Jan. 30, 1962 H. F. LATHROP 3,018,642

AIR CONDITIONER

Filed May 9, 1960 2 Sheets-Sheet 1

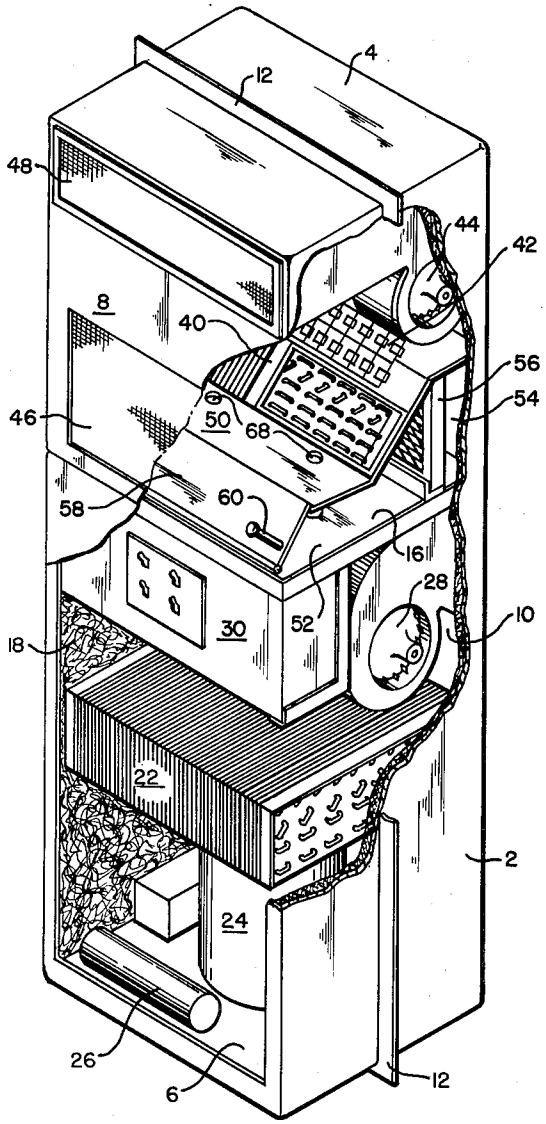


FIG. 1

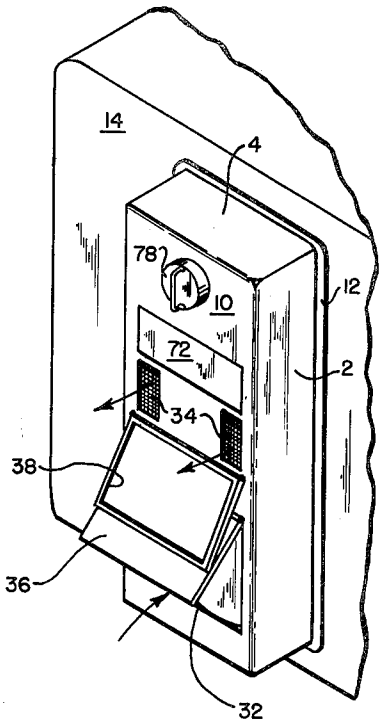


FIG. 2

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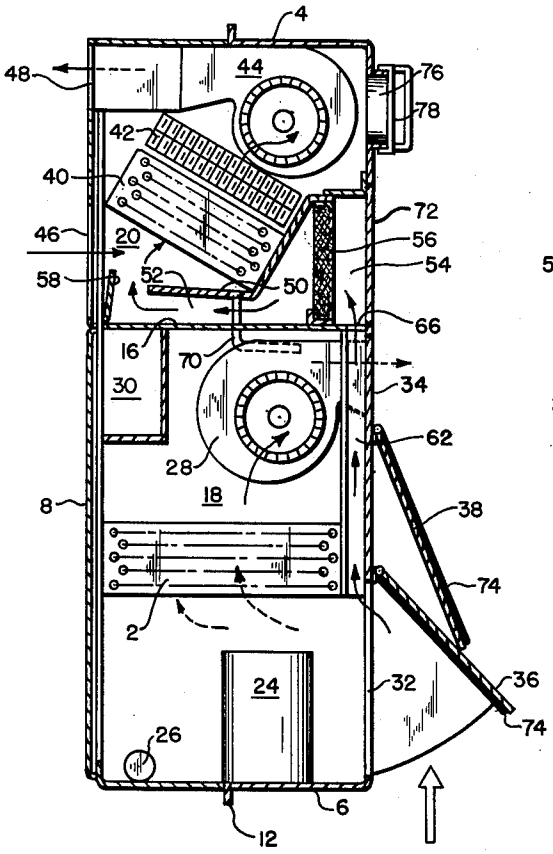


FIG. 4

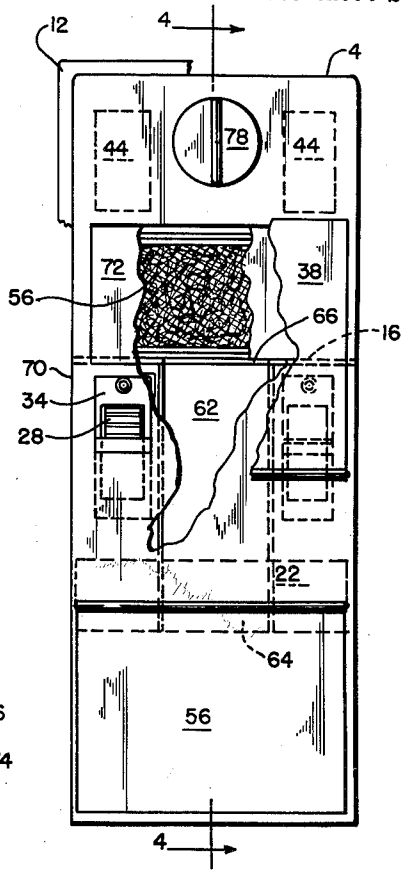


FIG. 3

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AIR CONDITIONER

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This invention relates to a self-contained air conditioner particularly adapted to be employed for cooling or heating mobile enclosures such as military ground support trailers or vans, or other portable shelters.

The objects of the present invention include the provision of a self-contained air conditioner of the air cooled type which: may be used to either cool or heat an enclosure; is relatively lightweight and has its component parts arranged to provide a compact package facilitating its transport; includes a compartmentalized construction to provide a separate compartment for a refrigeration condenser and evaporator respectively; includes provision for diverting a part of the outside air admitted into the condenser compartment to the evaporator compartment with means provided for regulating the proportion of outside air thus diverted; and is structurally arranged to minimize short circuiting of the condenser compartment discharge air back to the condenser compartment air inlet.

Other objects and features of the invention will be appreciated from the following description which is to be considered in connection with the accompanying drawing illustrating the principles of the invention incorporated in one embodiment by way of example and wherein:

FIGURE 1 is a partly broken isometric view of the air conditioner with certain parts deleted for clarity;

FIGURE 2 is an isometric view of the air conditioner mounted in an exterior wall of an enclosure to be conditioned, this view illustrating the condenser compartment air inlet and air outlet covers in a position for cooling cycle operation;

FIGURE 3 is a partly broken elevational view of the exterior or rear of the air conditioner with the condenser compartment covers in a closed position; and

FIGURE 4 is a partly diagrammatic vertical sectional view taken along the line 4—4 of FIGURE 3.

Referring to the drawing, the cabinet for the air conditioner is an upright generally rectangular casing formed by a pair of opposite sidewalls 2, a top wall 4, a bottom wall 6, a front or inner wall 8, and a rear or outer wall 10. The panels forming these cabinet walls are preferably of a lightweight material such as aluminum which is fabricated and welded so that the casing portion of the cabinet which projects outside of the enclosure is watertight and adapted to be sealed from the outside environment when its associated covers are closed, while the inside portion includes removable front panels which permit access to the interior of the cabinet. A peripheral mounting flange 12 which carries a gasket and extends around the top, bottom and side walls adds strength and rigidity to the cabinet. When the cabinet is mounted in an opening in an exterior wall of an enclosure 14 (FIGURE 2), the inner or front portion of the cabinet projects into the enclosure and the rear or outer portion of the cabinet projects outside of the enclosure.

The cabinet interior is divided by a horizontally disposed partition 16 into two main compartments; a lower condenser compartment 18 and an upper evaporator compartment 20. This main partition 16 generally seals the upper and lower compartment from each other and is insulated to minimize heat transmission between the compartments.

A finned coil condenser 22 extends horizontally across the lower compartment 18 to divide it into a lower portion which has suitably mounted therein a hermetic compressor

24, a liquid receiver 26 and certain other refrigeration system elements, and an upper portion containing a pair of motor driven centrifugal fans 28 and an electrical control box 30. Outside air for cooling the condenser during a cooling cycle operation is admitted into the condenser compartment through the outside air inlet 32 located in the lower rear panel of the lower compartment 18, with the major portion of the outside air admitted passing through the condenser 22 normally and being discharged by the fans 28 through separate, horizontally spaced condenser air outlets 34 which are spaced somewhat above the inlet 32.

An air inlet cover 36 in the form of a canopy having side walls which retract into the cabinet when the cover is closed is hinged along its upper edge so that the air inlet 32 is shielded from the top and sides when the cover is open as illustrated in FIGURES 2 and 4. To permit closing the condenser air outlets 34 when the refrigeration system is not being used, a cover 38 is provided. This cover is hinged along its lower edge and when swung to an open position as illustrated in FIGURE 2 rests against the opened cover 36 in a position in which the condenser air outlets 34 are unobstructed.

The upper compartment 20 includes a finned coil refrigeration evaporator 40 extending between the opposite cabinet side walls 2 and tilted or inclined forwardly so that its upper front edge is adjacent the front wall 8 and its lower rear edge is spaced above the main partition 16. A bank of electric heating elements 42 is mounted adjacent the upper air flow face of the evaporator in tandem relation thereto. A pair of centrifugal fans 44 mounted in the upper rear corner of compartment 20 are operable to induce air flow through the recirculation air inlet 46 in the cabinet front wall 8, through the evaporator 40 and heating elements 42, and to discharge conditioned air through the circulating air outlet 48, also located in the cabinet front wall 8 but spaced upwardly from the recirculation air inlet.

The upper compartment 20 also contains a baffle or second partition 50 spaced above the main partition 16 and underlying the evaporator 40. Baffle 50 has its front edge spaced rearwardly from the recirculation air inlet 46 and extends, on a level above the lower edge of the inlet 46 and between the opposite cabinet sidewalls 2, horizontally and rearwardly below the lower edge of the evaporator 40, then upwardly and rearwardly along the closed bottom surface of the evaporator, and then rearwardly to the cabinet rear wall 10. The forward portion of the baffle 50 forms, with the upper surface of the main partition 16 and the cabinet side walls 2, a horizontal fresh air duct 52 which terminates at its front or discharge end in rearwardly spaced relation from the cabinet front wall 8. The inclined portion of the baffle 50 forms the upper wall of a transition section joining the horizontal fresh air duct to an air filter plenum designated 54 and having its upper wall formed by the rear horizontal portion of baffle 50. A vertically disposed air filter 56 is suitably mounted in the filter plenum 54. The extent to which the discharge end of the horizontal fresh air duct 52 is opened to admit fresh air into the evaporator compartment 20 is controlled by a fresh air damper 58 pivotally supported along its lower edge adjacent the lower edge of the recirculation air inlet 46 in the cabinet front wall 8. A lever 60 fixed to the damper 58 projects through a vertical slot in the cabinet front wall 8 and is employed to manually adjust the damper setting between a forward extreme position (as shown in FIGURE 4) wherein the discharge end of the fresh air duct 52 is fully open and the recirculation air inlet 46 is partially blocked, and the opposite or rear extreme position (as shown in FIGURE 1) wherein the fresh air duct is fully closed and the recirculation air inlet is fully open.

The outside air flowing through the filter plenum 54, transition section and horizontal fresh air duct is induced by operation of the centrifugal fans 44 which draw fresh air from the lower portion of the lower compartment 18 upwardly through a vertical fresh air duct 62 (FIGURES 3 and 4) which has its lower open end 64 in communication with the space below the condenser 22, and its open upper end 66 in communication with the space on the upstream side of the air filter 56 in the filter plenum 54. The vertical duct 62 extends upwardly along the rear or outer wall 10 in the space behind the rear edge of the condenser 22 and centrally between the separate discharge plenums of the condenser air flow fans 28 and thence through the rear central notch or opening in the main partition 16. Since the lower open end 64 of the vertical duct 62 is open to the space below the condenser 22, the fresh air admitted thereto is unheated air which has not been used to cool the condenser. Further, when the air conditioner is being used for heating, since the vertical air duct is immediately adjacent the outside wall, whatever fresh air is admitted for ventilating flows into the open bottom end 64 without contacting other elements in the condenser compartment and while permitting the condenser air outlet cover 38 to remain closed.

The baffle 50 not only serves as the upper wall of the horizontal fresh air duct 56, but also serves as a drip tray for collecting condensate from the evaporator. The condensate which accumulates on the baffle upper surface flows into the open upper ends 68 of a pair of condensate drainage tubes 70 which pass downwardly through the horizontal fresh air duct and main partition 16, and then rearwardly where they terminate in open ends above the condenser air fan wheels 28 so that the condensate dropping from the open end of the tubes will be effectively atomized and discharged along with the condenser air to the outside.

Access to the fresh air filter 54 is provided on the exterior of the cabinet through the filter access panel 72 suitably secured in flush relation to the rear wall 10. The condenser air outlet cover 38 is of sufficient height and width that when closed it also covers the filter access panel 72. Both covers 36 and 38 have peripheral gaskets 74 on their inner surfaces so that the exterior portion of the cabinet is sealed when the covers are closed.

In the upper central part of the rear wall 10 an opening 76 is provided and is normally closed by a standard water tight female duct cover 78. Under circumstances of extreme low temperatures where the heat available from the bank of electrical heaters is not sufficient for a rapid warm up, a portable heater may be connected by suitable duct work to the opening 76 to provide additional heat for the enclosure.

As has been noted previously and is apparent in FIGURE 4, the rear edge of the condenser 22 is spaced from the rear wall 10 to accommodate the vertical fresh air duct. Since this vertical fresh air duct 62 has a width across the rear wall 10 limited by the spacing between the discharge plenums of the condenser fans 34 which in turn are spaced inwardly from the side walls 2, space for the piping and wiring between the refrigeration components in the lower compartment and upper compartment is available in the vertical rear corners of cabinet. Such piping (not shown) extends upwardly along the rear corners of the cabinet and then forwardly between the side walls 2 and the adjacent housing of the centrifugal fans 28, and then upwardly through partitions 16 and 50 into the upper compartment. The triangular space between the upper closed edge of the evaporator 40 and the front wall 8 is conveniently available for mounting the thermal expansion and solenoid valves used in connection with the refrigeration system.

Now considering the operation of the air conditioner in a cooling cycle, both covers 36 and 38 are opened to the position shown in FIGURES 2 and 4. The refrigeration system and fans 28 and 44 are placed in operation, and the damper 58 is adjusted to a position permitting the admission of a desired amount of fresh air. In FIGURE 4, the passage of condenser air flow is indicated by the dotted arrows while fresh and recirculation air flow to the upper compartment is indicated by the solid line arrows. Assuming that the damper is adjusted to its extreme open position (partially blocking the recirculation air inlet 46 and correspondingly increasing the fresh air suction effect of fans 44), the proportion of recirculated to fresh air may suitably be arranged to be, say, in the ratio of 3 to 1. This fresh air is drawn upwardly by fans 44 through the vertical fresh air duct 62 and into the filter plenum 54 where, because of the relatively large sectional area across which the air filter 56 extends, the velocity of the air flow is correspondingly reduced and filtering performance thereby enhanced. The fresh air discharged from the horizontal fresh air duct mixes with the recirculating air admitted into the upper compartment through recirculation air inlet 46 and then passes through the evaporator 40 past the de-energized electric heating bank 42 and is discharged into the enclosure through recirculation air outlet 48. Condensation which accumulates on the evaporator 40 and drips onto the baffle 50, which as shown is inclined slightly downwardly towards its rear, passes into the condensate drainage tubes 70 and is discharged out of the condenser air flow outlets 34 along with condenser air flow. It is noted in connection with the operation of the air conditioner in a cooling cycle that the hot condenser air discharged from outlets 34 tends to be thrown outwardly and then rise because of its heat content and that the fresh air inlet 32, being shielded by the cover 36, admits outside air drawn into the open bottom of the cover.

When it is desired to operate the air conditioner in a heating cycle, the condenser air outlet cover 38 is closed and sealed and the condenser air fans 28 are not operated. The cover 36 is opened to the extent deemed desirable in connection with the setting of the adjustable fresh air damper 58. The refrigeration system is not operated, and the bank of electrical heating elements 42 are energized from an energy source external to the air conditioner and controlled by a step controller in accordance with conventional practice.

The invention claimed is:

1. In an air conditioner assembly: an upright rectangular cabinet adapted to be sealably mounted in an exterior wall of a space to be conditioned; a first partition extending horizontally across the interior of said cabinet to divide said cabinet into an upper compartment and a lower compartment; a recirculation air inlet in the inner wall of said upper compartment adjacent the lower part thereof; a conditioned air outlet in the upper part of said upper compartment; heat exchange means extending across the upper compartment interior in the path of air flow therethrough; first blower means in said upper compartment for inducing said air flow through said heat exchange means; a second partition in the upper compartment having its inner edge spaced from said recirculation air inlet and extending horizontally and rearwardly in spaced relation above said first partition to form therebetween an air duct in communication at its rear end with an air filter plenum; a damper in said upper compartment disposed between the front end of said air duct and said recirculation air inlet, said damper being pivotally supported along its lower edge and disposed for selective positioning between one extreme position closing said front end of said air duct, and an opposite extreme position opening said front end and partially closing off said recirculation air inlet; an outdoor air inlet in the lower part of the outer wall of said lower compartment; an air outlet in the outer wall of said lower compartment and spaced upwardly from said outdoor air inlet; a refrigeration condenser extending horizontally across

said lower compartment between said lower compartment air inlet and air outlet and having its rear edge spaced from said outer wall to define a space therebetween; second blower means in said lower compartment adapted to induce air flow through said lower compartment; a vertical air duct having an open bottom end in communication with the space in said lower compartment below said condenser and extending upwardly in the space defined between said condenser and said outer wall and through said first partition for communication at its open top end with said filter plenum.

2. In an air conditioner assembly: an upright rectangular cabinet adapted to be mounted in sealed relationship in an exterior wall of a space to be conditioned; a first partition extending horizontally across the interior of said cabinet to divide said cabinet into an upper compartment and a lower compartment; an air inlet and an air outlet in the upper compartment in communication with said space to be conditioned and blower means between said air inlet and air outlet for inducing the flow of air therethrough; heat exchange means including a refrigeration evaporator extending across said upper compartment interior and transverse to the air flow therethrough, said evapoartor being inclined forwardly with its upper forward corner adjacent the inner wall of said upper compartment and its lower rearward corner spaced above said first partition; a second partition having its forward edge spaced rearwardly of said upper compartment air inlet and extending horizontally and rearwardly below said lower edge of said condenser and above said first partition to define a horizontal fresh air duct with said first partition with the forward end of said horizontal duct being open and spaced rearwardly from said upper compartment air inlet, said second partition extending upwardly and then rearwardly along the lower edge of said evaporator to define the upper wall of an air filter plenum of substantially greater cross sectional area than the cross sectional area of said horizontal fresh air duct; damper means disposed between said open forward end and said upper compartment air inlet, said damper means being operable to vary the proportions of air drawn from said space and from said duct into said upper compartment; an outdoor air inlet and an upwardly spaced condenser air outlet in the outer wall of said lower compartment; a refrigeration condenser extending across said lower compartment between said lower compartment air inlet and outlet and having its rear edge spaced from said outer wall; second blower means for inducing air flow through said lower compartment; and, a vertical fresh air duct having its lower end in communication with the space in said lower compartment below said condenser and its upper end in communication with said filter plenum, said vertical fresh air duct extending upwardly through the space defined between said condenser rear edge and said outer wall of lower compartment.

3. In an air conditioner assembly as specified in claim 2 including: condensate drainage means in the form of tube means having condensate inlet means in communication with the upper surface of said second partition and extending downwardly through said second and said first partitions with condensate outlet means in communication with the downstream side of said second blower means.

4. In an air conditioner assembly as specified in claim 2 including: cover means for said outdoor air inlet comprising a canopy-like member rotatably mounted along its upper edge adjacent the upper edge of said outdoor air inlet, and operable to an open position wherein one wall of said member projects outwardly between said outdoor air inlet and said condenser air outlet, and cover means for said condenser air outlet operable independently of said outdoor air inlet cover means and having its lower edge pivotally mounted along an axis above the upper edge of said canopy cover, whereby said outlet cover means may be swung outwardly and downwardly to

an open position permitting air discharge from said condenser air outlet directly outwardly.

5. In an air conditioner assembly as specified in claim 4 including: said upper compartment includes means defining a filter access opening in its rear wall between the rear edges of said second and first partition; panel means for closing said opening; and said condenser air outlet cover means includes an extended portion adapted to encompass said panel means when said outlet cover means is in a closed position.

6. In an air conditioner assembly as specified in claim 5 including: means defining a normally closed auxiliary air supply opening in said upper compartment for placing the space on the downstream side of said heat exchange means in said upper compartment in communication with a source of auxiliary air.

7. In a self-contained air conditioner assembly: a cabinet adapted to be mounted in an exterior wall of a space to be conditioned and having first horizontal partition means dividing said cabinet into an upper and lower compartment, said upper compartment having a recirculation air inlet and circulating air outlet in the interior wall of said cabinet with circulating air blower means disposed therebetween for inducing air flow through said upper compartment, and said lower compartment having an outside air inlet and an upwardly spaced condenser cooling air outlet in the exterior wall of said cabinet with condenser cooling air blower means therebetween for inducing air flow through said lower compartment; a refrigeration evaporator extending across the interior of said upper compartment between said recirculation air inlet and said circulating air outlet; a refrigeration condenser extending across the interior of said lower compartment between said outside air inlet and said condenser cooling air outlet; cover means for said outside air inlet operable to an open position in which a wall of said cover means projects outwardly between said outside air inlet and said condenser cooling air outlet for preventing short circuiting of air between said outlet and said inlet; a fresh air duct in said cabinet having an open bottom end adjacent said outside air inlet and extending vertically upwardly and forwardly with an open forward end spaced rearwardly from said recirculation air inlet; and damper means for controlling the admission of outside air to said upper compartment, said damper means being diposed between said outside air duct forward end and said recirculation air inlet and operable between one extreme position closing said forward end, and an opposite extreme position opening said forward end and blocking a portion of said recirculation air inlet.

8. In a self-contained air conditioner assembly: an upright cabinet including an upper compartment having an air inlet and an air outlet in communication with the space to be conditioned and containing blower means therein for inducing a first air flow through heat exchange means disposed between said inlet and outlet, and including a separate lower compartment having an air inlet and an air outlet in communication with the exterior of the space to be conditioned and containing blower means for inducing a second air flow through a refrigeration condenser disposed between said lower compartment air inlet and air outlet; a fresh air duct including a vertical portion having an open bottom end adjacent the air inlet of said lower compartment and an open top end in communication with an air filter plenum in said upper compartment, and including a horizontal portion extending forwardly from said filter plenum in underlying relation to said heat exchange means and having a forwardly open end spaced rearwardly from said upper compartment air inlet; and damper means disposed between said open forward end of said horizontal portion and said upper compartment air inlet, said damper means being operable to selective positions between one extreme position closing said forward end, and an opposite extreme position open-

ing said forward end and blocking a portion of said upper compartment air inlet.

9. In an air conditioner assembly as specified in claim 8 wherein: the rear edge of said condenser is spaced inwardly from the outer wall of said lower compartment to define a space therebetween to accommodate said vertical portion of said fresh air duct; said lower compartment blower means includes a pair of laterally spaced centrifugal fans adapted to discharge condenser cooling air through correspondingly laterally spaced outlets; and said vertical fresh air duct extends upwardly between said centrifugal fan outlet plenums.

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