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REMOVABLE REFRIGERATION PACKAGE

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(71) Applicant(s)
TrainNorman Assets Pty Ltd

(72) Inventor(s)
Martin, Kerron James

(74) Agent / Attorney
IP Gateway Patent and Trade Mark Attorneys Pty Ltd, PO Box 1321, SPRINGWOOD, QLD, 4127, AU

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ABSTRACT

A refrigeration package (14) for use with a refrigeration cabinet having a bottom package compartment, the refrigeration package being moveable between an operative position within the bottom package compartment and an inoperative position remote from the refrigeration cabinet. The package includes an inner wall (40) defining a first section (36) at the front of the package with an ambient air (AA) inlet, a refrigeration condenser unit (42) and a second section (38) with an evaporator unit (52). The second section (38) has a top opening for sealable air flow with the refrigeration cabinet. The inner wall (40), first and second sections (42, 38) are configured such that when the refrigeration package (14) is in the operative position, air flow channels (62, 64) are defined for drawing warmed air from the condenser unit (42) through outlets (66, 68) in the refrigerator package so as to direct air warmed (WA) from the condenser unit (42) toward the sealed top opening and/or the bottom wall of the refrigerated compartment and the warmed air is vented away from the rear wall (32) of the package.

Figure 8

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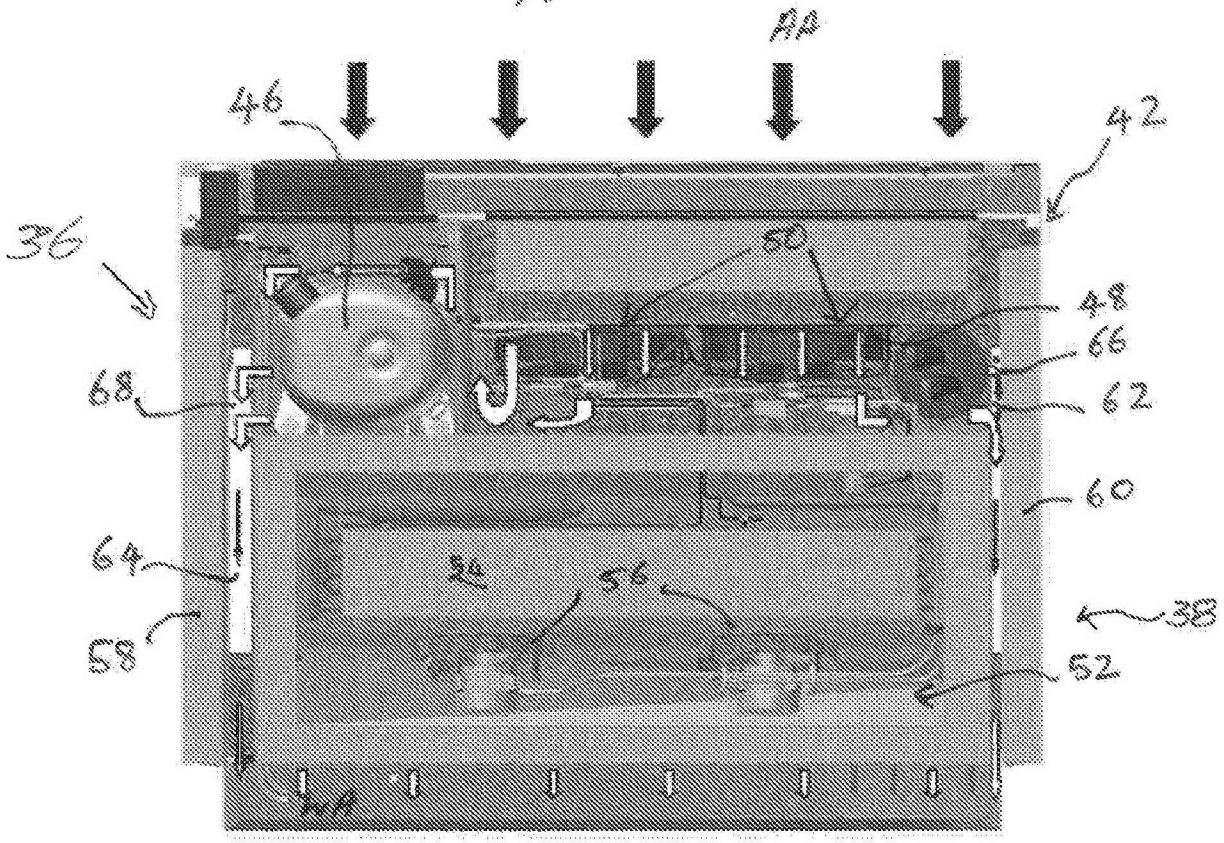


Fig. 8

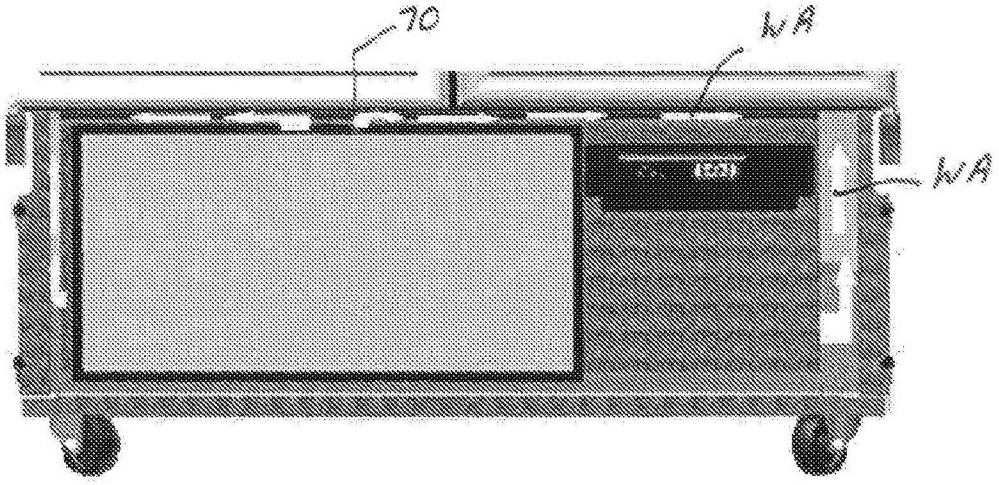


Fig. 9

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REMOVABLE REFRIGERATION PACKAGE

FIELD

The present disclosure relates to the field of removable refrigeration units or packages for use with refrigeration cabinets. In particular, the present disclosure relates to a bottom mounted refrigeration package for a freezer.

BACKGROUND

The present disclosure is primarily concerned with a bottom mounted removable refrigeration package for an upright freezer. However, it will be appreciated that the refrigeration package is also suitable for use in a refrigerator or freezer and no limitation is intended thereby.

Refrigeration systems are well known to include a compressor that constricts refrigerant vapor, raising its pressure, and pushing it into the coils on the outside of a refrigerator cabinet. When the hot gas in the coils meets the cooler air temperature of the ambient air it becomes a liquid. The liquid refrigerant passes through an expansion valve causing a sudden drop in pressure turning it into a cool gas that flows around evaporator coils in the refrigerator cabinet so as to absorb the heat inside the cabinet, cooling down the air. Last, the refrigerant evaporates to a gas, then flows back to the compressor, where the cycle starts over.

Such systems are widely used in domestic refrigerators and freezers. Commercial merchandising refrigerators and upright freezers are commonly used to display refrigerated or frozen goods at point of sale. Such refrigerators and freezers are subject to significant abuse when compared to domestic refrigerators and freezers. The cabinet doors are open and closed many times by customers with a subsequent almost constant flow of ambient air into the refrigerated space. Such cabinets are also subject to being moved either on site or a number of times during their working life. Commercial refrigerators and refrigerators must therefore be regularly serviced.

During such servicing it is often necessary to access parts for repair and/or replacement. This can be time consuming for conventional refrigerators. Further if lengthy repairs are required there is inconvenient and time consuming downtime of the unit. In order to

address these problems it is known to provide removable refrigeration cartridges or packages which incorporate all the cooling components such as the compressor, condenser, evaporator and fans. The removable packages may be readily removed from the refrigerator cabinet for remote repair. The removed package may be replaced with an operative unit so as to minimize downtime.

Merchandising refrigerators and freezers are available with the refrigeration package mounted in the top of the cabinet. Product presentation and access is very important for merchandising refrigeration and freezer units. An advantage of top mounting is that the package is above the useful refrigeration space of the cabinet such that product storage and display space is not compromised. However, one problem with top mounted refrigeration packages is that they are difficult (and dangerous) to remove because of their weight.

Bottom mounted units may initially appear to be the obvious solution to this problem. However, bottom mounts have their own problems. The packages are quiet bulky as they must include all of the refrigeration components. A larger size for top mounted packages can be tolerated as it does not interfere with product presentation and access. If a bottom package is too bulky, the top shelf can be inaccessible for a person of average height. Bottom mounted packages of an equivalent size can reduce the useable space for merchandise. It is therefore desirable for bottom mounted packages to be as compact as possible.

It will be appreciated that this desire for compactness creates design difficulties. This is particularly so for freezer refrigeration packages. Freezer units require more and larger componentry than a refrigerator. Air flow within a removable package is also very important for efficient and reliable operation. The air flow must be sufficient to cool the evaporator coils. Inefficient cooling will significantly reduce efficiency. It may be appreciated that fitting more and larger componentry into a package may compromise air flow.

In view of the desirability of bottom mounted packages some upright freezers have a condensing unit fitted in a compartment in the base of the cabinet and the evaporator in the top section of the refrigerated compartment. This is to keep the condensing unit as low as possible so as to allow access to the top shelf. However, the evaporator in this position takes up valuable storage space.

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The present inventor is unaware of any commercially available bottom mount refrigeration package for a vertical freezer in which both the condenser unit and evaporator unit are housed in the same package.

The present disclosure is therefore directed towards a removable refrigeration package that is suitable for use in bottom mounted upright freezer applications. The disclosed package is also suitable for use in refrigerators.

SUMMARY

According to a first broad aspect of the disclosure there is provided a refrigeration package for use with a refrigeration cabinet having a bottom package compartment and an upper refrigeration compartment, the refrigeration package being moveable between an operative position within the bottom package compartment and an inoperative position remote from the refrigeration cabinet, the package comprising;

a housing with a front wall, a rear wall, right and left side walls and a top section, the front wall having an ambient air inlet;

an inner wall defining a first section and a second section and which prevents air flow communication between the first and second sections, the first section being located towards the front wall and in air flow communication with the ambient air inlet;

a refrigerant condenser unit within the first section such that in use ambient air is drawn through the inlet and into the condenser unit so as to be warmed thereby;

a refrigerant evaporator unit within the second section that is in refrigerant fluid flow communication with the refrigerant condenser unit;

the second section having a top opening for sealable air flow communication between the second section and the refrigeration compartment when the refrigeration package is in the operative position

wherein the housing, inner wall, first and second sections are configured such that when the refrigeration cabinet is in the operative position within the bottom package

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compartment, air flow channels are defined for drawing the warmed air through outlets in the refrigeration condenser unit so as to direct the warmed air from the refrigeration condenser unit toward the sealed top opening and/or the bottom wall of the refrigerated compartment such that the warmed air is vented away from the rear wall of the package.

The refrigeration cabinet may be either a refrigerator cabinet or a freezer cabinet.

The condenser unit suitably includes a compressor, a condenser coil and one or more fans. Suitably the condenser unit includes two condenser fans. Suitably the fans have electronically commutated motors that are energy efficient. The fans draw ambient air through the inlet and across the condenser coil which warms the ambient air.
The package includes air flow channels for drawing the warmed air away from the condenser unit through outlets in the condenser unit.

Suitably the compressor is located within one of the air channels so that the compressor can be cooled by the warmed air flow.

The evaporator unit suitably includes an evaporator coil and at least one evaporator fan. Suitably there are two evaporator fans. Suitably the fans have electronically commutated motors that are energy efficient. The evaporator unit is located in the second section that has a top opening for sealable air flow communication with the refrigerated compartment of the refrigeration cabinet.

Suitably the opening corresponds to the full length and width of the second section so as to optimise air flow communication between the evaporator unit and the refrigeration compartment. Suitably the opening is divided into an air outlet and an air inlet, the outlet being in communication with an air inlet duct and the inlet in communication with an air outlet duct respectively of the refrigeration compartment. This arrangement facilitates a flow of cooled air through the refrigeration compartment.

Suitably, when in the operative position within the package compartment, air flow channels are defined between the right and left package walls and the respective inner right and left walls of the package compartment. Suitably right and left warmed air outlets in the condenser unit communicate with these channels. Warmed air within these channels can flow towards the sealed opening and the base of the refrigeration cabinet so as to minimise condensation.

Suitably there is a further channel defined between the top of the condenser unit and the bottom of the refrigeration compartment that draws air from outlets in the top of the condenser unit across the front of the sealed opening and the refrigeration cabinet.

The refrigeration package may further include an evaporator tray for receiving defrost water from the evaporator coils through a drain tube. The defrost tray is suitably disposed below the evaporator unit and extends away from the rear wall of the package. In this case, there is suitably a further warmed air channel that draws air below the evaporator unit and over the evaporator tray so as to facilitate evaporation of the defrost water collected therein. The warmed air also warms the drain tube so as to prevent icing up of the drain tube.

The package may also include conduits for hot gas flow from the condenser in the evaporator tray so as to further heat the evaporator tray.

Suitably the evaporator defrost is effected by hot gas. Use of hot gas and warmed air to effect defrost and also evaporation avoids the need for conventional electrical heating thereby increasing the overall efficient of the refrigeration package.

The package suitably includes a water trap associated with any defrost drain tube and evaporator tray. The water trap provides a water seal to prevent cooled air leaving the refrigerated compartment and warmed air entering the refrigerated compartment. The water trap also prevents vermin entry into the refrigerator compartment. Suitably the water trap is primed with water before the first defrost cycle.

Also disclosed herein is a refrigeration cabinet having a bottom refrigeration package compartment, an upper refrigerated cabinet and a refrigeration package as disclosed herein within the refrigeration package compartment.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 is a front perspective view of a refrigeration cabinet with a refrigeration package as disclosed herein remote from the cabinet;

Figure 2 is a front view of the refrigeration cabinet of Figure 1 with the refrigeration package in the operable position;

Figure 3 is a rear perspective view of the refrigeration cabinet of Figure 1 with the refrigeration package in the operable position;

Figure 4 is a front perspective view of the refrigeration package in Figure 1;

Figure 5 is a rear perspective view of the refrigeration package in Figure 1;

Figure 6 is a side elevational cross sectional view of the refrigeration package in Figure 1;

Figure 7 is a top perspective cross sectional view of the refrigeration package in Figure 1;

Figure 8 is a top cross sectional view section of the refrigeration package in Figure 1;

Figure 9 is a front view of the refrigeration package in Figure 1;

Figure 10 is a partial rear perspective view of the lower part of a refrigeration cabinet with the refrigeration package in Figure 1 in the operable position;

Figure 11 is a rear view of the lower part of a refrigeration cabinet with the refrigeration package in Figure 1 in the operable position;

Figure 12 is a side section view of a refrigeration cabinet with the refrigeration package in Figure 1 in the operable position;

Figure 13 is a detailed top view of a rear corner of the refrigeration package in Figure 1;

Figure 14 is a detailed perspective view of a rear corner of the refrigeration package;

Figure 15 is a perspective view of a water trap for use with the refrigeration package of Figure 1;

Figure 16 is the same view as figure 14 showing the water trap being removed from the refrigeration package; and

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Figure 17 is a cross sectional side view showing the water trap installed in the refrigeration package.

DETAILED DESCRIPTION OF THE FIGURES

Figure 1 shows an upright merchandising freezer cabinet 10 having a bottom section 12 for receiving a removable refrigeration package 14 and an upper refrigerated space 13. The cabinet 10 has left and right side walls 58, 60, two front glass doors 8, 9, a bottom floor 7 of the refrigerated space 12, a rear package back stop 6 and an electrical connector 5 for electrical connection with the package 14.

The front of the package 14 is provided with a removable cover 16. The package 14 is able to be removed from the cabinet 10 by non-qualified personnel without the use of tools.

Figures 2 and 3 are front and rear perspective views of the refrigeration cabinet 10 with the refrigeration package in the operative position within the cabinet 10.

Figure 4 is a front perspective view of the package 14. The package 14 has a front face 18 and right and left sides 20, 22. The front 18 of the package 14 is provided with an electronic control 24.

The top 26 of the package 14 has an opening 28 surrounded by a seal 30. When in the operative position, the seal 30 seals against the bottom of the refrigerated space of the cabinet 10 to allow for air flow between the package 14 and the refrigerated space 13. This will be discussed further below.

Figure 5 shows the rear perspective view of the package 14. The package 14 has an evaporation tray 34 extending rearwardly. The operation of the tray 34 will be discussed further below.

Figure 6 is a partial side cross sectional section view of the lower part of the cabinet 10 with the package 14 in the operational position. The package 14 has a front or first section 36 and a second or rear section 38 that are separated by interior wall 40. The wall 40 isolates the second section 38 from ambient air (A.A).

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Figure 7 is a top perspective cross sectional view of the refrigeration package (10) from the rear, and Figure 8 shows a top cross sectional section view of the lower part of the cabinet 10 with the package 14 in the operable position.

The first section 36 contains a condenser unit 42 that has a condensing unit cover 44 (as shown in Figure 7). The condenser unit 42 includes a compressor 46 for compressing refrigerant, condenser coils 48 for receiving condensed refrigerant from the compressor 46 and two condenser fans 50.

Figure 8 also shows the spatial relationship between the right and left side walls 58, 60 of the cabinet 10 and the package 14. Right and left side channels 62, 64 are defined between the respective outer side walls of the package 14 and inner side walls of the cabinet 10. The channels 62, 64 are in air flow communication with right and left hand side vents 66, 68.

The second section 38 contains an evaporator unit 52 that includes an evaporator coil 54 for receiving refrigerant fluid from the condenser coils 48 and two evaporator fans 56.

Figures 4 – 11 show the environmental air flow within the refrigeration package. Ambient air AA is drawn in through front cover 16 into the condenser unit 42. The ambient air AA is drawn through the heated condenser coils 48 and is warmed thereby to produce warmed air WA that is shown being discharged from the condenser unit 42 through the right and left side vents 66, 68 and also top vent 70.

Figure 6 shows that part of the warm air WA is drawn below inner wall 40 towards the rear 32 of the package to be vented form the rear of the package 14. This flow path has a working relationship with the evaporator tray 34 that will be discussed further below.

The rear face 32 cooperates with the rear package back stop 6 to direct the flow of warm air WA upwards. This reduces recirculation of the warm air into the incoming flow of cooler ambient air. This upward flow of air from the rear can also be seen in Figures 7 and 10. This upward flow of air also warms the rear wall of the cabinet, further preventing or minimising condensation.

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Warm air WA is also drawn though air channels through side vents 66, 68 into the channels 62, 64 defined between the sides of the package and inner walls of the cabinet. Drawing of warm air towards the right side vent 66 draws air over the compressor 46, thereby assisting in cooling the compressor.

The warm air that flows in channel 62 that passes between the package 14 and the cabinet wall warms the right side of the package seal 30, the bottom 7 of the refrigerated space 13, thereby preventing or minimising condensation. This warm air flow also assists with evaporation of water in the evaporation trays as discussed below.

Similarly, the warm air that flows in left channel 64 that passes between the package 14 and the cabinet wall warms the left side of the package seal 30, the bottom 7 of the refrigerated space 13, thereby preventing or minimising condensation. This warm air flow also assists with evaporation of water in the evaporation trays as discussed below.

Still further warm air flows through the top vent 70 as shown in figures 7 and 9 to further warms the front of the seal 30 and the base of the refrigerated space 13.

It may be appreciated that such an air flow design may offer advantages with respect to reliable, operation and efficiency.

Figure 12 is a cross section of the cabinet 10 with the package 14 n the operative position. This figure shows the passage of air cooled AC by the evaporator coil 54 into the refrigerated space 13. The cabinet 10 has back wall 78 with vents 76 for directing air MA across the merchandise on the shelves. The cabinet 10 also includes a solid bottom shelf 79 with an air duct 80 between the solid shelf 79 and the inside of the front doors of the cabinet 10. This arrangement prevents or can minimise entry of spilled fluids or the like into the evaporator unit. This ducting system also allows for even product temperature and air distribution.

The operation of the evaporator tray 34 will now be explained with reference to Figures 13 to 16.

During the defrost cycle, cold defrost water runs down drain tube 82 an into evaporator tray 34. The drain tube 82 is shown in figures 13 and 15.

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The end of the defrost drain tube 82 is received within a water trap 84. The water trap 84 and drain tube 82 are located within a warm air flow channel so as to warm the tube 82 and trap 84 and prevent them from requiring electrical heating to prevent blockage by ice.

Figure 14 shows that the trap 84 is mounted to the rear wall 32 of the package 14 by screws 86 that allow the trap to be removed for cleaning (as shown in figure 16).

The trap 84 is shown in Figure 15. The trap has side walls 88, 90, a front wall 92 with the securing flange 94 extending therefrom and a rear wall 96. The tops of side wall 88, front wall 92 and rear wall 96 abut the base of the package 14. Side wall 90 has an overflow notch 98. This arrangement provides a small surface area for evaporation of water from the water trap 84.

Figure 17 is a cross sectional view showing the trap 84 in use. The lower end of the defrost drain tube 82 terminates within the trap 84 below the water level 100. Defrost water can overflow through notch into the evaporation tray 34. The overflow notch 98 is positioned at 90º to the warm air flow 102 preventing warm air from passing over the surface of the water in the trap 84 reducing evaporation between defrosts (See Fig 16). It may be seen that the relationship between the distances between the bottom of the package, the tube 82, trap 84 and tray 34 allows the trap 34 to be easily removed for cleaning.

The water trap 84 prevents warm entering the refrigeration space and cold air exiting the refrigerated space. It also prevents vermin from entering the refrigerated space.

At the commissioning stage of the refrigerator or freezer, it is recommended that a small amount of water is poured down defrost drain tube 82 until it overflows into tray 34 creating an air tight seal.

It will be appreciated that the refrigeration package and cabinet as disclosed herein enables the package to operate with energy efficiency. This includes the use of the commutated condenser and evaporator fan motors, heating of the evaporator drip tray by hot gas, using hot gas and warm air to evaporate defrost water, heating of the drain tube by warm air. The use of hot gas and warm air for heating avoids the use of electric heating and associated additional circuits and energy usage. Further the unique air flow design also avoids the use of electric heating circuits to avoid frosting up or condensation

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being formed around the seal between the package and the refrigeration compartment and the bottom of the refrigeration compartment.

Further the package can be used for freezer applications in which both the condenser unit and evaporator unit are housed in a stand-alone package that can be removed by non-skilled personnel. The freezer packages can be manufactured to the same or similar dimensions to that of currently available refrigerator packages. This provides a commercial advantage as it enables a supplier to provide refrigerator and freezer models with the same unit compartment height so that the cabinets are matching (pigeon pair), both with removable packages.

It will be appreciated that various changes and modifications may be made to the package and refrigeration cabinet as described and claimed herein without parting from the spirit and scope thereof.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS

1. A refrigeration package for use with a refrigeration cabinet having a bottom package compartment and an upper refrigeration compartment, the refrigeration package being moveable between an operative position within the bottom package compartment and an inoperative position remote from the refrigeration cabinet, the refrigeration package comprising;

a housing with a front wall, a rear wall, right and left side walls and a top section, the front wall having an ambient air inlet;

an inner wall defining a first section and a second section and which prevents air flow communication between the first and second sections, the first section being located towards the front wall and in air flow communication with the ambient air inlet;

a refrigerant condenser unit within the first section such that in use ambient air is drawn through the inlet and into the condenser unit so as to be warmed thereby;

a refrigerant evaporator unit within the second section that is in refrigerant fluid flow communication with the refrigerant condenser unit;

the second section having a top opening for sealable air flow communication between the second section and the upper refrigeration compartment when the refrigeration package is in the operative position

wherein the housing, inner wall, first and second sections are configured such that when the refrigeration package is in the operative position within the bottom package compartment, air flow channels are defined for drawing the warmed air from the condenser unit through outlets in the refrigeration package so as to direct air warmed from the condenser unit toward the sealed top opening and/or the bottom wall of the refrigeration compartment and said warmed air is vented away from the rear wall of the package.

2. The refrigeration package of claim 1, wherein the refrigeration package has at least one warmed air outlet in the right side wall and at least one warmed air outlet in the left side wall.

3. The refrigeration package of claim 1 or claim 2, wherein the condenser unit includes a compressor, a condenser coil and one or more fans.

4. The refrigeration package of claim 3, wherein the condenser unit is configured such warm air drawn through the right side outlet or the left side outlet draws warmed air over the compressor.

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5. The refrigeration package of claim 3 or claim 4, wherein the fans draw ambient air through the inlet and across the condenser coil.

6. The refrigeration package of any one of claims 1 to 5, wherein the refrigeration package has at least one warmed air outlet in the top section.

7. The refrigeration package of any one of claims 1 to 6, wherein the top opening is divided into an air outlet and an air inlet.

8. The refrigeration package of any one of claims 1 to 7, wherein the package further includes an evaporation tray for receiving defrost water that is operatively associated with a warmed air channel for evaporation of any water in the tray.

9. The refrigeration package of claim 8, wherein the defrost water is received through an end of a water tube and the package further includes a water trap associated with the end of the water tube.

10. The refrigeration package of claim 9, wherein the trap is removably mounted to the rear wall of the package.

11. The refrigeration package of any one of claims 1 to 10, wherein the package comprises a rear back stop to direct the flow of warm air upwards.

12. A refrigeration cabinet having a right side wall, a left side wall, a bottom section for operatively receiving refrigeration package of anyone of claims 1 to 11 and an upper refrigerated space with a bottom floor, the bottom floor adapted for sealing air flow communication with the top section of the refrigeration package.

13. The refrigeration cabinet of claim 12, wherein the refrigerated space is a freezer space.

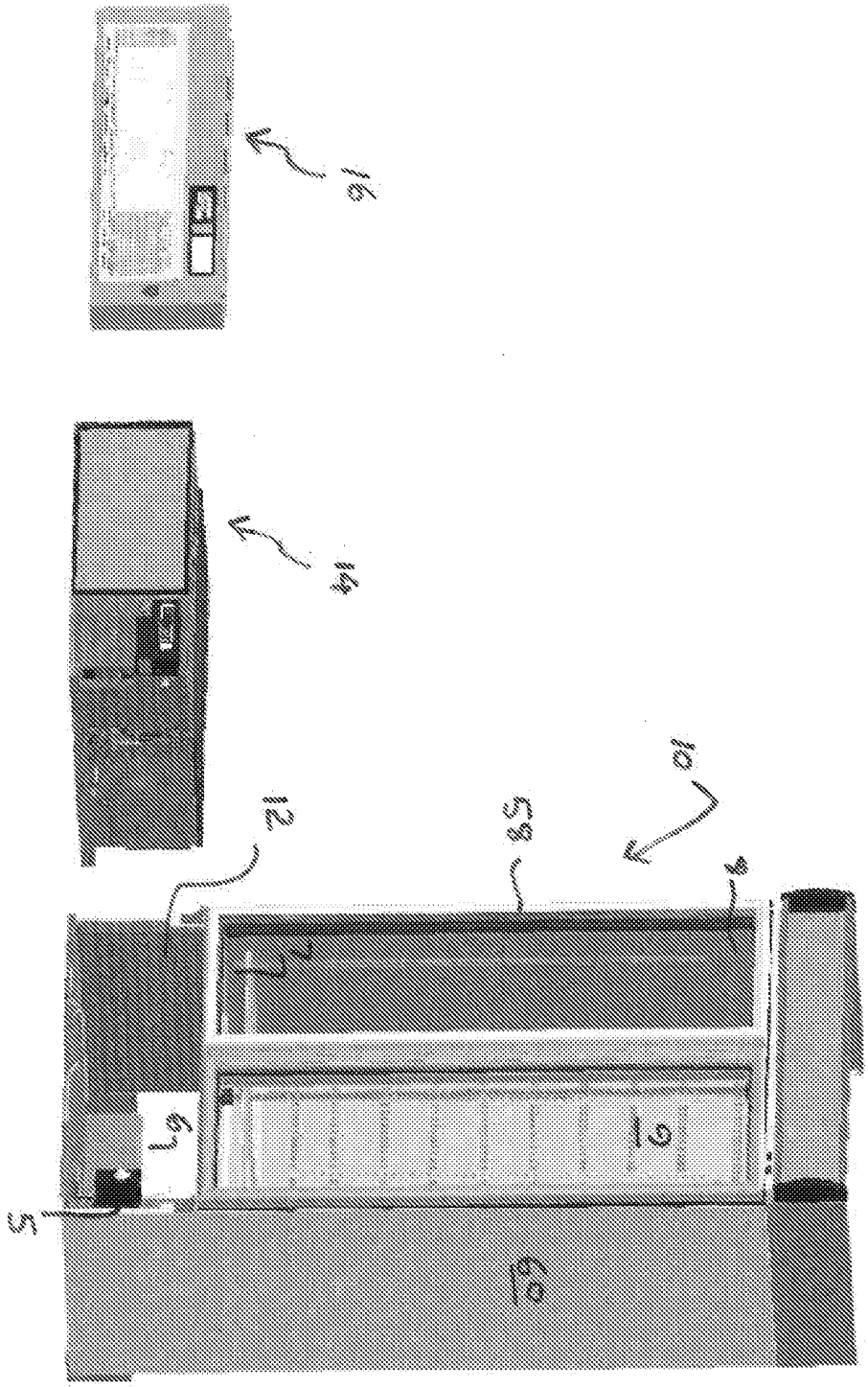
14. The refrigeration cabinet of claim 12 or claim 13, wherein a warmed air flow channel is defined between the inner right side wall of the cabinet and the right wall of the refrigeration package and a warmed air flow channel is defined between the inner left side wall of the cabinet and the left wall of the refrigeration package.

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15. The refrigeration cabinet of any one of claims 12 to 14, wherein warmed air is vented from the rear of the refrigeration package and is directed upwards along the rear wall of the cabinet.

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Fig. 1



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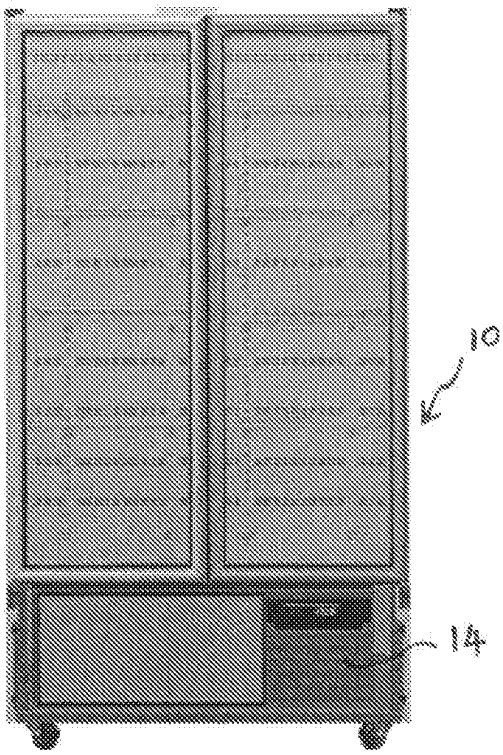


Fig. 2

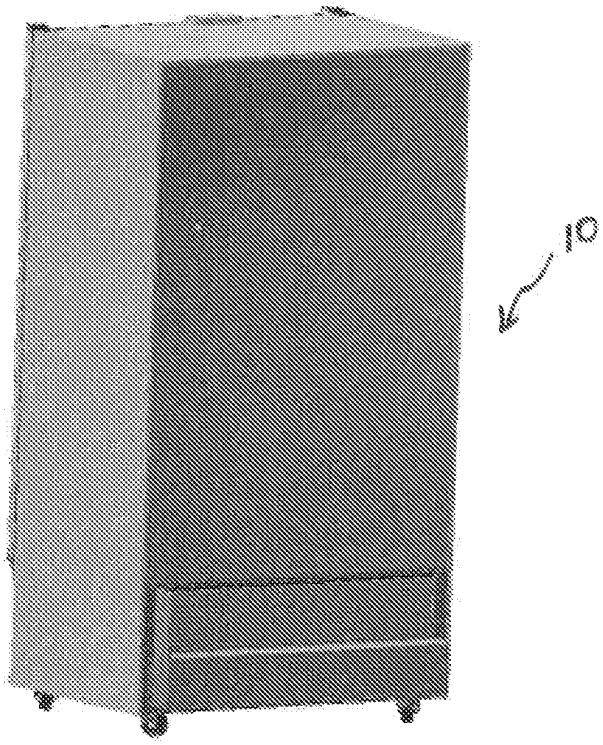


Fig. 3

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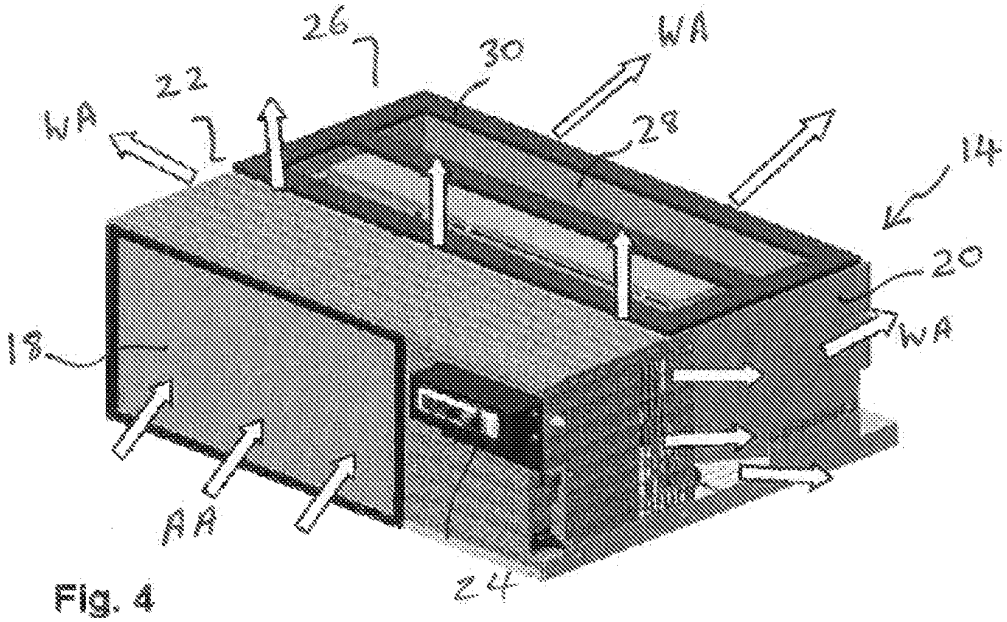


Fig. 4

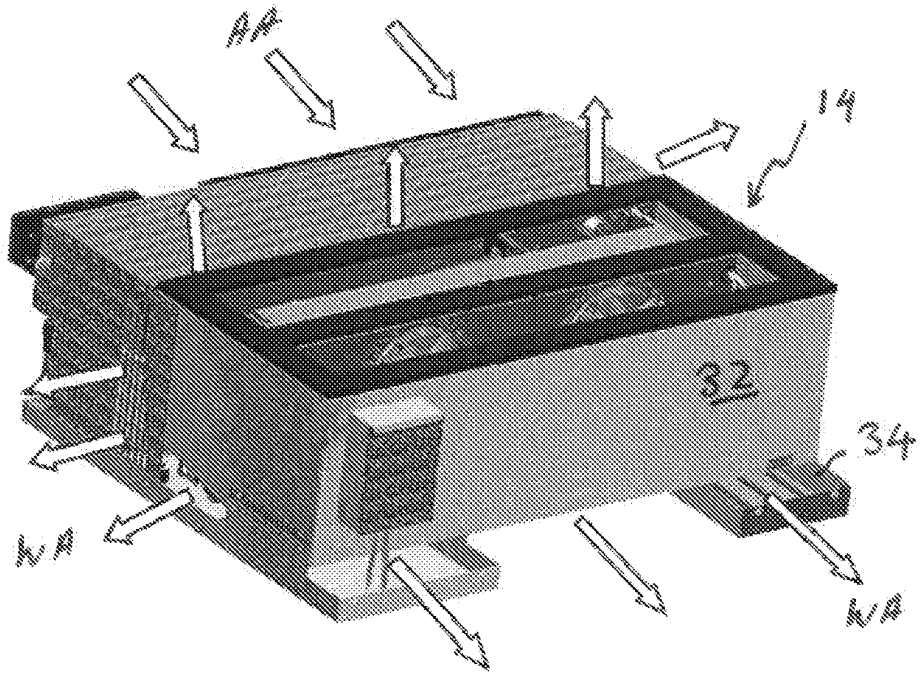


Fig. 5

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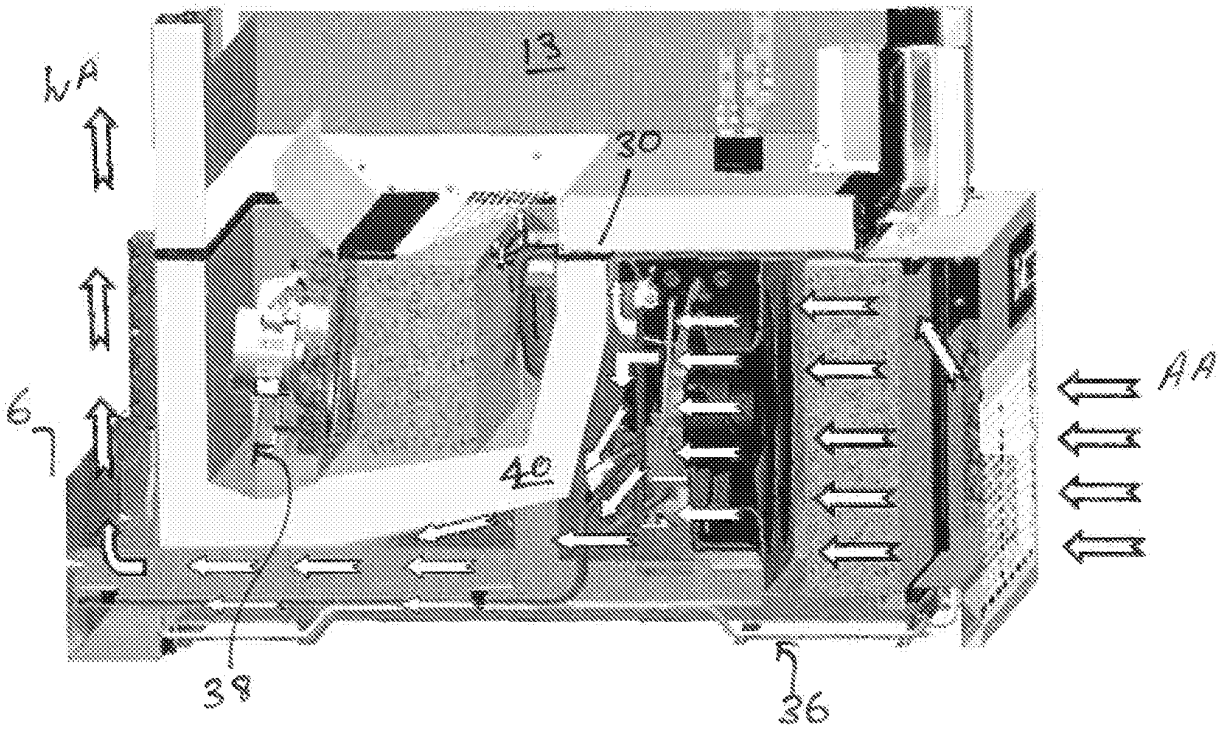


Fig. 6

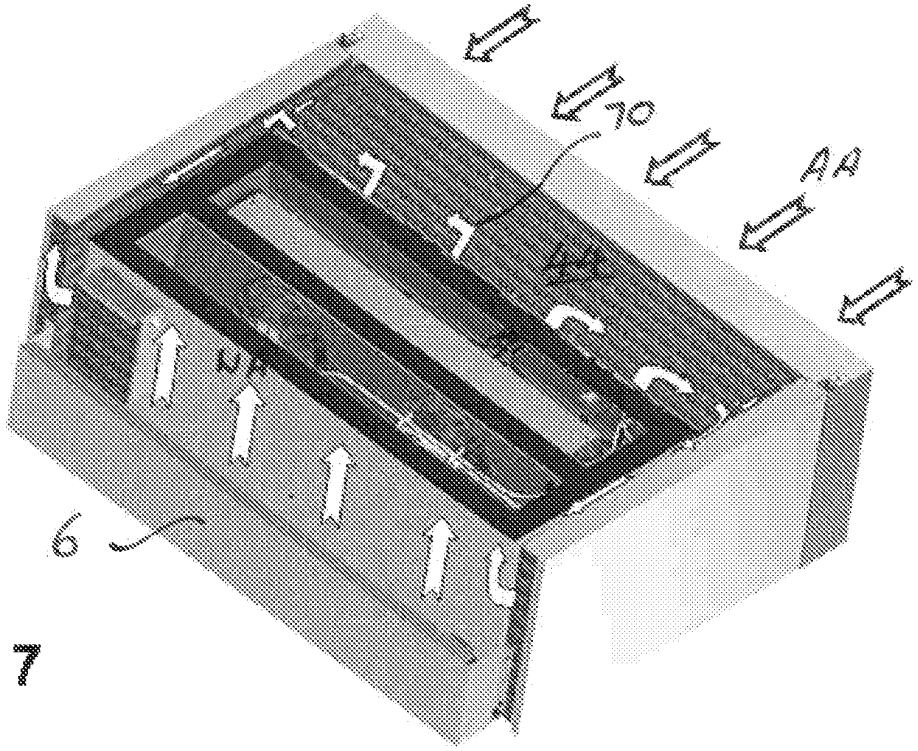


Fig. 7

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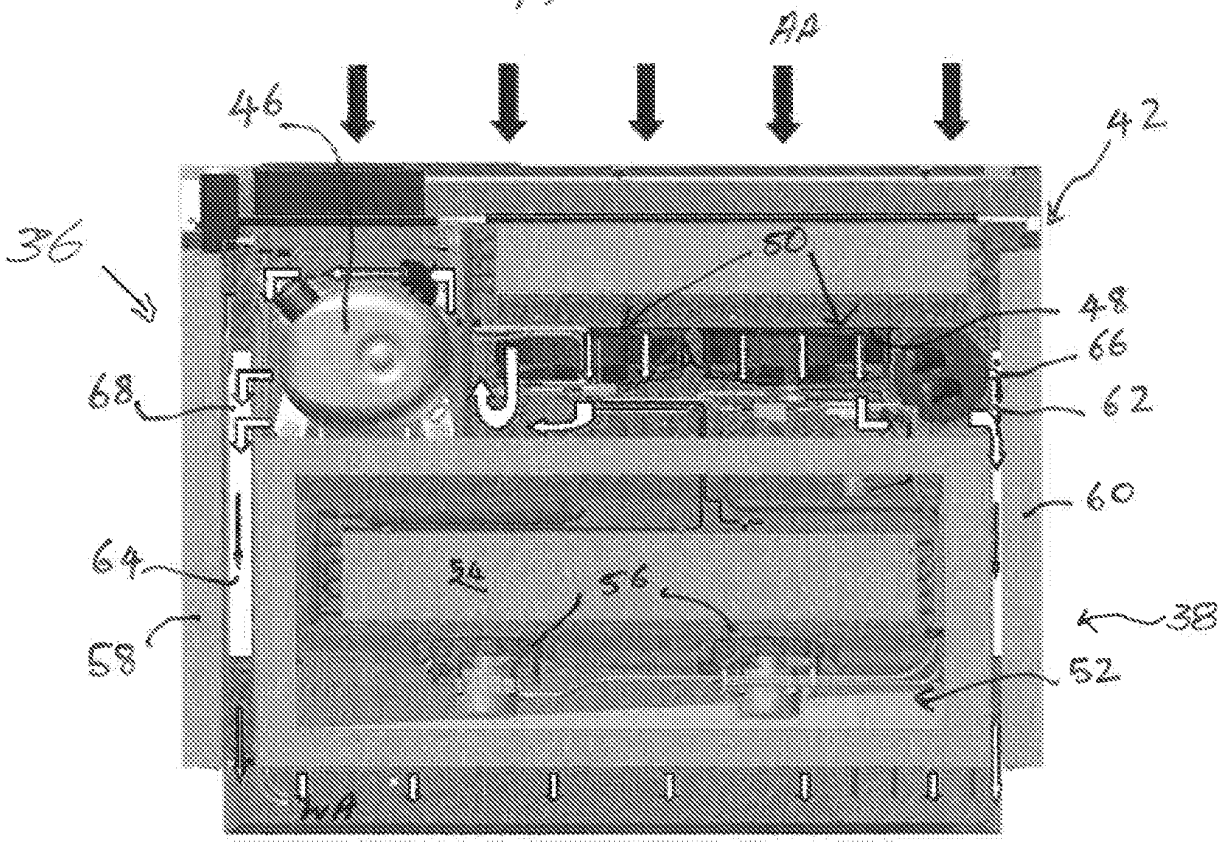


Fig. 8

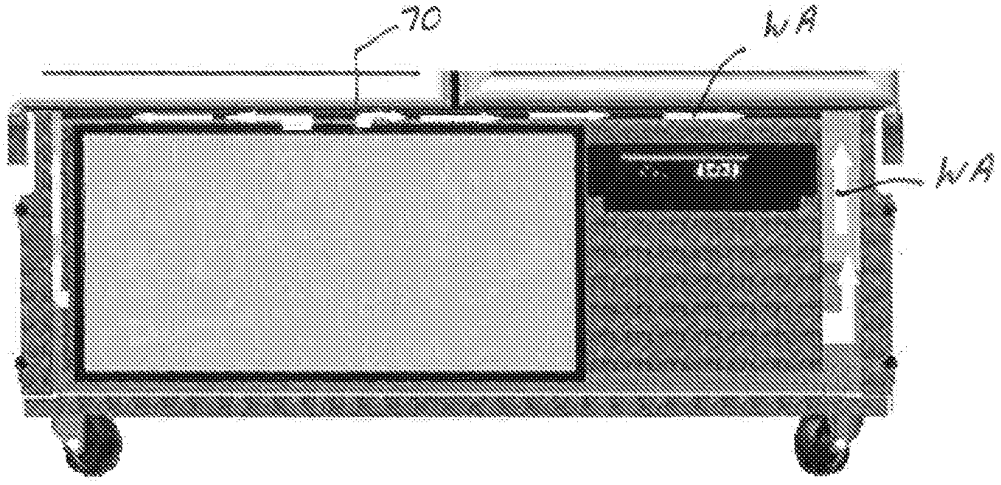


Fig. 9

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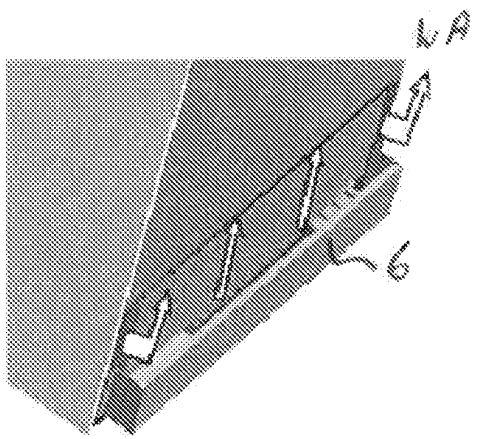


Fig. 10

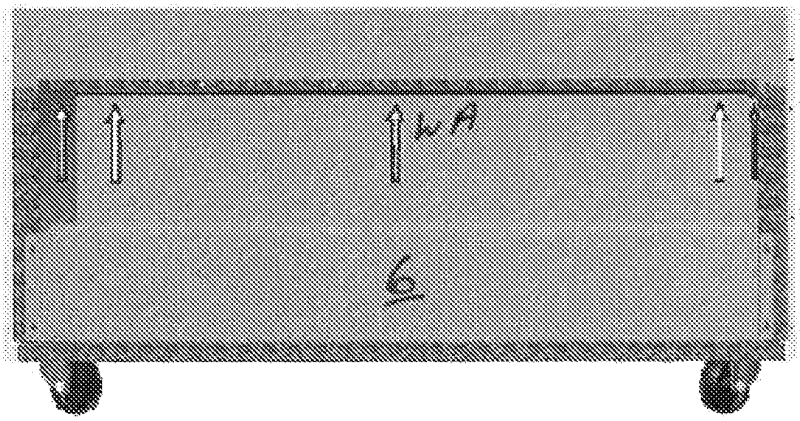


Fig. 11

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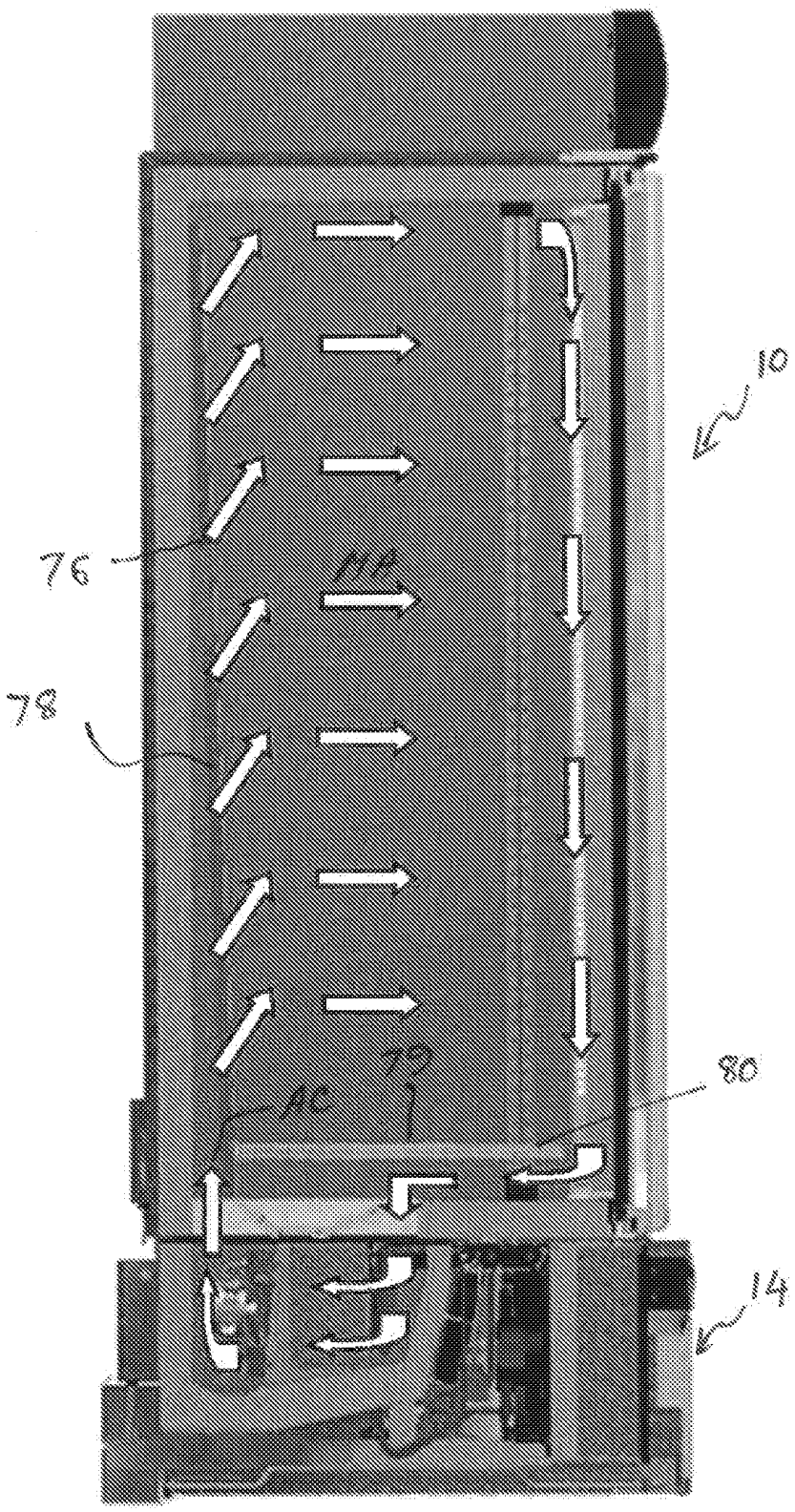


Fig. 12

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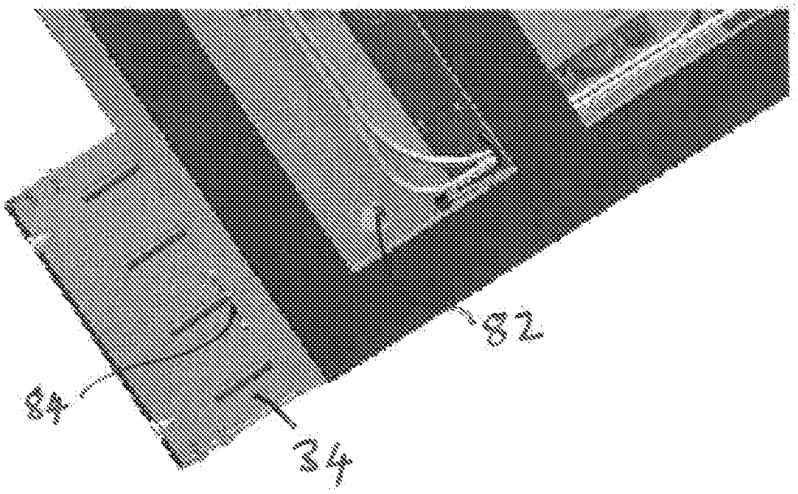


Fig. 13

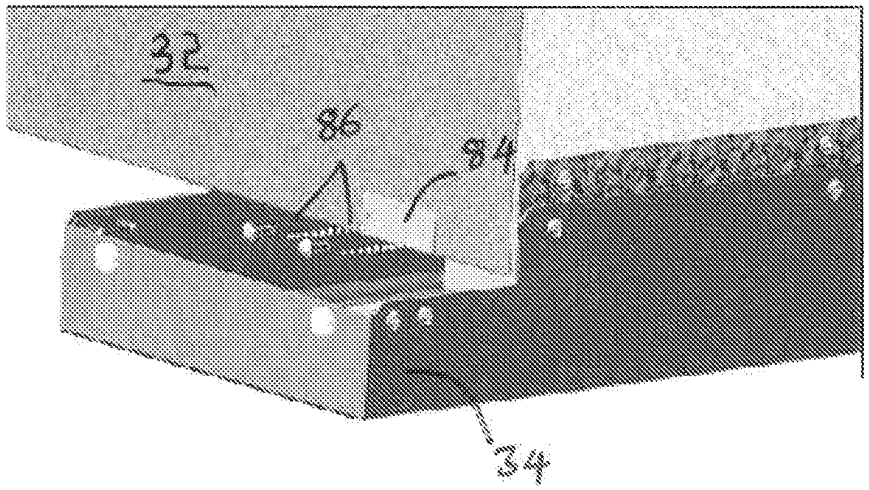


Fig. 14

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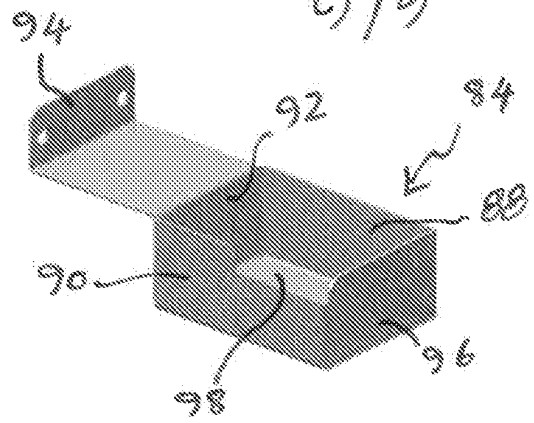


Fig. 15

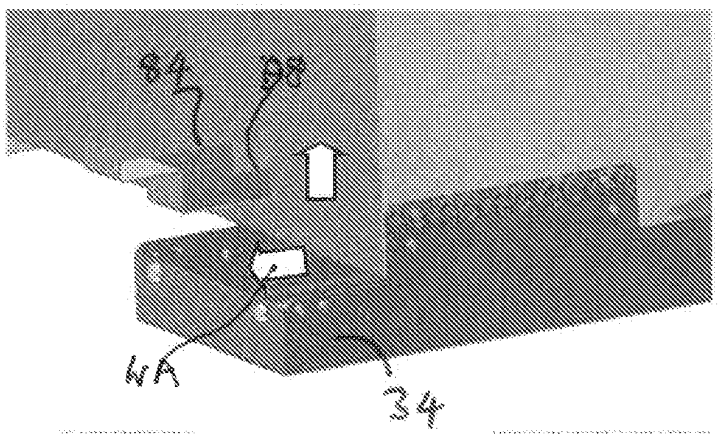


Fig. 16

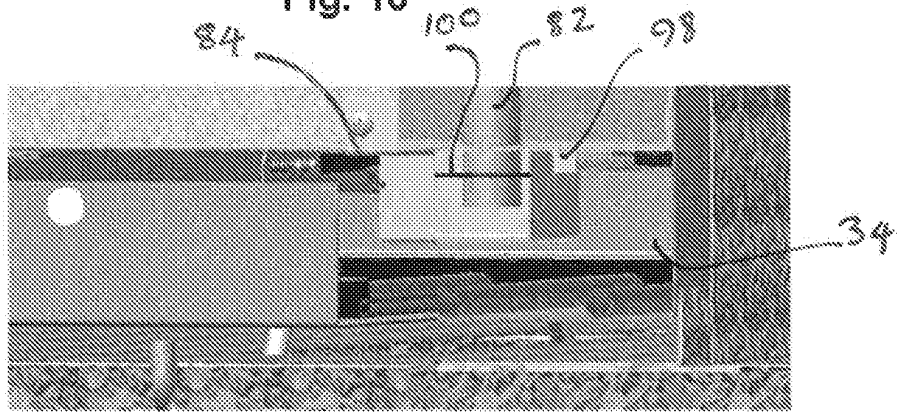


Fig. 17