United States Patent

Magnusson et al.

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[45] **June 13, 1972**

[54] GAS-OPERATED REFRIGERATOR HAVING SEALED COMBUSTION SYSTEM

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[30] **Foreign Application Priority Data**

Sept. 12, 1969 Sweden.....12566/69

[52] **U.S. Cl.** .....**62/476,** 126/85 B, 126/307 R

[51] **Int. Cl.**.....**F23j 11/00,** F25b 15/00

[58] **Field of Search** .....126/85, 85 B, 307; 98/32, 62; 62/490, 476

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Primary Examiner—Charles J. Myhre
Attorney—Edmund A. Fenander

[57] **ABSTRACT**

A heat-operated refrigerator heated by a gas burner and a heating flue associated therewith is disposed in a space having an apertured exterior side wall. The heating flue and burner form parts of a sealed combustion system which includes a first conduit for supplying all of the combustion supporting air to the burner to form a combustible gas mixture with gas supplied thereto and a second conduit for withdrawing all of the flue gases from the upper end of the flue. The ends of the first and second conduits removed from the burner and flue, respectively, are open and terminate in the apertured side wall, the open end of the first conduit serving as an inlet for ambient air and the open end of the second conduit serving as an outlet for flue gases. The flue gas outlet is disposed above the air inlet. The air inlet and flue gas outlet have the same cross-sectional areas and are flush with the outer surface of the exterior wall.

11 Claims, 6 Drawing Figures

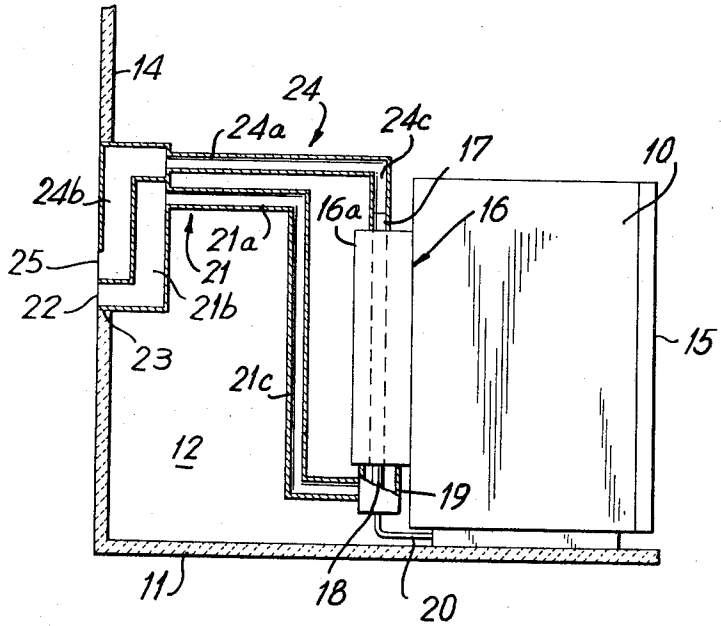


FIG. 1

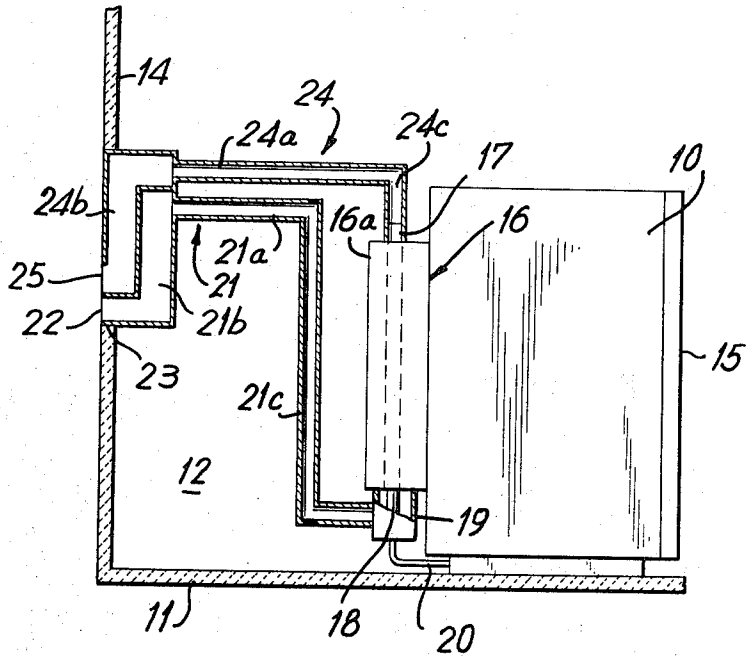


FIG. 2

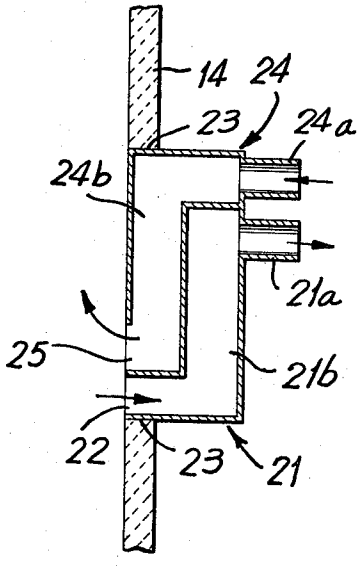


FIG. 3

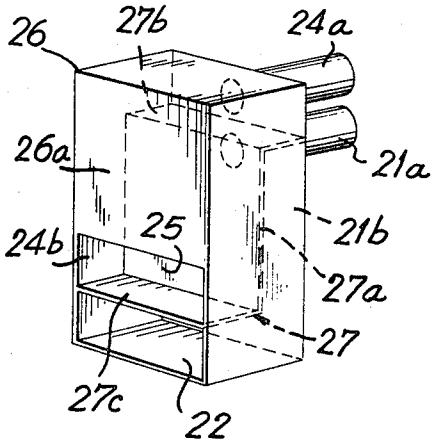


FIG. 4

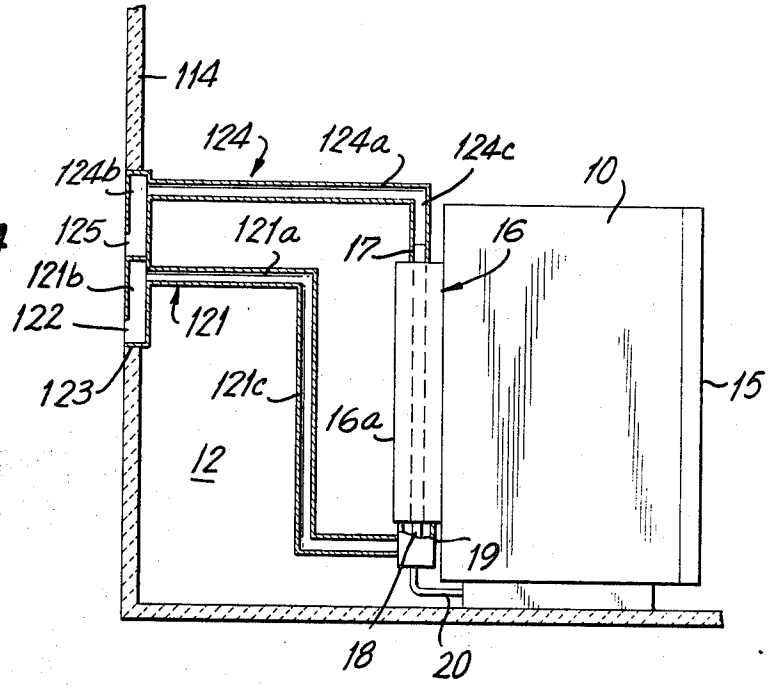


FIG. 5

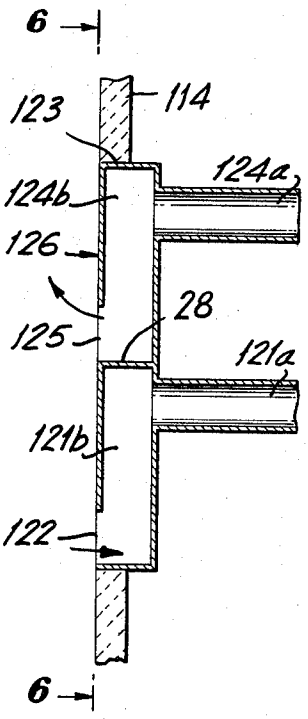
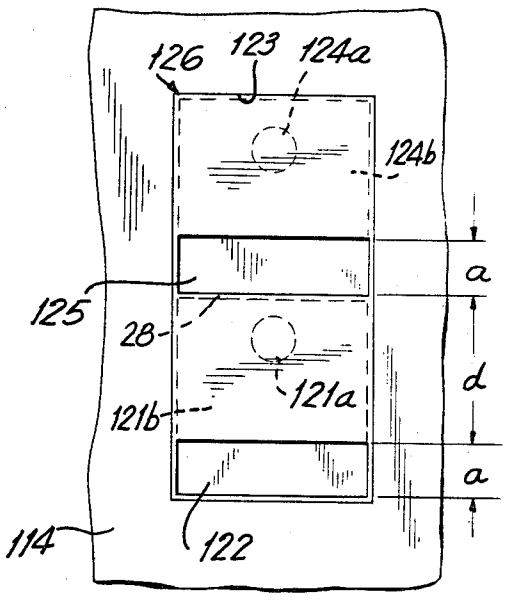


FIG. 6



GAS-OPERATED REFRIGERATOR HAVING SEALED COMBUSTION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to gas-operated refrigerators for enclosed spaces, such as a permanent residential structure, for example, mobile homes like trailers and campers, and boats in which a gas burner and heating flue coacting therewith form parts of a sealed combustion system having a first conduit for supplying ambient air to the burner, such ambient air constituting all of the air supplied to the burner to form a combustible gas mixture with a combustible gas supplied thereto, and having a second conduit for conducting all of the flue gases from the flue outside the space.

2. Description of the Prior Art

Sealed combustion systems of the kind referred to above have been employed for operating heat-operated refrigerators. However, sealed combustion systems heretofore employed have not been satisfactory due to the fact that the pressure of ambient air fluctuates and produces pressure changes which are reflected back through the system and often extinguish the burner flame. This has occurred in systems in which the ambient air inlet is relatively near to the burner and the flue gas outlet is located at a region removed from the air inlet and located at a region more or less convenient with respect to the upper end of the heating flue. This is objectionable because, although the supply of gas will be shut off automatically when the burner flame is extinguished, the food stored in the refrigerator may spoil due to lack of refrigeration.

For this reason efforts have been made to overcome this difficulty by locating the air inlet and flue gas outlet adjacent to one another in an apertured exterior side wall and providing conduits of approximately the same length for supplying combustion supporting air to the burner and withdrawing flue gases from the flue. However, the burner flame in systems of this type often is extinguished in spite of the fact that the air and flue gas conduits are of the same length and belief that, because the air inlet and flue gas outlet will be subjected to the same pressure fluctuations of ambient air, the pressure changes reflected back to the burner through both conduits will counteract one another so that the burner flame will always be maintained.

In combustion systems of the kind just described the outer end of the ambient air conduit and flue gas conduit extend through the apertured exterior side wall and project from the outer face of such wall and vertical screens are arranged in different ways to prevent strong winds perpendicular to the exterior wall from entering the open ends of the air conduit and flue gas conduit. Such screens also have been provided with openings in the top and bottom parts thereof to prevent gusts of wind parallel to the exterior side wall from producing pressure changes at the outer ends of the air and flue gas conduits which is objectionable. Besides not being able to maintain the burner flame under all adverse operating conditions encountered, the screens projecting from the exterior side wall are unsightly which also is objectionable.

SUMMARY OF THE INVENTION

It is an object of our invention to provide an improved sealed combustion system of the kind referred to above for operating a gas-operated refrigerator in which the burner flame will be maintained under all operating conditions encountered. We accomplish this by providing a sealed combustion system in which the outlet for flue gases is disposed above the inlet for ambient air and the air inlet and flue gas outlet have the same cross-sectional areas and are flush with the outer surface of the exterior side wall of the space in which the refrigerator is disposed.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic representation in elevation of a gas-operated refrigerator and conduit connections therefor through which combustion supporting air is supplied to the gas burner and heated products of combustion are withdrawn from a flue coacting with the gas burner;

FIG. 2 is a vertical sectional view of parts shown in FIG. 3 which are like the conduit connections shown in FIG. 1;

FIG. 3 is a perspective view of the parts of the conduit connections shown in FIG. 2;

FIG. 4 is a diagrammatic representation like that shown in FIG. 1 illustrating another embodiment of the invention;

FIG. 5 is an enlarged fragmentary view of the conduit connections shown in FIG. 4 to illustrate details more clearly; and

FIG. 6 is a fragmentary elevational view taken at line 6—6 of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 to 3, we have shown our invention in connection with a gas-operated refrigerator 10 which is supported on a floor 11 of an enclosure or space 12 having an exterior side wall 14. The floor 11 and side wall 14 may form parts of a permanent building, such as a residential structure, for example, a mobile home like a trailer or camper, or a boat.

The refrigerator 10, which has a front access opening closed by a door 15, is adapted to be operated by gas-operated refrigeration apparatus which may be an absorption refrigeration system of a uniform pressure type and like that described in U.S. Pat. No. 3,512,371 to Sven A. Gurt and Karl H. Lindström, granted May 19, 1970. The refrigeration system comprises a plurality of parts which are interconnected in a well-known manner and include a cooling unit (not shown) arranged to effect cooling of the interior of the refrigerator and a heat receiving part 16 having a heating flue 17 associated therewith. The heat receiving part 16, which is located at the rear of the refrigerator 10, is enclosed in an upright shell 16*a* through which the flue 17 extends.

In order to simplify the drawing, the parts of the refrigeration system other than the heat receiving part 16 have not been shown, such parts being well-known and their illustration not being necessary for an understanding of our invention. The disclosure in the aforementioned Gurt et al patent may be considered as being incorporated in this application, and if desired, reference may be made thereto for a detailed description of the refrigeration system.

A gas burner, which is diagrammatically shown at 18 in FIG. 1 and is disposed within a hood 19, is positioned at the bottom of the heat receiving part 16 and projects its flame into the lower end of the flue 17. Combustible gas is delivered to the burner 18 through a conduit 29 from a suitable source of supply. Combustion supporting air is supplied to the burner 18 through a conduit 21 having its inner end connected to the hood 19 and its outer end terminating in an inlet 22 at an opening 23 in the exterior side wall 14.

When the burner 18 is ignited in any well-known manner (not shown) and a combustible gas is supplied thereto through the conduit 20, combustion supporting air is supplied to the burner 18 through the conduit 21, such air being ambient air which is drawn into the conduit at its inlet 22. The hood 19 in which the burner 18 is disposed and the conduit 21 form a "closed" or "sealed" combustion system for the burner 18 in which all of the combustion supporting air is supplied through the conduit 21. Hence, the burner 18 does not operate in the open and so-called "secondary" air to support combustion is not provided at the vicinity of the burner flame.

The heated gases flowing in the flue 17 effect heating of the heat receiving part 16 whereby the refrigeration system will function to promote cooling of the interior of the refrigerator. All of the heated products of combustion, which may be referred to as flue gases, are discharged from the upper end of flue 17 and conducted exteriorly of the space 12 through a conduit 24. The inner end of the conduit 24 is connected to the upper end of the flue 17 and the outer end thereof terminates at an outlet 25 at the opening 23 in the exterior side wall 14. Hence, the conduit 24 for the flue gases also forms a part of the sealed combustion system.

The air inlet **22** and outlet **25** for flue gases are immediately adjacent to one another and in abutting relation. The conduit **21** is of inverted U-shape having a closed end or section **21***a* and depending vertical legs or sections **21***b* and **21***c*, the leg **21***b* terminating in the air inlet **22** and the leg **21***c* communicating with the burner hood **19**. The conduit **24** also is of inverted U-shape having a closed end or section **24***a* and depending vertical legs **24***b* and **24***c*, the leg **24***b* terminating in the outlet **25** for the flue gases and the leg **24***c* communicating with the upper end of the flue **17**.

The cross-sectional areas of the inlet **22** and outlet **23** and the conduit sections **21***b* and **24***b* connected thereto are greater than the cross-sectional areas of the conduit sections **21***a*, **21***c* and **24***a*, **24***c*. As seen in FIG. **3**, the air inlet **22** and outlet **25** for flue gases are rectangular with their major axes extending horizontally.

A rectangular-shaped casing **26** having suitable partitioning can be employed to provide the air inlet **22** and flue gas outlet **25** and vertical conduit sections **21***b* and **24***b* communicating therewith, as shown in FIG. **3**. The casing **26** fits snugly in the opening **23** in the exterior side wall **14** with the outer wall **26***a* of the casing flush with the outer surface or face of the side wall **14**. Partitioning **27** of zig-zag shape is provided within the casing **26** which includes a vertical portion **27***a* between the front and rear walls thereof and horizontal portions **27***b* and **27***c* projecting in opposite directions from the vertical portion at its top and bottom edges, respectively.

The portion **27***c* bisects a cut-out section at the bottom of the front wall **26***a* to form the air inlet **22** and flue gas outlet **25**. Conduit sections **22***a* and **24***a* are connected to the rear wall of the casing **26** at regions above and below the horizontal partition portion **27***b*. It will now be understood that the partitioning **27** in the casing **26** provides two vertical passageways therein which serve as the conduit sections **21***b* and **24***b* schematically shown in FIGS. **1** and **2**.

A protective grate (not shown) can be mounted on the casing **26** over the air inlet **22** and flue gas outlet **25** to prevent insects and the like from entering the conduits **21** and **24**. We have found that a slotted cover over the air inlet **22** and flue gas outlet **25** is not desirable because the burner flame may be extinguished when certain wind conditions prevail at the exterior side wall **14**. An important feature of the embodiment being described is that the air inlet **22** and flue gas outlet **25** have substantially the same cross-sectional areas and are flush with outer surface of the exterior side wall **14**.

We also have discovered that it is extremely important to provide an air inlet **22** and a flue gas outlet **25** each having a cross-sectional area greater than that of the heating flue **17**. Further, to insure optimum performance of the embodiment of our invention shown in FIGS. **1**, **2** and **3** and just described, the air inlet **22** and flue gas outlet **25** must be operatively associated with separate passageways or conduit sections **21***b* and **24***b* of substantially the same size or cross-sectional area. From the conduit sections **21***b* and **24***b* the other conduit sections **21***a*, **21***c* and **24***a*, **24***c* connected to the hood **19** and flue **17**, respectively, desirably are of smaller size or cross-sectional area.

We have illustrated another embodiment of our invention in FIGS. **4**, **5** and **6** in which parts similar to those shown in FIGS. **1**, **2** and **3** are referred to by the same reference numerals. In FIGS. **4**, **5** and **6** a conduit **121** extending from the exterior side wall **114** to the rear of the refrigerator **10** has an inlet **122** for combustion supporting air at its outer end and is connected to the hood **19** of the burner **18** at its inner end. A conduit **124** extending from the exterior side wall **114** to the rear of the refrigerator **10** has an outlet **125** for flue gases at its outer end and is connected to the upper end of the flue **17** at its inner end.

A rectangular-shaped casing **126**, which snugly fits in the opening **123** in the side wall **114**, includes a horizontal partition **28** which divides the casing into top and bottom compartments or spaces **124***b* and **121***b*, respectively.

The front wall of the casing **126** is formed with cut-away sections which provide the air inlet **122** and flue gas outlet **125** which are flush with the outer surface of the exterior side wall **114**. The conduit **121** for combustion supporting air includes a horizontal section **121***a* which is connected to the rear wall of the casing **126** at an opening therein which is below the partition **28**. Hence, the forward end of the conduit section **121***a* is in communication with the upper part of the vertical passageway in the bottom compartment of the casing **126** which serves as the conduit section **121***b*. The rear end of the conduit section **121***a* is connected to the vertical conduit section **121***c* which depends downward therefrom and is connected to the hood **19**.

The conduit **124** for flue gases includes a horizontal section **124***a* which is connected to the rear wall of the casing **126** at an opening therein adjacent to the top of the casing. Hence, the forward end of the duct section **124***a* is in communication with the upper part of the vertical passageway in the top compartment of the casing **126** which serves as the conduit section **124***b*. The rear end of the conduit section **124***a* is connected to the vertical conduit section **124***c* which depends downward therefrom and is connected to the upper end of the flue **17**. Suitable protective gratings (not shown) may also be provided in the casing **126** at the regions of the air inlet **122** and flue gas outlet **125**.

As seen in FIG. **6**, the air inlet **123** and flue gas outlet **125** are rectangular with their major axes extending horizontally and their cross-sectional areas are greater than the cross-sectional areas of the conduit sections **121***a* and **124***a* connected to the rear wall of the casing **126**. Further, the air inlet **122** is at the bottom of the bottom compartment of the casing **126** while the conduit section **122***a* projects rearward from the top part of the bottom compartment of the casing. Similarly, the flue gas outlet **125** is at the bottom of the top compartment of the casing **126** while the conduit section **124***a* projects rearward from the top part of the top compartment of the casing.

In the first-described embodiment of FIGS. **1**, **2** and **3**, the air inlet **22** and flue gas outlet **25** are in abutting relation and separated only by the horizontal portion **27***c* of the partition **27**. In FIG. **6** it will be noted that the air inlet **122** and flue gas outlet **125** have the same cross-sectional areas and the same height *a* and are separated by the vertical distance *d*. The distance *d* desirably is in a range which is from 5 cm. to 15 cm. Hence, when both of the embodiments described are considered together, the vertical distance between the air inlet **22**, **122** and flue gas outlet **25**, **125** can be in a range of from 0 to 15 cm.

We claim:

1. In structure defining a space having an exterior side wall, heat-operated refrigeration apparatus disposed in said space, said refrigeration apparatus comprising a heat receiving part having a heating flue, a gas burner coacting with said flue, means for supplying combustible gas to said burner, first conduit means for conducting combustion supporting air to said burner, second conduit means for conducting flue gases from the upper end of said flue, said first and second conduit means and burner and flue being constructed and formed to provide a sealed combustion system in which all of the combustion supporting air is supplied to said burner through said first conduit means and all of the flue gases are withdrawn from said flue through said second conduit means, said exterior side wall being apertured, the end of said first conduit means removed from said burner being open and terminating in said apertured side wall and serving as an inlet for ambient air, the end of second conduit means removed from said flue being open and terminating in said apertured side wall and serving as an outlet for flue gases, said flue gas outlet being disposed above said air inlet, and said air inlet and flue gas outlet having substantially the same cross-sectional areas and being substantially flush with the outer surface of said exterior side wall, said first conduit means including a vertically disposed section extending upward from said air inlet and said second conduit means including a vertically disposed section extending downward to said flue gas outlet.

2. Apparatus as set forth in claim 1 in which said apertured side wall has an opening therethrough and at least the vertically disposed section of said second conduit is in the vertical plane of said wall opening.

3. Apparatus as set forth in claim 1 which includes means defining two vertically extending spaces separated by partitioning, one of said spaces serving as the vertically disposed section of said first conduit and the other of said spaces serving as the vertically disposed section of said second conduit.

4. Apparatus as set forth in claim 3 in which said first conduit includes a horizontal section and said second conduit includes a horizontal section, each of said horizontal sections being in communication with a different one of said vertically extending spaces.

5. Apparatus as set forth in claim 1 which comprises a rectangular-shaped casing at the apertured side wall, said casing having partitioning defining said vertically extending sections of said first and second conduits, a wall of said casing flush with the outer surface of said exterior side wall being apertured to provide said air inlet and flue gas outlet at opposing sides of said partitioning.

6. Apparatus as set forth in claim 5 in which said partitioning comprises a zig-zag member having a vertical portion and horizontal portions projecting in opposite directions from said vertical portion at the top and bottom thereof, the air inlet and flue gas outlet being in abutting relation below and above said bottom horizontal portion at said apertured side wall of said casing.

7. Apparatus as set forth in claim 1 in which said vertically disposed section of said second conduit is flush with the outer surface of said exterior side wall and said vertically disposed section of said first conduit is at the rear of said vertically disposed section of said second conduit.

8. Apparatus as set forth in claim 1 in which said vertically disposed sections of said first and second conduits are both flush with the outer surface of said exterior side wall with said vertically disposed section of said first conduit below said vertically disposed section of said second conduit.

9. In structure defining a space having an exterior side wall, heat-operated refrigeration apparatus disposed in said space, said refrigeration apparatus comprising a heat receiving part having a heating flue, a gas burner coacting with said flue, means for supplying combustible gas to said burner, first conduit means for conducting combustion supporting air to said burner, second conduit means for conducting flue gases from the upper end of said flue, said first and second conduit means and burner and flue being constructed and formed to provide a sealed combustion system in which all of the combustion supporting air is supplied to said burner through said first conduit means and all of the flue gases are withdrawn from said flue through said second conduit means, said exterior side wall being apertured, the end of said first conduit means removed from said burner being open and terminating in said apertured side wall and serving as an inlet for ambient air, the end of said second conduit means removed from said flue being open and terminating in said apertured side wall and serving as an outlet for flue gases, said flue gas outlet being disposed above said air inlet, and said air inlet and flue gas outlet having substantially the same cross-sectional areas and being substantially flush with the outer surface of said exterior side wall, each of said first and second conduit means including first vertically disposed portions at the immediate vicinities of said air inlet and flue gas outlet and second portions extending from said first portions to said burner and flue, respectively, the cross-sectional areas of said air inlet and flue gas outlet being at least as great as the cross-sectional areas of said first vertically disposed portions of said first and second conduit means, and the cross-sectional areas of said first vertically disposed portions being greater than the cross-sectional areas of the second portions of said first and second conduit means.

10. Apparatus as set forth in claim 9 in which the first and second portions of each of said first and second conduit means is of inverted U-shape.

11. Apparatus as set forth in claim 9 in which the cross-sectional areas of said first vertically disposed portions of said first and second conduit means are at least equal to the cross-sectional area of said flue.

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