July 27, 1948. R. W. AYRES 2,445,988

REFRIGERATOR CONSTRUCTION WITH REMOVABLE REFRIGERATOR UNIT

Filed July 14, 1943 3 Sheets-Sheet 1

Fig-1

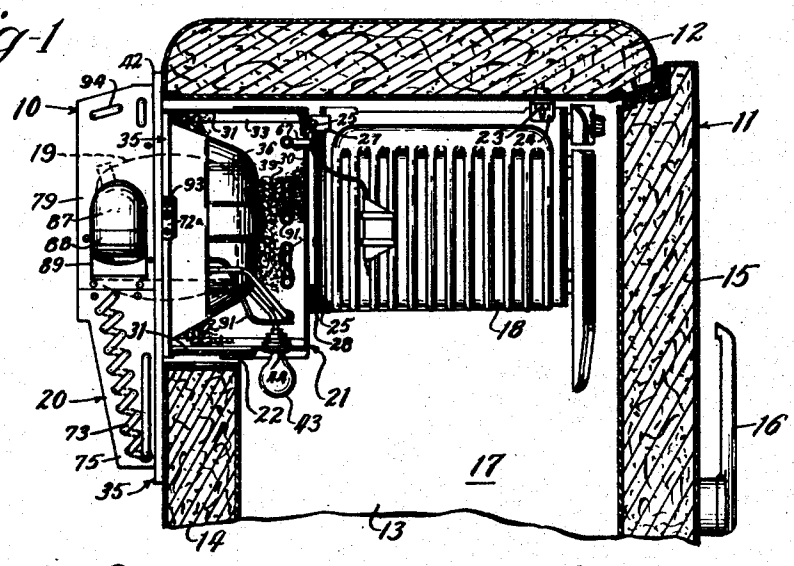
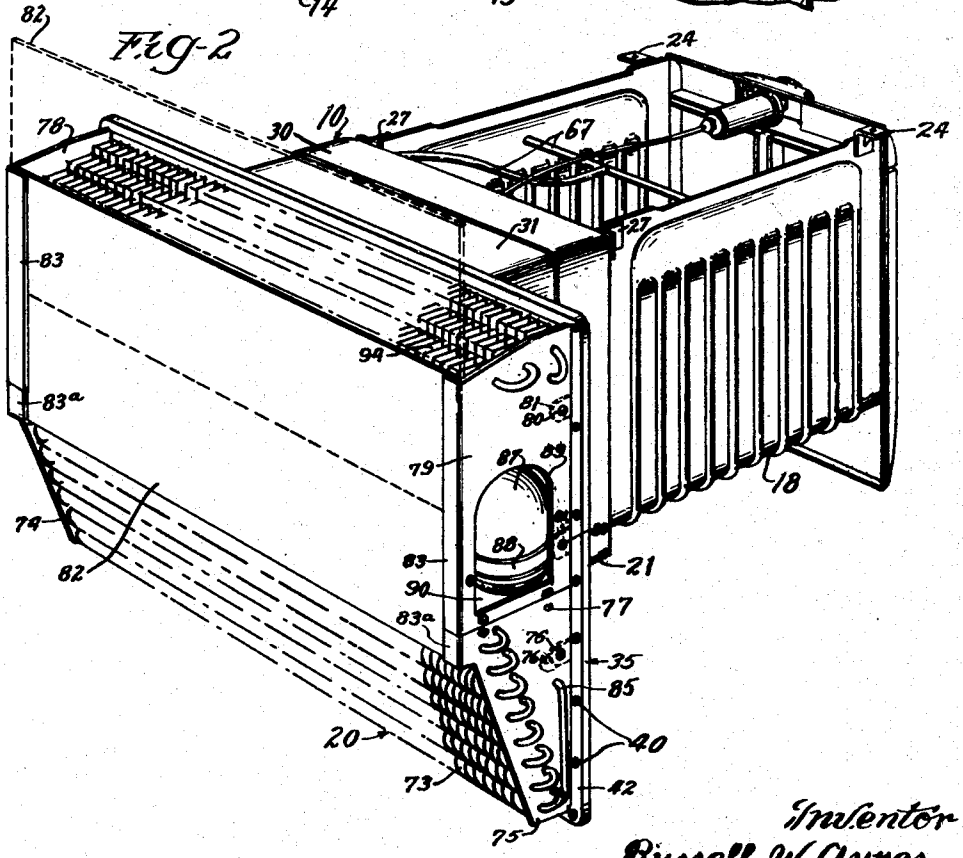


Fig-2



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Filed July 14, 1943 3 Sheets-Sheet 2

Fig-3

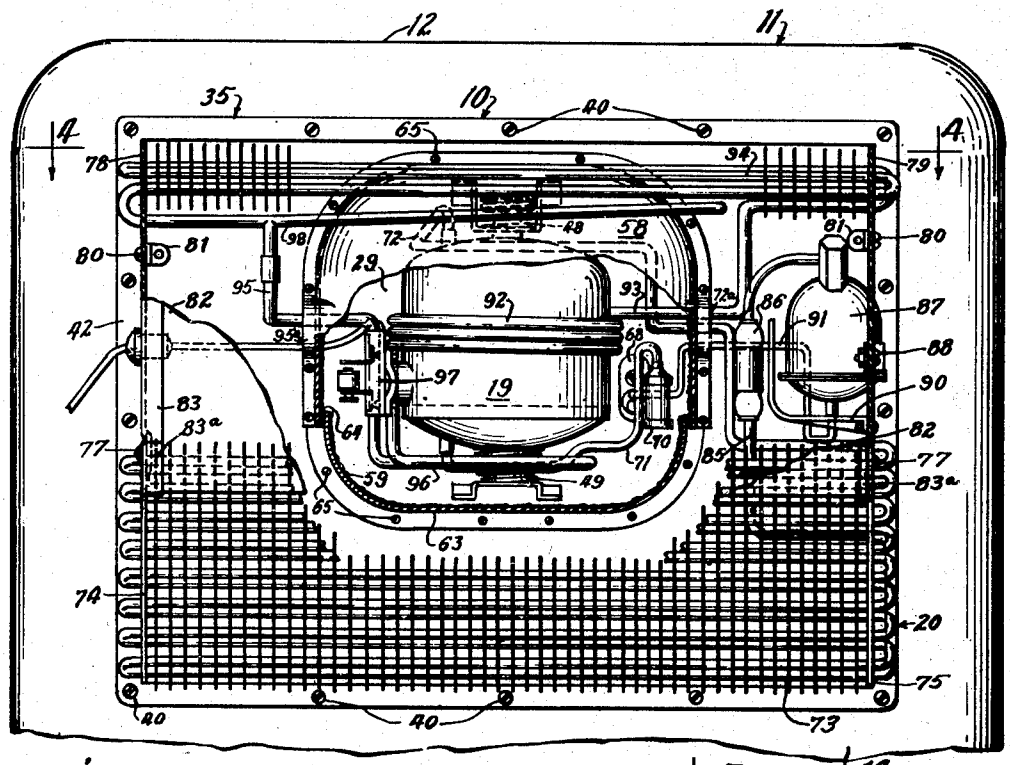
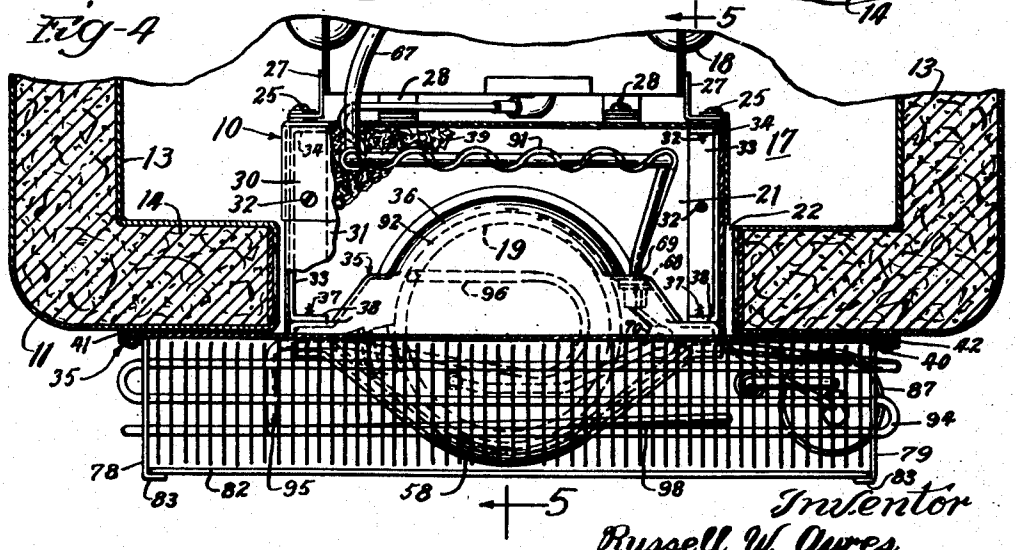


Fig-4



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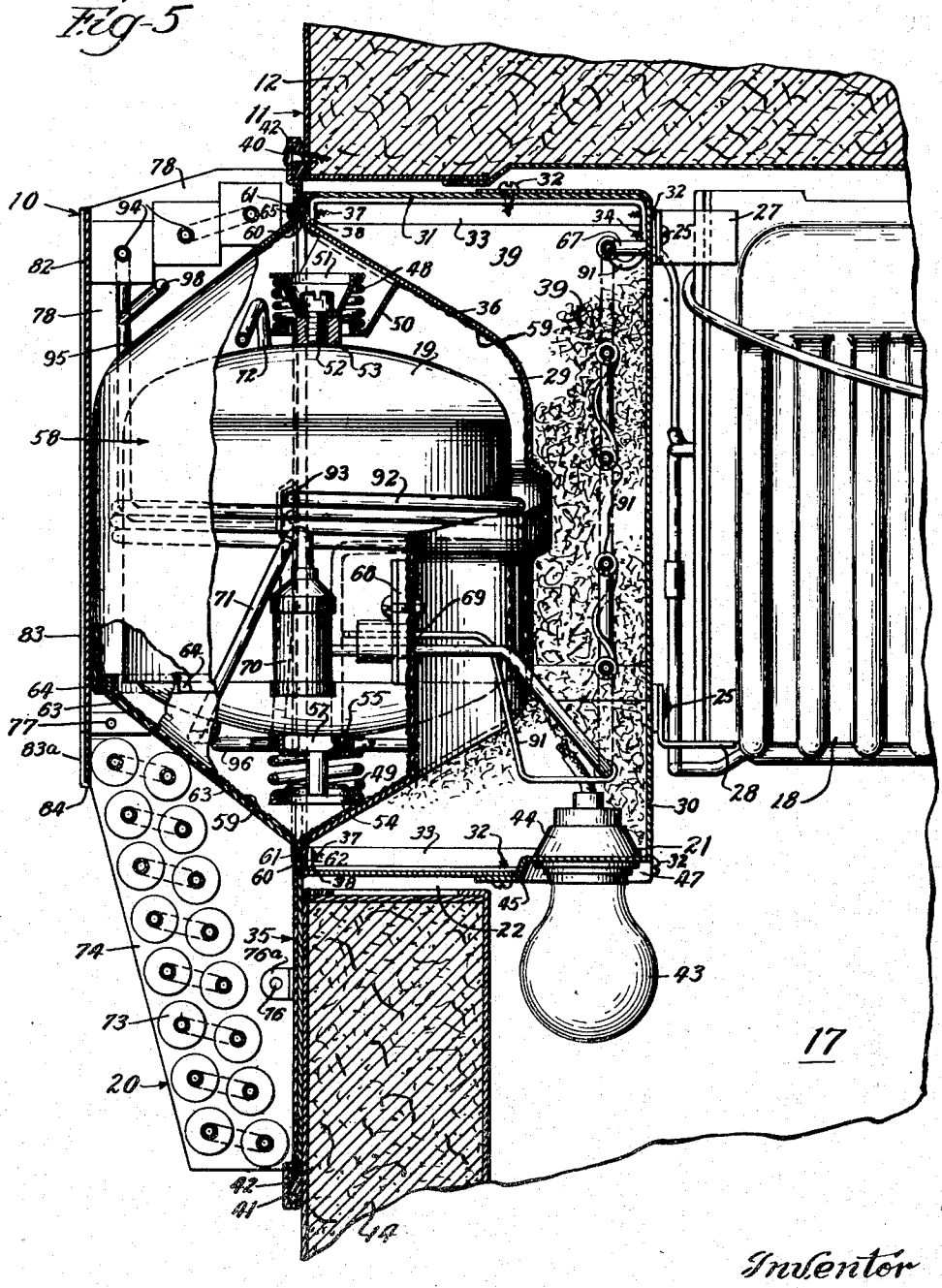
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July 27, 1948. R. W. AYRES 2,445,988

REFRIGERATOR CONSTRUCTION WITH REMOVABLE REFRIGERATOR UNIT

Filed July 14, 1943 3 Sheets-Sheet 3

Fig-5



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Patented July 27, 1948

2,445,988

UNITED STATES PATENT OFFICE

2,445,988

REFRIGERATOR CONSTRUCTION WITH REMOVABLE REFRIGERATOR UNIT

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Application July 14, 1943, Serial No. 494,600

28 Claims. (Cl. 62—116)

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My invention relates to mechanical refrigerator construction and more especially to improvements in household refrigerators of the type where the "high side" unit of the refrigerating apparatus is located within the refrigerator cabinet.

Among the principal objects of my invention is the provision of a more compact, efficient and economical arrangement of the refrigerating apparatus within the cabinet, and the freeing, for addition to the refrigerated food storage compartment, of a substantial volume of cabinet space formerly of necessity devoted to accommodation of the high side unit (that is, the compressor-motor-condenser unit). Or the newly freed space in the cabinet may be used to provide or enlarge a storage space, such as the vegetable bin, within the cabinet but without the refrigerated food storage compartment. Or it may be reflected in cabinets of reduced over-all sizes but undiminished in standard refrigerated storage volume ratings.

In present day household electric refrigerators, the high side unit is usually either "bottom mounted" or "top mounted." That is, while the evaporator is located within the insulated food storage compartment usually adjacent the top thereof, the high side of the system is mounted either in the bottom of the cabinet beneath the refrigerated food storage compartment or in the top of the cabinet above the food storage compartment. The latter arrangement makes for the more compact "package" type of refrigerating apparatus, because the high side unit and the low side or evaporator unit are close-coupled, the latter usually being suspended on the underside of a removable top wall section of the insulated food compartment, and the high side unit being mounted on the top side of the removable section and within a high side compartment of the cabinet above the food storage compartment. This makes the entire refrigerating apparatus readily removable as a unit for servicing or replacement without the necessity of connecting or disconnecting refrigerant tubing or otherwise opening the closed refrigerant system. But in both top mounted and bottom mounted units, substantial cabinet space is taken to accommodate the high side unit. This amounts to two or more cubic feet in the popular sizes of household refrigerators.

By my arrangement, the high side unit is mounted at the back of, and in the back wall of, the cabinet and behind the evaporator. In so doing, I take advantage of certain previously

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wasted spaces, with the result that the space usually devoted to the accommodation of the high side unit is made available for effective use in refrigerated food storage or otherwise as above mentioned. One of these usually wasted spaces is the space between the back of the evaporator and the back wall of the storage compartment, which is inaccessible for food storage. Another is the three or four inch depth of space behind the back wall of the cabinet which is usually occupied by an air flue or air passageway to permit the passage of cooling air upwardly along the back wall of the cabinet and between the cabinet and the wall of the room against which it is set.

With this placement of my high side unit to occupy these otherwise wasted spaces and my design and arrangement of the parts of the high side system and re-arrangement of certain necessary insulation, I am enabled to reduce the refrigerating apparatus in its entirety to a much more compact "package" unit than was possible even with the relatively compact top mounted refrigerating apparatus above described. Another advantage is that the apparatus, being "back mounted," is much more easily removed by one serviceman, partly because it is more readily detached and partly because its removal is horizontal rather than upward so that all of the movement occurs at a height convenient for the serviceman.

Another object of my invention is to dissipate into external air, and to control the dissipation of, the heat produced by the motor and compressor in such a manner as to avoid the necessity of bringing quantities of air over the motor and compressor, whereby the motor and compressor may be compactly disposed in a small space; yet the evaporator in the refrigerated storage space is still adequately protected from the heat of the motor and compressor despite their proximity thereto, both by maintaining the compressor and motor below excessive temperatures and by adequate insulation between them and the evaporator and refrigerated compartment.

A further object of my invention, quite apart from the ready removability of the apparatus as a unit, is the ready separation therefrom of those component parts—such as the motor-compressor and the evaporator—as are most liable to need repair.

Still further objects of my invention are concerned with: improvements in a separate refrigerant system for dissipating the heat of the motor-compressor; solutions of problems arising

therefrom when an inert gas is used with the refrigerant in the separate system; vibration-insulation mounting of the motor-compressor in the unit; framing of the unit for mounting in the cabinet; sound insulation for the motor-compressor; and an improved heat interchange between the liquid feed line and the suction return line.

These and other objects and advantages of my invention are set forth in the following description and the accompanying drawings of a specific embodiment of my invention.

Referring to the drawings, of which there are three sheets:

Fig. 1 is a vertical sectional view, taken in a front-to-rear plane, through the upper part of a domestic type refrigerator embodying the features of my invention;

Fig. 2 is a perspective view of the refrigerating unit alone;

Fig. 3 is a rear elevational view of the refrigerating unit installed, some parts being broken away and in section to reveal structural details;

Fig. 4 is a horizontal sectional view taken substantially along line 4—4 of Fig. 3; and

Fig. 5 is an enlarged vertical sectional view taken substantially along line 5—5 of Fig. 4.

In a refrigerator embodying the features of my invention, the cabinet may be of any popular commercial or preferred design as to external form and proportions and may be equipped with the usual or preferred operating controls and utilitarian accessories and arrangements, such as high and low humidity compartment arrangements, storage bin space, special shelving construction, etc. The only space occupied by the refrigerating apparatus within the confines of the cabinet proper, is that required for the evaporator and a very little space taken up by the heat insulating base plug upon which the motor-compressor assembly and the evaporator are mounted as a package unit, and which projects inwardly through an installation opening in the rear wall of the cabinet into formerly unused space back of the evaporator. A substantial proportion of the refrigerating apparatus aside from the evaporator is through this arrangement accommodated within the thickness of the insulated rear wall of the cabinet and projects only slightly rearwardly from the cabinet into a relatively narrow flue space in which is located the condenser structure of the unit. There is no need for disconnecting tubing or removing parts of the refrigerating apparatus piecemeal during servicing, because, by removing a few screws, the entire unit can be shifted away at the rear of the cabinet.

Having more particular reference to the drawings, a refrigerating unit 10 is shown in conjunction with a household refrigerator cabinet 11 of more or less conventional box design comprising a top wall 12, a bottom wall (not shown), side walls 13, a rear wall 14, and a front wall 15, which may be in the form of a hinged door having a latch (not shown) controlled by a handle 16.

All these cabinet walls, of course, are of insulated construction, and they define a refrigerated food storage compartment 17 within the cabinet. Various appurtenances, such as shelving, meat saver, racks, etc., have been omitted from the drawings as unnecessary to a full understanding of the invention, but their use, if and as desired, will be understood.

The refrigerating unit 10 is of such small, compact and relatively lightweight construction that it can easily be installed, removed and handled

by one serviceman alone. As shown, it is of the compression type and includes on the low pressure side an evaporator 18 of any preferred construction. On the high pressure side, the unit 10 includes a sealed motor-compressor assembly 19 located back of, and in alignment with, the evaporator, and a condenser structure generally identified by the numeral 20. All of the apparatus is mounted upon a base structure 21 of preferably rectangular form, which provides an insulated partition between the evaporator 18 and the motor-compressor assembly. The base 21 also serves as an insulating plug for an opening 22 in the rear wall 14 of the cabinet dimensioned to permit passage of the evaporator 18 therethrough during installation or removal of the refrigerating unit.

At its forward end, the evaporator 18 is supported conveniently adjacent to the door 15 by readily detachable means, such as bolts 23 suspended from the inside or roof surface of the top wall 12 and which engage brackets 24, one of which is located at each side of the evaporator. At its rear end, the evaporator 18 is removably attached to the mounting base plug 21 by means such as screws 25 respectively engaging top sidewall brackets 27 and bottom brackets 28 (Figs. 1 and 4) carried by the evaporator. A slight spaced relationship is maintained between the end of the evaporator 18 and the adjacent wall of the plug 21 so as to permit air circulation.

The distance between the rear end of the evaporator 18 and the plane of the inner face of the rear wall 14 may be, as shown, approximately equal to the thickness of the rear wall, in practice about three inches in an average size refrigerator. The front-to-rear or thickness dimension of the mounting base plug 21 is preferably sufficient not only to fill the installation opening 22, but also substantially to fill the intervening distance to the evaporator which would otherwise probably be unused space. This makes it entirely practicable to mount the motor-compressor 19 to a substantial extent within the rear or outer side of the mounting base plug 21, and yet preserve an insulated condition beween the motor-compressor and the interior of the refrigerator cabinet at least equal to the insulation afforded by the thickness of the rear wall 14.

To this end the mounting base plug 21 is formed of much the same material as the rear wall 14, and to a certain extent provides what may be considered as a removable portion of the rear wall inwardly offset to provide a recess 29 for accommodating the motor-compressor 19. Thus, the plug 21 may be constructed as a sheet metal shell comprising an inner face member 30, which may be substantially cup or pan shaped and telescoped over the inner margin of a rectangular tubular body member 31, to which it is secured removably by means such as screws 32 threaded into reinforcing bars 33 extending in a front-to-rear direction at the inside of the corners of the body member 31. The reinforcing bars 33 at the top of the structure may have inner right angular end flanges 34 tapped to receive the evaporator bracket screws 25.

An outer closure plate 35 on the base plug is embossed with a substantially concave area 36 at the rear center of the plug extending inwardly to a maximum depth of not much more than half the thickness of the plug, to provide the recess 29. This closure plate is removably secured in place on the plug by means such as screws 37

threaded into appropriately bored and tapped right angular flanges 38 formed on the rear ends of the reinforcing bars 33 (Fig. 4). The interior of the shell thus formed is filled with heat insulating material 39 which may be the same as that used in the other wall structure of the cabinet 11. As seen in Figs. 1, 4 and 5, the effective thickness of this insulation within the plug is at all points practically equal to the thickness of insulation in the rear wall 17 and at many points even thicker.

The rear closure plate 35 is preferably of substantially greater horizontal and vertical dimensions than the installation opening 22, so as to overlap the surrounding rear face of the cabinet. The overlapping portions of the plate are then removably secured to the cabinet by screws 40 for holding the entire refrigerating unit 10 in place assisted, of course, by the bolted attachment of the evaporator 18 to the roof of the cabinet.

In order to reduce heat leakage between the secured margins of the plate 35 and the opposing cabinet wall surfaces to a minimum and prevent rattling, an airtight resilient seal is provided by a rubber or like gasket 41, which is seated within an inwardly opening gasket channel 42 formed continuously around the margin of the plate and bears against the opposing cabinet wall surfaces.

A lamp 43 for illuminating the storage chamber 17 may be carried by a lamp socket 44 mounted on the lower telescoping margin of the inner face member 30 of the plug shell, the adjacent wall of the tubular body member 31 being cut out as at 45 to accommodate the socket. The supporting area of the shell margin immediately surrounding the socket 44 is preferably upwardly offset, as indicated at 47, in order to bring the outer end of the socket 44 entirely within the lower face plane of the plug shell so as to clear the upper edge of the rear wall 14 at the installation opening when the plug 21 is inserted or removed through the opening. The lamp socket 44 may be connected into an electrical circuit controlled in any preferred manner by opening and closing of the door 15 of the cabinet.

A floating suspension for the motor-compressor 19 within the recess 29 is attained by the use of similar upper and lower coaxial coiled compression springs 48 and 49, respectively. The upper spring 48 is seated upon an apertured sheet metal bracket 50 secured to the adjacent upper outer surface of the recess embossment 36. At its upper end, the spring 48 supports a centrally depressed cap 51, which is removably secured by means of of a screw 52 to the upper end of an axial boss 53 projecting upwardly from the motor-compressor casing through the bracket 50 into the spring 48. The lower suspension spring 49 is seated upon a bracket 54 and bears against a cupped thrust plate 55 held in centered position by an axial boss 57 extending down from the motor-compressor casing. The suspension springs 48 and 49 hold the motor-compressor 19 out of direct engagement with any adjacent part of the plug structure and effectually absorb operating vibrations.

In the preferred arrangement, the axis of the motor-compressor 19 is located in or close to the major outer vertical plane of the closure plate 35, thereby affording a reasonably balanced distribution of weight in the refrigerating unit as a whole, since it places the dead weight of the motor compressor as far rearwardly as practicable and in

that portion of the apparatus where it is more easily handled in the installation or removal of the apparatus. By this arrangement, also, a minimum of strain is imposed upon the closure plate 35 during handling of the refrigerating unit and also after installation since the weight is imposed in the direction of maximum strength of the plate. As a result of this relationship, about half of the motor-compressor assembly 19, or possibly a little more than half, is received freely within the recess 29 and the remainder projects rearwardly beyond the rear plane of the refrigerator cabinet. Such rearward projection however is not objectionable and to at least a certain extent is desirable since it places the motor-compressor 19 in the path of upmoving cooling air. Moreover, it permits the inwardly extending portion of the motor-compressor assembly to occupy space which actually goes not much deeper than the thickness of the rear wall 14 where, as in a typical example, the motor-compressor assembly is of an over-all diameter of six to seven inches, and the rear wall 14 is approximately three inches thick.

A certain amount of operating noise may be emitted from the motor-compressor assembly while running, but such noise is effectively absorbed by enclosing the outwardly projecting portion of the motor-compressor with a spaced, embossed cover-plate 58, substantially the counterpart of the rear plate embossment 36, and coating the inner surface of the cover-plate and the outer surface of the embossment 36 with a layer of sound-absorbing and deadening materail 59. This may comprise an asphalt base material that can be sprayed on to an effective coating of about one-sixteenth of an inch thickness. Such material has the advantage that the unit can be leak-tested by submerging it in water without affecting the sound-deadening qualities of the material.

Rattling of the cover-plate is prevented by inserting a sound deadening gasket 60 of resilient material such as rubber between an attachment flange 61 on the cover-plate and a gasket groove 62 offset within the plate 35 about the mouth of the recess embossment 36. For convenience in removal, the cover-plate 58 is formed in two portions, the major portion covering the upper part of the motor-compressor assembly and extending well down therealong and into overlapping relation to the upper edge of a lower cover-plate portion 63, from which it is separated by a sound-deadening gasket 64. Screws 65 secure both portions of the cover-plate 58 in place removably.

Evaporated refrigerant is withdrawn from the evaporator 18 through a suction line 67, which enters the interior of the plug 21 through the inner face 30 adjacent the top of the evaporator. Thence the line 67 passes into the recess 29 through moisture sealing fixture 68 secured about an exit aperture 69 in the recess embossment 36 adjacent the motor-compressor assembly 19. After passing through a check-valve 70 the refrigerant gas enters the bottom of the motor-compressor assembly through an inlet duct portion 71 of the suction line.

Following compression, the refrigerant leaves the compressor through a high pressure duct 72 leading off from the top of the motor-compressor casing and passing out of the recess 29 through an offset passageway 72a in one side margin of the cover-plate 58.

At its outer end the high pressure duct 72 communicates with an elongated finned-tube refrig-

erant condenser 73 which forms one part of the condenser structure 20. The condenser 73 is of relatively flattened shape and is supported immediately below the lower closure plate portion 63, horizontally lengthwise and upwardly and outwardly tilted transversely, by vertically extending rearwardly projecting parallel end plates 74 and 75, respectively. These end plates are formed with slanting rear edges parallel with the condenser and at their inner margins are removably secured by screws 76 to respective angle brackets 76a carried by substantially laterally and downwardly projecting apron portions of the rear closure plate 35 (Figs. 2 and 5). Through this arrangement, the condenser 73 can be conveniently removed or replaced as a unit.

At their upper ends, the condenser end plates 74 and 75 extend above the uppermost condenser fins and are removably secured by means of respective screws or bolts 77 to the lower ends of parallel vertical flue side plates 78 and 79, respectively. The latter extend to a short distance above the cover-plate 58 and are of a width only slightly greater than the maximum extent of the outward bulge of the cover-plate. At their rear edges the plates 78 and 79 are removably secured by screws or bolts 80 to respective pairs of vertically spaced angle brackets 81 on the outer face of the rear plate 35.

A vertically slidable protective closure and buffer plate 82 is received at its vertical edges within inwardly projecting right angular retaining flanges 83 on the outer vertical edges of the side plates 78 and 79 and aligned similar flanges 83a on upper forward edge portions of the condenser end plates 74 and 75 in front of the upper tube sections of the condenser. At its lower corners the slidable plate 82 rests upon horizontal inturned stop flanges 84 formed on the condenser end plates below the vertical flanges 83a. The cover 58 and the upper fins of the condenser 73 hold the plate 82 in place against the retaining flanges. The lower end of the vertical flue thus formed is completely traversed by the slanting refrigerant condenser 73. Heated air rising from the condenser is confined to the flue stack and the updraft is substantially unimpeded by cold air that might otherwise work in from the sides and the rear to throttle the draft. As a result of this flue arrangement, upsweep of cool air over the refrigerant condenser 73 is accelerated and the efficiency of the condenser improved.

Since the cover-plate 58 bulges directly into the condenser air flue, it is swept by the rising air column and cooled of heat acquired by radiation from the motor-compressor 19. Being substantially streamlined, the cover-plate 58 offers no objectionable resistance to flue updraft.

Liquid refrigerant is led from the condenser 73 through a riser 85 and a silica jell dehydrator 86 to a high-side flow controlling float valve reservoir 87. As best seen in Figs. 1, 2 and 3, the valve reservoir 87 is located above the condenser 73 between the bulge of the cover-plate 58 and side plate 79 to which it is connected by a supporting strap 88 extending across an air opening 89 from which the reservoir casing may project slightly. Below and extending up beside the innermost side of the reservoir 87 is an L-shaped shield 90 to deflect heated air rising from the condenser 73. Some cool air will be drawn into the condenser flue through the opening 89 and sweep and cool the reservoir 87.

From the reservoir 87 the liquid refrigerant is conveyed through a relatively long, restricted high pressure feed conduit 91 back to the evaporator 18. The feed conduit 91 extends through the passage 72a into the motor-compressor chamber, and through the sealing fixture 68 into the insulated space within the mounting plug 21. Therein the conduit 91 is entwined about the suction line 67, which in the present instance is of considerable length and formed with several return bent loops, into a flat vertical coil embedded within the insulation 39. In this manner there is a transfer of residual heat from the high pressure feed line to the suction line, which affords the double advantage of lowering the temperature of the liquid refrigerant and raising the temperature of the spent refrigerant within the suction line so as to gasify liquid refrigerant that may pass over into the suction line. In order to attain maximum heat transfer contact with the suction line, the high pressure feed conduit 91 is preferably of small diameter but it need not necessarily be of capillary fineness. The winding of the high pressure conduit is in a direction counter-current to the flow within the suction line 67.

In order to avoid overheating of the motor-compressor assembly 19 during operation within the sound-proofed chamber 29, a free circulation secondary-type of cooling system is employed including a coil 92 formed of a plurality of windings (three full windings being shown) tightly encircling the mid-portion of the motor-compressor casing horizontally. The system is charged with a refrigerant such as methylene chloride, which upon becoming heated vaporizes and flows from the upper winding of the coil 92 through a horizontal lead-off 93, which extends from the motor-compressor chamber outwardly through the passage 72a, and then is directed upwardly to an elongated condenser 94. The latter is carried horizontally by the upper end portions of the flue side plates 78 and 79 above the bulge of the cover-plate 58 across the top of the condenser air flue. The condensed refrigerant passes down from the condenser 94 through a return duct 95 and a liquid trap loop 96 which communicates with the lower winding of the cooling coil 92 to complete the refrigerant circuit. Entry of the return duct into the motor-compressor chamber is through an outwardly offset transverse passage groove 95a in the adjacent side margin of the cover plate 58 (Fig. 3).

Inasmuch as the compressor operates most efficiently when it is reasonably warm, in the neighborhood of 110° to 115° F., means is preferably provided in the motor-compressor cooling system for maintaining the refrigerant quiescent until the optimum operating temperature is attained, whereafter, as the temperature increases, there will be circulation of refrigerant proportionate to increases in temperature reaching 100% circulation near the point where a heat-responsive motor shut-off device forming part of a starting and overload relay unit 97 (Fig. 3) becomes effective to stop the motor. Herein such means comprises a non-condensable gas such as air enclosed within the system. In the cool state of the system, this non-condensable gas displaces refrigerant in the condenser 94 and maintains a pressure within the condenser which restrains circulation of the refrigerant until the predetermined compressor temperature of 110° to 115° F. is reached, whereafter the refrigerant gas pressure forces the non-condensable gas out of the condenser progressively as the temperature rises and the gas pressure correspondingly increases and pushes the air over into a collec-

ing chamber in the form of a tube 98, which in the present instance comprises a blind end length of tubing leading off at an upwardly slanting angle from the upper end of the return duct 95. Since the gas volume 98 slants towards the return duct, any liquid refrigerant carried over into the volume may freely run back into the liquid refrigerant stream.

To insure condensation, and consequent removal, of any refrigerant which might find its way into the collecting chamber 98, the latter should be located in a cool environment—at least as cool as the air passing over the condenser 94. This may compactly be effected by placing the tube 98, as shown, beneath the condenser 94; although it could be placed in the surrounding atmosphere outside of the flue 82.

Where the system is charged with about 90 cc. of methylene chloride, a proper amount of air will be enclosed with the refrigerant where about a 22" vacuum is drawn at the time of admitting the refrigerant. As a result of this arrangement, the running temperature of the compressor can very nicely be held up to 20° to 35° F. warmer than the condensing temperature of the refrigerant condenser 73, without the use of any mechanical controls in the motor-compressor cooling system. Even though the air which sweeps the condenser 94 of the motor-compressor cooling system is relatively heated by the heat absorbed from the refrigerant condenser 73, such air will still be cool enough to be entirely effective on the condenser 94 due to the substantially higher operating temperature of the motor-compressor cooling system.

From the foregoing it will be apparent that my invention affords many practical advantages over prior domestic refrigerators, chief among which are the additional food storage space now made available; the small and efficiently compact arrangement of the refrigerating unit and the convenient back-mounting thereof in the refrigerator cabinet so that assembly and service-removal thereof are simplified and expedited; the efficient natural draft air cooling of the refrigerant condenser, as distinguished from the usual fan circulation cooling; the novel sound-proofing and temperature control of the motor-compressor which is simpler and more efficient than has been attained heretofore; and the relatively small number of simply constructed parts used in the construction of the unit all of which are particularly well adapted for low cost quantity production methods of manufacture, so that the unit can be made and sold at a low competitive price while nevertheless giving substantially improved results.

It may be noted that for service purposes, every principal component of my refrigerating unit is easily and quickly accessible and separable. Thus, the evaporator is readily detachable from the supporting plug, the front and rear closure plates of the plug can be readily opened for entry into the plug, the motor-compressor is quickly exposed for inspection by sliding out the rear flue plate and opening the upper part of the motor-compressor cover-plate, the motor-compressor may then be released and removed from its recess after removing the flue side plates and lifting away the condenser of the motor-compressor cooling system, and the main refrigerant condenser can be removed conveniently and speedily by detaching the end plates from the supporting apron. All of the refrigerant lines, of course, have appropriate readily accessible unions to facilitate assembly.

While I have illustrated a preferred embodiment of the invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A refrigerator comprising a cabinet having a food storage compartment and having an insulated rear wall provided with an opening, a removable cooling unit comprising an insulated plug adapted to be inserted in the opening in said rear wall, said plug carrying an evaporator within said compartment, said plug being formed with an inner wall, a layer of insulation and an intermediate wall, said intermediate wall being inwardly recessed to receive refrigerating apparatus communicating with said evaporator and partially mounted within said recess, said apparatus, when inserted, projecting rearwardly beyond the plane of the rear wall of refrigerator said evaporator being shorter from front to back than the depth of said compartment, and being located forwardly in said compartment, and said plug projecting into said compartment behind said evaporator to utilize space behind said evaporator and to provide insulation thickness for the plug substantially equal to that of the rear wall.

2. In a refrigerator construction adapted to increase the available space in the food storage compartment, the combination of a substantially rectangular insulated cabinet provided with an insulated front closure and insulated walls, the rear wall of said cabinet being provided with an aperture, an insulated plug adapted to be inserted in said aperture and carrying an evaporator, said evaporator being shorter than the depth of said compartment from front to back and said evaporator, when inserted, being located forwardly in said compartment to utilize the space defined by a forward projection from said aperture in said cabinet and said plug being provided with insulation of substantially the same insulating characteristics as the walls of said cabinet, said plug, when inserted, projecting forwardly into the food compartment behind said evaporator and having its outer wall recessed to receive a refrigerating mechanism, a refrigerating mechanism carried by said plug, said mechanism projecting rearwardly out of said cabinet by a minimum amount due to the utilization of the space behind the evaporator.

3. In a refrigerator construction adapted to increase the available space in the food storage compartment, the combination of a substantially rectangular insulated cabinet provided with an insulated front closure and insulated walls, the rear wall of said cabinet being provided with an aperture, an insulated plug adapted to be inserted in said aperture and carrying an evaporator, said evaporator being shorter than the depth of said compartment from front to back and said evaporator, when inserted, being located forwardly in said compartment to utilize the space defined by a forward projection from said aperture in said cabinet and said plug being provided with insulation of substantially the same insulating characteristics as the walls of said cabinet, said plug, when inserted, projecting forwardly into the food compartment behind said evaporator and having its outer wall recessed to receive a refrig-

erating mechanism, a refrigerating mechanism carried by said plug, said mechanism projecting rearwardly out of said cabinet by a minimum amount due to the utilization of the space behind the evaporator, said mechanism including a motor compressor unit and a condenser, said condenser being located below said compressor unit whereby the air passes by convection over the condenser and thereafter over the compressor unit.

4. In a refrigerator construction adapted to increase the available space in the food storage compartment, the combination of a substantially rectangular insulated cabinet provided with an insulated front closure and insulated walls, the rear wall of said cabinet being provided with an aperture, an insulated plug adapted to be inserted in said aperture and carrying an evaporator, said evaporator being shorter than the depth of said compartment from front to back and said evaporator, when inserted, being located forwardly in said compartment to utilize the space defined by a forward projection from said aperture in said cabinet and said plug being provided with insulation of substantially the same insulating characteristics as the walls of said cabinet, said plug, when inserted projecting forwardly into the food compartment behind said evaporator and having its outer wall recessed to receive a refrigerating mechanism, a refrigerating mechanism carried by said plug, said mechanism projecting rearwardly out of said cabinet by a minimum amount due to the utilization of the space behind the evaporator, said mechanism including a motor compressor unit and a condenser, said condenser being located below said compressor unit whereby the air passes by convection over the condenser and thereafter over the compressor unit, said mechanism including lateral and rear walls forming a flue and having a float chamber, said float chamber projecting from one of said latter walls but being partially baffled from the air stream from said condenser.

5. In combination in a refrigerator, a cabinet providing a refrigerated chamber and having an insulated rear wall formed with an opening therethrough, an insulating closure plug structure for said opening removable therefrom from the rear of the cabinet, an evaporator attached to the forward side of said plug structure within the chamber and removable with the plug structure rearwardly through said opening, a motor-compressor assembly mounted upon said plug structure rearwardly of said evaporator, and partially projecting beyond the back face of said rear wall, supporting means on the outer side of said plug structure extending substantially below the opening and the motor-compressor assembly adjacent the back face of said rear wall and detachably secured thereto, and a refrigerant condenser communicating with said motor-compressor assembly and said evaporator and mounted upon said supporting means, below the projection of the motor-compressor assembly, to be cooled by updraft of air, induced by condenser heat, along the rear of the cabinet, said refrigerator including means defining a vertical flue carried by the closure plug structure with the lower end of the flue embracing the upper end of the condenser for circumscribing the heated air passing upwardly from the condenser to form a rising column protected from the laterally surrounding cool air whereby to accelerate the updraft of cool air from below the condenser.

6. In combination in a refrigerator, a cabinet providing a refrigerated chamber and having an insulated rear wall formed with an opening therethrough, an insulating closure plug structure for said opening removable therefrom from the rear of the cabinet, an evaporator attached to the forward side of said plug structure within the chamber and removable with the plug structure rearwardly through said opening, a motor-compressor assembly mounted upon said plug structure rearwardly of said evaporator, and partially projecting beyond the back face of said rear wall, supporting means on the outer side of said plug structure extending substantially below the opening and the motor-compressor assembly adjacent the back face of said rear wall and detachably secured thereto, and a refrigerant condenser communicating with said motor-compressor assembly and said evaporator and mounted upon said supporting means, below the projection of the motor-compressor assembly, to be cooled by updraft of air, induced by condenser heat, along the rear of the cabinet, the motor-compressor assembly being enclosed within a chamber including an outer wall which bulges in streamlined fashion rearwardly out over the refrigerant condenser into the air sweeping up therefrom.

7. A removable refrigerator unit comprising an insulating plug having a metallic housing of substantially rectangular shape, said plug having one of its walls formed with a recess for housing substantially half of a motor-compressor unit, and the thickness of said plug being sufficient to provide a thickness of insulation commensurate with that of the cabinet between the recess and the inner wall of said plug, an evaporator carried by the inner wall of said plug and communicating with the suction side of said motor-compressor, a condenser located below said motor-compressor and extending upwardly and outwardly to be interposed across the path of convection air currents passing upwardly toward said motor-compressor, a flue defined by side walls and rear wall members extending about the upper part of the condenser and said motor-compressor and having side walls attached to said plug whereby air passing over the condenser passes upward about the motor-compressor housing and tends to cool the same, and a float chamber member located in the line between said condenser and said evaporator, said float chamber being exposed to cooling air at the side of the flue and being provided with a baffle for baffling from the float chamber the warmer air passing upwardly from said condenser.

8. In combination in a household refrigerator, a cabinet enclosing a food storage compartment and having an insulated rear wall formed with an opening therethrough, a closure plug for said opening comprising a sheet metal shell including inner and outer walls and filled with heat insulating material substantially equivalent in insulating efficiency to the insulation within the rear wall of the cabinet, an evaporator mounted upon the inner wall of the closure plug and extending into the food storage compartment, a motor-compressor assembly having a suction line in communication with said evaporator and mounted upon the outer wall of the closure plug, a refrigerant condenser having high pressure communication with said motor-compressor assembly and said evaporator and also mounted upon the outer closure plug wall, said suction line being formed in part as a flat vertical coil and embedded in the insulation within said plug, and a high pressure feed line for conducting refrigerant from the condenser to the evaporator also

extending through the insulation filled space within the plug and being in heat transfer contact with said suction line.

9. A household refrigerator as set forth in claim 8 wherein the front and rear walls of the closure plug are in the form of removable plates and the plug includes a tubular body member providing the remaining wall structure with the opposite ends of which the plates are engageable to close the plug shell.

10. In combination in a package type refrigerating unit adapted to be mounted at and through the rear of a refrigerator cabinet, an evaporator, a motor-compressor assembly, a common mounting base for said evaporator and said motor-compressor assembly comprising an insulated structure adapted to provide a closure plug for an installation opening in the rear wall of the refrigerator cabinet, a condenser communicating with said motor-compressor assembly and said evaporator and also mounted on said base, an air flue for said condenser forming a protective enclosure rearwardly of the motor-compressor assembly, and a valve-controlled reservoir for refrigerant in the line of communication between the condenser and the evaporator, said reservoir being mounted partially enclosed within said flue and being arranged to be cooled by air unheated by the condenser.

11. A package type refrigerating unit including a mounting base structure constructed and arranged to provide a rearwardly removable closure block for a rear wall opening in a refrigerator cabinet, an evaporator mounted on the front side of the base structure to be inserted into or removed from the refrigerator cabinet through said opening, a motor-compressor assembly mounted on the rear side of the base structure and having suction communication with the evaporator, a main refrigerant condenser having high pressure communication with said motor compressor assembly and said evaporator, a cooling system for said motor-compressor assembly comprising a free circulating closed circuit charged with an evaporable refrigerant and including a condenser, and means removably securing said condensers to the rear side of said base structure with said motor-compressor cooling system condenser above the main refrigerant condenser, said securing means being constructed and arranged for independent removal of either of the condensers.

12. Refrigerating apparatus constituting a unitary package and comprising an insulation plug adapted to be inserted into an opening through the insulated wall of a refrigerator, an evaporator carried by the plug inwardly thereof to lie within the insulated refrigerated compartment of the refrigerator, the rear face of the plug being recessed, a motor-compressor assembly carried by the plug and disposed largely in the recess to lie largely within the wall of the refrigerator, an air-cooled condenser disposed to lie along the outside of the wall, an enclosure for the motor-compressor assembly, the compressor, condenser and evaporator being in communication to constitute a primary refrigerant system, and a second refrigerant system, arranged and constructed for free circulation by convection comprising an evaporator in heat-absorbing relation to the motor-compressor assembly and within its enclosure, and a condenser external to the enclosure and disposed along the wall of the refrigerator.

13. Refrigerating apparatus constituting a unitary package and comprising an insulation plug adapted to be inserted into an opening through the insulated wall of a refrigerator, an evaporator carried by the plug inwardly thereof to lie within the insulated refrigerated compartment of the refrigerator, the rear face of the plug being recessed, a motor-compressor assembly carried by the plug and disposed largely in the reces to lie largely within the wall of the refrigerator, an air-cooled condenser disposed to lie along the outside of the wall, the compressor, condenser and evaporator being in communication to constitute a primary refrigerant system, and a second refrigerant system, arranged and constructed for circulation by convection comprising an evaporator in heat-absorbing relation to the motor-compressor assembly, and a condenser external to the recess and exposed to outside cooling air.

14. Refrigerating apparatus according to claim 13 wherein the first-mentioned condenser is disposed to lie along the refrigerator wall below the motor-compressor assembly and the last-mentioned condenser is disposed to lie along the wall of the refrigerator above the motor-compressor assembly and wherein a vertical flue extends between the two condensers to provide a stack receiving air passing over the first-mentioned condenser and to discharge it over the second mentioned condenser.

15. In a heat dissipator for the motor-compressor assembly of a refrigerating unit, a motor compressor assembly and a separate system arranged and constructed for circulation by convection charged with a vaporizing refrigerant and an inert gas and having an evaporator in heat-absorbing relation to the motor-compressor assembly, an air-cooled condenser, and a dead-end chamber communicating with the discharge end of the condenser to receive the inert gas while the system is active and arranged to drain to the evaporator any refrigerant condensed in the volume chamber.

16. A heat dissipator according to claim 15 wherein the condenser and the dead end chamber are so positioned and arranged that the temperature surrounding the dead end chamber is lower than the temperature surrounding the condenser.

17. A heat dissipator according to claim 15 wherein the condenser lies in the path of an upflowing air-stream from the motor compressor assembly and the dead end chamber is positioned beneath the condenser and externally subjected to the air-stream before the air-stream reaches the condenser.

18. Refrigerating apparatus constituting a unitary package, comprising an insulation-filled box-like plug adapted to be inserted into an opening in the insulated wall of a refrigerator, an evaporator carried by, and disposed beyond the inner face of the plug, a recess formed in the back of the plug, a motor-compressor assembly resiliently mounted on the plug and disposed largely within the recess but in part outwardly from the plug, a closure cap closing the recess to house the outwardly protruding part of the motor-compressor assembly, the plug having a marginal plate adapted to lie along and be secured to the wall of the refrigerator adjoining the opening, laterally spaced vertical plates extending outwardly from the marginal plate, a condenser communicating with the compressor and the evaporator supported by and between the vertical plates below the motor-compressor

assembly, a separate refrigerating system arranged and constructed for circulation by convection charged with a vaporizing refrigerant and including an evaporator in heat-absorbing relation to the motor-compressor assembly, and a condenser also mounted by and between the vertical plates and disposed above the motor-compressor assembly, whereby air may flow upwardly along the wall of the refrigerator through the first-mentioned condenser and then through the last-mentioned condenser.

19. Refrigerating apparatus according to claim 18 wherein a plate extends between the vertical plates and outwardly spaced from the marginal plate to form a flue receiving air passing over the first-mentioned condenser and discharging it over the second-mentioned condenser.

20. In combination in a refrigerator, a cabinet providing a refrigerated chamber and having an insulated rear wall formed with an opening therethrough, an insulating closure plug structure for said opening removable therefrom from the rear of the cabinet, an evaporator attached to the forward side of said plug structure within the chamber and removable with the plug structure rearwardly through said opening, a motor-compressor assembly mounted upon said plug structure rearwardly of said evaporator, and partially projecting beyond the back face of said rear wall, supporting means on the outer side of said plug structure extending substantially below the opening and the motor-compressor assembly adjacent the back face of said rear wall and detachably secured thereto, and a refrigerant condenser communicating with said motor-compressor assembly and said evaporator and mounted upon said supporting means, below the projection of the motor-compressor assembly, to be cooled by updraft of air, induced by condenser heat, along the rear of the cabinet, the motor-compressor assembly being cooled by a free-circulating closed-circuit cooling system including a condenser mounted on the closure plug structure above the first-mentioned condenser and within the current of air sweeping upwardly therefrom.

21. A refrigerating apparatus including as a package unit, a supporting base structure, an evaporator on one side of said base structure, means defining a closed chamber on the opposite side of said base structure, a motor-compressor assembly mounted within said chamber and having suction communication with the evaporator, a main condenser mounted on said base structure exteriorly of said chamber and communicating with said motor-compressor and said evaporator, means for cooling said motor-compressor assembly comprising a secondary refrigerant system arranged for free circulation by convection including a refrigerant coil in heat transfer relation to said motor-compressor assembly within the chamber, a communicating condenser exteriorly of the chamber mounted upon said base structure, the secondary motor-compressor cooling system containing a non-condensable gas for maintaining a pressure within the condenser of such system up to a predetermined motor-compressor temperature, and a chamber in said system for receiving the non-condensable gas when the refrigerant pressure increases proportionate to temperature increases of the motor-compressor above said predetermined temperature and overbalances the non-condensable gas pressure whereby to displace such gas from the condenser.

22. A refrigerating apparatus including as a package unit, a supporting base structure, an evaporator on one side of said base structure, means defining a closed chamber on the opposite side of said base structure, a motor-compressor assembly mounted within said chamber and having suction communication with the evaporator, a main condenser mounted on said base structure exteriorly of said chamber and communicating with said motor-compressor and said evaporator, means for cooling said motor-compressor assembly comprising a secondary refrigerant system arranged for free circulation by convection including a refrigerant coil in heat transfer relation to said motor-compressor assembly within the chamber, a communicating condenser exteriorly of the chamber mounted upon said base structure, the secondary motor-compressor cooling system including a non-condensable gas for maintaining the system inactive below a predetermined motor-compressor temperature, said system including a chamber for receiving the non-condensable gas when displaced by increased refrigerant pressure after the motor-compressor temperature attains said predetermined or higher temperature, and said motor-compressor cooling system including a liquid refrigerant flow-promoting trap between the condenser and the heat transfer coil and at a substantially lower elevation than the coil.

23. A refrigerating apparatus including as a package unit, a supporting base structure, an evaporator on one side of said base structure, means defining a closed chamber on the opposite side of said base structure, a motor-compressor assembly mounted within said chamber and having suction communication with the evaporator, a main condenser mounted on said base structure exteriorly of said chamber and communicating with said motor-compressor and said evaporator, means for cooling said motor-compressor assembly comprising a secondary refrigerant system arranged for free circulation by convection including a refrigerant coil in heat transfer relation to said motor-compressor assembly within the chamber, a communicating condenser exteriorly of the chamber mounted upon said base structure, the secondary motor-compressor cooling system condenser being operated at a higher temperature than that of the main condenser and being mounted above the main condenser, and an air flue directing the heated air moving upwardly from the main condenser to travel in heat-abstracting relation to the higher temperature cooling system condenser.

24. A secondary cooling system for a motor-compressor comprising a closed tubular conduit having a plurality of cooling coils wrapped about the housing of a motor-compressor in heat-conducting contact therewith, whereby a charge of refrigerant in said coils is vaporized, the uppermost of said coils communicating with a section of finned condenser tubing located to be cooled by convection currents of air passing upward around the motor-compressor unit, the said section of condenser tubing being downwardly tilted toward its other end and having a communication with a liquid trap which communicates with the lowermost of the coils on said motor-compressor housing, whereby the condensed refrigerant flows downward into said trap and is returned to said cooling coils to be used again, said condenser section also communicating at its lower end with a dead end pipe section for receiving a predetermined amount of inert gas, said dead end section being located to be cooled by the

convection currents of air passing over the condenser section.

25. A cooling system for cooling the motor compressor units of refrigerator systems, comprising cooling coils in heat conducting contact with a part of the motor compressor unit, the said cooling coils having their upper outlet connected to a condenser, whereby refrigerant, which is caused to boil in the cooling coils, passes upward into the condenser, the condenser having its outlet connected by a return conduit to the lower inlet of the cooling coils, whereby the refrigerant vapor is condensed in the condenser to liquid which flows down by gravity to the cooling coils so that the cooling cycle may be repeated, the said system being provided with a separate housing forming an air chamber communicating with the condenser and return conduit, but located substantially out of the course of circulation of the refrigerant.

26. In a closed cooling system for cooling heated devices to a predetermined temperature, the combination of a condenser, comprising a tube, said tube communicating at one end with a downwardly extending conduit leading to metal cooling conduits which are in heat conducting relation to the device to be cooled, said latter cooling conduits being in communication at their uppermost end with a vapor conduit leading to the inlet end of said condenser, said system being closed and charged with refrigerant, whereby the heated device causes the refrigerant to boil in the cooling conduits and to pass up the vapor conduit to the condenser, where the vapors are cooled and condensed to liquid, which passes out of the outlet end of the condenser down the return conduit to the cooling conduits to repeat the cycle, the said system also including a chamber located substantially out of the course of circulation of refrigerant, but communicating with said course for receiving a predetermined amount of noncondensable gas, whereby the system will not cool said device below a predetermined temperature, the said noncondensable gas being a predetermined amount of air which is left in the system by reducing the initial vacuum only to a predetermined point before charging with refrigerant, the said system including an amount of refrigerant which is adapted to fill the cooling conduits thereof, the said chamber being formed by a dead end portion of the condenser tube backwardly bent and located below the condenser to be subjected to cooling air currents drawn upward by the condenser.

27. In a closed cooling system for cooling heated devices to a predetermined temperature, the combination of a condenser, comprising a tube, said tube communicating at one end with a downwardly extending conduit leading to metal cooling conduits which are in heat conducting relation to the device to be cooled, said latter cooling conduits being in communication at their uppermost end with a vapor conduit leading to the inlet end of said condenser, said system being closed and charged with refrigerant, whereby the heated device causes the refrigerant to boil in the cooling conduits and to pass up the vapor conduit to the condenser, where the vapors are cooled and condensed to liquid, which passes out of the outlet end of the condenser down the return conduit to the cooling conduits to repeat the cycle, the said system also including a chamber located substantially out of the course of circulation of refrigerant, but communicating with said course for receiving a predetermined amount of noncondensable gas, whereby the system will not cool said device below a predetermined temperature, the said noncondensable gas being a predetermined amount of air which is left in the system by reducing the initial vacuum only to a predetermined point before charging with refrigerant, the said system including an amount of refrigerant which is adapted to fill the cooling conduits thereof, the said chamber comprising a separate closed housing member which communicates with the outlet end of the condenser and is located adjacent the stream of air passing the condenser.

28. In a cooling system for a device heated with an intermittent source of heat, the combination of an air condenser having an inlet and an outlet, the inlet connecting with an evaporator coil arranged in heat absorption relationship with the source of heat and the other end of said evaporator coil being connected with the opposite end of said condenser, said condenser draining downward at one end toward the lower coils of the evaporator and being provided with a separate chamber communicating with and draining into the evaporator and located to be cooled by the air passing over the condenser, the said system being charged with a predetermined amount of refrigerant and a predetermined amount of noncondensable gas, whereby the refrigerant is evaporated by the heat from the heat source and passes up into the higher end of the condenser to be condensed to liquid and drained back from the lower end of the condenser to the evaporator coils until a predetermined lower temperature is reached when the expansion of the noncondensable gas prevents the further effective operation of the cooling system except at higher temperatures.

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