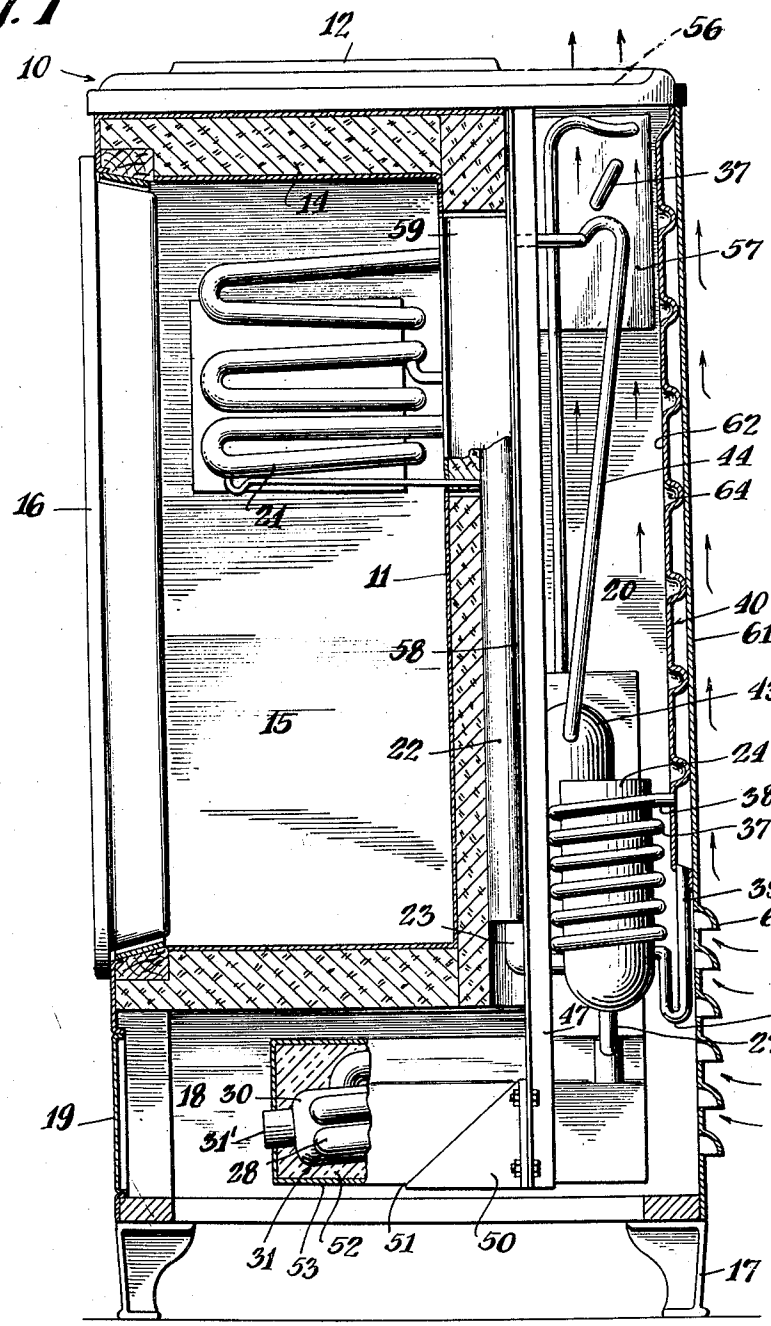
Oct. 24, 1939. W. A. KUENZLI 2,177,072

REFRIGERATOR

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Fig. 1



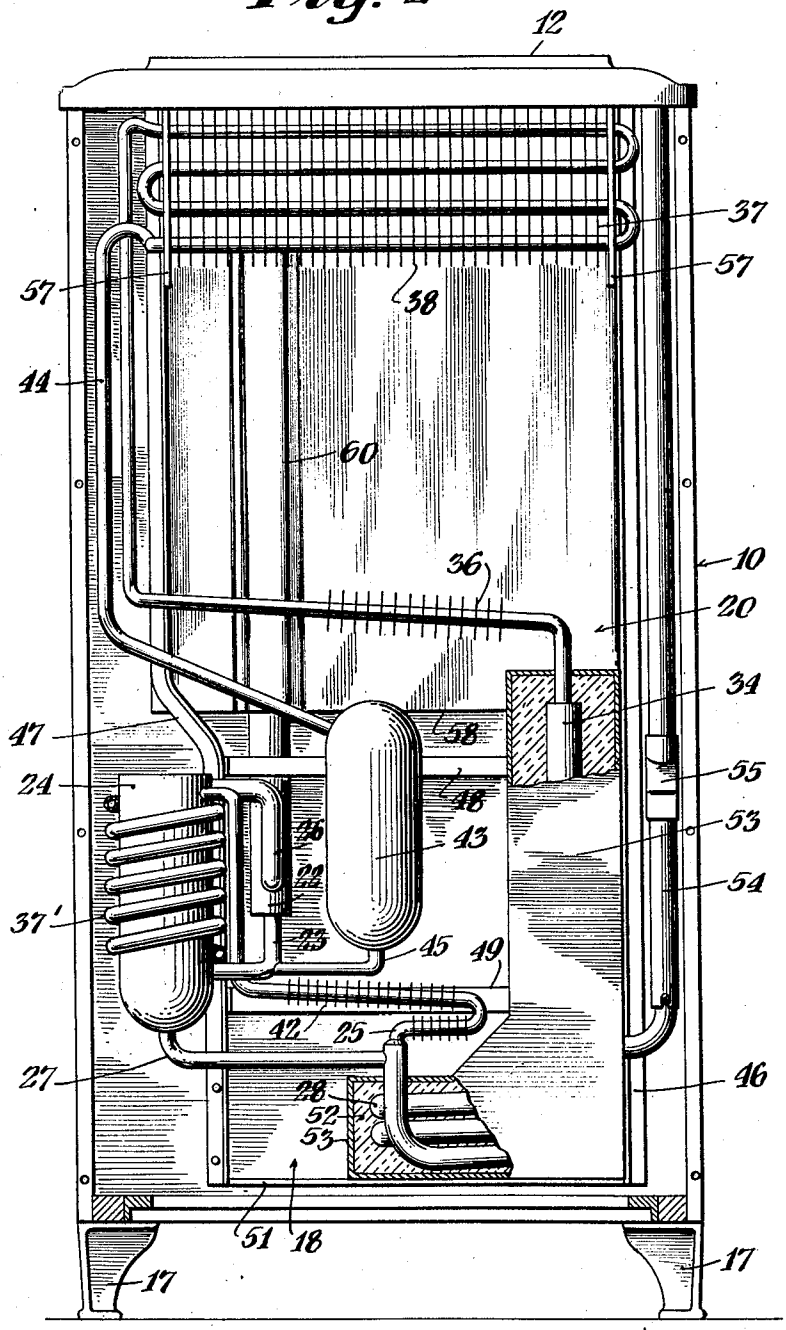
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Fig. 2



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Fig. 3

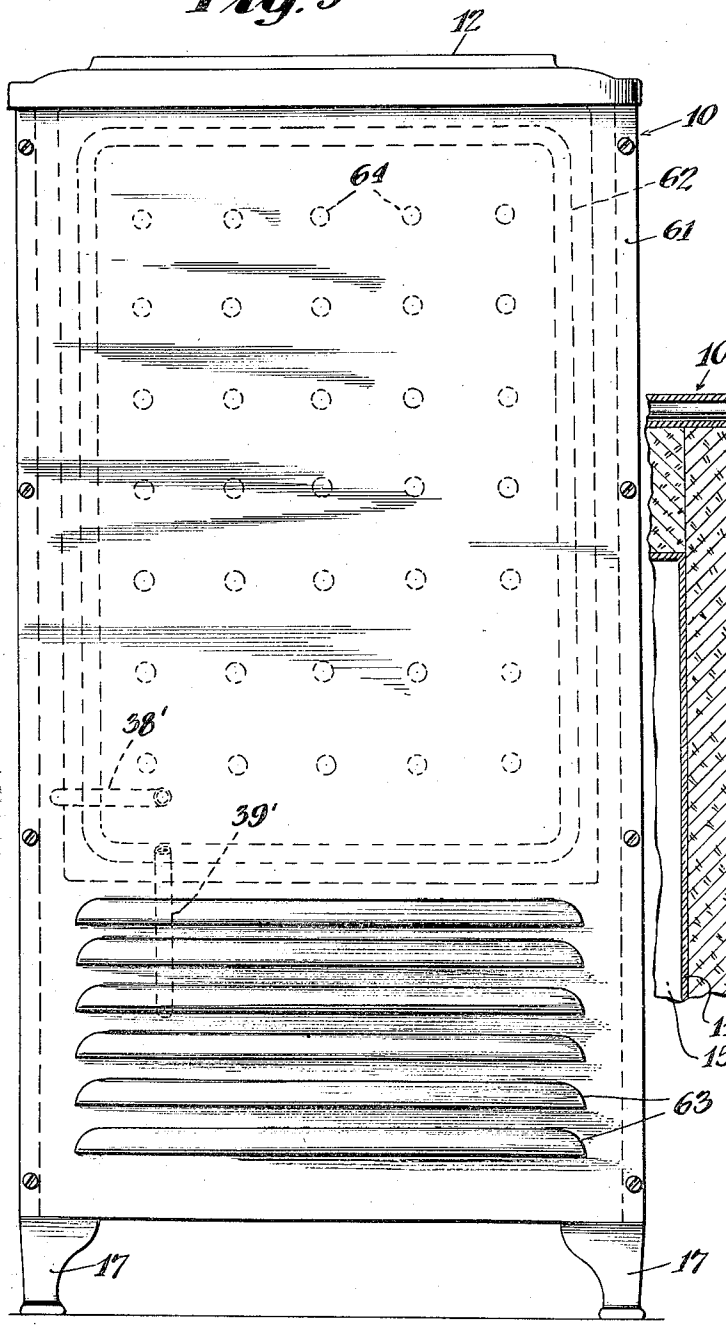
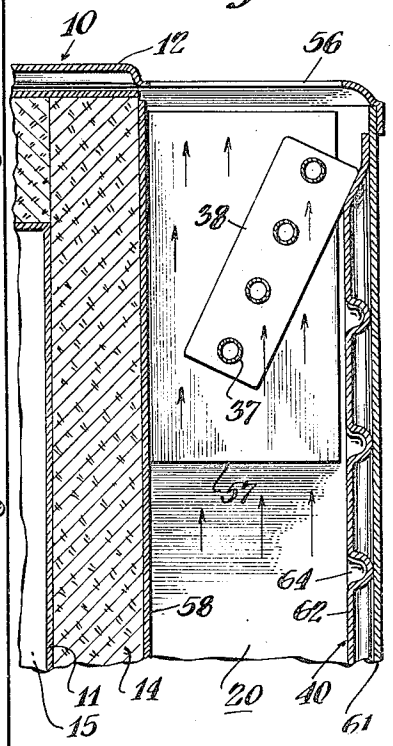


Fig. 4



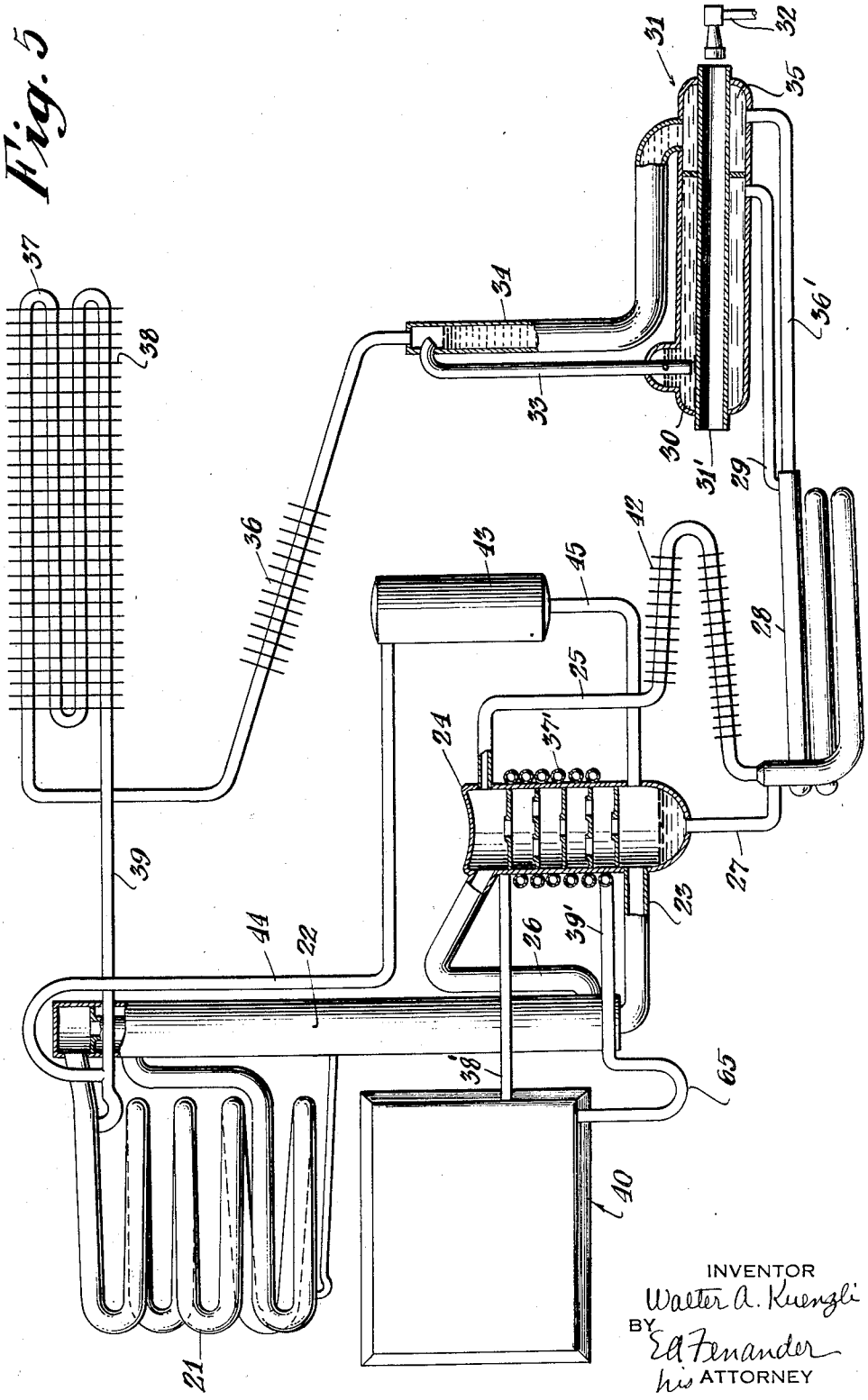
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Fig. 5



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2,177,072

REFRIGERATOR

Walter A. Kuenzli, Evansville, Ind., assignor to Servel, Inc., New York, N. Y., a corporation of Delaware

Application June 10, 1937, Serial No. 147,455

4 Claims. (Cl. 62—119.5)

My invention relates to refrigerators, and more particularly to refrigeration apparatus having one or more parts cooled by circulation of air which is induced either by forced or natural draft.

In refrigerators of this type it has generally been the practice to provide a vertically extending compartment at the rear of the cabinet for housing parts of the refrigeration apparatus. These parts include one or more heat rejecting elements which are usually formed of looped coils provided with heat dissipating elements or cooling fins, such elements being cooled by circulation of air which is induced either by forced or natural draft.

It is an object of my invention to provide an improved refrigerator whereby one or more heat rejecting elements having a relatively extensive heat transfer surface are fabricated from sheets of metal having a fluid passage therebetween.

Another object of my invention is to utilize a heat rejecting element formed of contacting metallic sheets as the condensation portion of a hermetically closed heat transfer system in which a volatile fluid circulates naturally to cool a part of the refrigeration apparatus.

A further object of my invention is to employ a heat rejecting element formed of contacting metallic sheets as the rear panel or wall of a refrigerator to provide a completely enclosed flue space in which one or more heat rejecting elements may be disposed.

The above and other objects and advantages of the invention will be more fully understood from the following description taken in conjunction with the accompanying drawings forming a part of this specification, and of which Fig. 1 is a side vertical sectional view of a refrigerator embodying the invention; Fig. 2 is a rear elevation of the refrigerator shown in Fig. 1 with the rear wall or panel removed; Fig. 3 is a rear elevation of the refrigerator shown in Fig. 1 with the rear wall or panel in position; Fig. 4 is a fragmentary sectional view illustrating more clearly parts of the refrigerator shown in Fig. 1; and Fig. 5 diagrammatically illustrates refrigeration apparatus of which parts are shown in Figs. 1 and 2.

Referring to Fig. 1, I have shown my invention embodied in a refrigerator comprising a cabinet 10 having an inner metal shell 11 arranged to be supported within an outer metal shell 12 and insulated therefrom with any suitable insulating material 14. The inner metal shell 11 defines a thermally insulated storage space 15 into which access may be had by a door 16 hinged to the front of the cabinet.

The cabinet 10 is mounted on supporting legs 17, and below the storage space 15 is provided an apparatus compartment 18 into which access may be had by a door 19 arranged at the front of the cabinet. The apparatus compartment 18 extends to the rear of the cabinet and communicates with an upward extending compartment 20 which also houses parts of the refrigeration apparatus. The refrigeration apparatus I have shown in Figs. 1 and 2 is of a uniform pressure absorption type, generally as described in Patent No. 1,609,334 to von Platen and Munters, which contains an auxiliary pressure equalizing gas.

Referring to Fig. 5, the apparatus or system includes a cooling element or evaporator 21 which is disposed in the enclosed space 15. A refrigerant fluid, such as ammonia, evaporates in the cooling element 21 and diffuses into an inert gas, such as hydrogen, to produce a refrigerating effect. The resulting gas mixture of ammonia and hydrogen flows from the cooling element 21 through the inner passage of a gas heat exchanger 22 and a conduit 23 into an absorber 24.

In absorber 24 ammonia vapor is absorbed by a suitable liquid absorbent, such as water, which enters through a conduit 25. The hydrogen, which is practically insoluble and weak in ammonia, is returned to the lower end of cooling element 21 through conduit 26 and the outer passage of the gas heat exchanger 22; and the enriched absorption liquid is conducted from absorber 24 through conduit 27, the outer passage of a liquid heat exchanger 28, and conduit 29 to the rear chamber 30 of a generator 31.

By heating the generator 31, as by a gas burner 32, for example, which projects its flame into a horizontal flue 31', ammonia vapor and absorption liquid are raised by vapor-lift action through conduit 33 into the upper part of a stand-pipe 34 which communicates at its lower end with a forward chamber 35 of the generator. Liberated ammonia vapor entering stand-pipe 34 through conduit 33, as well as the ammonia vapor expelled from solution in stand-pipe 34 and chamber 35, flows upward through an air-cooled rectifier 36 into a condenser 37 which is in the form of a looped coil provided with heat dissipating elements or cooling fins 38. The ammonia vapor is condensed in condenser 37 and returned to cooling element 21 through conduit 39 to complete the refrigerating cycle.

The weakened absorption liquid from which ammonia has been expelled is conducted from

chamber 35 through conduit 36', the inner passage of liquid heat exchanger 28 and conduit 25 into the upper part of absorber 24. The heat liberated with absorption of ammonia vapor in absorber 24 is transferred to a coil 37' which is disposed about and in thermal relation with the absorber. The coil 37' forms the vaporization portion of a heat transfer system and is connected by conduits 38' and 39' to a condensation portion 40, as will be described hereinafter. Conduit 25 may be provided with cooling fins 42 for cooling weakened absorption solution flowing toward absorber 24.

A pressure vessel 43 is connected by conduits 44 and 45 to the lower part of condenser 37 and to the gas circuit, as at absorber 24, for example, so that any hydrogen which may pass into the condenser can flow into the gas circuit. Ammonia vapor not liquefied in condenser 37 will flow through conduit 44 to displace hydrogen in vessel 43 and force such hydrogen through conduit 45 into the gas circuit, thereby raising the total pressure in the system so that an adequate condensing pressure is obtained to insure condensation of ammonia vapor in condenser 37.

The different elements or parts of the refrigeration apparatus just described are made of metal and permanently secured together, as by welding, for example, to provide a hermetically closed system. The apparatus, as shown in Figs. 1 and 2, is mounted on a frame comprising vertical angle members 46 and 47, horizontal angle members 48 and 49, end brackets 50, and a bottom metallic sheet 51. The liquid heat exchanger 28, generator 31, and stand-pipe 34 are preferably embedded in a body 52 of insulating material contained in a shell 53. The lower part of shell 53 is disposed in the lower apparatus compartment 18 with the forward end of the horizontal flue 31' extending through an opening in the shell. The burner 32 (not shown in Fig. 1) may be supported in any suitable manner to project its flame into flue 31'.

The rear end of flue 31' is connected to an offtake duct 54 which extends upward in the rear compartment 20 to the top of the cabinet. A suitable device, diagrammatically indicated at 55, may be connected in the offtake duct 54 to permit air to flow into the flue for diluting and cooling the flue gases before being discharged through openings 56 provided at the top of the cabinet 10.

To the ends of condenser 37 are secured side plates 57 between which are disposed the heat dissipating elements 38. The side plates 57 are mounted at their forward edges to the vertical angle members 46 and 47. Between the vertical angle members 46 and 47 is fixed a back-plate 58 to which is secured a removable insulated wall section 59 which fits in an opening in the rear wall of the storage space 15. The conduits connecting the cooling element 21 and the other parts of the apparatus, as shown most clearly in Fig. 5 and described above, extend through the removable wall section 59.

The rear insulated wall 11 is recessed to receive the gas heat exchanger 22 against which the raised portion 60 of backplate 58 bears. The raised portion 60 is preferably lined with insulating material so that a large portion of the gas heat exchanger will be well insulated. The frame upon which the refrigeration apparatus is mounted is secured in position at the rear of cabinet 10 in any suitable manner well known in the art, and a rear panel or wall member 61 is secured to the lateral side walls of the cabinet.

In accordance with my invention the rear panel 61 is employed as a part of the condenser member 40 of the heat transfer system for cooling absorber 24. To the upper part of rear panel 61 and to the inner surface thereof is secured a metallic sheet 62 which is slightly narrower in width than the rear panel and extends from the top of the cabinet to a region at the same height as the absorber 24. The lower portion of rear panel 61 is provided with a plurality of air inlet openings 63 extending between the lateral side walls of cabinet 10.

The metallic sheet 62 is provided with a plurality of spaced depressed portions 64 which may be spot-welded to the rear panel 61 to maintain the sheet and panel in spaced relation to provide a fluid passage therebetween, and the peripheral edges of the sheet are secured, as by welding or brazing, to the rear panel. The inner metallic sheet 62 is provided with an inlet opening above the lower edge thereof to which an end of conduit 38' is secured. Below the inlet opening and at its extreme lower edge the metallic sheet 62 is provided with an outlet opening to which an end of conduit 39' is connected. The conduit 39' is provided with a U-shaped bend 65 and is connected at its other end to the lower end of coil 37'. The coil 37', conduits 38' and 39', and condenser member 40 form a hermetically closed circuit adapted to contain a suitable volatile fluid, such as methyl chloride.

When the refrigeration apparatus is operating, the liquid in coil 37' is evaporated due to the liberation of heat with absorption of ammonia vapor in absorber 24. The vapor passes through conduit 38' into the condenser member 40. The vapor is condensed by air passing over the surfaces of rear panel 61 and metallic sheet 62, and the condensate flows downward through conduit 39' and returns to the coil or evaporation member 37'. In the evaporation-condensation circuit that has been provided, therefore, the fluid serves as a heat transfer agent which circulates naturally in the closed fluid system. The evaporation of liquid in coil 37' takes up heat from absorber 24, and the condensation of vapor in condenser member 40 gives up heat to air passing over the surfaces thereof.

Although coil 37' may be located slightly higher than shown in Fig. 1 and sufficient liquid used in the heat transfer system so that the liquid level in condenser member 40 will correspond to the highest point of coil 37', it may be desirable to position coil 37' below the active condenser surface of condenser 40. In such case the internal diameter of coil 37' is preferably made sufficiently small so that coil 37' will be flooded, or at least entirely active, by pumping of liquid in the coil by vapor-lift action. In other words, vapor bubbles formed in the lower part of coil 37', due to their inability to pass liquid freely, will lift liquid into the upper part of coil 37' to effectively take up heat from absorber 24.

The vertical compartment 20 is completely closed by the rear insulated wall of the storage space and back-plate 58 associated therewith, the lateral side walls of cabinet 10 which project beyond the rear insulated wall 11, and rear panel 61. This enclosed space constitutes a flue whereby natural cooling of the heat rejecting portions of the apparatus is efficiently effected. Air is drawn into the flue space through the inlet opening 63, as indicated by the arrows in Fig. 2. The heat radiated from condenser member 40, combined with the heat radiated from the air-cooled rectifier 36, cooling fins 42 and air-cooled condenser

37, causes sufficient upward flow of air by natural draft to cool the apparatus during its operation. Since no air is admitted into the flue space above the inlet openings 63, the column of air in the flue space is at a higher temperature and lighter than an equivalent column of surrounding air at room temperature. By providing a flue space of this character, a high velocity air stream is produced which flows upward and is discharged through the openings 56 at the top of the cabinet, as shown most clearly in Fig. 4.

The provision of the side plates 57 for supporting the condenser 37 is particularly advantageous for accelerating the upward flow of air since all of the air flowing in thermal contact with the closely spaced cooling fins 38 is effectively heated and must flow upward in the space defined by the back-plate 58, side plates 57, and condenser member 40. The lower ends of cooling fins 38 preferably extend forward, as shown in Fig. 4, so that heat radiated from these cooling fins will be effectively transferred to air passing over their surfaces.

In addition to providing a completely enclosed space constituting a flue and presenting a relatively large inner heat transfer surface, the condenser member 40 possesses the further inherent advantage that heat is radiated from the outer surface to surrounding air. When the rear panel 61 is located against a wall of a room, for example, a flue effect is produced at the outer surface to cause upward flow of air, as indicated by the arrows in Fig. 1.

With the condenser member 40 formed directly on the rear panel 61, the necessity of locating this part within the flue space is eliminated and the amount of tubing required to provide the heat transfer system is reduced considerably.

Although I have shown and described one particular embodiment of my invention, it will be apparent to those skilled in the art that modifications and changes may be made without departing from the spirit and scope of the invention. It is therefore contemplated to cover all modifications and changes which come within the spirit of the invention, as pointed out in the following claims.

What is claimed is:

1. A refrigerator including a cabinet having a vertical insulated wall, refrigeration apparatus including first and second heat rejecting elements, said first element being disposed alongside said wall, said second element comprising contacting metallic sheets having a fluid passage therebetween, and members including said insulated wall and said metallic sheets forming a vertical flue surrounding said first heat rejecting element, one of said metallic sheets being of greater height than the other and having an air inlet opening in the lower part thereof.

2. An absorption type refrigerator including a first condenser, a generator connected to supply refrigerant to said condenser, an absorber, and a hermetically closed volatile fluid circuit for cooling said absorber and including a vaporization portion in heat exchange relation with said absorber and a condensation portion, said condensation portion including contacting metallic sheets having a fluid passage therebetween, and members including said metallic sheets forming a natural draft flue surrounding said first condenser.

3. A refrigerator including a cabinet having a vertical apparatus compartment at one side thereof, refrigeration apparatus including a plurality of heat rejecting elements, one of said heat rejecting elements comprising a looped coil provided with cooling fins and another of said elements comprising contacting metallic sheets having a fluid passage therebetween, said looped coil and fins being disposed in said apparatus compartment near the upper part thereof, and means including said metallic sheets and imperforate wall members to close said apparatus compartment and provide a flue space surrounding said looped coil and fins.

4. In refrigeration apparatus of the absorption type, a first condenser, a generator connected to supply refrigerant to said condenser, an absorber, means for cooling said absorber including a second condenser comprising contacting metallic sheets having a fluid passage therebetween, and members including said metallic sheets forming a natural draft flue, said first condenser being disposed in said flue.

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