US 20210003328A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2021/0003328 A1**

Iovanel (43) **Pub. Date: Jan. 7, 2021**

(54) **MODULAR REFRIGERATION SYSTEM**

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(21) Appl. No.: **17/027,934**

(22) Filed: **Sep. 22, 2020**

Related U.S. Application Data

(63) Continuation-in-part of application No. 14/999,763, filed on Jun. 23, 2016.

Publication Classification

(51) **Int. Cl.**

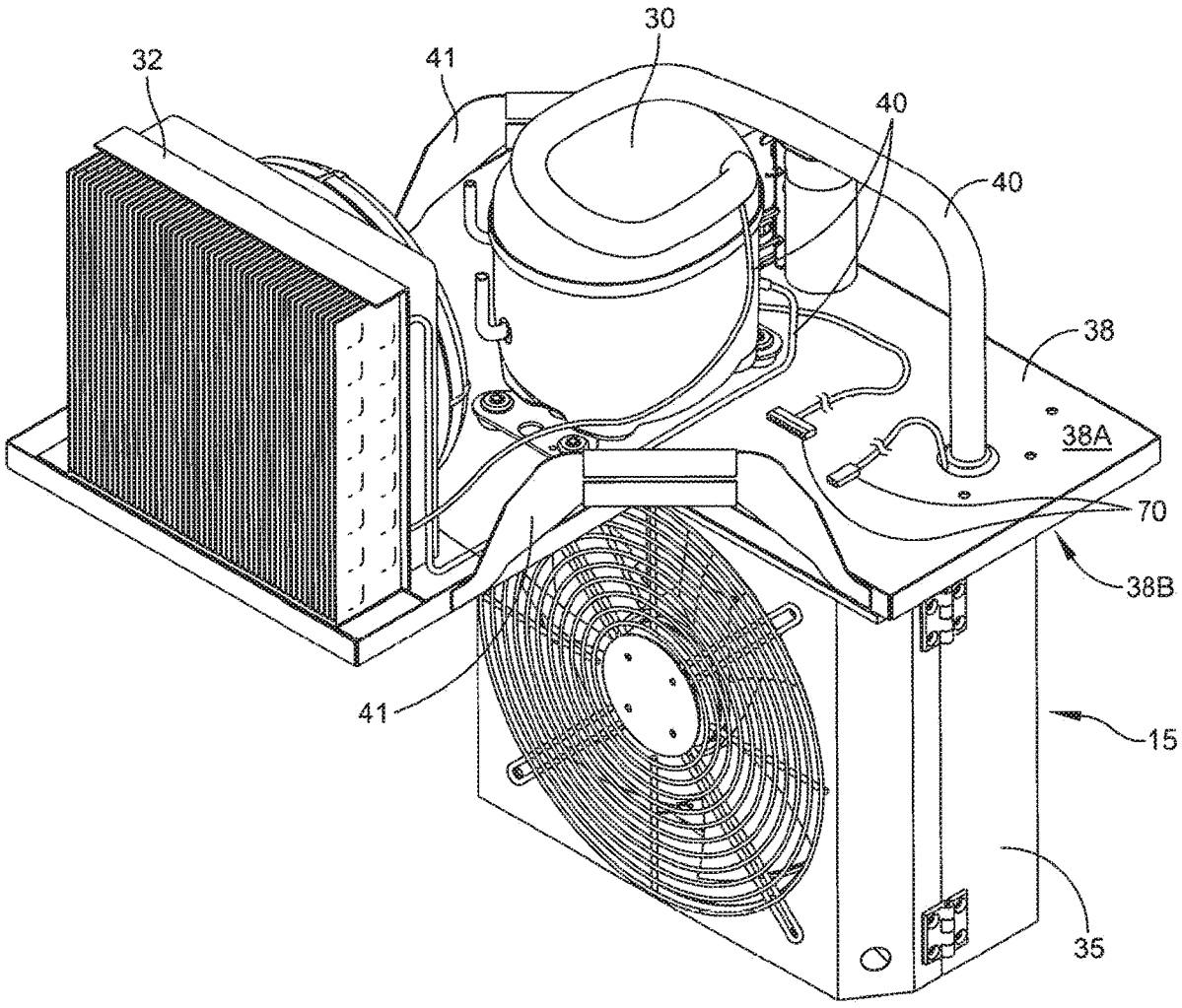
F25B 41/00	(2006.01)
F25B 39/00	(2006.01)

(52) **U.S. Cl.**

CPC ***F25B 41/003*** (2013.01); *F25B 2400/21* (2013.01); ***F25B 39/00*** (2013.01)

(57) **ABSTRACT**

Various aspects of the present disclosure are directed toward refrigeration apparatuses, systems, and methods that include a housing and a cabinet arranged within the housing and including an opening configured to operate as a cooling or freezing space. The refrigeration apparatuses, systems, and methods may include a modular refrigeration assembly including a condenser assembly, a compressor, and an evaporator, the modular refrigeration assembly being configured to arrange the evaporator within the cabinet and arrange the condenser assembly and compressor within the housing and external to the cabinet and one or more conduits arranged between the condenser assembly, the compressor, and the evaporator forming a closed loop system configured to contain refrigerant.



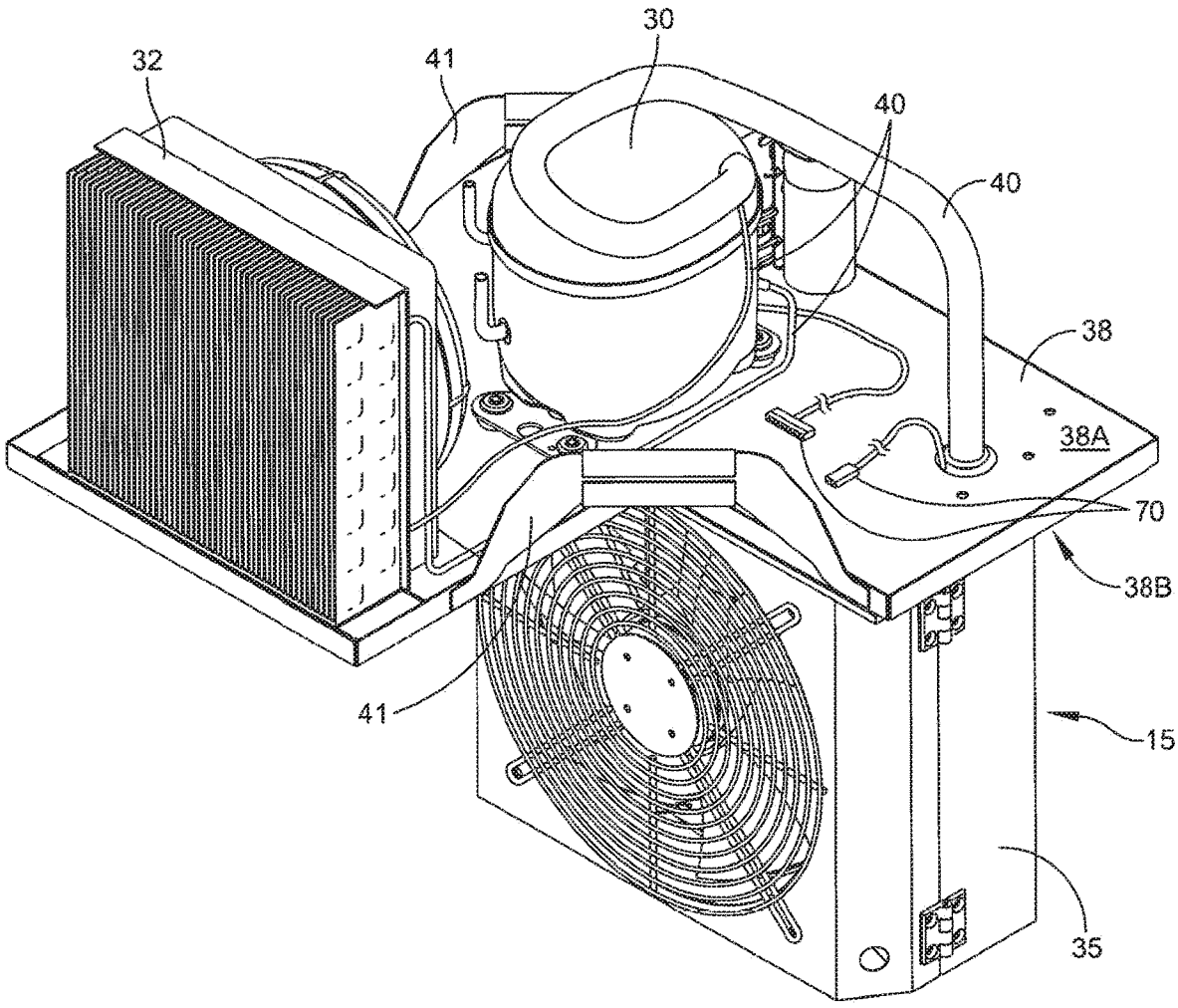


FIG. 1

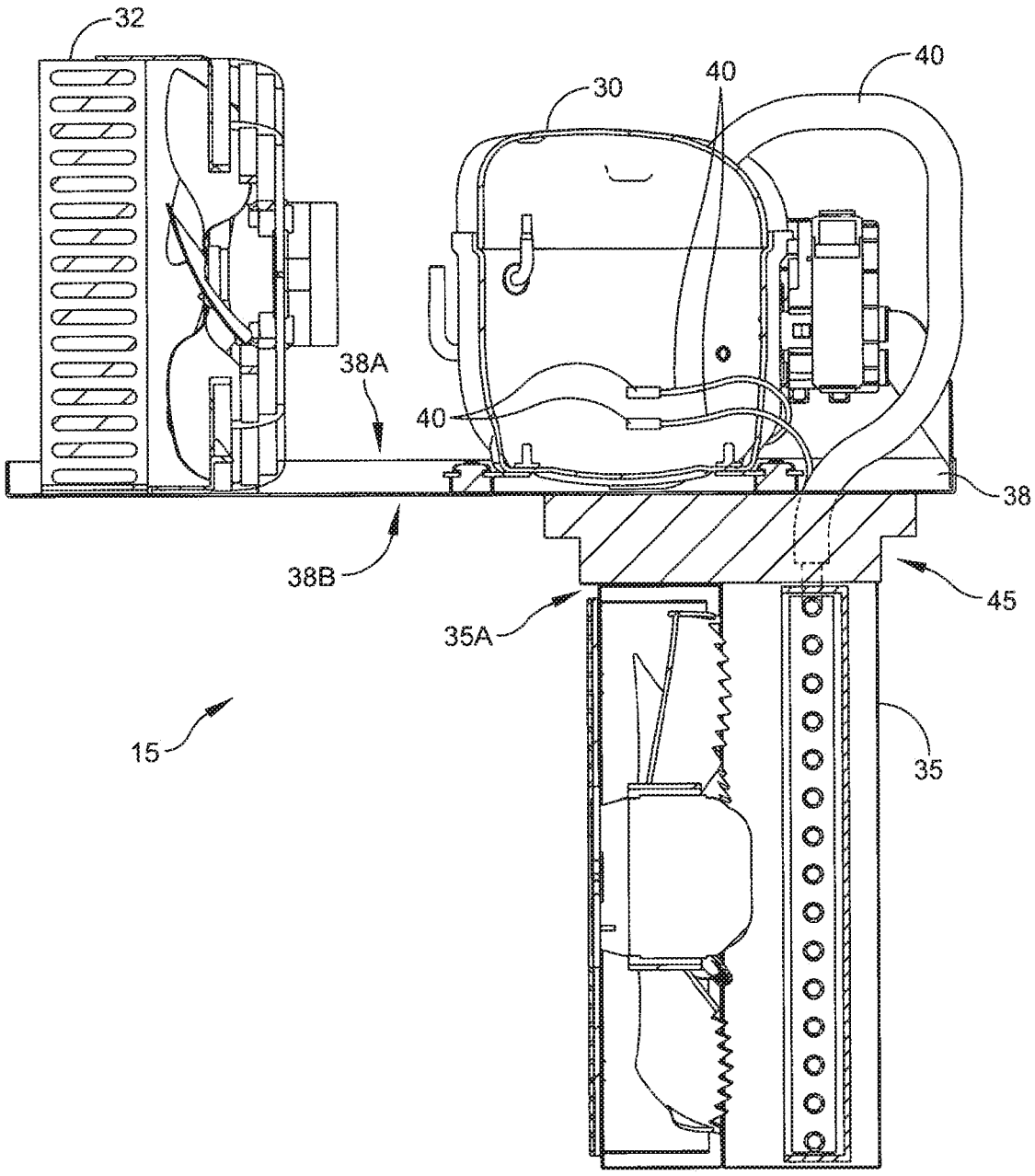


FIG. 2

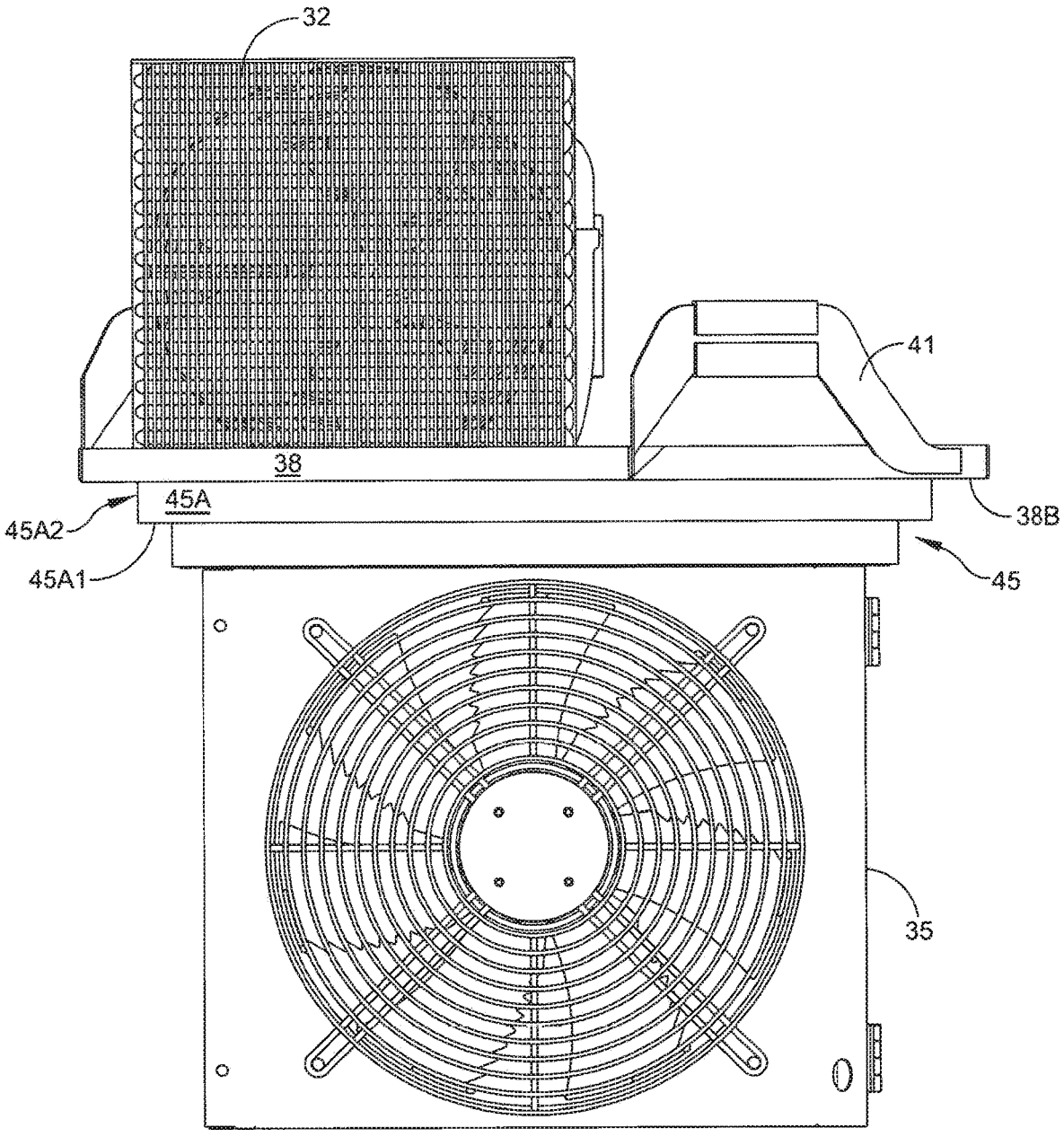


FIG. 3

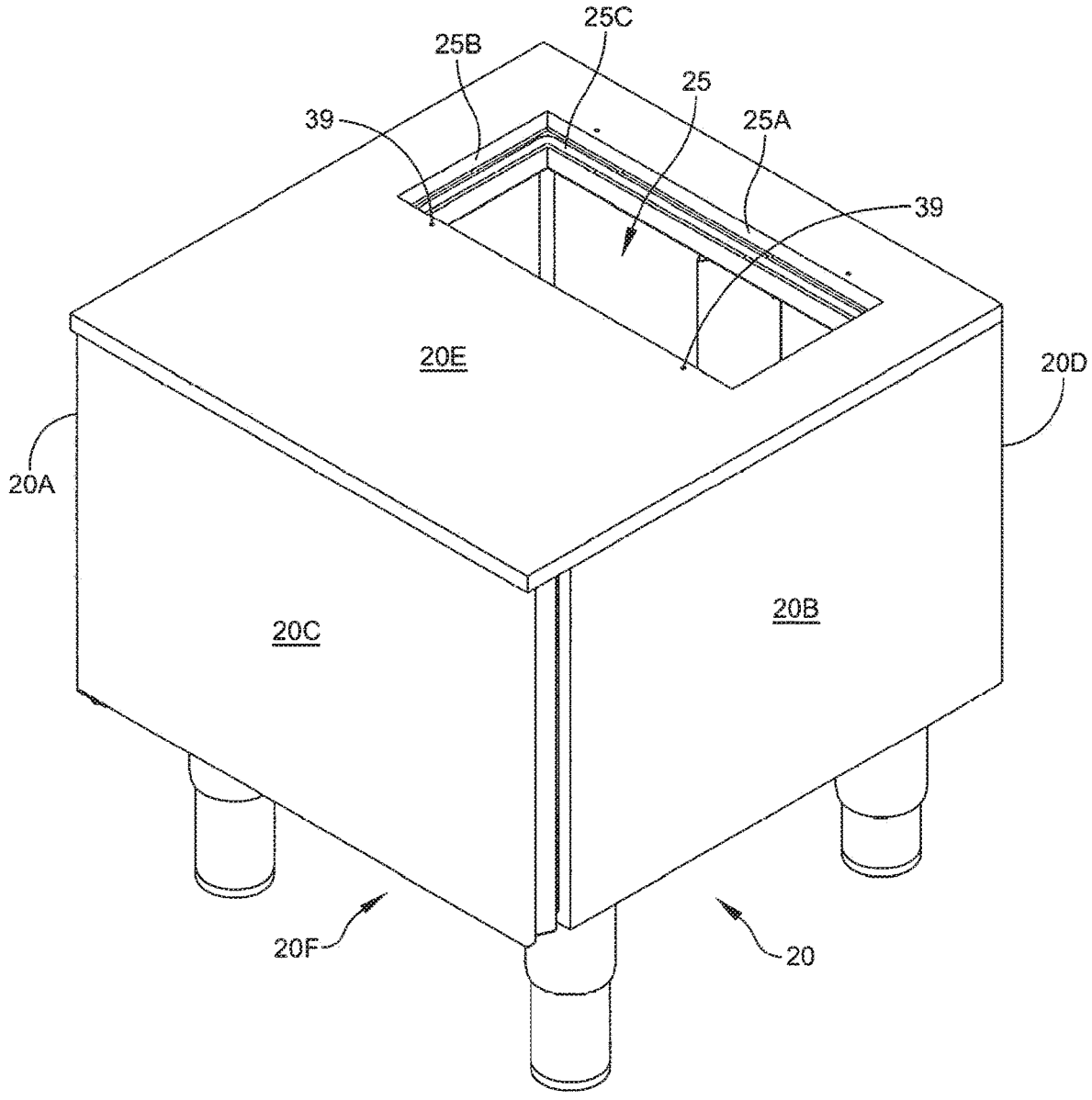


FIG. 4

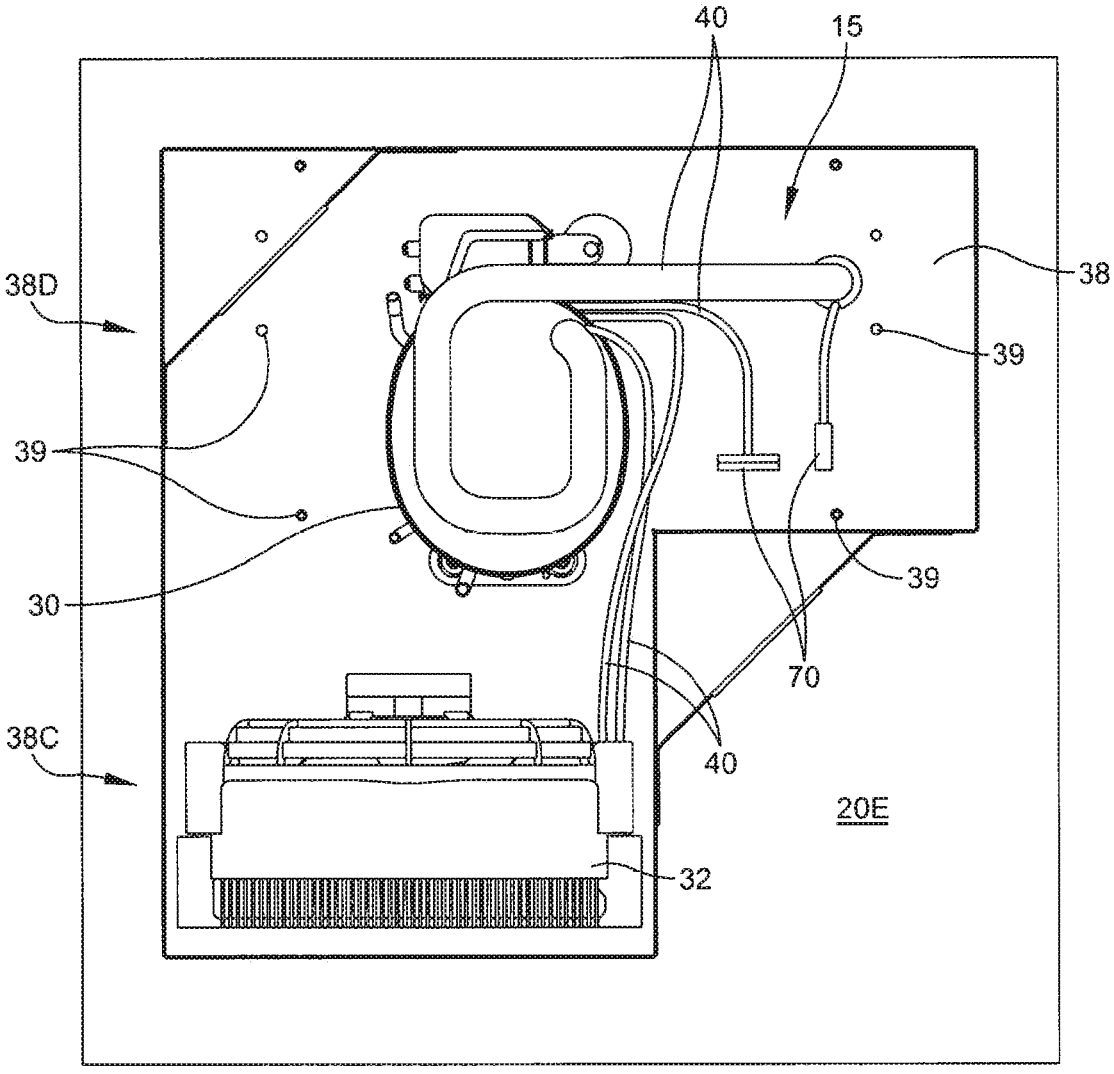


FIG. 5

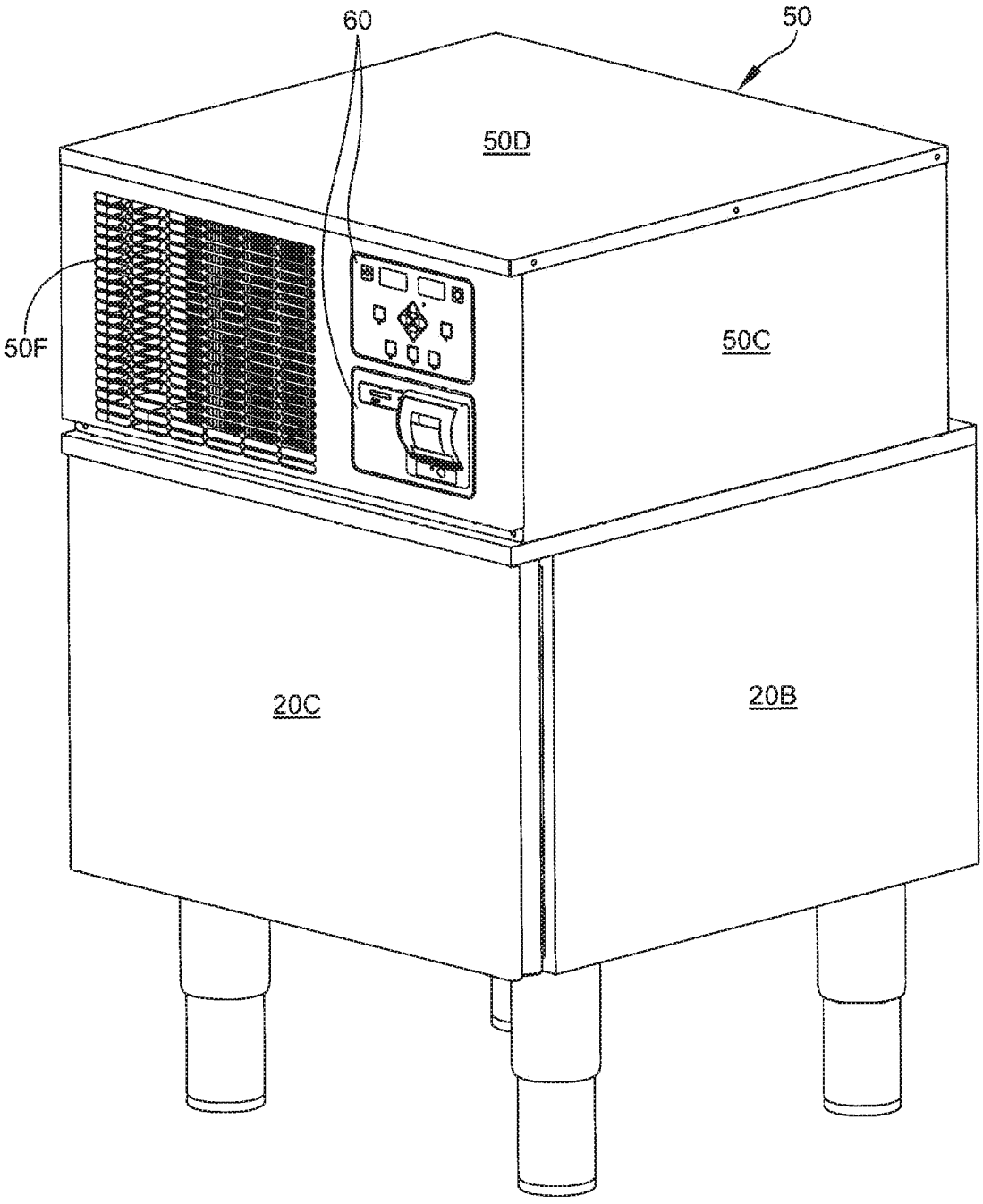


FIG. 6

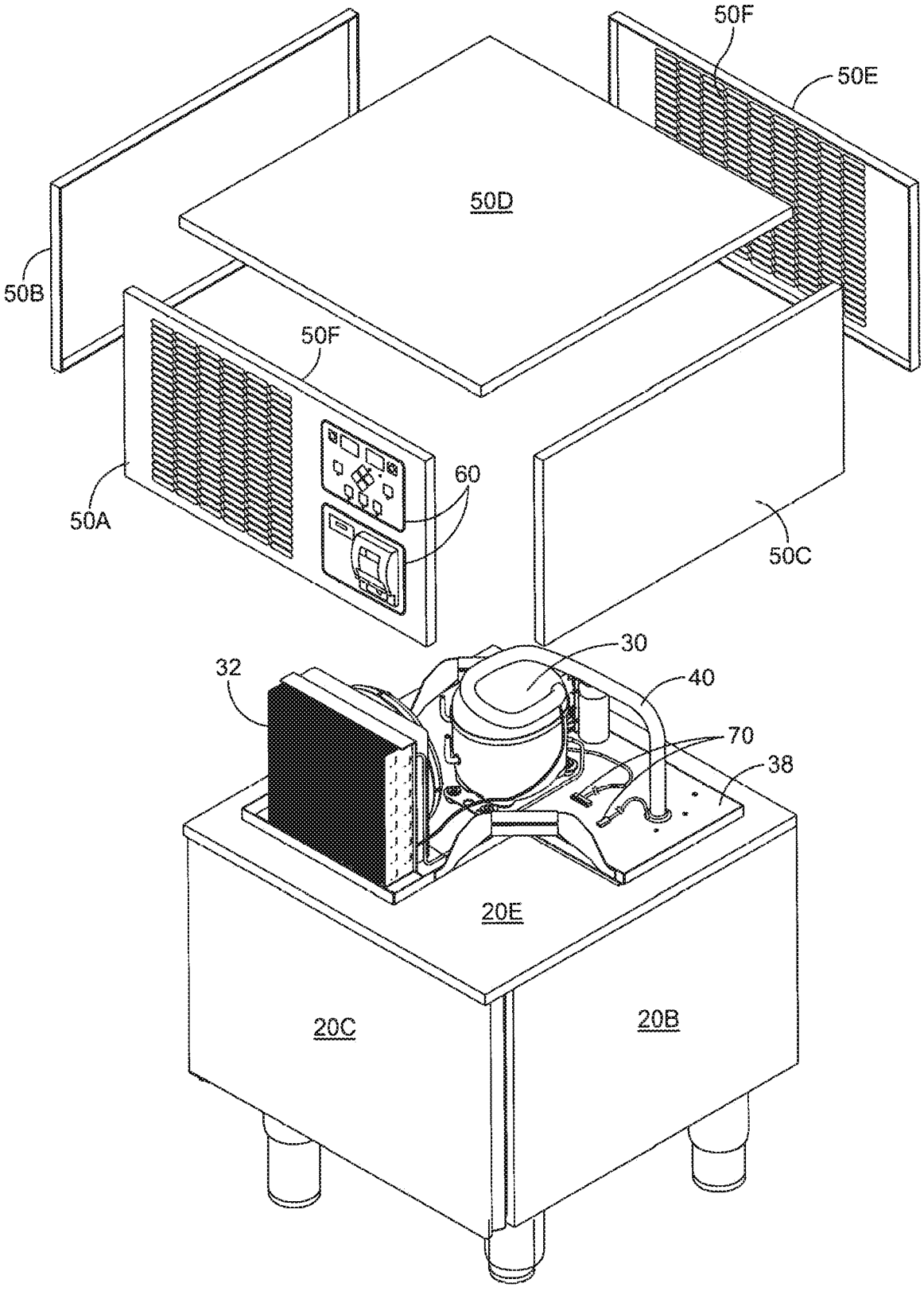


FIG. 7

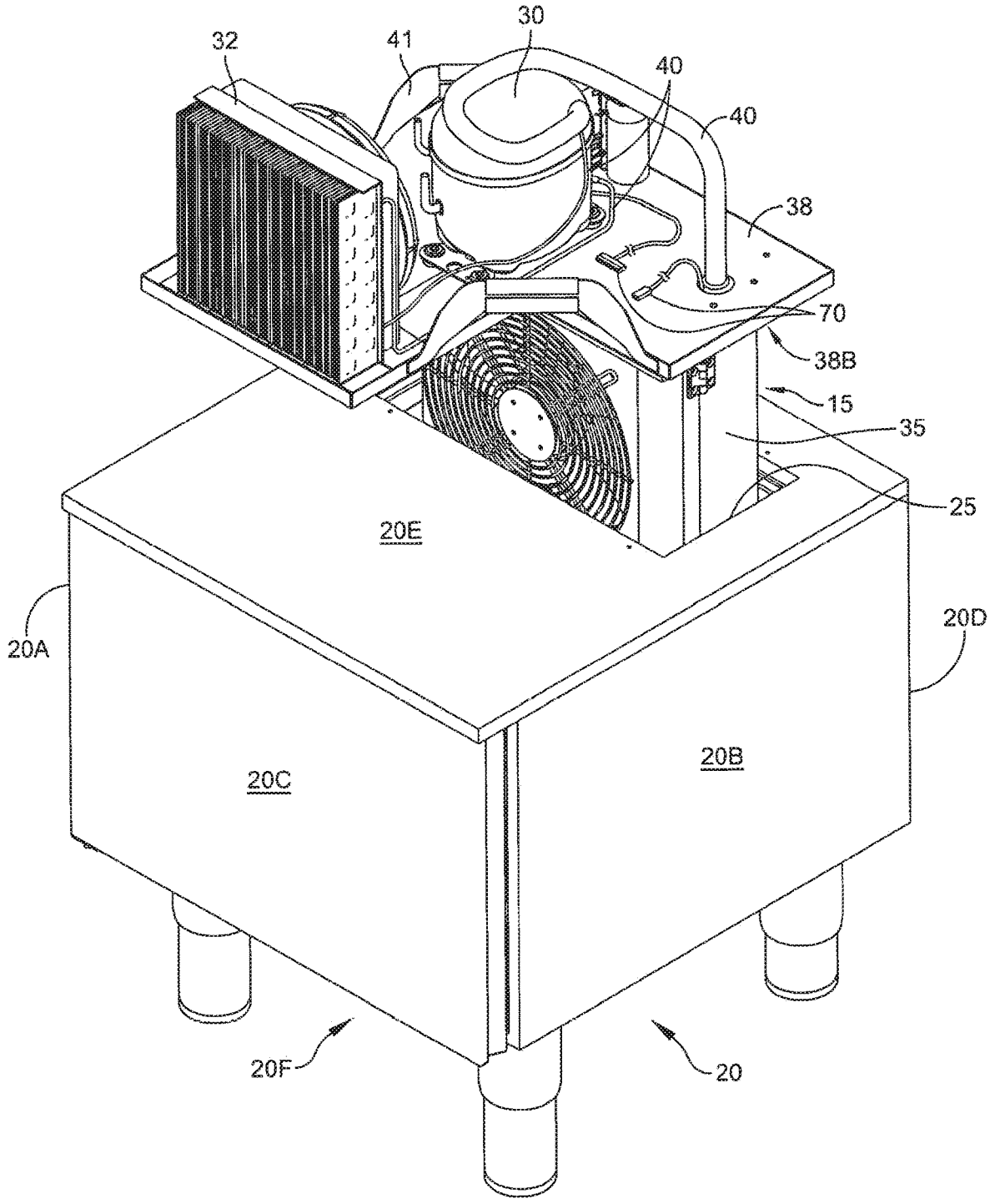


FIG. 8

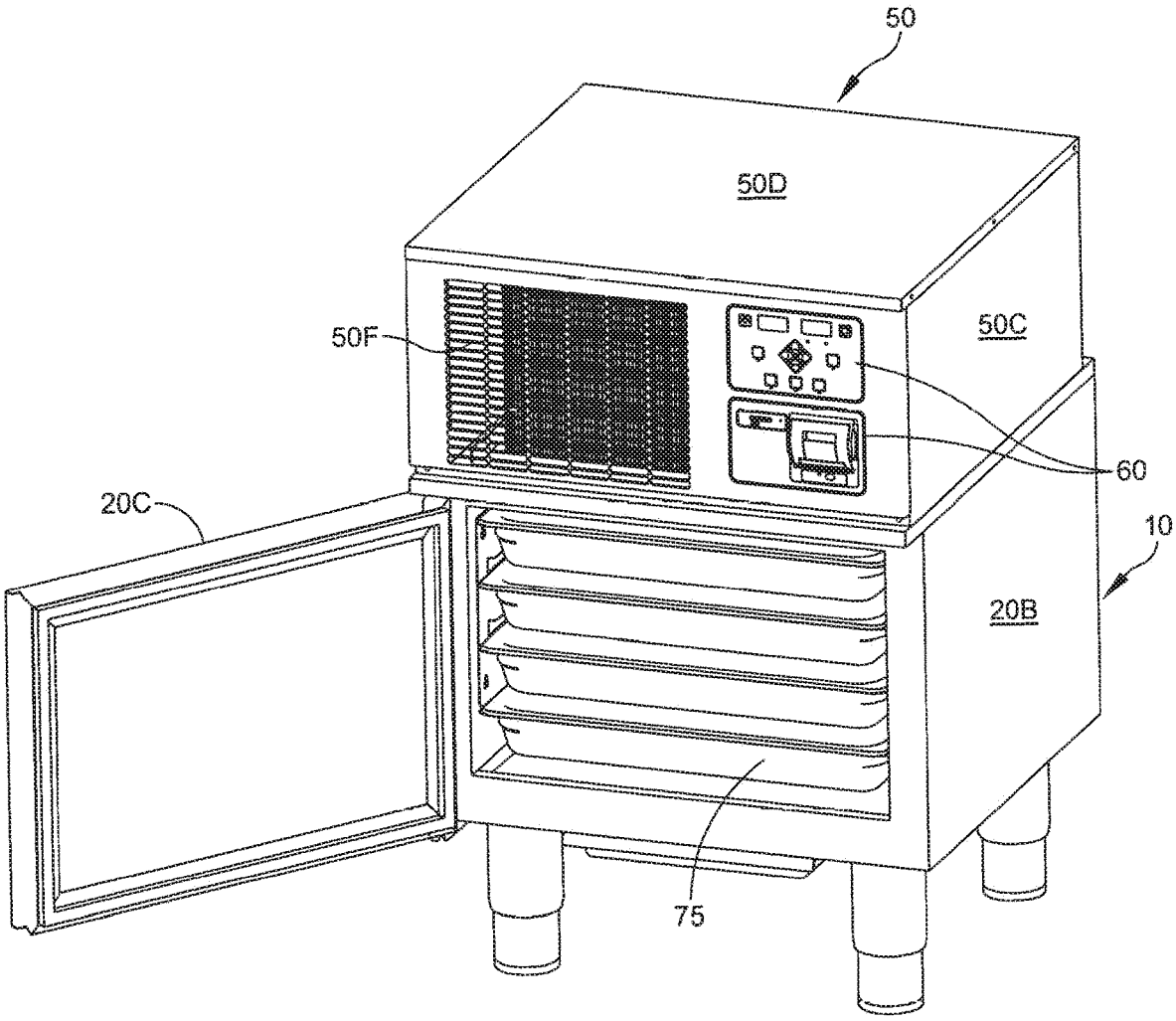


FIG. 9

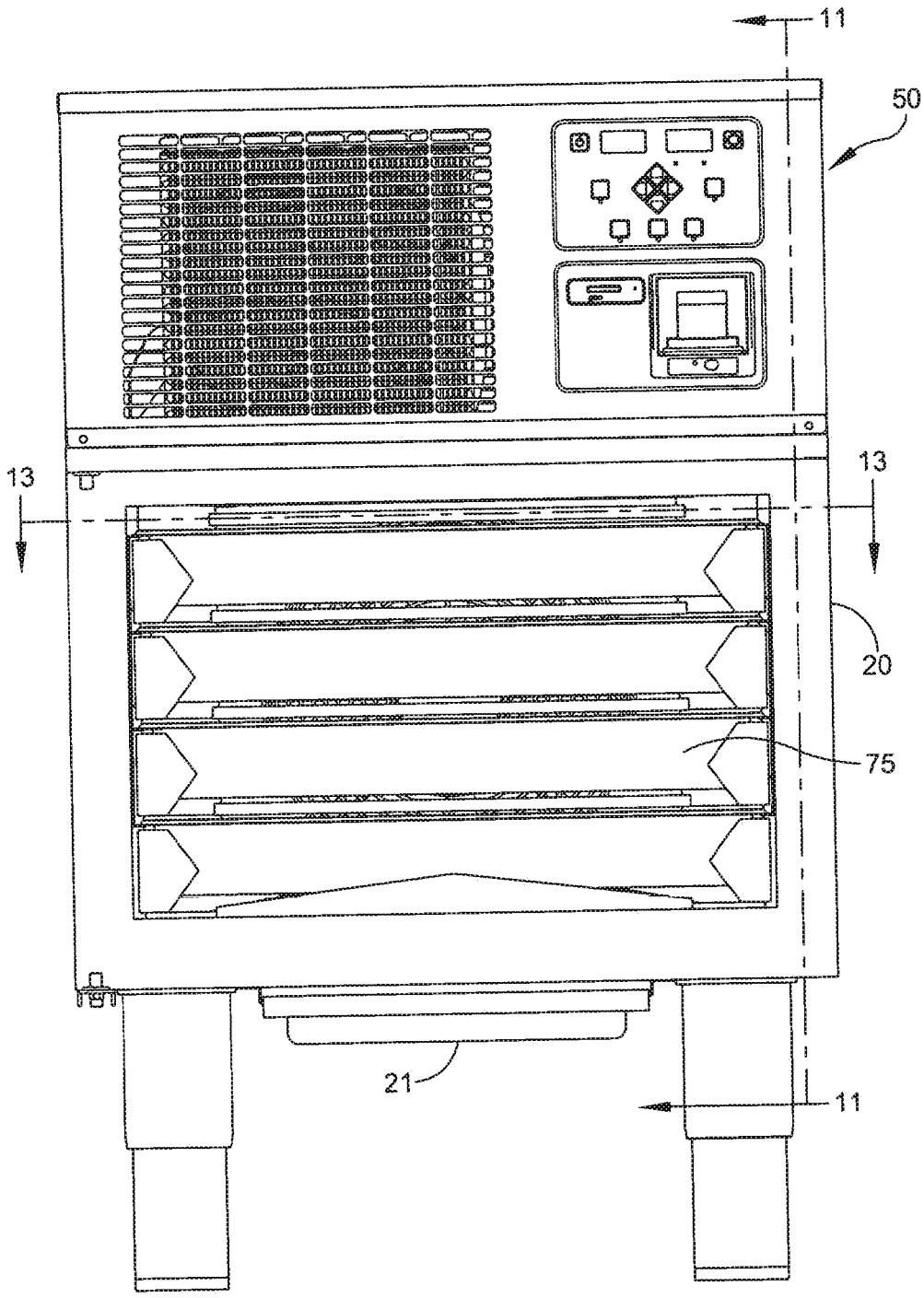


FIG. 10

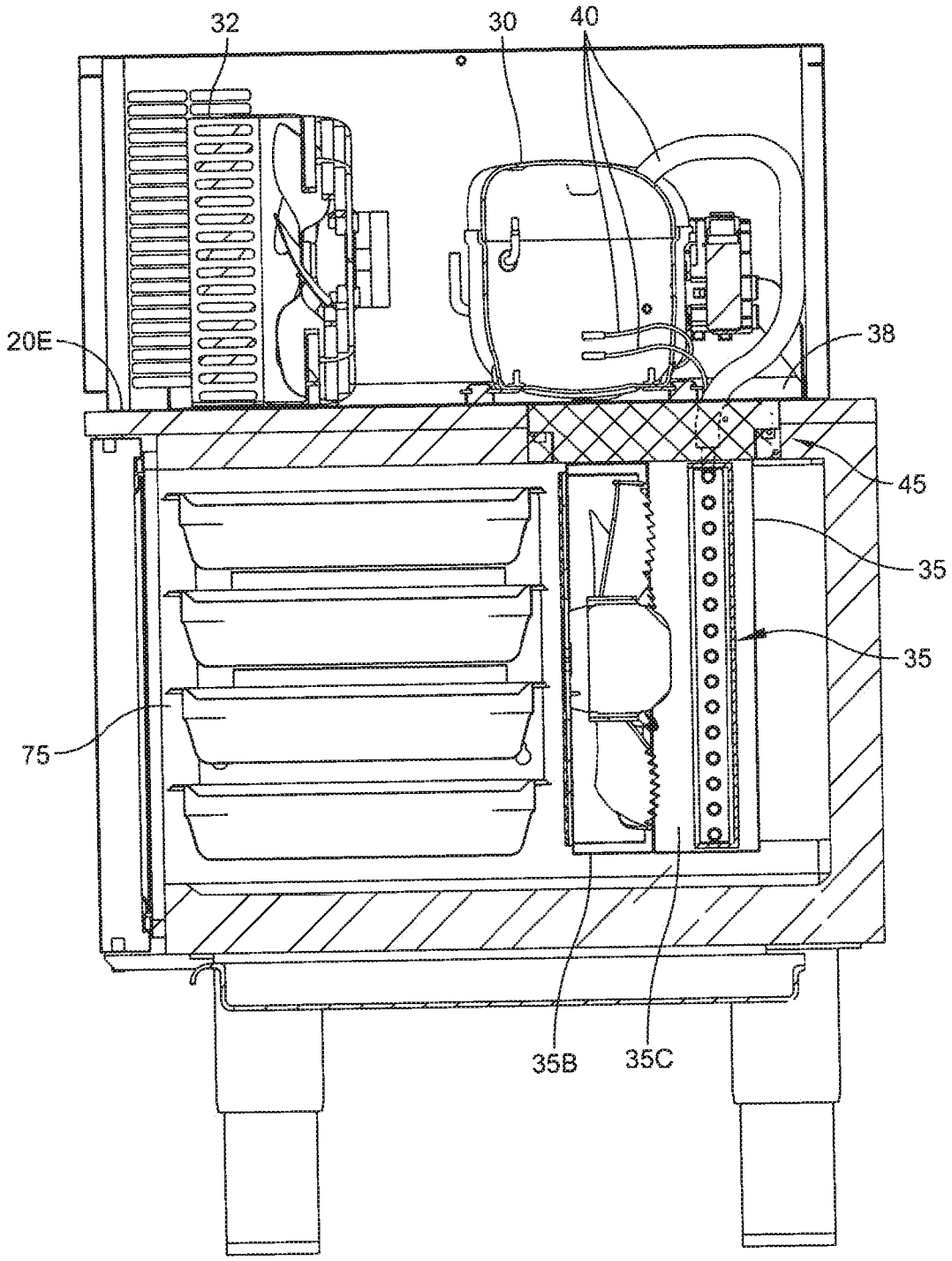


FIG. 11

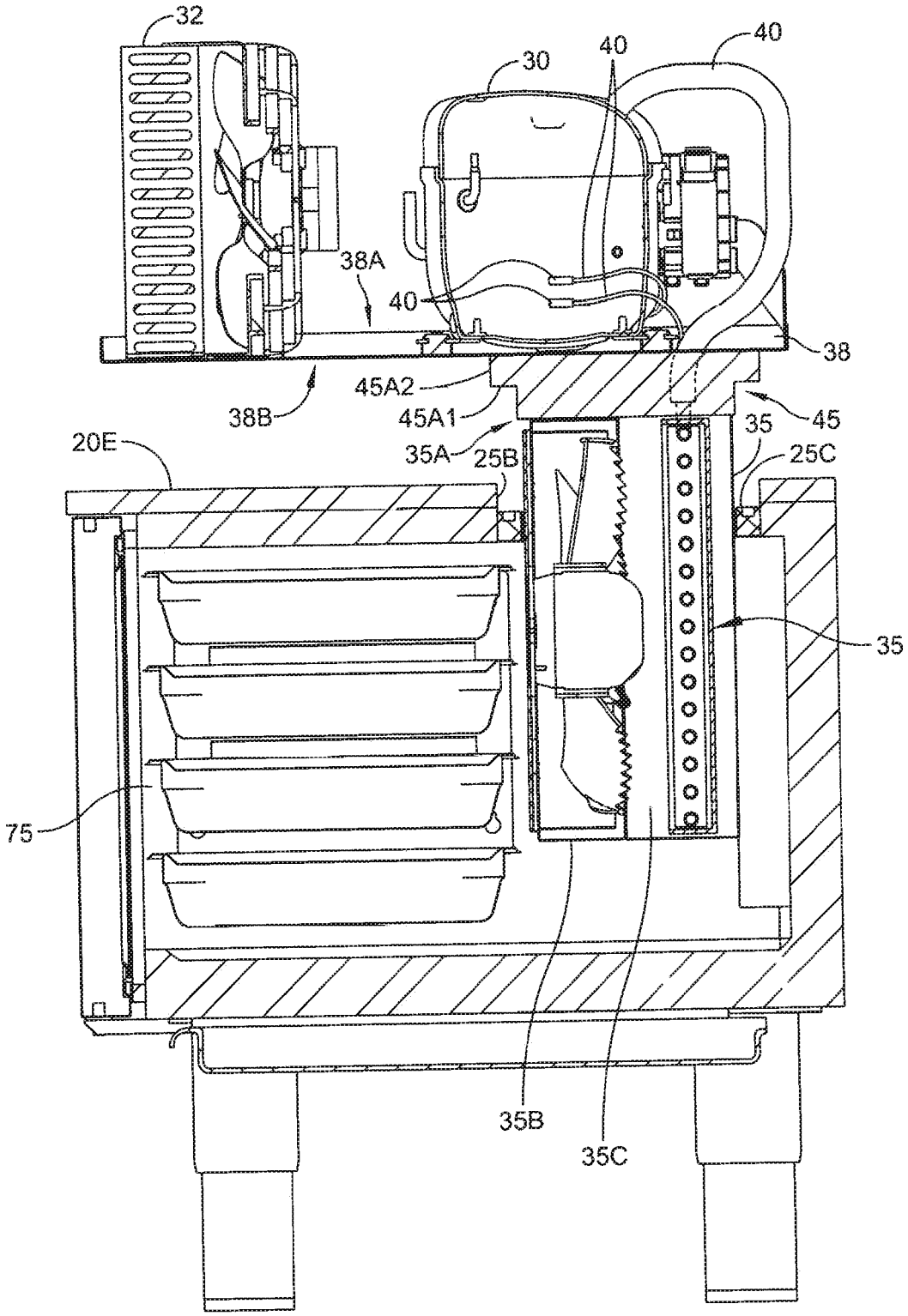

32
30
40
40
38A
40
38
38B
45A2
45A1
45
35
35A
25B
25C
20E
35
75
35B
35C

FIG. 12

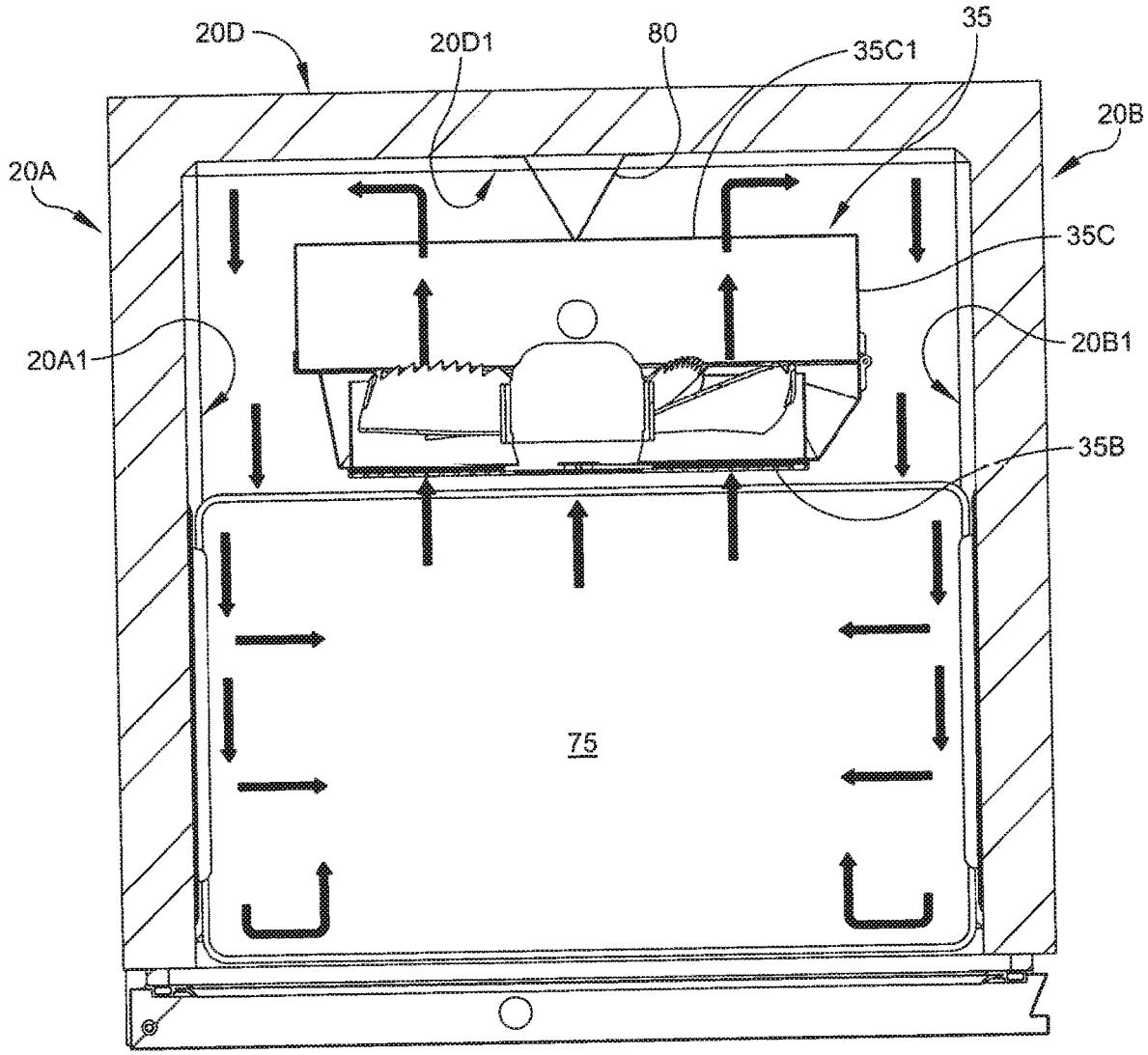


FIG. 13

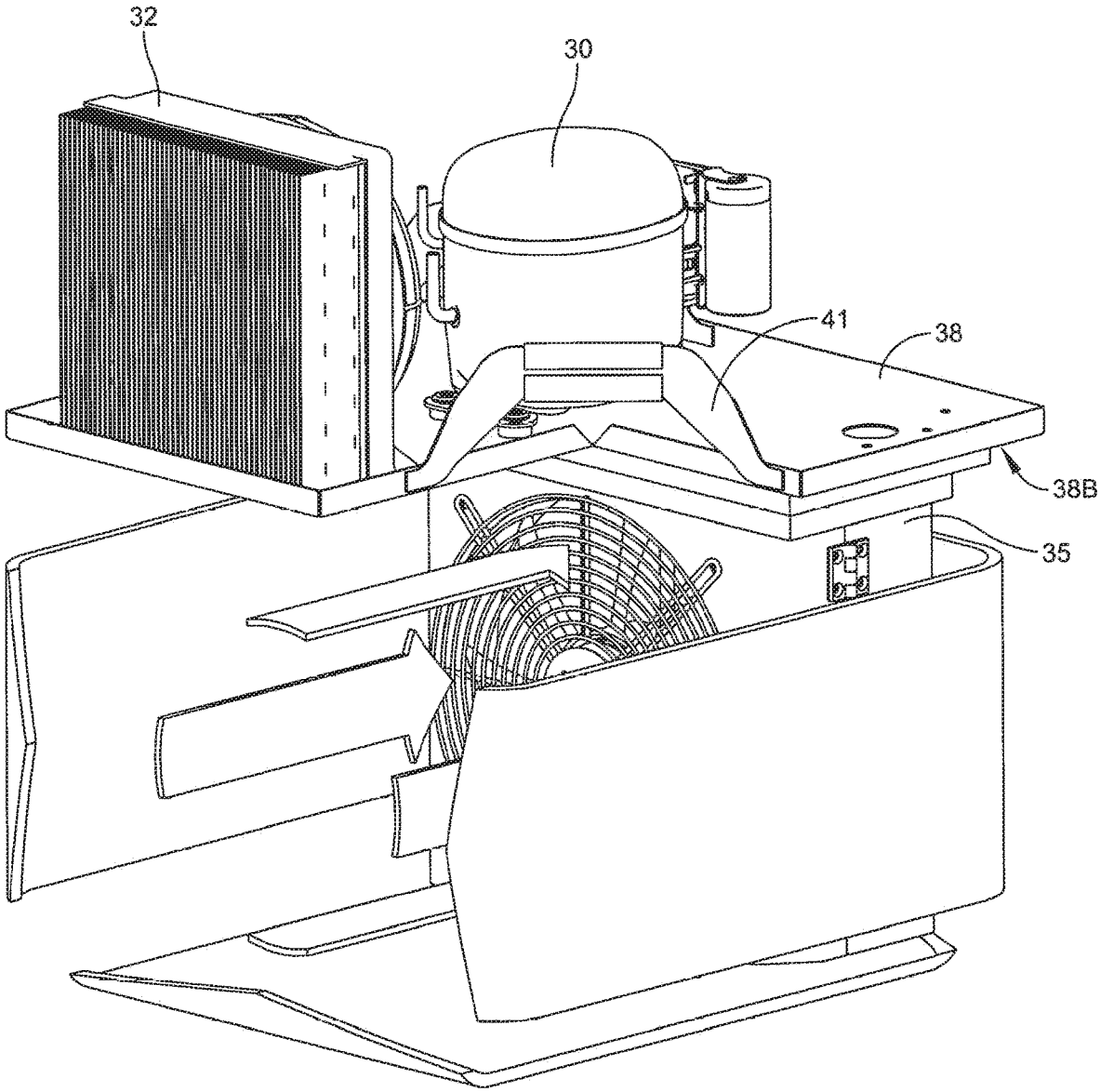


FIG. 14

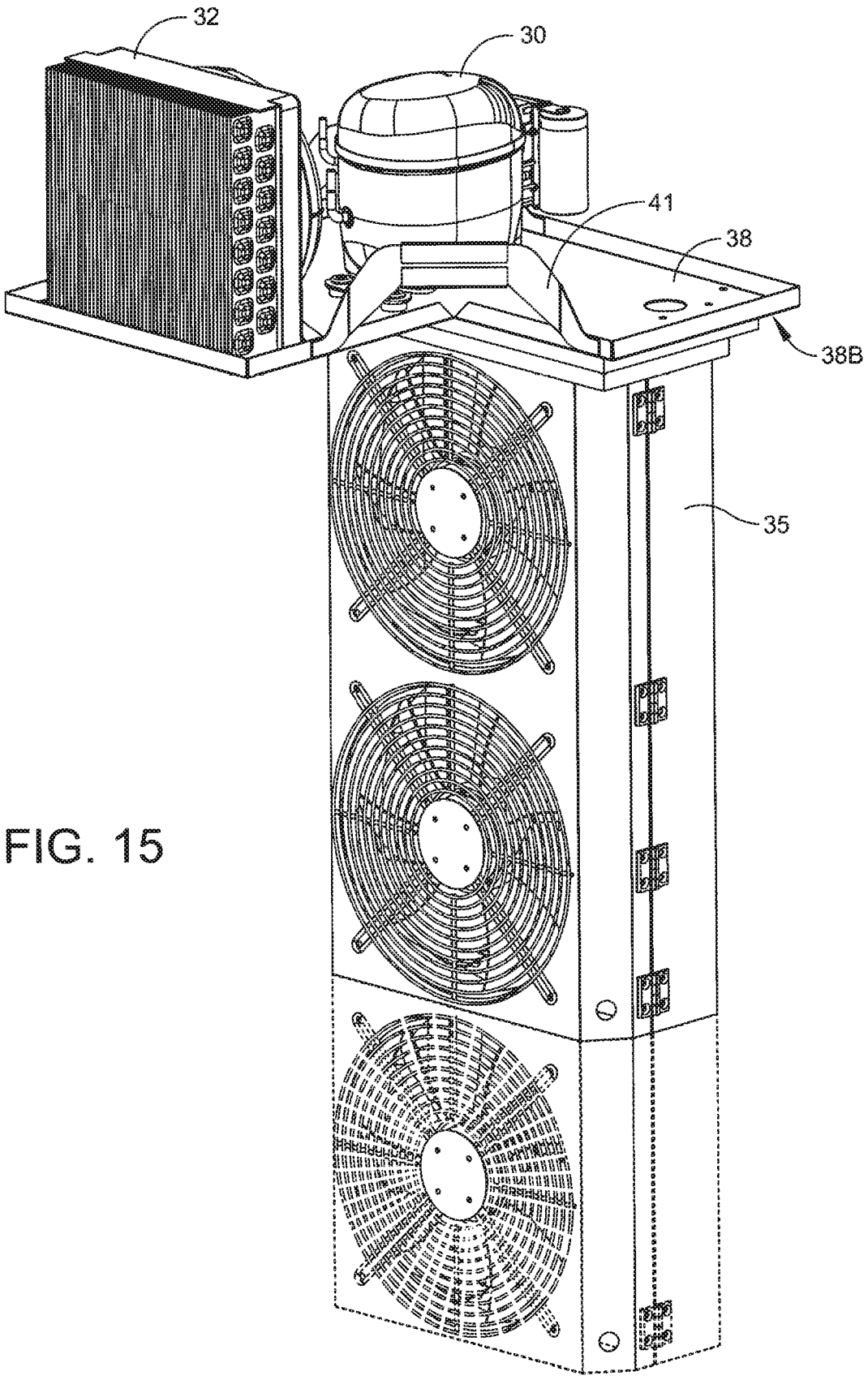


FIG. 15

MODULAR REFRIGERATION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation-in-part of U.S. patent application Ser. No. 14/999,763, filed Jun. 23, 2019, which is incorporated herein by reference in its entirety for all purposes.

FIELD

[0002] The present invention related generally to a refrigeration system having modular components for ease of servicing and installation. More particularly, the refrigeration system may be environmentally friendly and efficient.

BACKGROUND

[0003] Refrigeration appliances are generally provided with a refrigeration system to cool the interior of the refrigerator enclosure. Refrigeration systems may include a compressor, evaporator, condenser, and expansion device connected by a plurality of conduits. The system also includes control electronics for operation of the system. Some refrigeration appliances include a refrigeration system having the components thereof individually mounted within the appliance. In the case of failure of one of the components, the malfunctioning component must be replaced. In order to repair the system, the refrigerant charge in the failed component and the conduits interconnecting the component to the system must be removed. The component is replaced via a welding process, and the system is then recharged with refrigerant then leak checked.

[0004] A problem with this type of system is that if the component is replaced on site, the repair could be time consuming and messy, and require a substantial amount of equipment to be brought to the job site to effect the repair. If the entire refrigeration appliance is taken off-site to be repaired, the time necessary to complete the repair and return the appliance may be substantial. The cost of the repair and travel time may also significant.

SUMMARY

[0005] In Example 1, a refrigeration system includes a housing; a cabinet arranged within the housing and including an opening configured to operate as a cooling or freezing space; a modular refrigeration assembly including a condenser assembly, a compressor, and an evaporator, the modular refrigeration assembly being configured to arrange the evaporator within the cabinet and arrange the condenser assembly and compressor within the housing and external to the cabinet; and one or more conduits arranged between the condenser assembly, the compressor, and the evaporator forming a closed loop system configured to contain refrigerant.

[0006] In Example 2, further to the refrigeration system of Example 1, the one or more conduits are configured to contain the refrigerant and facilitate temperature control within the modular refrigeration assembly free of a refrigerant reservoir.

[0007] In Example 3, further to the refrigeration system of Example 1, the one or more conduits are configured to contain the refrigerant.

[0008] In Example 4, further to the refrigeration system of Example 3, the one or more conduits are configured to maintain the refrigerant within the system without direct contact with any ignition source.

[0009] In Example 5, further to the refrigeration system of Example 4, the refrigerant is R290 propane.

[0010] In Example 6, further to the refrigeration system of Example 1, the modular refrigeration assembly is configured to remove from the cabinet and the housing for service and replacement of one or more parts of the modular refrigeration assembly.

[0011] In Example 7, further to the refrigeration system of Example 1, the modular refrigeration assembly includes modular connections configured to connect to power and control connections.

[0012] In Example 8, further to the refrigeration system of Example 1, the modular refrigeration assembly is configured to insulate and seal the evaporator within the cabinet.

[0013] In Example 9, further to the refrigeration system of Example 1, the condenser assembly and the compressor are arranged on a base plate that includes a substantially linear surface.

[0014] In Example 10, further to the refrigeration system of Example 1, the evaporator is arranged laterally adjacent the opening in the cabinet, and the evaporator is configured to intake hot air from the opening, cool and return the air in a first direction, and the cabinet is configured to direct the cooled air in a second direction and a third direction perpendicular to the first direction evaporator back toward the opening.

[0015] In Example 11, refrigeration system includes a housing; a cabinet arranged within the housing and including an opening configured to operate as a cooling or freezing space, and a wherein the evaporator is arranged laterally adjacent the opening in the cabinet, a diverter configured to facilitate air circulation relative to the opening; a modular refrigeration assembly including a condenser assembly, a compressor, and an evaporator, the modular refrigeration assembly being configured to removably insert the evaporator within the cabinet to intake hot air from the opening, cool and return the air in a first direction, and direct the cooled air toward the diverter to circulate the cooled air in a second direction and a third direction perpendicular to the first direction evaporator back toward the opening; and one or more conduits arranged between the condenser assembly, the compressor, and the evaporator forming a closed loop system configured to contain refrigerant.

[0016] In Example 12, further to the refrigeration system of Example 11, the modular refrigeration assembly is configured to arrange the condenser assembly and compressor within the housing and external to the cabinet and seal the evaporator within the cabinet.

[0017] In Example 13, further to the refrigeration system of Example 12, the modular refrigeration assembly is configured to the condenser assembly and compressor external to the cabinet and above the opening within the cabinet.

[0018] In Example 14, further to the refrigeration system of Example 12, the opening is configured to house one or more food racks.

[0019] In Example 15, further to the refrigeration system of Example 11, the modular refrigeration assembly is configured to arrange the evaporator directly adjacent the opening.

[0020] In Example 16, further to the refrigeration system of Example 11, the housing includes a controller configured

to interface with the modular refrigeration assembly and facilitate multiple levels of cooling cycles.

[0021] In Example 17, a method of servicing a refrigeration system that includes a housing, and a cabinet arranged within the housing having an opening configured to operate as a cooling or freezing space, and a modular refrigeration assembly having a condenser assembly, a compressor, and an evaporator, the method includes: removing the panels of the housing to reveal the condenser assembly and the compressor of the modular refrigeration assembly; disconnecting the modular refrigeration assembly from the cabinet; removing the modular refrigeration assembly to lift the evaporator from within the cabinet; and repairing or replacing one or more parts of the modular refrigeration assembly.

[0022] In Example 18, the method of Example 17, the modular refrigeration assembly includes a base configured to hold the condenser assembly, the compressor, and the evaporator in place.

[0023] In Example 19, the method of Example 17, the method also includes placing the modular refrigeration assembly within the housing and the cabinet after repairing or replacing the one or more parts of the modular refrigeration assembly

[0024] In Example 20, the method of Example 18, the method also includes sealing the evaporator within the cabinet after placing the modular refrigeration assembly within the cabinet.

[0025] The foregoing Examples are just that, and should not be read to limit or otherwise narrow the scope of any of the inventive concepts otherwise provided by the instant disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The foregoing and other objects, features, and advantages of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

[0027] FIG. **1** illustrates a perspective view of a modular refrigeration assembly of the present invention;

[0028] FIG. **2** illustrates a right side view of FIG. **1**;

[0029] FIG. **3** illustrates a front view of FIG. **1**;

[0030] FIG. **4** illustrates the refrigeration enclosure adaptable to accept the refrigeration assembly of FIG. **1**;

[0031] FIG. **5** illustrates a top view of the modular refrigeration assembly of FIG. **1** integrated into the refrigeration enclosure of FIG. **4**;

[0032] FIG. **6** illustrates a front perspective view of the refrigeration enclosure of FIG. **4** with the modular refrigeration assembly of FIG. **1** installed therein;

[0033] FIG. **7** illustrates the refrigeration system of FIG. **6** showing in exploded view the enclosure panels for the assembly, the enclosure panels including the electronics board with the quick connect/disconnect feature;

[0034] FIG. **8** illustrates a perspective view of the modular refrigeration assembly of FIG. **1** while being semi-engaged in opening of refrigeration enclosure;

[0035] FIG. **9** illustrates a front perspective view of an integrated refrigeration system showing the food racks within the refrigeration enclosure;

[0036] FIG. **10** illustrates a front view of FIG. **9**;

[0037] FIG. **11** illustrates a sectional view of FIG. **10** showing the interior placement of the food racks forward of the evaporator;

[0038] FIG. **12** illustrates the sectional view of FIG. **11** and further illustrates the evaporator semi-engaged in opening of refrigeration enclosure;

[0039] FIG. **13** illustrates a sectional view of FIG. **10** showing the evaporator and direction of airflow;

[0040] FIG. **14** illustrates the airflow direction of the refrigeration system of FIG. **6**; and

[0041] FIG. **15** illustrates an alternative embodiment of the modular refrigeration assembly of FIG. **1**.

DETAILED DESCRIPTION

[0042] Various aspects of the present disclosure are directed toward apparatuses, systems, and methods that include a refrigeration system. In certain instances, the refrigeration system may include refrigeration assembly. The refrigeration assembly may secure or include all aspects directed toward the functionality or operability of cooling air. More specifically, the refrigeration assembly may include a condenser assembly, a compressor, and an evaporator (as well as conduits and electrical components arranged between these aspects). The refrigeration assembly securing each of these aspects may facilitate efficient serviceability as explained in further detail below.

[0043] The refrigeration assembly, in certain instances, is an environmentally friendly and efficient unit. The refrigeration assembly, for example, may be configured to use a refrigerant that is recognized as being highly efficient. In addition, the refrigerant may safely contain the refrigerant within the system while maintaining enhanced serviceability.

[0044] FIG. **1** illustrates a perspective view of a modular refrigeration assembly **15** of the present invention. The modular refrigeration assembly **15** may include a condenser assembly **32**, a compressor **30**, and an evaporator **35**. The modular refrigeration assembly **15** may secure each of the condenser assembly **32**, the compressor **30**, and the evaporator **35** together as one modular unit. As shown in FIG. **1**, the condenser assembly **32** and the compressor **30** are arranged substantially in a first plane and the evaporator **35** is arranged in a second plane that is substantially perpendicular to the first plane. The evaporator **35** is also vertically offset from the condenser assembly **32** and the compressor **30**. As explained in further detail below, this arrangement of the condenser assembly **32**, the compressor **30**, and the evaporator **35** facilitates placement of the evaporator **35** within a cabinet (e.g., where food may be placed for cooling of freezing) while also arranging the condenser assembly **32** and the compressor **30** external to the cabinet.

[0045] The modular refrigeration assembly **15** may include a base plate **38** to which the condenser assembly **32**, the compressor **30**, and the evaporator **35** are releasably secured. The base plate **38** may include a top surface **38**A and a bottom surface **38**B. As shown, the condenser assembly **32** and the compressor **30** are secured on the top surface **38**A of the base plate **38** and the evaporator **35** is secured on the bottom surface **38**B of the base plate **38**.

[0046] The modular refrigeration assembly **15** may also include conduits **40** that connect the refrigeration system components (e.g., the condenser assembly **32**, the compressor **30**, and the evaporator **35**). Further, the base plate **38** may include a handle **41** for ease of lifting the assembly **15** in and out of a refrigeration enclosure (shown in FIG. **4**). In certain instances, the modular refrigeration assembly **15** is a blast chiller/blast freezer. The arrangement of the system

components are advantageously arranged when the modular refrigeration assembly **15** is a blast chiller/blast freezer to allow for a highly efficient and environmentally friendly system **15** as described in further detail below.

[0047] FIG. **2** illustrates a right side view of FIG. **1**, and shows the condenser assembly **32** and the compressor **30** being arranged substantially in the same plane and the evaporator **35** being arranged vertically offset from the condenser assembly **32** and the compressor **30**. The base plate **38** may also include a sealing interface **45** attached to the bottom surface **38**B and/or the top surface **35**A. The sealing interface **45** (e.g., insulative foam) may seal the evaporator **35** within a refrigeration enclosure (shown in FIG. **4**) and seal out the condenser assembly **32** and the compressor **30**.

[0048] In certain instances and as shown in FIG. **3**, the sealing interface **45** includes a lip extension **45**A including a bottom surface **45**A and a side surface **45**A**2**. The sealing interface **45** may be aligned and fixedly attached along the base plate **38**.

[0049] FIG. **4** illustrates the refrigeration enclosure adaptable to accept the modular refrigeration assembly **15**. In certain instances, the modular refrigeration assembly **15** is a blast chiller/blast freezer. The arrangement of the system components are advantageously arranged when the modular refrigeration assembly **15** is a blast chiller/blast freezer to allow for a highly efficient and environmentally friendly system **15** as described in further detail below. The refrigeration enclosure may be a cabinet **20** that is arranged within a housing (e.g., shown in FIG. **6**) that includes an opening configured to operate as a cooling or freezing space. The cabinet **20** includes a left **20**A right **20**B, front **20**C, rear **20**D, top **20**E and bottom **20**F walls defining an interior refrigeration space (an opening), where front wall **20**C provides front door access to the interior of cabinet **20**. Top wall **20**E includes an opening **25** having a peripheral edge **25**A and a side surface **25**B that extends down to a stepped extension **25**C. Stepped extension **25**C may include a gasket (which may be magnetic) seated on the surface thereof. The opening **25** is dimensioned to accept the evaporator **35** and sealing interface **45** therein. The evaporator **35** may project downward into the interior refrigeration space of cabinet **20** up to a point where base plate **38** bottom surface **38**B rests on top surface **20**E of cabinet **20**. In certain instances, at that point sealing interface **45** bottom surface **45**A engages stepped extension **25**C of opening **25** and side surface **25**B of opening **25** rests flush with side surface **45**A**2** of sealing interface **45**.

[0050] FIG. **5** illustrates a top view of the modular refrigeration assembly **15** integrated into the cabinet **20** shown in FIG. **4**. The modular refrigeration assembly **15** may be placed (with portions extending within) the cabinet **20**. The evaporator **35**, for example, is arranged within the cabinet **20** when the modular refrigeration assembly **15** and the cabinet **20** are arranged together. The base plate **38** may be formed by injection molding, pressure molding, casting, or the like and is constructed from a material such as plastic, reinforced plastic, or lightweight metals such as aluminum. Ay be As shown in FIG. **5**, the base plate **38** substantially L shaped including a forward section **38**C and a rear section **38**D, where the condenser assembly **32** is located in forward section **38**C, and sits forward of the compressor **30** located in rear section **38**D. The evaporator **35** projects downward from bottom surface **38**B (FIG. **2**) and is positioned beneath compressor **30**. Conduits **40** fluidly connect the refrigeration system components. With the components interconnected by conduits **40**, the assembly **15** is initially charged with refrigerant prior to being shipped to the which facilitates quick and easy assembly of refrigeration appliance **10**. The base plate **38** may include a handle **41** for ease of lifting the assembly **15** in and out of a refrigeration cabinet **20**. The condenser assembly **32** may be mounted to forward section **38**C of base plate **32** by any suitable fasteners such as screws and the like and the compressor **30** may be mounted to a rearward section **38**D of the base plate **32**.

[0051] As discussed in further detail below, the conduits **40** may contain the refrigerant in a closed-loop system with the condenser assembly **32**, the compressor **30**, and the evaporator **35**. The refrigerant may be a highly efficient and environmentally friendly component (e.g., propane). In certain instances, the refrigerant loaded in to the closed-loop system is approximately 100 grams to 200 grams. The closed-loop system is without a reservoir and contains the refrigerant within the loop formed by the conduits **40** and the condenser assembly **32**, the compressor **30**, and the evaporator **35**.

[0052] The assembly **15** is configured to be removed and installed seamlessly into the opening **25** (shown in FIG. **4**) of the cabinet **20**. Various connection apertures **39** are provided in the base plate **38** that are in alignment with apertures **39** of top surface **20**E which can be engaged by any suitable type of fasteners or methods known in the art, such as screws to secure assembly **15** to refrigeration cabinet **20**.

[0053] As noted above, the base plate **38** includes a sealing interface **45** rigidly attached to the bottom surface **38**B of the base plate **38** and/or the top surface **35**A of evaporator **35**. Upon removal of assembly **15** from the cabinet **20** connection plugs **70** may be disconnected from the assembly **15** and from portions of the housing as shown in FIG. **6**.

[0054] FIG. **6** illustrates a front perspective view of the refrigeration enclosure of FIG. **4** with the modular refrigeration assembly of FIG. **1** installed therein. The refrigeration enclosure (or housing **50**) may include multiple removable panels that facilitate installation of the assembly **15**. FIG. **7** illustrates the refrigeration system of FIG. **6** showing in exploded view the enclosure panels **50**A-E for the assembly of the housing. The housing **50** includes an electronics board with the quick connect/disconnect feature. As noted above, the modular refrigeration assembly **15** is a blast chiller/blast freezer. The arrangement of the system components are advantageously arranged when the modular refrigeration assembly **15** is a blast chiller/blast freezer to allow for a highly efficient and environmentally friendly system **15** as described in further detail below.

[0055] As shown in FIGS. **6** and **7**, the assembly **15** is installed in the cabinet.

[0056] The removable panels **50**A, **50**B, **50**C, **50**D and **50**E form a housing **50** over the assembly **15**. The panels **50**A, **50**B, **50**C, **50**D and **50**E may be secured together to form the housing **50** or the panels **50**A, **50**B, **50**C, **50**D and **50**E may be individual removable to reveal the assembly **15**. In certain instances, at least two panels include vents **50**F (or louvers) for ventilation of heat generated by the assembly **15**.

[0057] The housing **50** also includes an operator interface and controller **60** having a microprocessor based programmable computer for controlling the operation of assembly **15**

components. The operator interface and controller **60** may be integrated into or mounted on a removable panel by any suitable type of fasteners. Upon removal of assembly **15** from refrigeration cabinet **20** cover **50** panels are removed and controller **60** is disconnected via connection plugs **70**.

[0058] The controller **60** may be configured to interface with the modular refrigeration assembly **15** and facilitate multiple levels of cooling cycles. During servicing of the refrigeration system, one or more of the panels **50**A, **50**B, **50**C, **50**D and **50**E of the housing **50** may be removed to reveal the condenser assembly **32** and the compressor **30** of the modular refrigeration assembly. The modular refrigeration assembly **15** may be disconnected the cabinet **20** (e.g., by uncoupling, unscrewing, or detaching the base plate **38** from the top **20**E of the cabinet **20**). In certain instances, the connection plugs **70** between the controller **60** and the assembly **15** may be disconnected. In addition, the conduits **40** that connect the assembly **15** may be disconnected. The modular refrigeration assembly **15** may be removed from the cabinet **20**, which includes lifting the evaporator **35** from within the cabinet **20**.

[0059] The assembly **15** may be completely separated and removed from the cabinet **20** to easily and accessible service the assembly **15**. The assembly **15** is modular in that the parts can be removed from the assembly **15** and quickly repaired or replaced. This ensures the safety of technicians, as well as minimizing the downtime of your blast chiller in the event a repair is needed. To service the assembly **15**, one or more of the parts (e.g., condenser assembly **32**, compressor **30**, and evaporator **35**, conduits **40**, refrigerant contained within the conduits **40**) may be repaired or replaced. The parts (e.g., condenser assembly **32**, compressor **30**, and evaporator **35**, conduits **40**) may by coupled together by the connection plugs **70** (and in some instances the conduits **40**), which enable modular quick disconnection of the parts of the assembly **15** and reinstallation of the new or repaired part.

[0060] After repairing or replacing one or more of the parts, the assembly **15** may be placed back the housing **50** and the cabinet **20**. In addition, the evaporator **35** may be sealed within the cabinet after placing the modular refrigeration assembly **15** within the cabinet **20**. Thus, in the event of component failure, the modular refrigeration assembly **15** may be removed from the cabinet **20**, and a new component may be replaced on the assembly **15**. In other instances, a new assembly **15** entirely may be installed within the cabinet **20**. The assembly **15**, new or with a component replaced or repaired, is slid into and out of the cabinet as a unit, with the only installation steps including bolting the assembly **15** in place and connecting the connection plugs **70**. FIG. **7**, for example, shows one or more of the panels **50**A-E being removed to expose portions of the assembly **15**. FIG. **8** shows the modular refrigeration assembly **15** as partially removed from the cabinet **20**. As shown in FIG. **8**, the entire modular refrigeration assembly **15** is removed as one unit. The system is shown and discussed in additional detail with reference to FIG. **9-14**.

[0061] FIG. **9** illustrates a front perspective view of an integrated refrigeration system showing the food racks **75** within the refrigeration enclosure (or cabinet **20**) and FIG. **10** illustrates a front view of FIG. **9**. The cabinet **20** may include a front wall **20**C that opens to expose the refrigeration enclosure or opening **25**. Food racks **75** or other objects to be refrigerated or frozen may be arranged within the cabinet **20**. The cabinet **20** may include a drain pan **21** that would allow moisture through drainage holes (not shown) to enter the pan, and exit the pan via a drain connection to an outside location (not shown).

[0062] FIG. **11** illustrates a sectional view of FIG. **10** showing the interior placement of the food racks forward of the evaporator **35**. As described in detail above, the modular refrigeration assembly **15** may include the condenser assembly **32**, the compressor **30**, and the evaporator **35**. Each of the condenser assembly **32**, the compressor **30**, and the evaporator **35** may be arranged together on a base plate **38** and can be removed and replaced on the cabinet **20** as an entire assembly **15**.

[0063] As shown in FIG. **11**, the modular refrigeration assembly **15** is configured to arrange the evaporator **35** within the cabinet **20** and arrange the condenser assembly **32** and compressor **30** within a housing **50** and external to the cabinet **20**. One or more conduits **40** are arranged between and connect the condenser assembly **32**, the compressor **30**, and the evaporator **40** forming a closed loop system configured to contain refrigerant. The closed loop system formed by the conduits **40** and the condenser assembly **32**, the compressor **30**, and the evaporator **40** holds the refrigerant the assembly **15** requires without a reservoir.

[0064] The one or more conduits **40** are configured to contain the refrigerant and facilitate temperature control within the modular refrigeration **15** assembly free of a refrigerant reservoir. In certain instances, the conduits **40** are also configured to maintain the refrigerant within the system without direct contact with any ignition source. In addition, the refrigerant may be R290 propane. Prior refrigeration systems or blast chillers use refrigerants with high global warming potentials. The assembly **15** may use R290 propane refrigerant, which is non-toxic with a low global warming potential (e.g., GWP rating of 3 and no Ozone Depleting Properties (ODP)). The Environmental Protection Agency (EPA) has named R290 as its preferred hydrocarbon alternative.

[0065] Although R290 propane may be highly flammable, the assembly **15** fully contains and seals the R290 propane within the closed loop system of the conduits **40** and the condenser assembly **32**, the compressor **30**, and the evaporator **40**. As a result, there risk of leaking is minimized and there is no direct contact with any ignition source. It has been shown that the assembly **15**, using R290 propane, has a substantially similar fire risk as compared to a similar appliance using a different refrigerant.

[0066] In addition to the environmentally friendly nature of the assembly **15**, the assembly **15** is also highly serviceable. For example, the modular refrigeration assembly **15** is configured to remove from the cabinet **20** and the housing **50** for service and replacement of one or more parts of the modular refrigeration assembly **15** (as shown in FIG. **12**). The conduits **40** and electrical/control components include snap-fit connections that allow disconnection and disconnection of the condenser assembly **32**, the compressor **30**, and the evaporator **40** from the assembly **15**. The connections are modular connections configured to connect to power and control connections.

[0067] In certain instances, the modular refrigeration assembly **15** is configured to insulate and seal the evaporator **35** within the cabinet **20**. The base plate **38** may also include a sealing interface **45** attached to the bottom surface. The sealing interface **45** (e.g., insulative foam) may seal the

evaporator **35** within the cabinet **20** and seal out the condenser assembly **32** and the compressor **30**. In addition and as shown, the condenser assembly **32** and the compressor **30** are arranged on the base plate **38** that includes a substantially linear surface. The evaporator **35** being arranged within the cabinet **20** facilitates direct and efficient cooling of interior items within the cabinet **20** (e.g., refrigeration enclosure) than a system that incorporates components both interior and exterior to refrigerator interior. The opening **25** into which items to be cooled or frozen is situated directly land laterally adjacent to the evaporator **35**. As shown in FIG. in the proximity of back wall **20**D to facilitate the orientation of evaporator **35** towards the rear of the internal refrigeration space. This allows for the placement of food racks **75** (or other aspects) directly forward of the evaporator **35** such that the evaporator **35** can intake hot air from a front side **35**B of the evaporator **35** and output cooled air to a back side **35**C of the evaporator **35**.

[0068] FIG. **13** illustrates a sectional view of FIG. **10** showing the evaporator **35** and direction of airflow. As shown in FIG. **13**, the evaporator **35** is directly adjacent food racks **75** (although other objects to be cooled or frozen can be arranged in place of the food racks **75**). The modular refrigeration assembly **15** is configured to arrange the evaporator **35** directly adjacent the opening into which the food racks **75** or other objects are placed.

[0069] The position and arrangement of the evaporator **35** to facilitate efficient air flow within the interior refrigeration space of cabinet **20**. Left **20**A, right **20**B, and rear **20**D walls include surfaces **20**A**1**, **20**B**1**, and **20**D**1** interior to cabinet **20**. A space for airflow is created between interior surfaces **20**A**1**, **20**B**1**, and **20**D**1** and the periphery of evaporator **35**. As illustrated by arrows indicating the direction of the airflow, there exists three way circulation of air within the refrigeration cabinet **20**.

[0070] In certain instances, the evaporator **35** is arranged laterally adjacent the opening (in which the food racks **75** are arranged) in the cabinet **20**, and the evaporator **35** is configured to intake hot air from the opening, cool and return the air in a first direction as shown. In addition, the cabinet **20** is configured to direct the cooled air in a second direction and a third direction perpendicular to the first direction evaporator back **35** toward the opening as shown. The back wall **20**D**1** of the cabinet **20** may deflect cooled air back toward the side walls **20**A**1**, **20**B**1** and back toward the opening (in which the food racks **75** are arranged). The cabinet **20** includes space between the side walls **20**A**1**, **20**B**1** and the evaporator **35** such that cooled air can circulate back toward the opening (in which the food racks **75** are arranged). In certain instances, the evaporator **35** is positioned co-extensively with opening (in which the food racks **75** are arranged) to draw heat evenly from the opening (in which the food racks **75** are arranged) into the evaporator **35** (a heat exchanger). In certain instances, the cabinet **20** may include an air deflector **80** positioned between evaporator rear surface **35**C**1** and back wall interior surface **20**D**1** to split airflow to opposite sides of opening (in which the food racks **75** are arranged). In certain instances, the air deflector **80** is angled inward towards surface **35**C**1**, is 'V' shaped, and is coextensive with evaporator **35**C. FIG. **14** shows the cabinet **20** and air pulling into the evaporator **35**. As illustrated in FIG. **15**, the evaporator **35** may include a plurality of evaporator/fans to accommodate coolers of varying dimensions.

[0071] The invention of this application has been described above both generically and with regard to specific embodiments. It will be apparent to those skilled in the art that various modifications and variations can be made in the embodiments without departing from the scope of the disclosure. Thus, it is intended that the embodiments cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A refrigeration system comprising:

a housing;

a cabinet arranged within the housing and including an opening configured to operate as a cooling or freezing space;

a modular refrigeration assembly including a condenser assembly, a compressor, and an evaporator, the modular refrigeration assembly being configured to arrange the evaporator within the cabinet and arrange the condenser assembly and compressor within the housing and external to the cabinet; and

one or more conduits arranged between the condenser assembly, the compressor, and the evaporator forming a closed loop system configured to contain refrigerant.

2. The refrigeration system of claim **1**, wherein the one or more conduits are configured to contain the refrigerant and facilitate temperature control within the modular refrigeration assembly free of a refrigerant reservoir.

3. The refrigeration system of claim **1**, wherein the one or more conduits are configured to contain the refrigerant.

4. The refrigeration system of claim **3**, wherein the one or more conduits are configured to maintain the refrigerant within the system without direct contact with any ignition source.

5. The refrigeration system of claim **4**, wherein the refrigerant is R290 propane.

6. The refrigeration system of claim **1**, wherein the modular refrigeration assembly is configured to remove from the cabinet and the housing for service and replacement of one or more parts of the modular refrigeration assembly.

7. The refrigeration system of claim **1**, wherein the modular refrigeration assembly includes modular connections configured to connect to power and control connections.

8. The refrigeration system of claim **1**, wherein the modular refrigeration assembly is configured to insulate and seal the evaporator within the cabinet.

9. The refrigeration system of claim **1**, wherein the condenser assembly and the compressor are arranged on a base plate that includes a substantially linear surface.

10. The refrigeration system of claim **1**, wherein the evaporator is arranged laterally adjacent the opening in the cabinet, and the evaporator is configured to intake hot air from the opening, cool and return the air in a first direction, and the cabinet is configured to direct the cooled air in a second direction and a third direction perpendicular to the first direction evaporator back toward the opening.

11. A refrigeration system comprising:

a housing;

a cabinet arranged within the housing and including an opening configured to operate as a cooling or freezing space, and a wherein the evaporator is arranged later-

ally adjacent the opening in the cabinet, a diverter configured to facilitate air circulation relative to the opening;

a modular refrigeration assembly including a condenser assembly, a compressor, and an evaporator, the modular refrigeration assembly being configured to removably insert the evaporator within the cabinet to intake hot air from the opening, cool and return the air in a first direction, and direct the cooled air toward the diverter to circulate the cooled air in a second direction and a third direction perpendicular to the first direction evaporator back toward the opening; and

one or more conduits arranged between the condenser assembly, the compressor, and the evaporator forming a closed loop system configured to contain refrigerant.

12. The refrigeration system of claim **11**, wherein the modular refrigeration assembly is configured to arrange the condenser assembly and compressor within the housing and external to the cabinet and seal the evaporator within the cabinet.

13. The refrigeration system of claim **12**, wherein the modular refrigeration assembly is configured to the condenser assembly and compressor external to the cabinet and above the opening within the cabinet.

14. The refrigeration system of claim **12**, wherein the opening is configured to house one or more food racks.

15. The refrigeration system of claim **11**, wherein the modular refrigeration assembly is configured to arrange the evaporator directly adjacent the opening.

16. The refrigeration system of claim **11**, wherein the housing includes a controller configured to interface with the modular refrigeration assembly and facilitate multiple levels of cooling cycles.

17. A method of servicing a refrigeration system that includes a housing, and a cabinet arranged within the housing having an opening configured to operate as a cooling or freezing space, and a modular refrigeration assembly having a condenser assembly, a compressor, and an evaporator, the method comprising:

removing the panels of the housing to reveal the condenser assembly and the compressor of the modular refrigeration assembly;

disconnecting the modular refrigeration assembly from the cabinet;

removing the modular refrigeration assembly to lift the evaporator from within the cabinet; and

repairing or replacing one or more parts of the modular refrigeration assembly.

18. The method of claim **17**, wherein the modular refrigeration assembly includes a base configured to hold the condenser assembly, the compressor, and the evaporator in place.

19. The method of claim **17**, further including placing the modular refrigeration assembly within the housing and the cabinet after repairing or replacing the one or more parts of the modular refrigeration assembly.

20. The method of claim **18**, further including sealing the evaporator within the cabinet after placing the modular refrigeration assembly within the cabinet.

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