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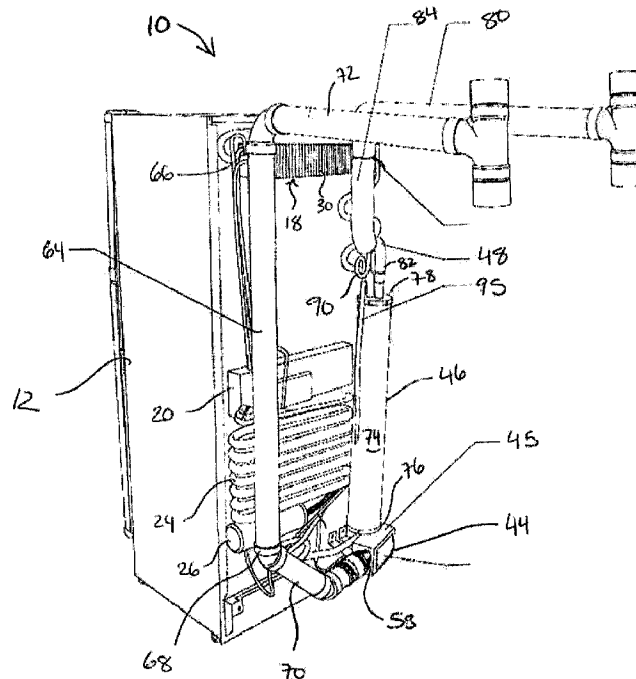
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(54) Titre : SYSTEME D'AERATION DIRECTE POUR REFRIGERATEUR A ABSORPTION ALIMENTE AU PROPANE ET AUTONOME

(54) Title: DIRECT VENTING SYSTEM FOR FREE-STANDING PROPANE POWERED ABSORPTION REFRIGERATOR



(57) Abrégé/Abstract:

A direct venting system for a free-standing propane powered refrigerator is disclosed. The direct venting system pre-installed on the refrigerator, the system having an air intake for drawing air from outside and directing the air to a burner box for combustion of the

(57) Abrégé(suite)/Abstract(continued):

propane gas flame that runs the refrigerator, and an exhaust outlet for venting all of the flue gases or products of combustion out of the system with the system being hermetically sealed with respect to an interior environment within which the refrigerator is installed. The fresh air is directed to a burner box by means of a specially designed air inlet adapter that includes a step-down feature that reduces the likelihood of blow-out of the gas flame. The flue gases are directed through an offset chimney structure and a three-layered exhaust outlet that reduces the formation of condensate thereby protecting the system from blow-out and corrosion.

ABSTRACT

A direct venting system for a free-standing propane powered refrigerator is disclosed. The direct venting system pre-installed on the refrigerator, the system having an air intake for drawing air from outside and directing the air to a burner box for combustion of the propane gas flame that runs the refrigerator, and an exhaust outlet for venting all of the flue gases or products of combustion out of the system with the system being hermetically sealed with respect to an interior environment within which the refrigerator is installed. The fresh air is directed to a burner box by means of a specially designed air inlet adapter that includes a step-down feature that reduces the likelihood of blow-out of the gas flame. The flue gases are directed through an offset chimney structure and a three-layered exhaust outlet that reduces the formation of condensate thereby protecting the system from blow-out and corrosion.

DIRECT VENTING SYSTEM FOR FREE-STANDING PROPANE POWERED ABSORPTION REFRIGERATOR

TECHNICAL FIELD

[0001] The invention relates to a direct venting system for a free-standing, propane powered absorption refrigeration unit or refrigerator.

BACKGROUND

[0002] Free-standing, residential propane powered absorption refrigerators are often used in remote or "off-grid" areas that do not have access to electricity for running conventional refrigerators. Previously, free-standing propane refrigerators for sale and installation in Canada were required to have either (i) a direct vent system for venting the flue gases or products of combustion directly to the outdoors or (ii) a carbon monoxide alarm with safety shut-off to ensure that the appliance shuts down if the detector senses unsafe levels of carbon monoxide. Direct vent systems typically were in the form of a kit sold separately to the refrigerator that required assembly and installation by the user/owner of the refrigerator. These were not only difficult to install but were also unreliable in that they were prone to freeze-ups during the winter months and also prone to blow-outs caused by wind blowing-out the burner flame or by flue gases collapsing in the chimney snuffing out the burner causing the refrigerator to shutdown. As well, the direct vent systems were also prone to leakage, therefore flue gases and/or products of combustion were often leaked to the interior during use and therefore did not provide true venting of the system to the outdoors. Accordingly, previous direct vent systems were perceived to be unreliable and were extremely unpopular with customers. Early versions of the carbon monoxide alarm with safety shut-off tended to be extremely sensitive and therefore prone to false alarms causing the appliance to shutdown. Improvements to the carbon monoxide alarm with safety

shut-off, which made them far more reliable, led to dramatic decline in the demand for direct vented appliances.

[0003] Based on perceived safety concerns, Provincial safety authorities, in conjunction with Inter-Provincial safety authorities, eventually mandated that all free-standing propane refrigerators for residential use (i.e. installed in a primary dwelling) be of the direct venting type thereby requiring that the entire combustion process be completely sealed from the interior in that all air for combustion be drawn from the outdoors and that all flue gases and/or products of combustion be vented directly to the outdoors. However, existing direct vent systems were challenged in meeting current safety standards and were unacceptable to most users due to the fact that they (i) were difficult to install and (ii) were prone to freeze-ups and/or blow-outs and were therefore, unreliable.

[0004] Accordingly, there exists a need for an improved direct venting system for free-standing, propane refrigerators.

SUMMARY OF THE PRESENT DISCLOSURE

[0005] In accordance with an example embodiment of the present disclosure there is provided a free-standing, direct venting propane refrigerator having a storage unit for storing perishable items and a cooling unit for providing cooling to the storage unit, the refrigerator comprising a burner element for providing a gas flame for powering the cooling unit; a burner box mounted directly to a rear, exterior surface of the refrigerator for sealingly housing the burner element, the burner box having an integral mounting flange; an air intake assembly mounted directly to the rear, exterior surface of the refrigerator, the air intake assembly having a first end for drawing in fresh air from an outdoor environment and a second end coupled to said burner box for supplying the fresh air to said burner element for combustion of said gas flame; a chimney assembly mounted directly to

the rear, exterior surface of the refrigerator, the chimney assembly in fluid communication with said burner box for drawing products of combustion away from the burner box; an air outlet coupled to said chimney assembly for delivering the products of combustion to the outdoor environment; wherein said burner box further comprises an air inlet adapter having a first end in direct communication with said air intake assembly and a second end in direct communication with said burner box, the first end being larger than said second end.

[0006] In accordance with another example embodiment of the present disclosure there is provided a direct venting system for a free-standing propane refrigerator, the direct venting system comprising an air intake for drawing fresh air from an outdoor environment; a burner box for housing burner elements associated with providing a heat source in the form of combustion of a propane gas flame for powering the refrigerator; a chimney assembly for drawing products of combustion away from said burner box; an air outlet for delivering said products of combustion from said chimney assembly to said outdoor environment; wherein said burner box comprises an air inlet adapter having a first end coupled to said air intake and a second end coupled to said burner box, said first end being larger than said second end for delivering air to said burner box.

[0007] In accordance with another example embodiment of the present disclosure there is provided a burner box assembly for a direct venting free-standing propane refrigerator, the burner box assembly comprising a burner box defining an open interior cavity for housing burner elements for providing a propane gas flame; an integrally formed mounting flange extending from open edges of said burner box for sealingly mounting said burner box to said refrigerator; an air intake adapter sealingly mounted to said burner box in fluid communication with said open interior cavity, the air intake adapter having a first open end for receiving fresh air from an outside environment and a second open end in fluid communication with said open interior cavity for delivering said fresh air to said open interior cavity; wherein said first open end is larger than said second open end.

[0008] In accordance with another example embodiment of the present disclosure there is provided a chimney assembly for a direct venting free-standing propane refrigerator, the chimney assembly comprising a first tubular portion; a second tubular portion laterally offset with respect to the first tubular portion; a horizontally extending tubular portion interconnecting said first tubular portion and said second tubular portion in their laterally offset relationship, the horizontally extending tubular portion forming two generally 90 degree bends with respect to said first and second tubular portions; wherein said first, second and horizontally extending tubular portions are three layered tubular members, each of which comprises an inner tubular member; an insulating member surrounding said inner tubular member; and an outer covering surrounding said insulating member.

[0009] Further objects and advantages of the present invention will be apparent from the following description, reference being made to the accompanying drawings, wherein like reference characters designate corresponding parts.

BRIEF DESCRIPTION OF THE DRAWINGS

[00010] Exemplary embodiments of the present disclosure will now be described, by way of example, with reference to the accompanying drawings, in which:

[00011] **Figure 1** is a perspective, rear view of a free-standing, propane refrigerator incorporating a direct venting system in accordance with an example embodiment of the present disclosure;

[00012] **Figure 2** is a perspective side view of the refrigerator of Figure 1 illustrating the refrigerator installed against an exterior wall of a building;

[00013] **Figure 3** is a schematic diagram illustrating the operation of the cooling unit of the refrigerator of Figure 1 in accordance with principles known in the art;

- [00014]** **Figure 4A** is a perspective front, bottom view of a burner box of the direct venting system of the refrigerator shown in Figure 1;
- [00015]** **Figure 4B** is a front elevation view of the burner box of Figure 4A;
- [00016]** **Figure 4C** is a back or rear view of the burner box of Figure 4A;
- [00017]** **Figure 4D** is a left end view of the burner box of Figure 4A;
- [00018]** **Figure 4E** is a bottom view of the burner box of Figure 4A;
- [00019]** **Figure 4F** is a sectional view of the burner box taken along section line 4F-4F shown in Figure 4E;
- [00020]** **Figure 4G** is a top view of the burner box of Figure 4A;
- [00021]** **Figure 4H** is a perspective rear, bottom view of the burner box of Figure 4A;
- [00022]** **Figure 5** is a detail, perspective view of a portion of the burner box as shown in Figure 4;
- [00023]** **Figure 6** is a side elevation view of the portion of the burner box of Figure 5;
- [00024]** **Figure 7** is a sectional view of the portion of the burner box taken along section line 7-7 shown in Figure 6;
- [00025]** **Figure 8** is a detail, perspective view of a chimney assembly of the direct venting system of the refrigerator shown in Figure 1;
- [00026]** **Figure 9** is a front elevation view of the chimney assembly shown in Figure 7;
- [00027]** **Figure 10** is a sectional view of the chimney assembly taken along section line 10-10 shown in Figure 12;

[00028] **Figure 11** is a side elevation view of the fresh air vent or fresh air intake;

[00029] **Figure 12** is a side elevation view of the flue exhaust vent or air outlet;

[00030] **Figure 13** is a perspective bottom view of the burner box housing burner components mounted to a flue assembly in accordance with the direct venting system of the present disclosure;

[00031] **Figure 14** is a perspective view of a burner box cover for use with the burner box of the direct venting system in accordance with the present disclosure;

[00032] **Figure 15** is a side elevation view of the burner box cover of Figure 14;

[00033] **Figure 16** is a front elevation view of the burner box cover of Figure 14;

[00034] **Figure 17** is a front elevation view of a faceplate for use in conjunction with the burner box cover of Figure 14; and

[00035] **Figure 18** is a perspective view of the faceplate shown in Figure 17.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENT

[00036] Referring now to Figure 1, there is shown a direct venting free-standing propane refrigerator 10 according to an example embodiment of the present disclosure. The direct venting refrigerator 10 comprises a refrigeration storage unit 12 (with refrigerator and freezer compartments) equipped with a propane-powered refrigeration system or cooling unit 14 in accordance with principles known in the art, and a direct venting system 40 in accordance with an exemplary embodiment of the present disclosure. In general, the refrigeration system or cooling unit 14 comprises a boiler 16 that is coupled to a condenser 18.

The condenser 18, in turn is connected to an evaporator 20, which in turn is connected to an absorber 22 comprising absorber coils 24 and an absorber tank 26. The cooling unit 14 is provided with any suitable refrigerant, such as a liquid ammonia solution, which solution is sealed within the cooling unit and flows through the various components in order to provide cooling to the storage unit 12 of the refrigerator 10. The cooling unit 14 is illustrated schematically in Figure 3 in accordance with principles known in the art.

[00037] As is generally understood in the art, during use of the propane refrigerator 10, the boiler 16 generates heat by means of a heat source such as a gas flame from a propane burner 28 (or any other suitable heat source in accordance with principles known in the art), which heat is transferred to the refrigerant solution that is fed to the boiler 16 from the absorber tank 26. The propane flame typically produces 700 to 1800 BTU as compared to a furnace which operates between 30,000 to 75,000 BTU. The refrigerant solution (i.e. the ammonia-rich refrigerant solution) begins to vaporize and travels upwards through the boiler 16 to the condenser 18 where it is cooled by air passing through the metal fins 30 of the condenser 18 forcing the ammonia or refrigerant vapour back to a liquid state where it enters the evaporator 20. In the evaporator section 20 of the cooling unit 14, heat extracted from the storage unit 12 (i.e. the refrigerator/freezer sections of the refrigerator 10) causes evaporation of the liquid ammonia or liquid refrigerant solution, which vaporized mixture is returned or drops back down to the absorber tank 26 and the refrigeration cycle continues.

[00038] As briefly described above, the refrigeration cycle begins with a heat source in the boiler 16 which begins the vaporization of the refrigerant or ammonia-rich solution. The heat source to power the absorption system can come from an electric heating element or from a flame. In remote or off-grid areas where there is no source of AC/10 electricity, propane fuels a gas flame that serves as the heat source within the boiler 16. In order to comply with government mandated safety regulations in Canada, free-standing propane refrigerators for use in residential dwellings must be of the direct vent type which requires that all of the air used for

combustion purposes be taken or drawn from the outdoors with all flue gases and/or products of combustion being exhausted outdoors. The entire combustion process associated with the propane refrigerator, therefore, must not communicate with the interior environment of the building within which the refrigerator is installed.

[00039] Accordingly, the refrigerator 10 according to an example embodiment of the present disclosure is equipped with a direct venting system 40 for ensuring that any flue gases and/or products of combustion are successfully vented to the outdoors or outside the residential dwelling or building without any of the products of combustion leaking into the building or residential dwelling while ensuring proper and reliable functioning of the propane refrigerator 10. The direct venting system 40, therefore, (i) sealed so as not to allow any products of combustion to leak into the building, (ii) allows for correct air balance between the air inlet and the chimney to allow for natural venting while providing sufficient oxygen for the burners to operate and sufficient evacuation to allow continued combustion, (iii) allows for collection and dissipation of corrosive condensate (such as hydrochloric acid) in the flue system, and (iv) is also capable of operating properly and efficiently in a wide range of temperatures (-22°C to +38°C) as well as operate under high wind conditions (i.e. 60 kph (40 mph)).

[00040] The direct venting system 40 comprises an air intake assembly 42, a burner box 44, a flue assembly 46 and a chimney assembly 48 that are pre-assembled and pre-installed on the rear of the refrigerator 10. The burner box 44 is mounted directly to the exterior, rear surface of the refrigerator 10, the burner box 44 housing the burner elements (not shown) for the propane gas flame for heating and/or powering the refrigeration or cooling unit 14. The burner box 44, as shown in Figures 4A-4H, has a closed top 43, rear 45, and end 47, 49 walls or sides, which together define an open interior cavity 50 for housing the various components associated with the burner elements 37 (shown generally in Figure 13).

[00041] The burner box 44 mounts directly and permanently to the frame of the refrigerator 10 with at least one bracket member 41, one of which is partially shown in Figure 13, leaving the open front and bottom sides 51, 53 easily accessible for receiving and/or housing the burner components. Alternatively, the burner box 44 can be directly and permanently mounted to the frame of the refrigerator by any suitable means. Additional mounting brackets (not shown) for the burner assembly or burner components then mount inside the attached burner box 44 to allow for the installation, removal and maintenance of all burner components without having to remove the burner box 44. The design and custom shaping of the top 43 and rear 45 walls of the burner box 44 allows the burner box 44 to be easily positioned over and/or around the structure of the refrigerator and cooling coil. More specifically, various openings and/or recesses 39 are formed in the top 43 and rear 45 walls of the burner box 44 and various recesses 56 are formed in the peripheral flange 57 that surrounds the open front and bottom sides 51, 53 of the burner box 44, with the openings and/or recesses 39, 56 being adapted to fit around components of the refrigerator cooling unit 14 and the direct venting system 40. A burner box cover 55 and faceplate 67, as shown in Figures 14-18 are provided and mounted over the open sides 51, 53 of the burner box 44 to ensure that the burner box 44 is completely and hermetically sealed with respect to the interior environment when mounted on the refrigerator 10 and in operation. Gasket material (not shown) or any other suitable sealing device is sandwiched between the burner cover 55 and burner box 44 and/or the burner cover 55 and faceplate 67 to ensure proper sealing of the burner box 44. The design and installation of the burner box 44, burner box cover 55 and gasket facilitates maintenance (i.e. servicing and/or repair) of the burner components housed within the burner box 44 since the burner box cover 55 and faceplate 67 can be easily removed without requiring complete disassembly of the burner box 44 and/or direct venting system 40. Any suitable sealing or gasket devices (not shown) may also be provided around any openings and/or recesses 39, 56 formed in the burner box 44 to ensure that the burner box 44 is hermetically sealed.

[00042] Figures 14-18 illustrate an exemplary embodiment of the burner box cover 55 and faceplate 67. As shown, the burner box cover 55 comprises a generally L-shaped cover having a closed face 63 and an open face 65 that fits over and is removably mounted to the bottom and front open sides 53, 51 of the burner box 44 with appropriate gasket or sealing material positioned therebetween. The closed face 63 seals the open bottom 53 side of the burner box 44 while the open face 65 of the cover 55 partially closes the open front side 51 of the burner box 44. Once the burner box cover 55 is positioned over the open sides 51, 53 of the burner box 44, the open face 65 is then covered and sealed by means of faceplate 67 that is positioned and removably mounted over the opening in the open face 65 of the burner box cover 55. Once again, appropriate sealing or gasket material can be positioned between the faceplate 67 and cover 55 to ensure appropriate sealing of the burner box 44. When maintenance and/or repair of the components housed within the burner box 44 is required, the faceplate 67 and burner box cover 55 can easily be removed without having to remove the entire burner box 44 structure.

[00043] The burner box 44 further comprises an air inlet adapter 58 that is securely mounted at one end of the burner box 44 in fluid communication with the interior cavity 50. In the subject example embodiment, the air inlet adapter 58 is welded to the burner box 44 through an air inlet opening 59 formed in the end wall 47 of the burner box 44. The air inlet adapter 58 has a first end 60 for receiving air from the outdoors through the air intake 42 and a second end 62 for delivering the air to the burner box 44 for fueling or feeding the combustion process, the second end 62 being sealingly mounted to the burner box 44 in fluid communication with the air inlet opening 59. The first end 60 of the air inlet adapter 58 is generally circular and has a diameter larger than the diameter of the second end 62, which is also generally circular. A step-down region 63 interconnects the first end 60 and the second end 62. The first end 60, second end 62 and step-down region 63 are specifically designed and sized to ensure that air is delivered to the open interior cavity 50 of the burner box 44 at an appropriate angle and in a manner to ensure that proper combustion occurs within the burner box 44. If the air enters the burner box 44 through the inlet adapter 58 at too fast a rate or with increased

velocity or turbulence within the air flow, or at an inappropriate angle, it risks blowing out the burner flame which effectively shuts-off the refrigerator. As well, if the air enters the burner box 44 through the adapter 58 at too slow a rate or without the proper velocity and/or turbulence within the flow, etc., combustion may not occur properly within the burner box to ensure the optimal functioning of the refrigerator 10. The transition from the first, larger end 60 to the smaller diameter second end 62 via step-down region delivers the air to the burner box 44 with the desired flow properties to greatly decrease the risk of blow-out and therefore improves the efficiency and reliability of the refrigerator 10. In accordance with one example embodiment, the second end 62 is generally about half the diameter of the first end 60 with the first end 60 having an inner diameter of about 55mm and the second end having an inner diameter of about 29mm.

[00044] Referring now to Figures 1 and 2, the direct venting system 40 will be described in further detail. As shown, the air intake assembly 42 comprises a first, vertical length of tube or pipe 64 that generally runs up the back of the free-standing refrigerator 10, the first length of tubing 64 having opposed upper and lower ends 66, 68. The lower end 68 of the first length of tubing 64 is fluidly coupled to the first end 60 of the air inlet adapter 58 of the burner box 44 by means of a second length of tubing 70 disposed at an angle with respect to the first length of tubing 64. The interconnection of the first, vertical length of tubing 64, the second, angled section of tubing 70 and the air inlet adapter 58, and the orientation of the second length of tubing 70 with respect to the first length of the tubing 64 and the first end 60 of the air inlet adapter 58 ensures that the air drawn from the outdoors enters the burner box 44 with the appropriate properties to promote combustion within the burner box 44 and to reduce the likelihood of blow-out to provide improved overall performance of the refrigerator 10. The upper end 66 of the first length of tubing 64 is fluidly coupled to a third length of tubing 72 (as shown in Figure 2) that extends horizontally away from the back of the refrigerator 10 and through an exterior wall 13 of a building within which the refrigerator is installed, the third length of tubing being in fluid communication with the exterior, outside environment. Accordingly, the third length of tubing 72 serves as the fresh

air intake or air inlet for drawing fresh air from the outdoors through the system 40. The third length of tubing 72 is assembled and connected to the refrigerator 10 at the time of installation of the refrigerator 10 at the desired location within the building. To ensure proper air flow through the direct venting system 40, the third length of tubing 72 must have a length that does not exceed 18 inches. Accordingly, it will be understood that the refrigerator 10 must be positioned against an exterior or outside wall of the building within which it is installed, as illustrated schematically in Figure 2.

[00045] The flue assembly 46 comprises a cylindrical housing 74 having a first, lower end 76 mounted to the upper surface or wall 45 of the burner box 44 and a second end 78 connected to the chimney assembly 48. The first or lower end 76 of the cylindrical housing 74 is adapted to be in fluid communication with the interior cavity 50 to receive flue gases and/or the products of combustion from within the burner box 44 while the second or upper end 78 is fluidly coupled to the chimney assembly 48 with the flue gases and/or products of combustion travelling upwards through the flue assembly 46 to the chimney assembly 48 before being vented to the outdoors through the direct venting system outlet or flue gas exhaust 80.

[00046] Referring now to Figures 8 and 9, the chimney assembly 48 is in the form of an offset pipe structure having a first vertical portion 82 and a second vertical portion 84 interconnected by means of a generally horizontal portion 86 which forms curved or rounded 90 degree bends in the pipe structure thereby forming the offset nature of the chimney assembly 48. The length of the first vertical portion 82 is less than the length of the second vertical portion 84 of the chimney assembly 38, with the generally horizontal portion 86 providing a transition region between the two vertical portions 82, 84.

[00047] An outlet or exterior flue vent 80 is mounted to the upper end of the vertical portion 84 of the chimney assembly 48 and extends horizontally away from the back of the refrigerator 10. Like the fresh air intake 72, the exterior flue vent 80 is mounted to the chimney assembly 48 at the time of installation of the

refrigerator 10, with the exterior flue vent 80 extending through the exterior wall 13 of the building, as shown in Figure 2. To ensure the proper functioning of the chimney assembly 48 and the exhausting of the flue gases from the direct venting system 40, the exterior flue vent 80 must have a length that does not exceed 18 inches.

[00048] As flue gases and/or the products of combustion travel upwards through the flue assembly 46 and chimney assembly 48, the temperature of the gases cools and the gases tend to condense and form condensate. This condensate can drip down the chimney and flue assemblies 48, 46 and back into the burner box 44, which can snuff or blow-out the burner flame causing the refrigerator 10 to shutdown. The condensate is also known to be highly acidic and corrosive. Therefore, any condensate that drips or drains down through the chimney assembly 48 and flue assembly 46 into the burner box 44 can corrode or otherwise damage any of the components of the direct venting system 40 and burner elements housed within the burner box 44 and negatively impact the functioning of the refrigerator 10.

[00049] In order to improve reliability and proper functioning of the refrigerator 10 and to protect the flue assembly 46 and burner box 44 from corrosion due to condensate, it is important to prevent and/or decrease the amount of condensate formed during operation of the propane refrigerator 10. Accordingly, the exterior flue vent 80 is formed as a three-layer insulated structure which maintains the warmer or higher temperatures of the flue gases or products of combustion as they travel upwards through the chimney assembly 48 to the exterior flue vent 80 which prevents or decreases the amount of condensate formed as the gases or combustion products travel upwards through the direct venting system 40.

[00050] As shown in Figure 10, the exterior flue vent 80 comprises a corrosion resistant inner chimney tube 87, an insulation layer 88 surrounding the inner chimney tube 87 and an outer cover layer 89 such as an outer layer of Ipex™ piping. The combination of materials in the three-layered exterior flue vent 80

combined with the offset structure of the chimney assembly 48 has been found to significantly decrease the formation of condensate within the system thereby protecting the components from corrosion and decreasing the risk of blow-out due to flue gas condensate draining into the burner box 44 thereby improving the overall performance of the propane refrigerator 10.

[00051] In the event that condensate does form within the chimney assembly 48 during operation or use of the refrigerator 10, a condensate trap 90 is incorporated into the direct venting system 40. The condensate trap 90 is a small diameter tubular member that is formed with a 360 degree bend therein. A first end 92 of the condensate trap 90 is mounted in fluid communication with the second vertical portion 84 of the chimney assembly 48 for receiving condensate that may drip down from the exterior flue vent or chimney assembly 48. A second end 94 of the condensate trap 90 is fluidly connected to evaporator trays (not shown) located at the bottom of the refrigerator 10 by means of any suitable tubing 95 (as shown in Figure 1). As condensate forms in the exterior flue vent 80 or chimney assembly 48 it enters the condensate trap 90 through first end 92 and fills or collects within the bottom half of the 360 degree bend formed in the trap 90 creating a pocket of fluid. The pocket of fluid (i.e. condensate) that forms in the trap creates a fluid barrier between the chimney assembly 48 and the condensate trap outlet 94 which ensures that the direct venting system 12 remains sealed with regard to the interior of the dwelling or building within which the refrigerator is installed. As additional condensate collects in the trap 90, the condensate will eventually push the pocket of fluid (i.e. condensate) collected in the bottom half of the trap through the 360 degree bend where it will eventually drain out of the trap 90 through any suitable tubing 96 to the evaporator trays (not shown). Accordingly, the condensate trap 90 protects the direct venting system 40 from corrosion while ensuring that the system 40 remains completely and hermetically sealed at all times.

[00052] While an exemplary embodiment of the direct venting system has been described and shown in the drawings, it will be understood that certain

adaptations and modifications of the described exemplary embodiment can be made as construed within the scope of the present disclosure. Therefore, the above discussed embodiment is considered to be illustrative and not restrictive.

What is claimed is:

1. A direct venting system for a free-standing propane powered refrigerator housed within a building having an exterior wall, the direct venting system comprising:

an air intake assembly, extending through the exterior wall, for drawing fresh air from an outdoor environment;

a burner box defining an interior chamber for housing burner elements for combustion of a propane gas flame for providing a heat source for powering the refrigerator;

a flue assembly having a first end mounted in communication with the interior chamber of the burner box for receiving products of combustion produced in the burner box, and a second, discharge end;

a chimney assembly, mounted in series with the flue assembly, for receiving the products of combustion from the second discharge end of the flue assembly; and

an exhaust outlet disposed in fluid communication with said chimney assembly for receiving said products of combustion from the chimney assembly and discharging said products of combustion to said outdoor environment, the exhaust outlet extending horizontally away from the refrigerator and through the exterior wall;

wherein:

said burner box comprises an air inlet adapter for delivering air drawn in through the air intake assembly to the burner box for providing a combustion air supply to the burner box, the air inlet adapter having:

a first end coupled to said air intake assembly, the first end having a first diameter and extending along a central longitudinal axis of the air inlet adapter;

a second end coupled to said burner box, the second end having a second diameter and extending along the central, longitudinal axis of the air inlet adapter, wherein the second diameter is half that of the first diameter; and

a step-down region extending between and interconnecting the first end to the second end, the step-down region being funnel-shaped;

and

said chimney assembly includes:

a first vertical portions defining an inlet at a first end thereof;
and

a second vertical portion defining an outlet at a second end thereof;

wherein:

the second vertical portion is connected to the first vertical portion such that the outlet is horizontally spaced apart from and disposed vertically higher than the inlet such that a vertical plane extending through the first vertical portion and the second vertical portion is disposed parallel to a rear exterior surface of the refrigerator; and

the outlet of the chimney assembly is in communication with the horizontally extending exhaust outlet.

2. The direct venting system as claimed in claim 1, wherein the first vertical portion and the second vertical portion are interconnected by a horizontal

region such that a first 90 degree bend is formed between the first vertical portion and the horizontal region, and a second 90 degree bend is formed between the second vertical portion and the horizontal region.

3. The direct venting system as claimed in claim 1 or claim 2, wherein said exhaust outlet is a three layered structure comprising:

a inner tubular member of corrosion resistant material;

an insulating member surrounding said inner tubular member; and

an outer covering surrounding said insulating member.
4. The direct venting system as claimed in claim 2, further comprising a condensate trap for receiving condensate of the products of combustion and draining said condensate exterior to said direct venting system; wherein the condensate trap includes:

an inlet end disposed in communication with the horizontal region of the chimney assembly, and

an outlet end disposed exterior to the burner box, the condensate trap directing condensate away from the first vertical portion of the chimney assembly and the interior chamber of the burner box.

5. The direct venting system as claimed in claim 4, wherein said condensate trap further comprises:

a 360 degree loop formed therein and disposed intermediate said inlet end and said outlet end, said 360 degree loop collecting condensate in a lower portion thereof for maintaining a hermetic seal within said direct venting system.
6. The direct venting system as claimed in any one of claims 1 to 5, wherein said air intake assembly comprises:

a first length of pipe vertically mounted on the rear, exterior surface of the refrigerator, the first length of pipe having opposed upper and lower ends;

a second length of pipe interconnecting said first length of pipe and said air intake adapter, said second length of pipe arranged at an angle with respect to said first length of pipe; and

an air inlet having a first end for mounting in fluid communication with the upper end of said first length of pipe and a second end adapted for fluid communication with the outdoor environment, the air inlet extending horizontally away from the rear, exterior surface of the refrigerator.

7. The direct venting system as claimed in claim 6, wherein said air inlet has a maximum length of 18 inches.
8. The direct venting system as claimed in claim 1, wherein said exhaust outlet has a maximum length of 18 inches.
9. The direct venting system as claimed in any one of claims 1 to 8, wherein said system is hermetically sealed with respect to an interior environment.
10. A free-standing, direct venting propane powered refrigerator having a burner element for providing a gas flame for powering said refrigerator, the refrigerator comprising:

a burner box mounted directly to a rear, exterior surface of the refrigerator, the burner box defining an open interior chamber for housing and sealingly enclosing the burner element, the burner box comprising an air inlet adapter having a first end having a first diameter and extending along a central longitudinal axis of the air inlet adapter for receiving a source of fresh air from an outdoor, exterior environment, a second end disposed in direct communication with said open interior cavity for delivering said fresh air for combustion of said gas flame, the second end having a second diameter and extending along the central longitudinal axis of the air inlet adapter, wherein the second diameter is half of the first diameter; and a step-down region extending between and interconnecting the first end to the second end, the step-down region being funnel-shaped;;

an air intake assembly mounted directly to the rear, exterior surface of the refrigerator, the air intake assembly having a first end adapted for fluid communication with said outdoor environment for drawing in said fresh air and a second end coupled to said first end of said air inlet adapted of said burner box;

a flue assembly having a first end mounted in communication with the interior chamber of the burner box for receiving products of combustion produced in the burner box;

a chimney assembly mounted directly to the rear, exterior surface of the refrigerator and in series with the flue assembly for receiving the products of combustion from the flue assembly; and

an exhaust outlet disposed in fluid communication with said chimney assembly for receiving the products of combustion from the chimney assembly and discharging said products of combustion to said outdoor environment, the exhaust outlet extending horizontally away from the refrigerator and through the exterior wall;

wherein:

said chimney assembly includes:

a first vertical portion defining an inlet at a first end thereof;
and

a second vertical portion defining an outlet at a second end thereof;

wherein:

the second vertical portion is connected to the first vertical portion such that the outlet is horizontally spaced apart from and disposed vertically higher than the inlet such that a vertical plane extending through the first vertical portion and

the second vertical portion is disposed parallel to a rear exterior surface of the refrigerator; and

the outlet of the chimney assembly is in communication with the horizontally extending exhaust outlet.

11. The refrigerator as claimed in claim 10, wherein said air intake assembly comprises:

a first length of pipe vertically mounted on the rear, exterior surface of the refrigerator, the first length of pipe having opposed upper and lower ends;

a second length of pipe interconnecting said first length of pipe and said air intake adapter, said second length of pipe arranged at an angle with respect to said first length of pipe; and

an air inlet having a first end for mounting to the upper end of said first length of pipe and a second end in fluid communication with the outdoor environment, said air inlet extending generally horizontally away from said first length of pipe through an exterior wall of a building at the time of installation of the refrigerator.

12. The refrigerator as claimed in claim 10 or 11, wherein the first vertical portion and the second vertical portion are interconnected by a horizontal region such that a first 90 degree bend is formed between the first vertical portion and the horizontal region, and a second 90 degree bend is formed between the second vertical portion and the horizontal region.

13. The refrigerator as claimed in any one of claims 10 to 12, wherein said exhaust outlet comprises:

an inner tubular member of corrosion resistant material;

an insulating member surrounding said inner tubular member; and

an outer covering surrounding said insulating member.

14. The refrigerator as claimed in claim 12, further comprising a condensate trap for receiving condensate of the products of combustion and draining the condensate exterior to said direct venting system, wherein the condensate trap includes:

an inlet end disposed in communication with the horizontal region of the chimney assembly, the condensate trap directing condensate away from the inlet of the chimney assembly, and

an outlet end disposed exterior to the burner box.

15. The refrigerator as claimed in claim 14, wherein said condensate trap further comprises a 360 degree loop formed therein and disposed intermediate said inlet end and said outlet end, said 360 degree loop collecting condensate in a lower portion thereof for providing a hermetic seal with respect to an interior environment.

16. The refrigerator as claimed in any one of claims 10 to 15, wherein said exhaust outlet has a maximum length of 18 inches.

17. The refrigerator as claimed in claim 11, wherein said air inlet has a maximum length of 18 inches.

18. The refrigerator as claimed in any one of claims 10 to 17, wherein said burner box includes a burner box cover removably mounted to said burner box for providing access to said open interior cavity, said burner box cover hermetically sealing said burner box with respect to an interior environment.

19. The refrigerator as claimed in claim 18, wherein a gasket is arranged intermediate said burner box and said burner box cover for providing said hermetic seal.

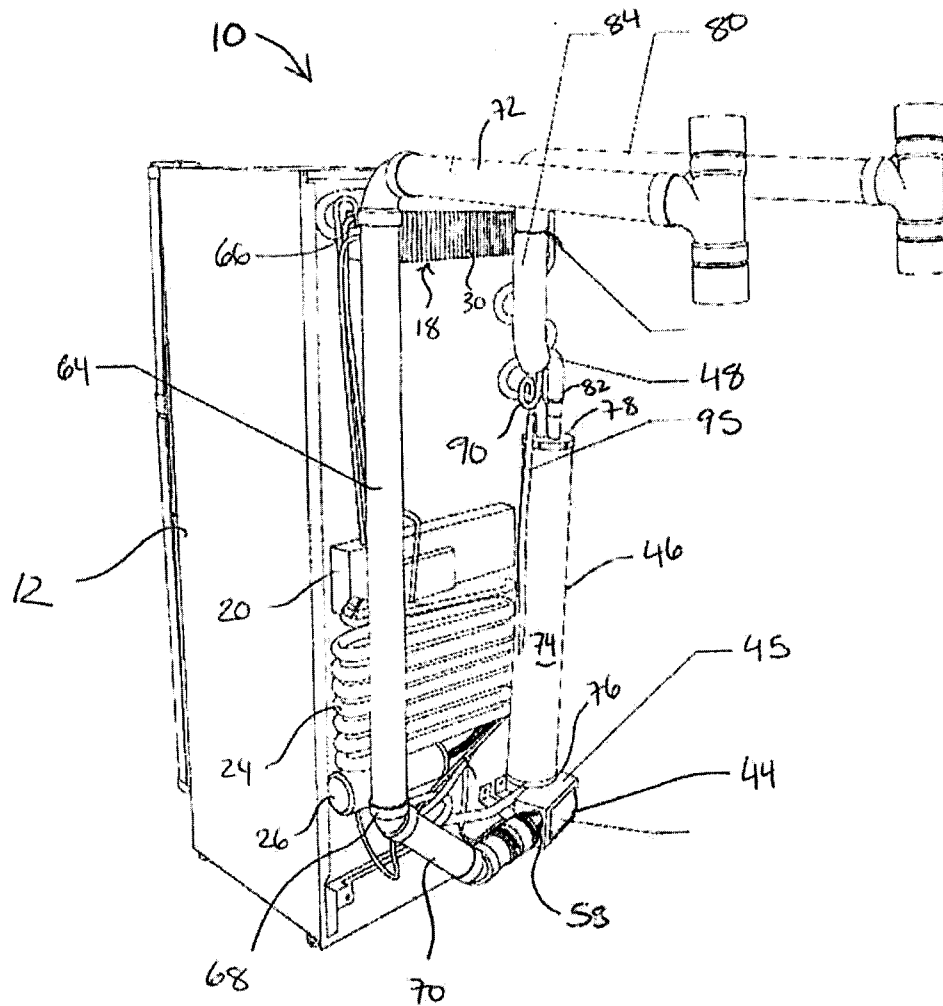


FIG 1

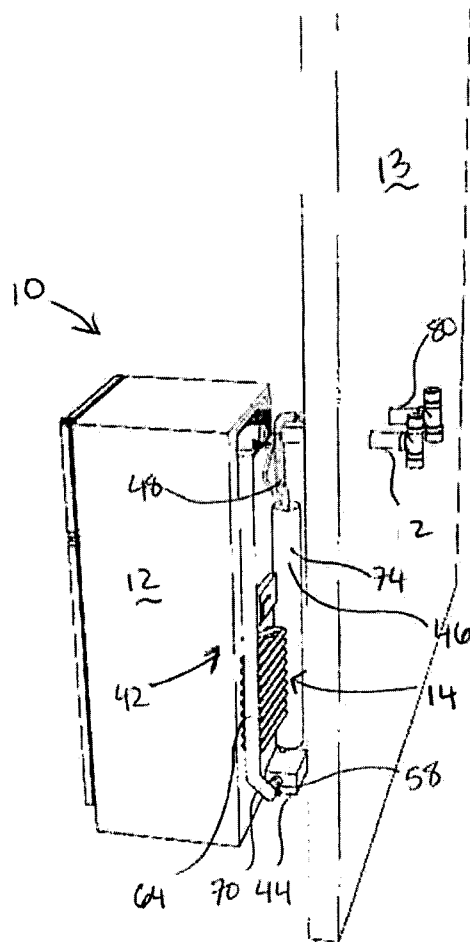


FIG. 2

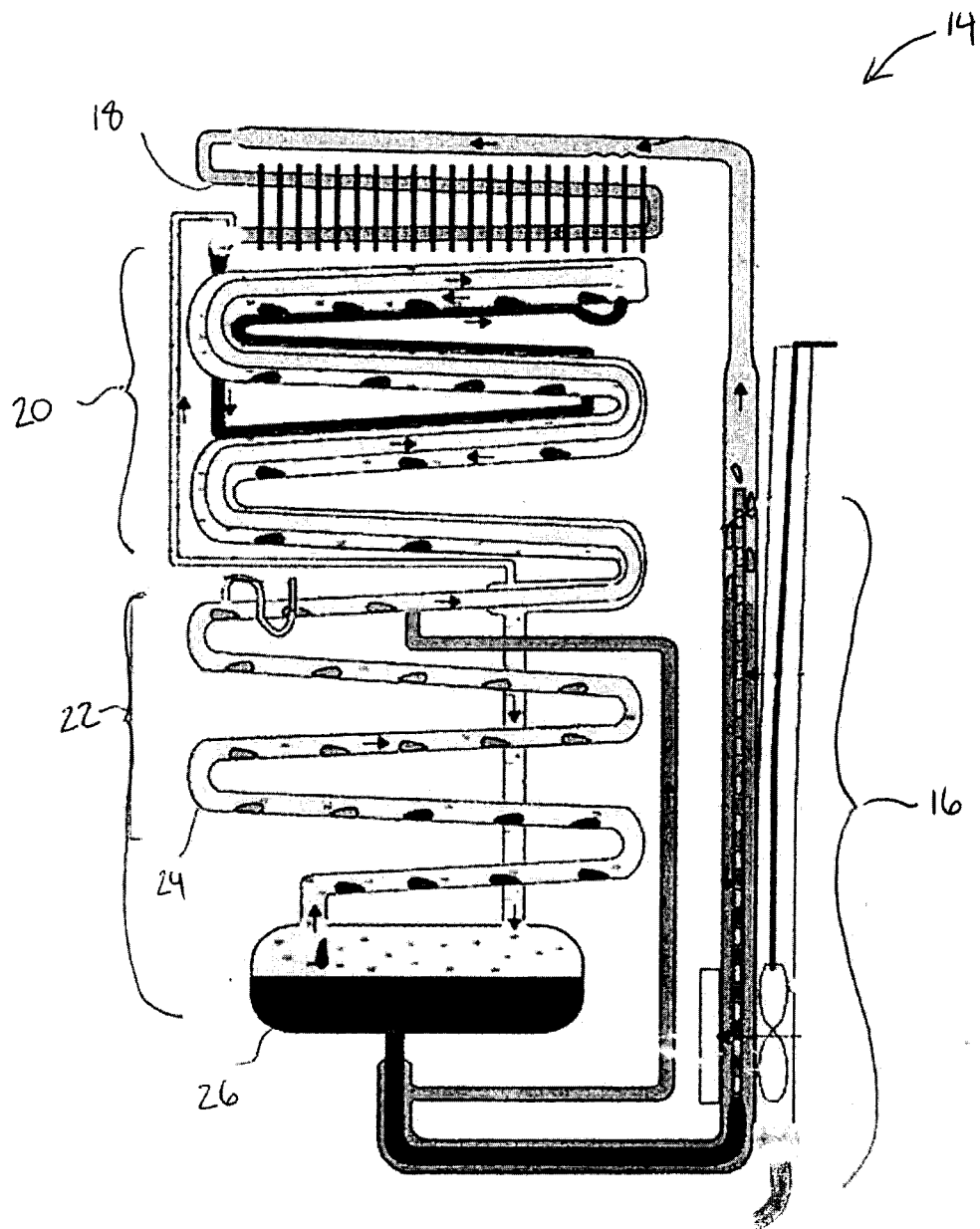


FIG. 3
(PRIOR ART)

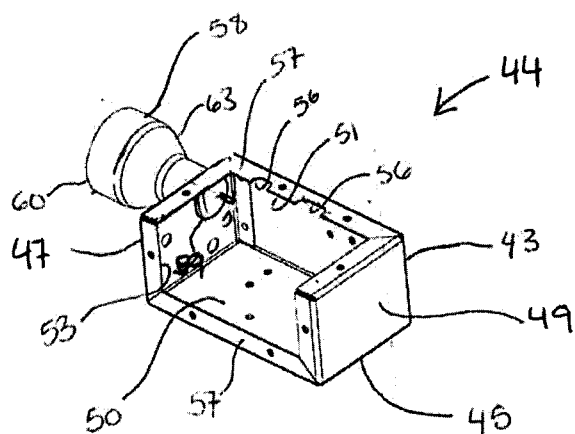


FIG. 4A

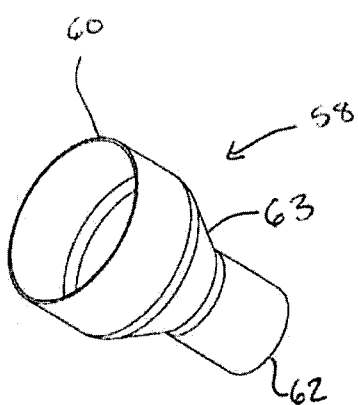


FIG. 5

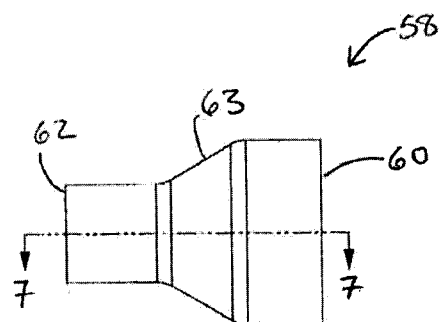


FIG. 6

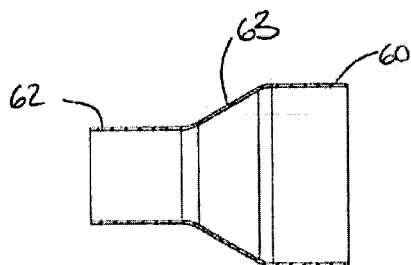
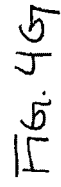
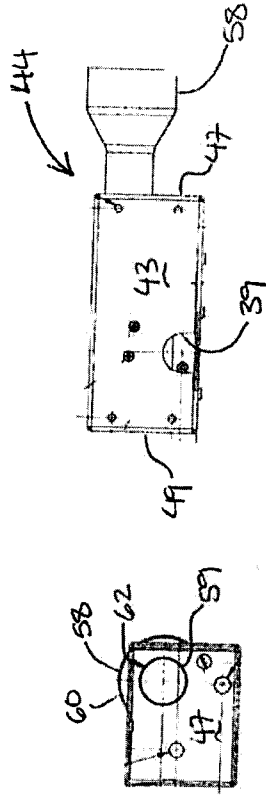
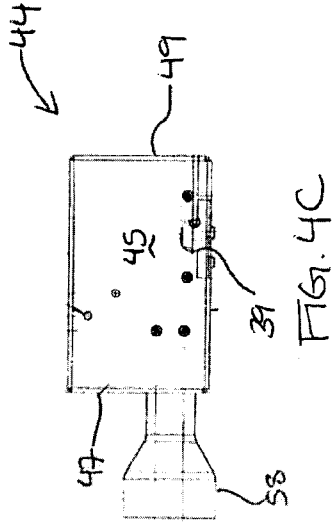
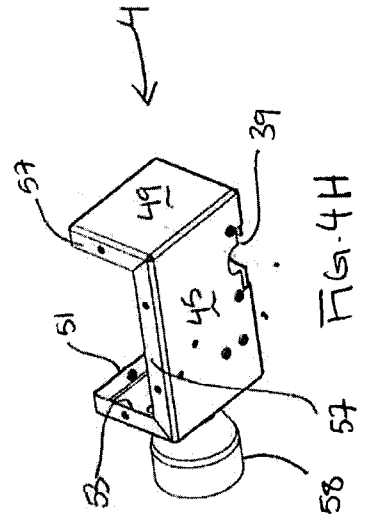
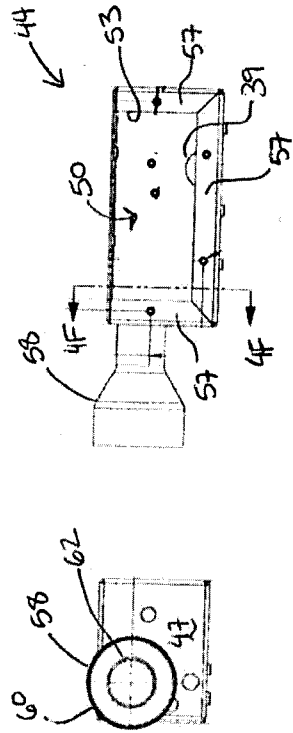
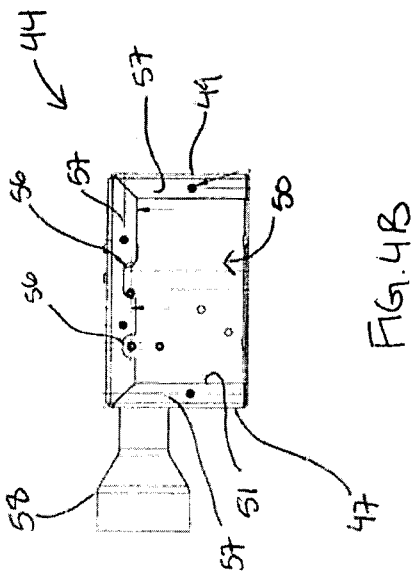
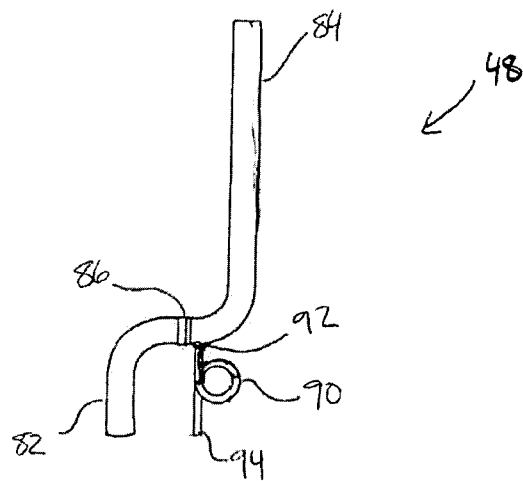
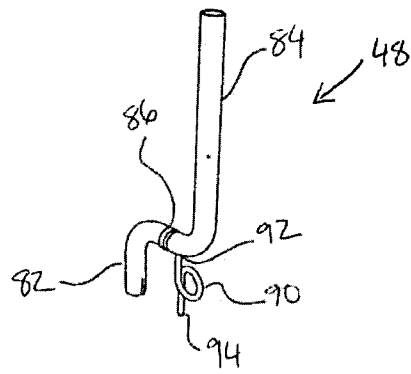


FIG. 7





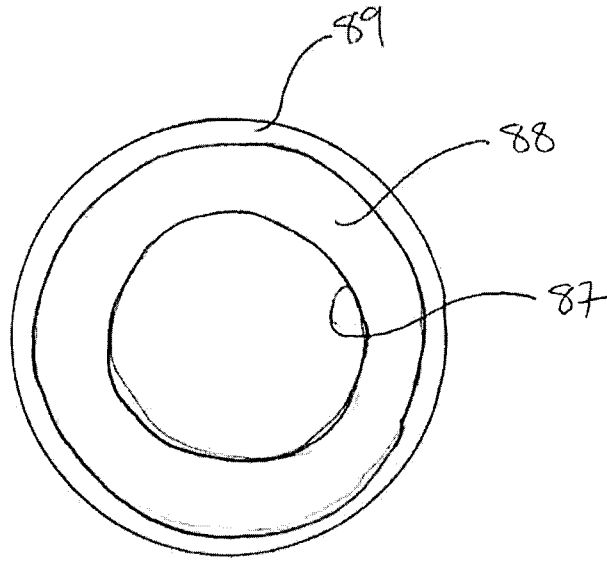


FIG. 10

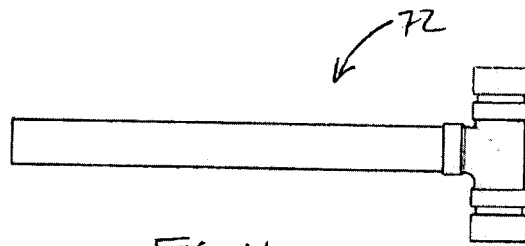


FIG. 11

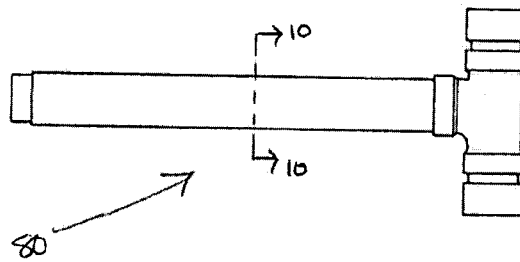


FIG. 12

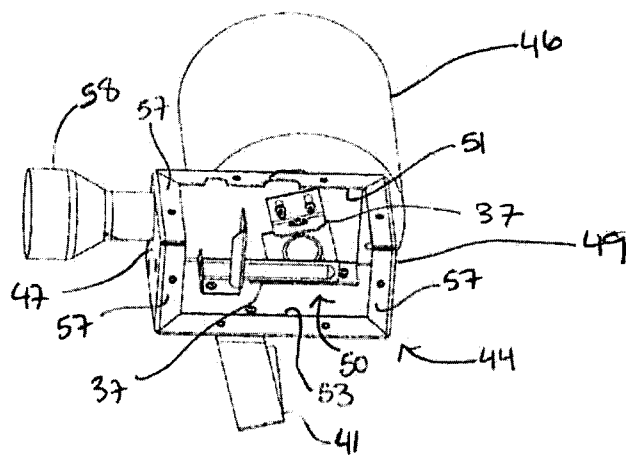


FIG. 13

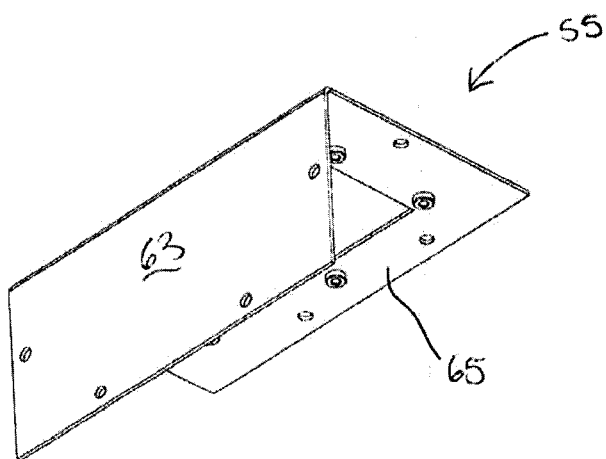


FIG. 14

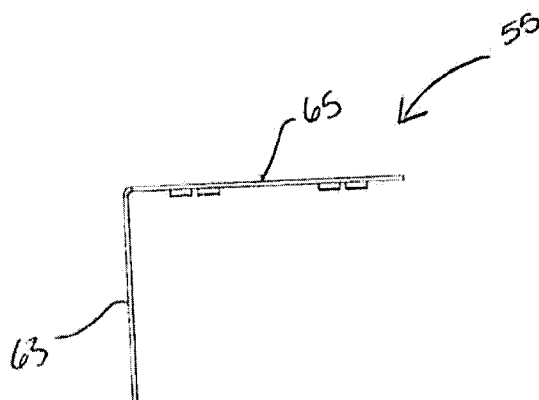


FIG. 15

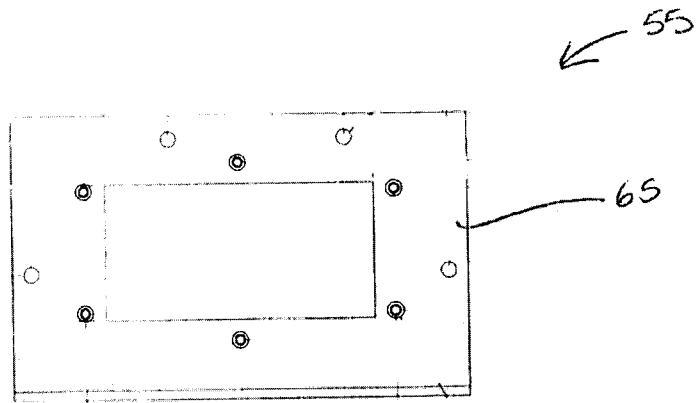


FIG. 16

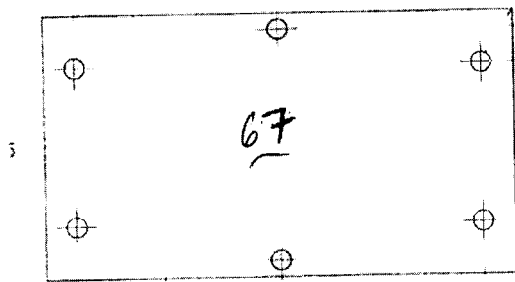


FIG. 17

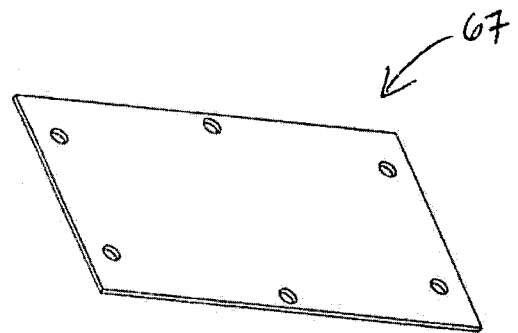


FIG. 18

