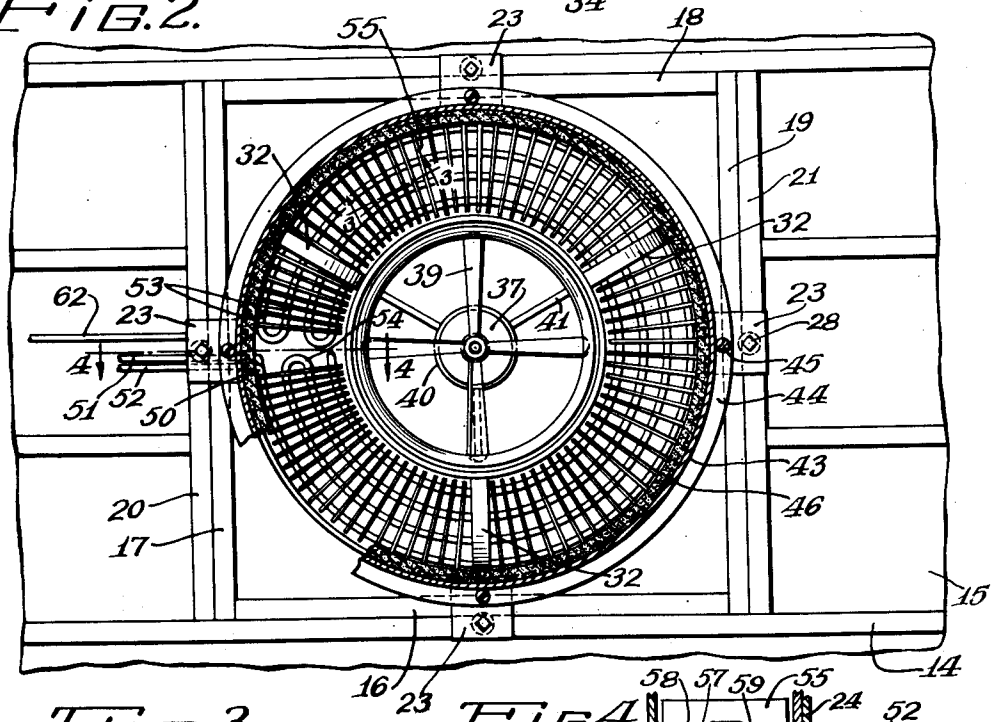


FIG. 3.

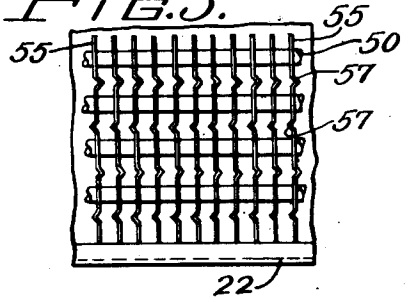
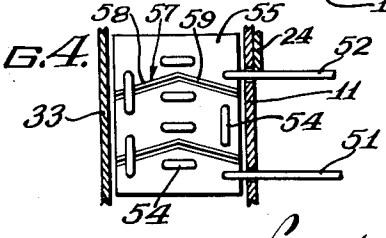


FIG. 4.



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CEILING MOUNTED AIR-CONDITIONING APPARATUS

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10 Claims. (Cl. 62—140)

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This invention relates generally to air conditioning apparatus and more particularly to a unit adapted to be mounted in the ceiling of a room.

Many buildings were originally constructed with no provisions for air conditioning so that to equip such a building with a centralized air condition unit, it is necessary to install individual air ducts to the various rooms of the building. Since such installations entail considerable expense, many home owners have purchased package-type units which do not require duct systems, such as the window-type unit or the console-type unit. Although these units are usually quite compact, they still obstruct usable floor space and a portion of a window. For this reason, a unit adapted to be mounted in a room ceiling has proved to be desirable since it obstructs no part of the floor space and can be made an attractive part of the ceiling. As is well known in the art, a part of the water which is held by warm air will condense on the surfaces of the cooling element of a refrigeration system when the air passes over the cold surfaces thereof and is cooled below its dew point. A ceiling mounted unit must have efficient means for removing all the water that condenses in order to prevent the water from running onto the ceiling or dripping onto the floor therebelow. One object of the present invention is to provide a ceiling mounted air conditioning unit which is complete in itself and does not require air ducts to individual rooms.

Another object of the invention is to provide a unit of the character mentioned with simple and novel means for completely removing all the condensate therefrom.

Another object of the invention is to provide a unit of the character mentioned with a casing which is adapted to be removably secured within an opening provided in a ceiling of a room.

Another object of the invention is to provide a unit of the character mentioned with a top cover which extends into an attic above the room and is removably secured to the unit in order to provide access into the unit for servicing.

Another object of the invention is to provide a unit of the character mentioned with a cooling element having tubes which are formed into slightly tipped U-bends from which condensate will drain into troughs positioned therebelow.

Another object of the invention is to provide the tubes of the cooling element with vertical fins having inclined ribs formed thereon so that the water which condenses on the fins will be drained to the edges thereof by the ribs into troughs positioned therebelow.

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Another object of the invention is to provide a unit of the character mentioned with an air outlet surrounded by an air inlet whereby the air being cooled is thoroughly circulated.

Another object of the invention is to provide a unit of the character mentioned with an inturned flange member over which the air from the cooling element will pass so that any moisture in the air will be caught by the flange and drained into a trough for disposal.

Another object of the invention is to provide a unit of the character mentioned which is small, compact and light in weight so that it can be easily raised from the room floor to the ceiling.

The foregoing, together with other objects and advantages of the invention, will be apparent to those skilled in the art from a consideration of the following description of the embodiment shown in the accompanying drawings, in which:

Fig. 1 is a vertical sectional view through a ceiling mounted air conditioning unit embodying features of the invention.

Fig. 2 is a sectional view of the unit taken along line 2—2 of Fig. 1.

Fig. 3 is an enlarged fragmentary sectional view taken along line 3—3 of Fig. 2.

Fig. 4 is an enlarged fragmentary sectional view taken on line 4—4 of Fig. 2 showing one end of the evaporator in detail.

Referring to the drawing for a detailed description of the invention, an air conditioning unit is designated generally by reference numeral 10. The unit comprises a circular shaped casing 11 which is disposed within an opening 12 provided in the ceiling 13 of a room. The ceiling is located between a room and an attic and comprises suitable beams 14 and a plaster or other suitable finishing material 15. The opening 12 is encased by short beam members 16, 17, 18, and 19 with beam members 20 and 21 positioned adjacent beams 17 and 19 respectively for additional strength.

The unit 10 comprises a circular shaped outer casing 11 having the lower edge bent inwardly to form a continuous groove or trough 22 around the casing. Spaced apart L-shaped brackets 23 are provided for securing the casing 11 to the ceiling 13. Each bracket 23 has a vertically disposed leg 24 removably secured to the upper edge of the casing 11 by screw 25 and a horizontally disposed leg 26 resting on a resilient mount 27 and secured thereto by a bolt 28. A circular rim 29 is secured to the lower edge of the casing 11 and is provided with an outturned flange 30 which fits against the plaster material 15. Removably secured to the rim 29 are circular-shaped louvers 31 which are slightly inclined in order to direct the air currents into the casing

11 and to conceal the interior of the unit from the room.

Fixedly secured to the inner surface of casing 11 are spaced apart braces 32 which extend inwardly toward the center of the casing. Secured to the braces 32 is a circular-shaped inner casing 33 having a lower end 34 which extends below the louvers 31 and flares outwardly. The upper edge of the inner casing 33 is bent inwardly and downwardly to form a continuous trough 35 therearound, then upwardly and outwardly to form an outturned flange 36 which terminates above the trough. Fixedly secured to the outer surface of the casing 33 is a continuous trough 56 located opposite the trough 22. Centrally disposed within the inner casing 33 is an electric motor 37 having an armature shaft 38 to which a propeller-type fan 39 is secured. The motor 37 is secured in position by a collar 40 having radially extending braces 41 secured to the inner surface of the inner casing 33. Removably secured to the casing 33 are circular formed louvers 42 which are slightly tilted in order to conceal the interior of the casing and direct the air from the casing into the room.

A dome-shaped cover 43 fits over the upper edge of outer casing 11 and is provided with an outturned flange 44 which is fastened to the horizontally extending legs 26 of brackets 23 by screws 45. A sound-deadening material 46, of woven glass or similar material, is secured to the inner side of the cover. The space enclosed between outer casing 11 and inner casing 33 provides an air inlet passageway 47 whereas the space enclosed by inner casing 33 provides an air outlet passageway 48. Removably secured within inlet passageway 47 is a refrigerant evaporator 49 comprising a continuous tube 50 having an inlet 51 and outlet 52. The tube 50 is formed into several horizontal disposed circular-shaped U-bends 53 joined at one end by loops 54 so that the refrigerant will enter inlet 51, circulate through the several U-bends 53 and loops 54 and then be discharged through outlet 52. Spaced evenly around the U-bends 53 are vertically disposed cooling fins 55 which are fixedly secured to the bends at substantially right angles thereto. As best seen in Fig. 1, the U-bends 53 are tilted downwardly toward the troughs 22 and 56 so that any condensate formed thereon will be drained toward the outer edges of the evaporator 49 and caught by the troughs. Fins 55 are provided with shallow inverted V-shaped ribs 57 having downwardly sloping legs 58 and 59. As best seen in Fig. 3, each side of the fins 55 is provided with ribs 57 so that the water which condenses on the fins will drain along the downwardly sloping legs of the ribs 57 and drip into the troughs 22 and 56. Outlets 60 and 61 are provided for troughs 22 and 56 respectively which connect into a drain tube 62. The tube 62 also connects to trough 35 so that water, which drains thereinto in a manner explained hereafter, will be removed. The tube 62 slopes downwardly away from the evaporator 49 and may be joined to a suitable waste pipe (not shown) in order that the water collected in the troughs 35, 22 and 56 will be removed.

The inlet 51 and outlet 52 of evaporator 49 are connected to a suitable compressor and condenser (not shown) which may be located in the attic, the room or other suitable place. As is well known in the art, the refrigerant will be delivered to the evaporator 49 in a liquid form at a low pressure and while circulating through

the tube 50, the refrigerant will absorb heat from the air being passed thereover. The fins 55 have a large surface area so that they will absorb heat from the air and produce good heat transfer between the air and the refrigerant. With motor 37 running, fan 39 will pull room air through louvers 31 into inlet passageway 47, over evaporator 49 and out louvers 42 by way of outlet passageway 48. As the warm room air strikes the cold surfaces of the evaporator 49, the air will be cooled to its dew point and moisture will condense on the evaporator. The water which condenses on the U-bends 53 will drip into troughs 22 and 61, and the water which collects on the fins 55 will be drained along ribs 57 into said troughs. As previously explained, tube 62 will carry the water to a suitable waste pipe.

As the air is pulled from inlet passageway 47 into outlet passageway 48 by fan 39, it will be forced over outturned flange 36. If any water droplets are carried upwardly from the evaporator 49 by the air, the water will be caught by the flange 36 and drained into the trough 35 from where it will be removed by tube 62. The sound-deadening material 46 will also absorb any water carried by the air and this water will drain back to trough 22. The shape of the cover 43 insures drainage back to the trough 22 since it curves downwardly toward the trough. As is apparent from the preceding description, the structure assures effective removal of condensate so that there will be no danger of water dripping into the room below or onto the ceiling 13. This is an important feature of the invention since a ceiling mounted unit of the type illustrated must have provisions for preventing damage to the ceiling by water drippage.

The unit 10 may be installed by raising it from the room below and then attaching brackets 23 to the casing 11. Cover 43 may be removed from the unit 10 by working from the attic above the ceiling 13 if servicing is required while the unit 10 is secured to the ceiling. Louvers 31 and 42 may be removed if access from below is desired for servicing and oiling electric motor 37. Suitable controls (not shown) may be provided for operating the fan and refrigeration system. It is contemplated that the unit 10 be installed in the most centralized room of a building. By opening the doors between the rooms to be cooled and lowering the top window sash slightly in the rooms, some of the warm air will be pushed out of stagnant areas. The fan 39 will draw the warm air through the upper portions of the room into inlet passageway 47. The cold air from the unit 10 will be discharged through louvers 42 and will travel along the floors of the rooms and crowd the warm air to the ceiling. In this way the air in several rooms will be properly cooled and the circulation of the air will prevent objectionable drafts or stagnant areas in the rooms.

It is to be understood that the embodiment shown is only for illustrative purposes and various changes and modifications may be made therein without departing from the scope of the invention. For example, the evaporator 49 could be made in sections for convenience of handling or the louvers 31 and 42 could be made in any geometric arrangement such as a square or rectangle.

From the foregoing it is apparent that a ceiling mounted air conditioning unit is provided which is light in weight and small in size. It can be easily assembled in a ceiling and access thereinto is provided for servicing. No cooling water

is required and the condensate is effectively removed so that the hazard of water leakage is eliminated. The proper circulation of room air is assured without the necessity of air circulating ducts. The unit is simple in construction and economical in operation since only a small amount of air is wasted out of the windows.

While the invention is shown in but one form, it will be obvious to those skilled in the art that it is not so limited, and it is desired that only such limitations be placed thereupon as are specifically set forth in the appended claims.

What is claimed is:

1. In a heat exchange unit mounted in a room ceiling, a casing provided with interconnecting inlet and outlet passageways, a refrigerant evaporator comprising a tube formed into a series of U-bends with fins secured thereto, troughs positioned under each edge of said evaporator, said U-bends tilted downwardly toward said troughs so that condensate formed thereon will drip into said troughs, and means for removing the condensate from said troughs.

2. In a heat exchange unit mounted in a room ceiling, a casing provided with interconnecting inlet and outlet passageways, a refrigerant evaporator comprising a tube to which are secured spaced apart fins, troughs positioned below the edges of said fins, ribs formed on said fins along which condensate will drain and drip into said troughs, and means for removing the condensate from said troughs.

3. In a heat exchange unit mounted in a room ceiling, a casing provided with interconnecting inlet and outlet passageways, a cooling element positioned in said inlet passageway, a fan positioned in said outlet passageway which pulls room air into said inlet passageway over said cooling element and discharges it through said outlet passageway, and a protruding flange positioned between said inlet and outlet passageways so that moisture retained in the air after passing over said cooling element will be removed by the flange as the air is circulated thereover by said fan.

4. In a heat exchange unit mounted in a room ceiling, a casing provided with interconnecting inlet and outlet passageways, a refrigerant evaporator positioned in said inlet passageway, said evaporator comprising a tube to which vertical fins are secured, said fins having inclined ribs formed thereon so that condensate will drain therealong to the edges of the fins, fan means for circulating room air through said inlet passageway and out said outlet passageway, and means for removing moisture from the air after it has passed over said evaporator.

5. In a heat exchange unit mounted in a room ceiling, a casing provided with interconnecting inlet and outlet passageways, a refrigerant evaporator positioned in said inlet passageway, said evaporator having fins which are provided with inclined ribs along which condensate will drain to the edges of the fins, troughs positioned below said edges for collecting and removing the condensate, fan means for circulating room air through said inlet passageway, over said evaporator and out said outlet passageway, and means for removing moisture from the air after it has passed over said evaporator.

6. A heat exchange unit comprising a casing having an air passageway therethrough, a refrigerant evaporator positioned in said passageway with means for circulating room air therethrough, said evaporator comprising a tube formed into a series of slightly tilted U-bends, vertical fins secured to said tube which are provided with downwardly sloping ribs along which condensate will drain to the edges of the fins, and means for collecting and removing the condensate as it drips from said evaporator.

7. A heat exchange unit comprising a casing having an air passageway therethrough, a refrigerant evaporator positioned in said passageway with means for circulating room air thereover, said evaporator comprising a tube having vertical fins secured thereto which are provided with downwardly sloping ribs along which condensate will drain to the edges of the fins, and troughs positioned under the edges of said fins for collecting and removing said condensate.

8. A heat exchange unit comprising a casing having an air passageway therethrough, a refrigerant evaporator positioned in said passageway with means for circulating room air thereover, said evaporator comprising a tube having vertical fins secured thereto which are provided with downwardly sloping ribs along which condensate will drain to the edges of the fins, troughs positioned under the edges of said fins for collecting and removing said condensate, and a protruding flange over which the air is circulated after passing over said evaporator so that moisture retained in the air will be removed therefrom by the flange.

9. A heat exchange unit comprising a casing having an air passageway therethrough, a refrigerant evaporator positioned in said passageway with means for circulating room air thereover, said evaporator comprising a tube having vertical fins secured thereto which are provided with downwardly sloping ribs along which condensate will drain to the edges of the fins, troughs positioned under the edges of said fins for collecting condensate, a protruding flange over which the air is circulated after passing over said evaporator so that moisture retained by the air will be removed therefrom by the flange and collected in a trough positioned therebelow, and a drain tube connected to said troughs for removing water from the unit.

10. A heat exchange unit comprising a casing having an air passageway therethrough, a refrigerant evaporator positioned in said passageway with means for circulating room air thereover, said evaporator comprising a tube having vertical fins secured thereto which are provided with downwardly sloping ribs along which condensate will drain to the edges of the fins, troughs positioned under the edges of said fins for collecting and removing said condensate, a protruding flange over which the air is circulated after passing over said evaporator so that moisture retained in the air will be removed therefrom by the flange, and a removable cover provided for said casing, said cover having a sound-deadening material secured on the inner surface thereof which will absorb moisture from the air after it passes over said evaporator.

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