

## [54] EVAPORATIVE AIR CONDITIONER

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[58] Field of Search: 261/DIG. 4, 28, 29, 98, 261/106; 62/DIG. 16, 314-316; 98/2.11, 2.14

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## [57]

## ABSTRACT

An evaporative air conditioner is provided with a continuously extending water-absorbent air filter pad which is enclosed within a housing so that air entering through openings in the housing will surround the filter pad and flow through the pad substantially uniformly throughout the entire area of the pad. A baffle plate is mounted between the openings in the housing and the pad for deflecting air flowing through the openings into the space between the pad and the housing. A water distribution channel is positioned above the pad for supplying water to the pad, the channel having openings above the pad spaced along the length of the pad. The water distribution channel is supplied with water by a plurality of supply channels which communicate with the distribution channel at spaced locations along the length of the channel so that the pressure of the water is substantially uniform throughout the distribution channel. The filter pad is supported by the top wall of an enclosed water tank, and openings are provided through the top wall of the tank below the filter pad to permit excess water to drain into the tank. An air exhaust tube extends between the top and bottom walls of the tank, and an exhaust grille having an upwardly extending plenum tube which is adapted to extend upwardly through the ceiling of the room to be cooled is telescopically received in the exhaust tube. A fan may be adjustably mounted in the exhaust tube for drawing air through the filter pad and forcing it into the room.

3 Claims, 7 Drawing Figures

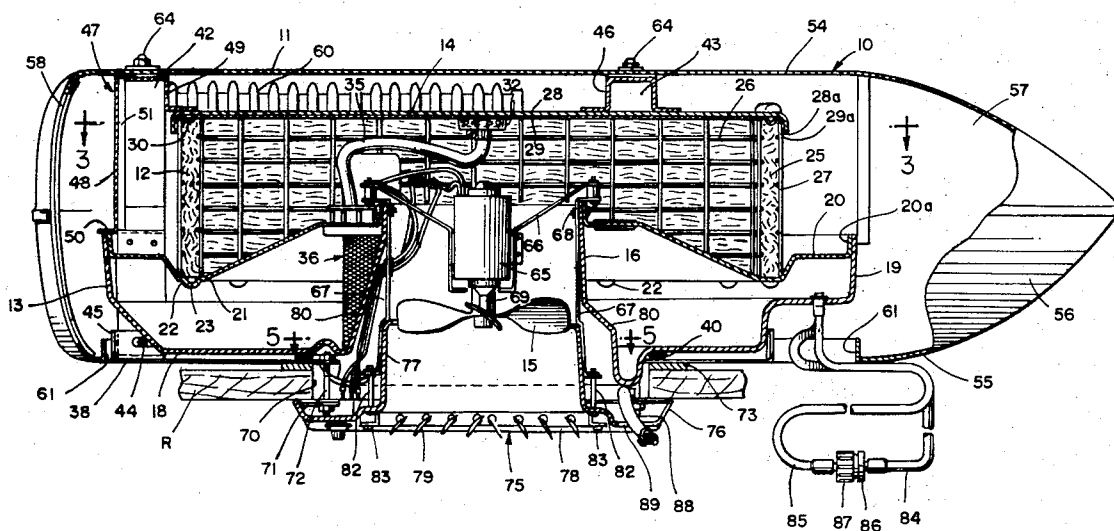


FIG. 1

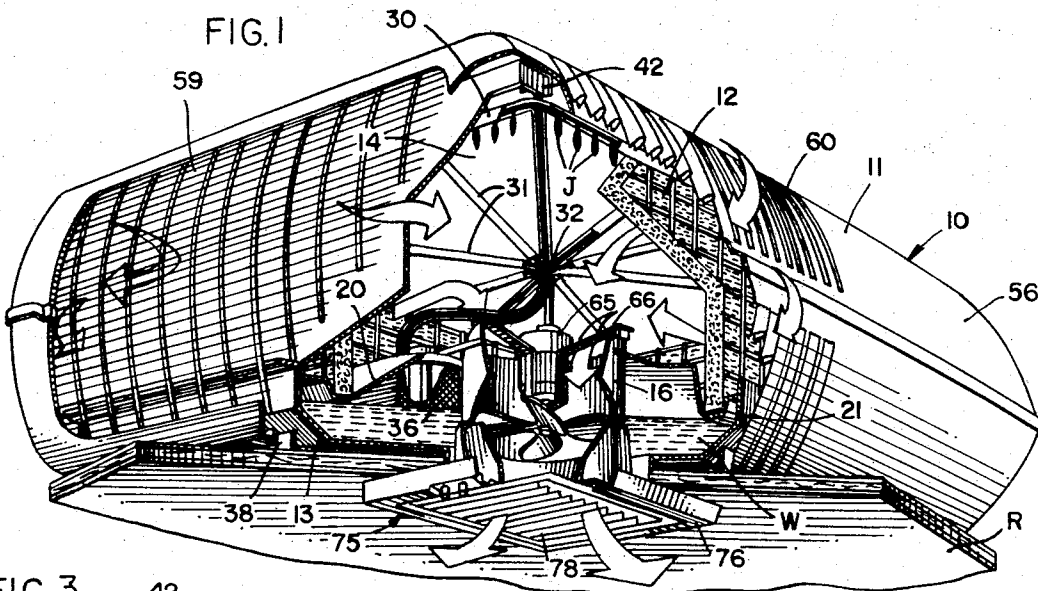


FIG. 3

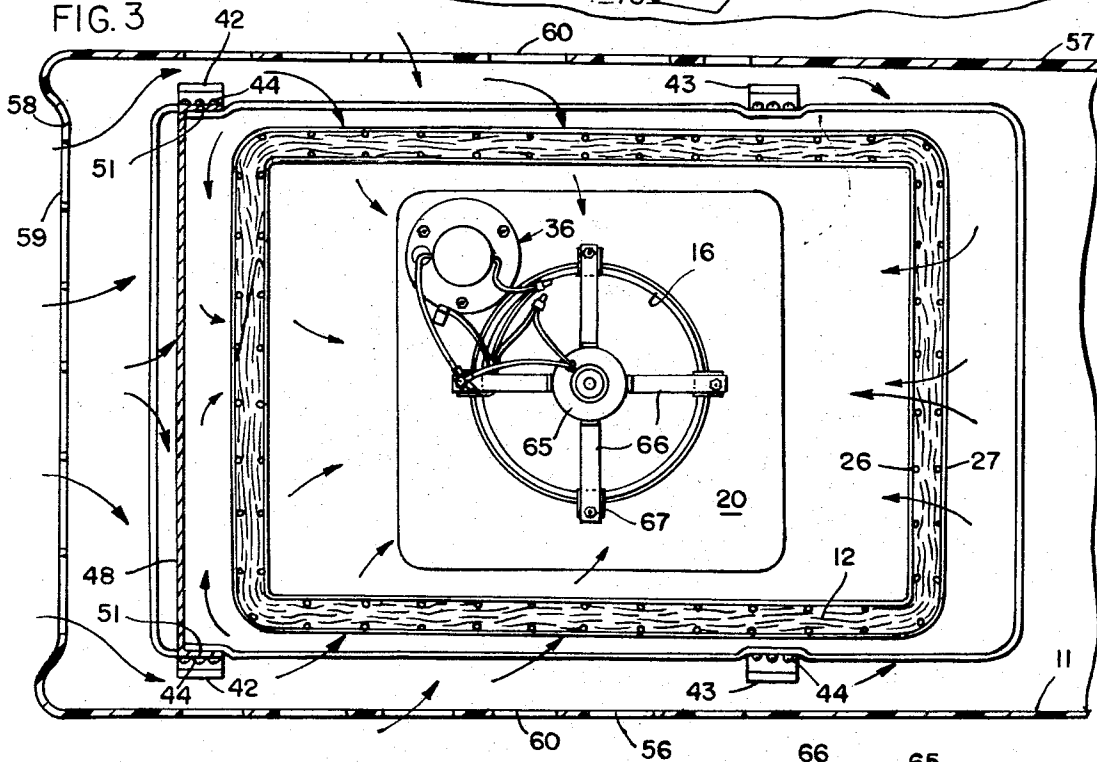


FIG. 6

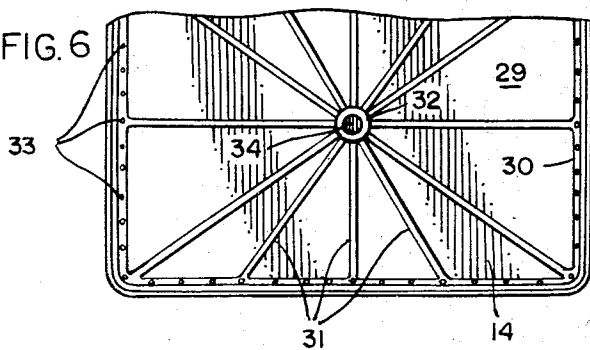


FIG. 7

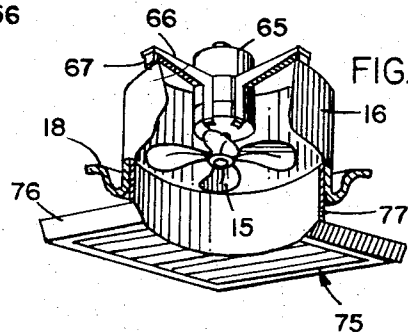
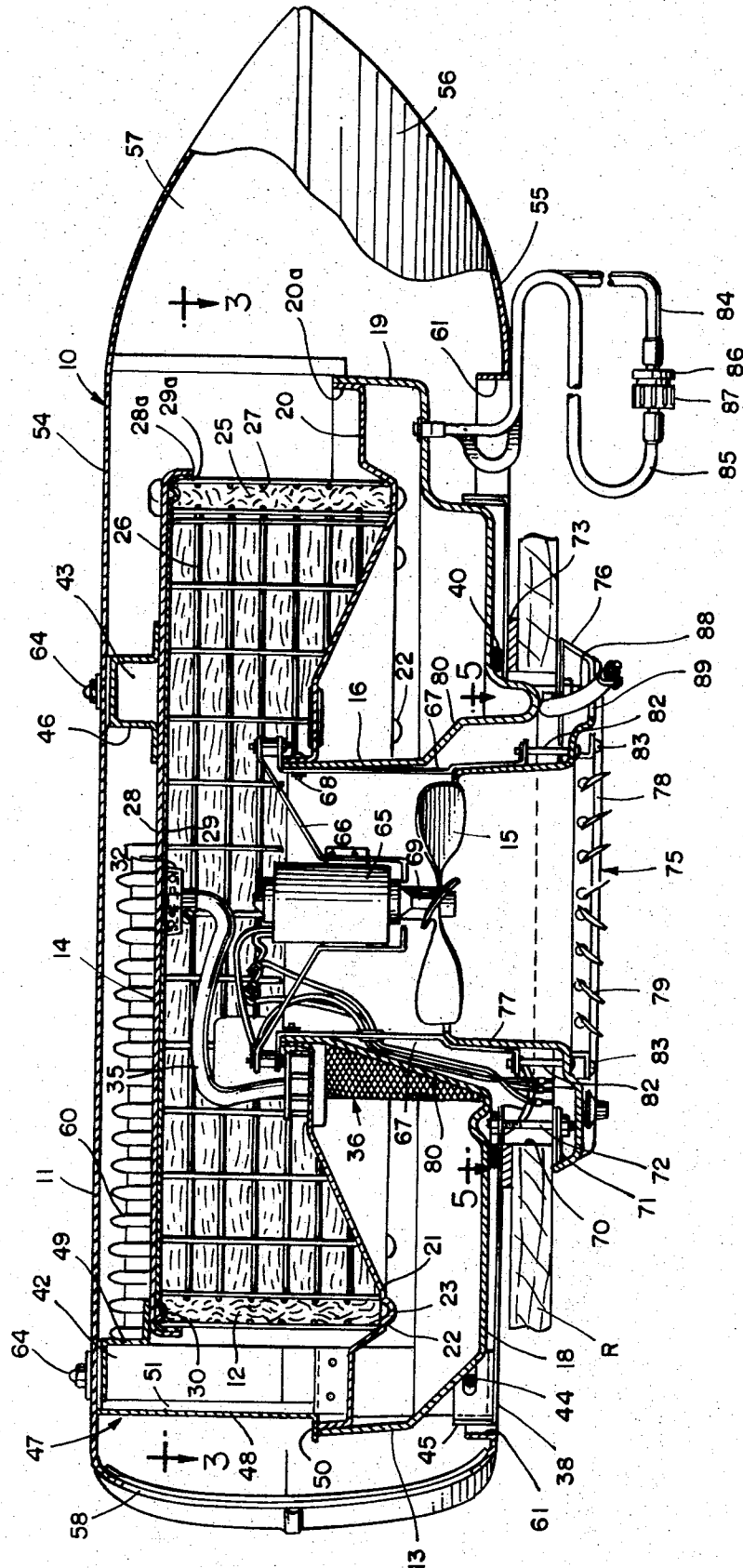
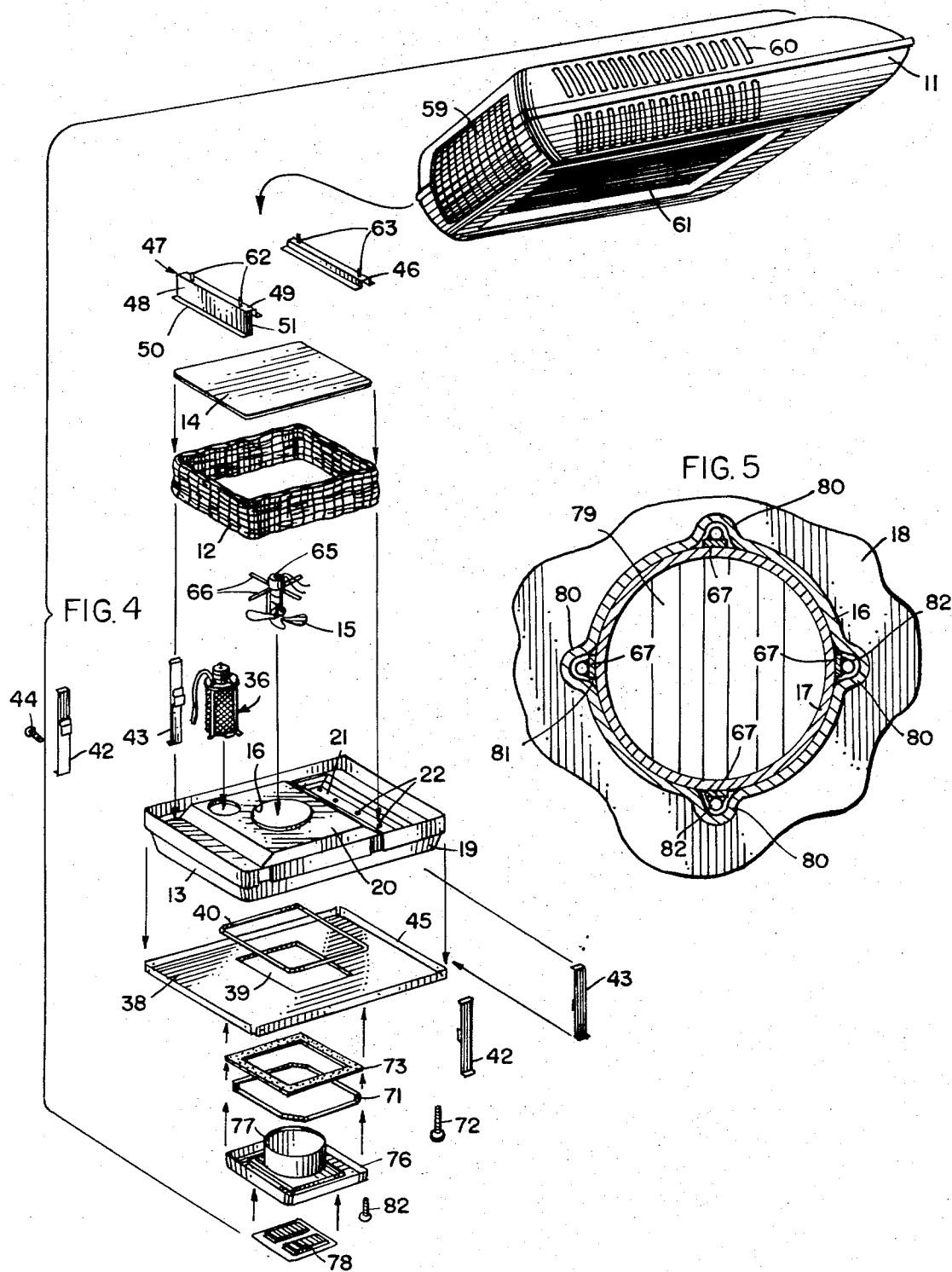


FIG. 2





## EVAPORATIVE AIR CONDITIONER

## BACKGROUND

This invention relates to evaporative air conditioners, and, more particularly, to an evaporative air conditioner which is adapted to be mounted on the roof of a vehicle.

Evaporative air conditioners conventionally include an air filter medium which is saturated with water. Outside or ambient air of relatively low humidity is directed through the saturated filter medium, and as the air comes into contact with the wet material of the filter and the water vapor generated by the saturated filter, a heat exchange occurs. The velocity of the air passing through the wet filter increases the evaporation process. The objective with most evaporative air conditioners is to saturate the relatively dry entering air with water vapor until equilibrium, i.e., full wet bulb depression, is accomplished. The entering air will then be saturated to its full moisture carrying capability. Expressed in temperature, this would be the wet bulb reading of the outside air. This heat exchange is felt by occupants of the room into which the saturated air flows as a sensible temperature drop equal to the difference of the dry bulb and wet bulb reading of the entering air.

In attempting to achieve the foregoing objectives, prior evaporative air conditioners have been provided with means for supplying water to the filter medium, means for directing air through the filter medium, and air blower means for drawing the air through the filter medium and directing it into the room to be cooled. However, prior art constructions have not always achieved the objectives or operated at full efficiency. For example, in many evaporative air conditioners the entering air does not flow through the filter medium substantially uniformly throughout the entire area thereof. As a result portions of the filter medium may become relatively dry due to the passage of an excessive amount of air, and air passing through these portions will not become fully saturated. Once a relatively dry area is established, even more air will tend to flow through this because the dry filter material provides less air resistance than wet filter material. Problems have also arisen in supplying water uniformly throughout the length of the filter medium and in insuring that the air passes from the filter medium into the room without leaking back to the outside.

## SUMMARY

These and other problems are solved by the invention. A water distribution channel is positioned above the filter pad and is provided with openings spaced along the length of the pad. Water is supplied to the distribution channel by a plurality of supply channels which maintain the water pressure in the distribution channel substantially constant throughout the length of the distribution channel. The filter pad is continuous and forms an enclosure within the pad which is covered by the water distribution tray. The filter pad is supported by an enclosed water tank, and an exhaust tube extends from the enclosure through the top and bottom walls of the tank. Air can flow through the exhaust tube only by flowing through the saturated filter pad, and air is caused to flow through the pad substantially uniformly throughout the length thereof by a housing which encloses the pad and is spaced therefrom to form

an air flow channel around the pad. The front of the housing is provided with an air intake grille, and a baffle is mounted behind the intake grille to deflect the incoming air so that air of excessive velocity will not pass directly through the pad. The deflected air flows into the air flow channel, and the back pressure created by the housing enclosure forces the air through the filter pad at a substantially uniform rate throughout the pad.

## DESCRIPTION OF THE DRAWING

The invention will be explained in conjunction with an illustrative embodiment shown in the accompanying drawing, in which

FIG. 1 is a perspective view, partially broken away, of an air conditioner formed in accordance with the invention and shown mounted on the roof of a room to be cooled;

FIG. 2 is a longitudinal sectional view of the air conditioner of FIG. 1;

FIG. 3 is a fragmentary sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is an exploded view of the air conditioner;

FIG. 5 is a fragmentary sectional view taken along the line 5—5 of FIG. 2;

FIG. 6 is a fragmentary bottom plan view of the water distribution tray; and

FIG. 7 is a perspective view, partially broken away, of the ceiling grille and the exhaust tube.

## DESCRIPTION OF SPECIFIC EMBODIMENT

Referring first to FIGS. 1 and 2, the numeral 10 designates generally an evaporative air conditioner which includes an outer housing or shroud 11 enclosing a generally rectangularly shaped air filter pad 12 which is supported by an enclosed water tank 13. Water is supplied to the top of the filter pad by a water distribution tray 14 which is supported by the filter pad and which covers the enclosure formed by the filter pad. The unit is adapted to be mounted on a roof R of a vehicle such as a travel trailer, motor home, or other recreational vehicle, and air is withdrawn from the enclosure of the filter pad by a fan 15 which is mounted within an exhaust tube 16 which extends through the water tank.

Referring now to FIGS. 2 and 4, the enclosed water tank 13 is generally rectangular in outline and includes a bottom wall 18, an upstanding perimetric side wall 19, and a top wall 20 which includes an upstanding edge flange 20a which is secured to the periphery of the side wall. The top wall is provided with a generally V-shaped well or channel 21 adjacent the outer periphery of the tank, and a plurality of downwardly extending embossments or dimples 22 are formed in the top wall at the bottom of the channel, each dimple having a central drain opening 23.

The generally rectangularly shaped filter pad 12 is positioned in the bottom of the V-shaped well 21 in the top wall of the tank and extends upwardly to form an air enclosure therewithin. The filter pad can be formed of a variety of well known water-absorbent materials through which air can pass, and the particular filter illustrated is formed of wood excelsior 25 which is enclosed and supported between a pair of wire grids 26 and 27.

The top of the air enclosure defined by the air filter is closed by the water distribution tray 14 which fits over the filter pad and is supported thereby. The distribution tray is formed of top and bottom plastic plates

28 and 29 which are suitably sealed together, as by ultrasonic welding, and both of the trays include depending perimetric flanges 28a and 29a which extend below the top edge of the filter pad. As can be seen best in FIGS. 1 and 6, the bottom tray 29 is formed to provide an outer peripheral downwardly extending channel or groove 30 which extends around the entire periphery of the tray above the filter pad and a plurality of downwardly extending channels or grooves 31 which extend outwardly from a cavity formed by a central cup 32 to the distribution channel 30. The distribution channel is provided with substantially uniformly spaced openings 33, and the supply channels 31 communicate with the distribution channel at substantially equally spaced locations around the length of the distribution channel.

The central cup 32 is provided with a central opening 34 into which a flexible water hose 35 can be inserted. The flexible hose 35 is part of a conventional water pump assembly 36 which is positioned within the water tank and which extends through the top wall of the tank. Water W (FIG. 1) is pumped from the reservoir formed by the tank by the pump into the central cup 32 of the water distribution tray, and the water flows outwardly through the plurality of supply channels 31 to the perimetrically extending distribution channel 30. Water is forced through the openings 33 in the distribution channel in the form of water jets J (FIG. 1) which saturate the filter pad. Because water is supplied to the distribution channel at substantially uniformly spaced locations around the length of the channel, the water pressure within the distribution channel is maintained substantially constant, and there is little pressure drop between perforations in the channel. Accordingly, the water is supplied to the filter pad substantially uniformly around the entire length of the pad.

Excess water which is not evaporated by air passing through the filter accumulates in the V-shaped well 21 in the top cover of the tank and drains through the openings 23 into the water reservoir. This is controlled by the number and size of the openings 23 to permit back flow of the water in the well into the filter pad by capillary action if portions of the pad are not sufficiently saturated. The water reservoir is fully enclosed except for these openings, and excessive splashover from the tank as the vehicle turns a corner or makes a sudden stop is thereby prevented. Water which does flow outwardly through the openings will be absorbed by the pad or substantially retained in the well of the tank top.

The water tank 13 is supported in a generally rectangular metal base pan 38 having a central rectangular opening 39 (FIG. 4). A generally rectangular sealing gasket 40 can be positioned between the bottom wall of the tank and the base pan around the exhaust tube of the tank and the central opening of the base pan. The water distribution tray 14 is held against the top of the filter pad by a pair of front and a pair of rear brackets 42 and 43 which are secured by bolts 44 (FIG. 2) to the upstanding periphery 45 of the base pan. The upper ends of the rear brackets 43 are boltably secured to a cross channel 46 which extends across the top of the distribution tray from one of the rear brackets to the other.

The upper ends of the front brackets 42 are secured to a baffle assembly 47 which includes a generally vertically extending baffle or deflector plate 48 and a generally Z-shaped retainer flange 49 which extends along

the front edge of the distribution tray and holds the tray against the filter pad. The bottom of the baffle includes a forwardly extending flange 50 which extends forwardly above the upper edge of the water tank where the top and side walls are joined and substantially prevents the passage of air between the bottom of the baffle and the water tank. The baffle is seen to be spaced forwardly of the filter pad and extends beyond the sides of the filter pad and terminates in rearwardly extending side portions 51 (FIGS. 2 and 4).

The housing 11 includes top and bottom walls 54 and 55 which taper together at the rear end of the housing, and side walls 56 and 57. The front end of the housing is provided with an air intake opening 58 which is covered by a screen or grille 59, and air intake louvers 60 are provided along the sides of the housing for about half the length thereof. The bottom wall of the housing is provided with an enlarged opening 61 which is sized to permit the housing to be moved downwardly over the baffle assembly and the water tank to enclose the baffle, filter pad, and the water tank. The Z-shaped retainer flange 49 of the baffle assembly includes a pair of upwardly extending bolts 62 (FIG. 4), and the retaining channel 46 includes a pair of upwardly extending bolts 63. These bolts are received by openings in the top of the housing as the housing is lowered over the water tank, and the housing is secured by acorn nuts 64 which are threaded onto the bolts 62 and 63.

Referring to FIG. 3, the housing is spaced from the filter pad around the entire periphery of the pad, and the baffle plate 48 is positioned between air intake grille 59 and the forward end of the filter pad and is spaced forwardly of the filter pad. As will be described more fully hereinafter, the spacing between the filter pad and the housing and between the filter pad and the baffle plate form an air flow channel around the entire periphery of the filter pad.

A fan motor 65 is supported within the exhaust tube 16 by four equally spaced brackets 66 which are supported above the upper end of the exhaust tube by four brackets 67 which are secured to the exhaust tube by bolts 68. A drive shaft 69 extends downwardly from the fan motor, and the fan blade 15 is adjustably secured to the drive shaft so that the position of the fan blade along the drive shaft can be varied as desired.

The roof R of the room to be cooled, which may be the interior of a recreational vehicle or other vehicle, is provided with a rectangular opening 70 there-through, and the base pan 38 is secured to the roof by a rectangular mounting frame 71 (FIGS. 2 and 4) and four bolts 72 which extend between the mounting frame and the base pan and clamp the mounting frame and the base pan to the roof. A rectangular gasket 73 can be positioned between the roof and the base pan around the opening in the roof to provide a weather-tight seal. The base pan can be secured to the roof without providing any holes through the roof and without removing the housing 11 from the remainder of the air conditioner.

After the base pan is clamped to the roof, a ceiling shroud assembly 75 is secured. The ceiling shroud assembly includes a generally rectangular cover plate 76 having a rectangular central opening and a upwardly extending cylindrical plenum tube 77. A louver assembly 78 is removably attached to the cover plate 76 and includes movable louvers 79 which can be moved to

fully close the central opening of the cover plate or to vary the amount of air flowing into the room.

The louver assembly is installed by inserting the plenum tube 77 through the opening formed in the roof of the vehicle and into the exhaust tube 16. The exhaust tube is sized to telescopingly receive the plenum tube relatively snugly, and the plenum tube is pushed upwardly in the exhaust tube until the cover plate 76 engages the bottom surface of the roof. The exhaust tube is provided with four radially outwardly extending enlargements 80 (FIGS. 2 and 5) which are spaced about 90° apart, and the four support brackets 67 which are secured to the upper end of the exhaust tube by the bolts 68 extend downwardly along the inside of the tube in line with these cavities. The cover plate 76 is secured to the lower ends of the support brackets 67 by attaching bolts 82, which hold the cover plate tightly against the roof. Thereafter, the louver assembly 78 can be secured to the cover plate by screws 83.

The plenum tube 77 provides a fixed plenum chamber downstream of the louver assembly 78, and the position of the fan blade 15 relative to the plenum tube can be adjusted before the louver assembly is installed to provide maximum efficiency. The fan blade is adjustably mounted on the drive shaft 69 of the fan motor, and after the cover plate 76 is attached to the support brackets 67, the fan blade can be adjusted as desired to accommodate roofs of different thicknesses. For maximum efficiency it is suggested that the position of the fan blade on the drive shaft be adjusted so that about one-third of the vertical depth of the fan blades is below the upper edge of the plenum tube. The air drawn by the fan will be forced by the fan into the plenum tube, and maximum air flow will be available for distribution by the louver assembly. Loss of air through the periphery of the cover plate is substantially prevented.

The mounting plate 71 and the telescoping feature of the plenum tube of the ceiling shroud assembly permits fast and accurate installation of the air conditioner. The air conditioner can be installed without drilling holes through the roof, and the telescoping feature of the plenum tube permits accurate centering of the ceiling assembly.

A pair of water filling tubes 84 and 85 extend into the interior of the water tank above the normal water level and are equipped with male and female fittings 86 and 87, respectively, which may be connected when the hoses are not being used. When the tank is to be filled, one or the other of the filling hoses 84 and 85 is connected to a suitable source of water depending upon the type of connection on the water source, and the other hose can function as an overflow drain tube to prevent excessive filling.

A drain tube 88 is connected to the bottom of the tank above the ceiling cover plate 76 for draining the water reservoir when the air conditioner will not be used for a period of time. The drain tube can be concealed above the cover plate when not being used by a removable plate which covers an access opening 89 in the cover plate.

In operation water is pumped from the water reservoir through a filter screen in the pump assembly 36 to the central cup 32 of the water distribution tray and outwardly to the distribution channel 30. Water is sprayed onto the filter pad by the distribution channel and gravitates toward the bottom of the filter pad, and

a certain amount of water is absorbed by the capillary action of the pad.

The air conditioner is designed for use when the vehicle is either moving or is stationary. When the vehicle is stationary, air may be drawn inwardly through the openings in the housing by the fan 15. When the vehicle is moving, air flows through the openings in the housing whether or not the fan is being operated. The air intake grille 59 faces the front of the vehicle, i.e., the direction in which the vehicle generally moves, and air will flow into the housing through the intake grille and the side louvers 60. Air which enters through the front intake grille is deflected by the front baffle 48 to the flow channel between the sides of the filter pad and the housing as illustrated by the arrows in FIG. 3. Air which enters through the side louvers will also flow into the flow channel between the filter pad and the housing. Since air will generally enter the housing at a faster rate than it can pass through the water soaked filter pad, particularly when the vehicle is moving, a back pressure will be created within the enclosure of the housing between the housing and the filter pad. This back pressure will create a substantially uniform pressure around the outside of the filter pad, and air will be forced through the filter pad at a substantially uniform rate throughout the entire area thereof as indicated by the arrows in FIG. 3, including the front portion of the filter pad which is spaced rearwardly of the baffle 48.

As the air passes through the filter pad, dust and other foreign particles are filtered from the air, and the air is saturated with water. The cooled, saturated air is drawn by the fan through the exhaust tube and forced into the plenum tube and through the adjustable louvers 79. Some opening should be provided in the room which is being cooled, for example, by opening a window slightly, so that air which flows into the room through the air conditioner forces an equal amount of air out of the room.

While in the foregoing specification a detailed description of a specific embodiment of the invention has been set forth for the purpose of illustration, it will be understood that many of the details herein given may be varied considerably by those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. An evaporative air conditioner adapted to be mounted on a vehicle comprising a housing having front and rear ends, the housing having openings provided in the front end to permit inward flow of air as the vehicle moves forward, a tank within the housing providing a liquid reservoir and having a bottom wall and an upwardly extending side wall, a liquid-absorbent air filter pad supported above the tank and having an upwardly extending closed continuous shape defining a central enclosure, cover means above the filter pad for closing the top of the central enclosure so that air can enter the central enclosure only through the filter pad, air exhaust means extending through the bottom wall of the tank for permitting air to flow from the central enclosure of the filter pad, means for supplying liquid to the filter pad, the housing being spaced laterally outwardly from the filter pad around the entire periphery of the filter pad to provide a continuous air flow space between the housing and the filter pad around the entire periphery of the filter pad, and an imperforate baffle plate positioned between the front end of the

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housing and the filter pad and behind the openings in the front end of the housing to prevent direct impingement of air flowing through the openings on the filter pad and to deflect the air into the air flow space between the housing and the filter pad.

2. The air conditioner of claim 1 in which the liquid supplying means comprises a fluid supply cavity formed in the cover, a fluid distribution channel formed in the cover above the filter pad and extending around the entire periphery of the pad, a plurality of fluid supply channels formed in the cover extending from the fluid supply cavity to the fluid distribution channel at sub-

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stantially uniformly spaced locations along the length of the distribution channel, and means for supplying pressurized liquid to the fluid supply cavity.

5 3. The air conditioner of claim 1 in which the filter pad is generally rectangular and includes a front portion which extends generally transversely to the inward flow of air through the front end openings in the housing and a pair of side portions which extend rearwardly from the front portion, the baffle extending laterally beyond the side portions of the filter pad.

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