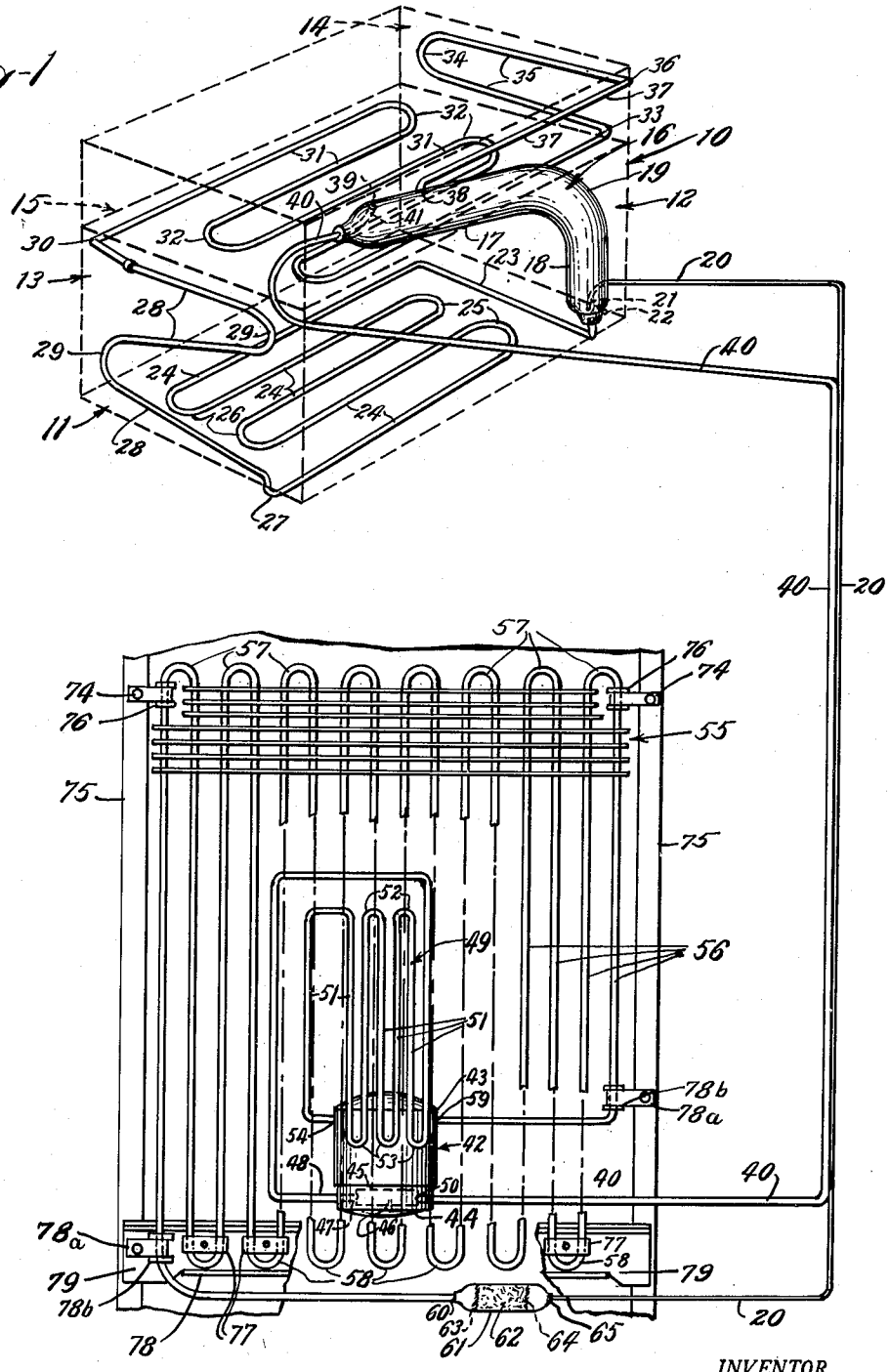
April 24, 1956 C. F. ALSING 2,742,767

REFRIGERATION APPARATUS, INCLUDING A PRECOOLER

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Fig-1



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Fig-2

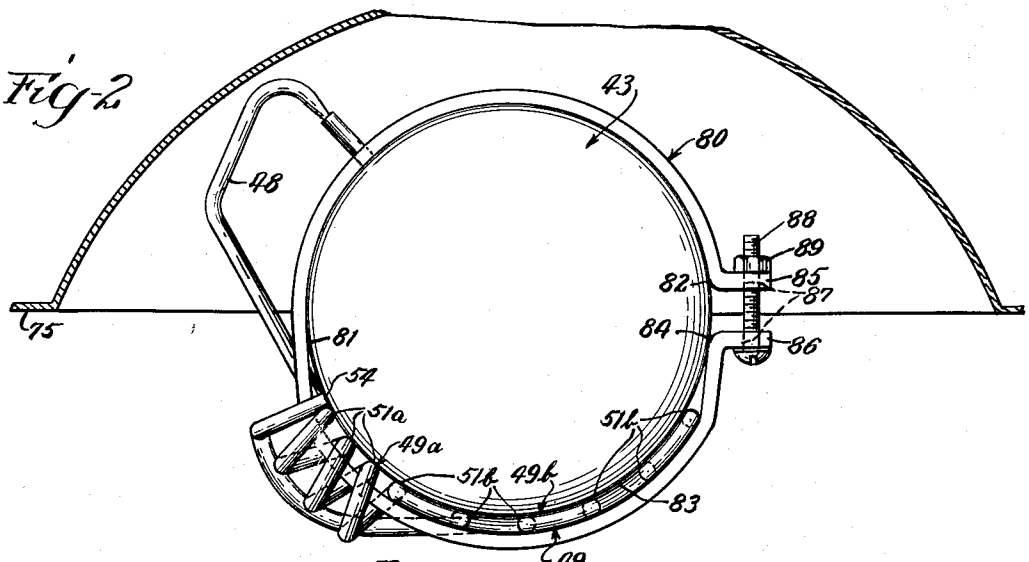
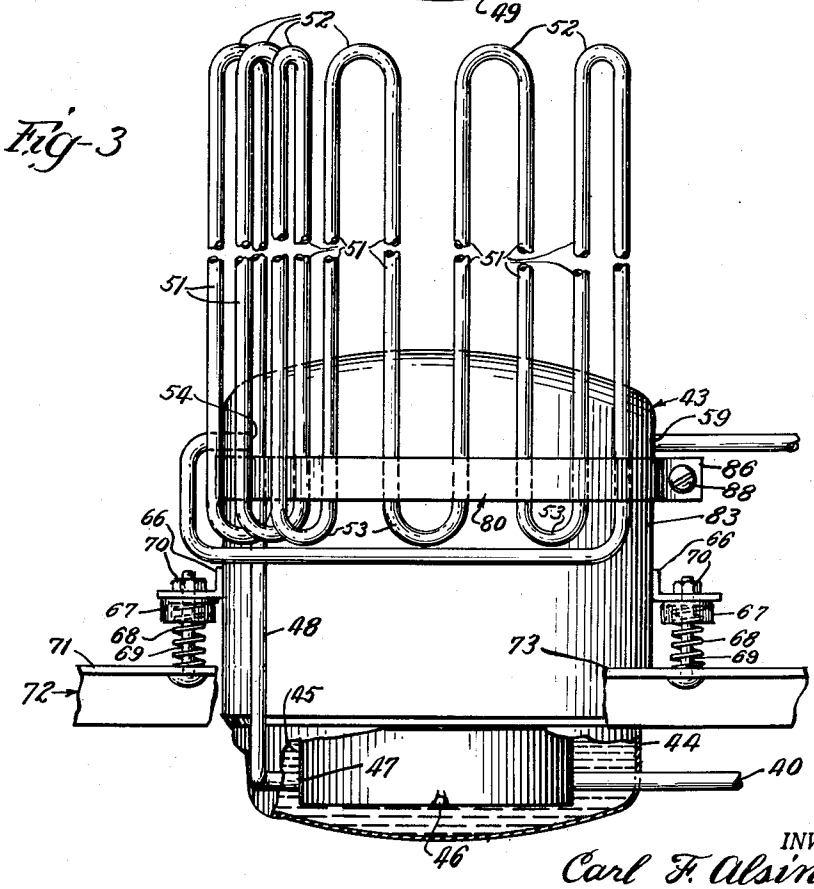


Fig-3



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REFRIGERATION APPARATUS, INCLUDING A PRECOOLER

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Application February 23, 1954, Serial No. 411,795

8 Claims. (Cl. 62—117.8)

The present invention relates to a refrigeration apparatus and system of the type in which a precooler is employed for the heated gas which is taken directly from the compressor outlet to the precooler, and returned from the precooler to the motor compressor housing for cooling the motor.

In the refrigeration systems of this type the refrigerant and entrained oil are cooled in the precooler and some of the refrigerant is condensed, and the oil and refrigerant are then delivered to the upper part of the motor compressor housing where the liquid refrigerant trickles down over the motor parts, cooling the motor, and the oil in the form of droplets runs down to an oil sump which surrounds the compressor in the bottom of the motor compressor housing.

The effectiveness of the precooling coils of this type of the prior art is somewhat impaired because the temperature of the refrigerant and coils drops rapidly through this coil, which is operating in a room temperature and heat does not radiate effectively from the precooler coil part which does not have a considerable difference in temperature from that of the air to which the heat is transferred.

In the precoolers of the prior art the latter half of the tubing of the precooler coil may be operating in an ambient or room temperature of 110 degrees under the most adverse conditions, and the last part of the tubing may be at temperatures of 140 to 157 degrees, while the inlet portion of the precooler may run as high as 230 degrees F.

One of the objects of the invention is the provision of an improved refrigeration apparatus including such a precooler in which all of the precooler tubing is maintained at a temperature which is considerably elevated above the ambient or room temperature at all times, so that all of the precooler tubing will effectively radiate and dissipate heat.

Another object of the invention is the provision of an improved precooler coil structure which radiates heat to the surrounding atmosphere more efficiently and which is simple in construction, sturdy, and adapted to be manufactured at a low cost.

Another object of the invention is the provision of an improved mode of support for the precooler coil by means of which the precooler coil not only dissipates heat from the refrigerant and oil emerging from the compressor, but it also dissipates heat taken directly from the motor housing.

Another object of the invention is the provision of an improved mode of precooler support on the motor compressor housing which aids in dissipating or attenuating noise from the operation of the compressor, and by means of which the precooler coil is arranged in the stream of air which moves upward by convection from the motor compressor housing.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of

reference indicate similar parts throughout the several views.

Referring to the drawings, of which there are two sheets, accompanying the specification,

Fig. 1 is a diagrammatic view of the refrigeration system embodying the present invention;

Fig. 2 is a top plan view of the motor compressor and precooler unit;

Fig. 3 is a side elevational view of the motor compressor and precooler unit.

The refrigeration apparatus embodying the invention preferably includes an evaporator **10**, Fig. 1, which may comprise a box-like member of sheet aluminum having a bottom **11**, rear wall **12**, side walls **13** and **14**, and shelf **15** extending from side wall to side wall.

The top is open but is closed by the top of the refrigerator liner to which it is secured, and the front of the evaporator is closed by an evaporator door, not shown.

The evaporator may include a receiver **16**, comprising two enlarged portions **17** and **18**, joined by an easy bend at **19** and mounted in a complementary slot or opening in the rear wall **12**.

The refrigerant inlet to the evaporator is by tube **20**, which extends through the receiver wall in the portion **18**, and is pointed downwardly and provided with a nozzle **21**, extending toward the receiver outlet **22**.

From the receiver outlet a tube **23** extends along the bottom wall **11** to the bottom of which it is secured, and the tubing is arranged sinuously at **24** on the bottom wall **11**, by providing the straight portions **24** and the U-shaped bends **25** and **26** joining these portions.

From the bottom tubing **24**, the tubing is bent upwardly at **27**, on the outside of the end wall **13**, and slopes upwardly sinuously at **28**, with a plurality of straight portions which are joined by U-bends **29**.

At the shelf level the tubing is turned inwardly through the wall at **30**, and has a plurality of straight portions **31** arranged sinuously on the bottom of the shelf **15**, and joined by U-shaped bends **32**.

At the rear end of the shelf the tubing emerges at **33** through the side wall **14**, and has a single U-shaped bend **34** joining two straight portions **35**.

The uppermost tubing **35** is bent at **36**, around the corner, and extends at **37** along the rear wall **12** to an upper part of the receiver **16**, where there is an inlet at **38** into the upper horizontal portion **17** of receiver **16**.

The outlet from the receiver **16** and from the evaporator is at **39**, at its upper horizontal end, where a tube **40** extends into the end **41**, and has its open end **39** turned upwardly to be located above any liquid in the receiver **16**.

The outlet tube **40**, which is also the suction tube, is arranged in heat conducting relation with the capillary tube **20**, coming from the motor compressor.

The motor compressor unit **42** comprises an outer motor housing **43**, the lower part of which **44**, contains the compressor **45**, which is directly connected to the shaft of the motor located in housing **43**.

The lower part **44** of the motor housing forms an oil sump, which is in direct communication with the rest of the motor housing and which is filled with oil surrounding the motor compressor **45**, which may be immersed in the oil.

There is an oil inlet **46** in the bottom plate of the compressor **45**, so that the compressor may draw oil from the sump and pump it along with the refrigerant for lubricating the compressor and motor.

The outlet of the compressor **45** is at **47**, and is connected by means of a tube **48** with the precooler unit **49**. Tube **48** extends through the wall of the motor housing **44**, from the compressor outlet **47**, and conducts refrig-

erant in the form of a compressed heated gas with entrained oil directly from the compressor to the precooler.

The inlet to the motor compressor is at **50**, and is connected directly to the tube **40**, which also passes through the wall of the motor housing **44** and through the oil sump to the compressor.

The precooler condenser **49** may consist of a plurality of straight, vertical runs **51** of tubing joined by U-shaped bends **52**, **53**, at the top and bottom, and the outlet from the precooler unit **49** is at **54**, where the precooler tubing discharges into the top of motor housing 43.

The main condenser **55** consists of a plurality of straight, vertical runs **56**, of tubing, connected at the top and bottom of the U-shaped bends **57**, **58**. The inlet to the main condenser is at **59**, from the top of the motor housing **43**, and the main condenser outlet is indicated at **60**, where the tubing is joined to a refrigerant drier capsule **61**, comprising a tubular member provided with a filling of silica gel powder **62** between a pair of screens **63**, **64**. The outlet from the drier is at **65**, leading to the capillary tube **20**.

The main condenser may have its vertical passes joined by a multiplicity of welded heat dissipating fins or wires.

The motor compressor may be provided with diametrically opposite angle brackets **66**, resting upon cup-shaped members **67**, within which there is seated one end of a spring **68**, surrounding a screw bolt **69**, having a nut **70**.

Screw bolt **69** also passes through a transverse frame member **71**, which has its ends **72** secured to the cabinet and upon the top of which the spring **68** is seated.

The transverse frame member **71** has its central portion **73** bowed outwardly to arch about the motor compressor housing **43**, and the main condenser coils **55** are also arranged in an arcuate arrangement about the outside of the motor compressor **43**.

At their upper ends the main condenser coils are supported by a pair of brackets **74**, mounted on the rear of the cabinet **75**, and provided with a split rubber grommet **76**, which surrounds the outermost U-bend **57** at each side of the main condenser **55**.

At their lower ends the main condenser coils **55** are clamped by a plurality of welded clips **77** to a transverse frame member **78**, the ends **79** of which are secured to the rear wall of cabinet **75**.

The present precooler coil **49** is supported directly upon the motor compressor housing **43**, by means of a clamping band **80**, comprising a metal strip which is curved over the major portion of its length from **81** to **82** to fit the cylindrical outer surface **83** of the motor housing **43**.

Brackets **78***a* with rubber grommets **78***b* secure the outermost coils of main condenser **55** to the rear panel at the lower end of said coils. The main condenser **55** and details of its support and the compressor support may be substantially as disclosed in application Ser. No. 294,091 of Harry Nadler, filed June 17, 1952, U. S. Patent No. 2,687,625.

From the point **81** to the point **84** the band **80** is curved on a larger diameter which provides room for the precooler coils **49** between the band **80** and the cylindrical surface **83**, of the motor housing **43**.

At its ends the clamping band **80** has a pair of outwardly turned securing flanges **85** and **86**, provided with apertures **87** for passing the screw bolt **88**, having nut **89**.

The outlet from the precooler coils into the top of the motor housing is again indicated at **54**, and the inlet tube **48** extends directly from the precooler **49** through the lower part **44** of the motor housing into the motor compressor outlet **47**.

The motor compressor housing **43** may be arranged with the forward half of the motor housing **43** under the lower edge of the rear wall of the cabinet, while the rear half of the motor compressor housing **43** is disposed rearwardly of the rear cabinet wall in the chimney, which is formed by the vertically extending passes **56** of the main condenser **55**.

Therefore, the precooler **49**, which is to be carried by the motor housing **43**, must be arranged on the outer half of the motor housing **43**, which is that portion below the center in Fig. 2, so that the vertical passes **51** of precooler **49** may extend vertically behind the rear wall of the cabinet **75**, which customarily has a cavity for receiving the front half only of the motor housing **43**.

This makes only half of the periphery of the motor housing **43** available for mounting the precooler coils, of which there are too many in the particular system to have them all spread circumferentially on the motor housing **43**.

Therefore, one portion, **49***a*, of the precooler coils is arranged with only one leg of each pair of vertical passes engaging the housing, such as the legs **51***a*, while the portion **49***b* of the precooler **49** has both of the legs **51***b* of each U-shaped portion directly engaging the motor housing **43**.

As pointed out preliminary to the description, the precooler coils of the prior art had their efficiency impaired by the fact that the temperature dropped rather rapidly through these coils from a temperature of 230 degrees F., for example, at the precooler inlet **47**, to a temperature of, for example, 140 to 157 degrees F. for the last half of the tubing.

According to the present invention the precooler tubing is in heat conducting relation with the hot motor housing **43**, and its heat dissipating temperature may be maintained, for example, at a minimum of about 173 degrees F. by the conduction of heat from the motor housing **43** to the precooler **49**.

From the foregoing it will be evident that it is the last half of the precooler tubing **49**, that is the portion **49***b*, which needs the most heat conduction to bring it up to a temperature, such as 173 degrees F., at which it can radiate heat efficiently to the surrounding ambient temperature, which may be as high as 110 degrees F.

Therefore, the last portion **49***b* of the precooler has its vertical passes all directly engaged with the motor housing **43**, and welded to the inside of the band **80**, to conduct heat readily from the band to the coils and to clamp the coils against the motor housing **43** for efficient heat conduction.

The other earlier portion **49***a* of the precooler **49** is arranged with its U-shaped bends extending outwardly and with only the innermost of two legs, indicated at **51***a*, between the band **80** and the motor housing **43**, where these two coils are again welded to the band **80**.

At this inlet end of the precooler coil **49**, the temperature is already high and does not need so much heat conduction from the motor housing **43**, to elevate its temperature to an efficient level for radiating heat to the air.

Therefore, there is less heat transmitting contact between the vertical passes **51***a* and the band and motor housing than is true for the vertical passes **51***b*. The vertical passes **51** of the precooler **49** are preferably secured to the band **80** at the lower end of these vertical passes; and the band **80** is preferably arranged at the upper end of the motor housing and has heat engaging contact with the motor housing **43** from the point **81** to the point **82**.

Thus the precooler coils **49** are supported in the air above the motor housing **43** and are in the current of air which is produced by convection of the air that is heated by motor housing **43**.

Supporting the precooler coils **49** only at one end permits the other ends and U-shaped bends **52** to be free for vibration, which will dissipate in some measure the vibration and motor compressor noise that is transmitted to the free ends **52** of the precooler coils **49**, and attenuated by the vibrating action of the precooler coils **49** on the motor housing **43**.

The springs **68** may be clamped fixedly by tightening nuts **70** on cups **67** and bolts **69** during shipment, but

the nuts are loosened before operating the system; and the springs **68** are adapted to absorb vibration of the motor compressor **43** and precooler **49**.

It will thus be observed that the present refrigeration apparatus maintains a precooler temperature throughout, which is sufficiently elevated above the ambient temperature to radiate heat effectively to the surrounding air, and more heat is dissipated from the motor housing and from the refrigerant and oil in the precooler.

The result is a more efficient motor cooling by the precooler arrangement, and motor compressor noise is also substantially reduced.

While I have illustrated a preferred embodiment of my 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.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a household refrigerator, a motor compressor and precooler unit comprising, a housing having an upper portion enclosing a motor, and a lower portion forming an oil sump communicating with the upper portion and surrounding a compressor directly driven by said motor, a precooler coil having its inlet directly connected through the wall of the lower part of said housing to the compressor outlet to remove the hot compressed gas immediately from the compressor, said precooler unit comprising a plurality of upwardly and downwardly extending passes of tubing arranged parallel to each other and joined at the top and bottom by U-shaped tube formations, the said precooler coils being in one continuous length of tubing and discharging into the upper part of said motor housing, all of said precooler coils having their lower U-shaped portions mounted on said motor compressor housing in heat conducting relation with said housing to raise the temperature of said precooler coils by heat conduction from the motor housing to an elevated temperature for more efficiently radiating heat to the surrounding air, the said precooler coils being fixedly clamped to said motor housing at their lower ends and having their upper ends free for limited vibration and dissipation of noise.

2. In a household refrigerator, a motor compressor and precooler unit comprising, a housing having an upper portion enclosing a motor, and a lower portion forming an oil sump communicating with the upper portion and surrounding a compressor directly driven by said motor, a precooler coil having its inlet directly connected through the wall of the lower part of said housing to the compressor outlet to remove the hot compressed gas immediately from the compressor, said precooler unit comprising a plurality of upwardly and downwardly extending passes of tubing arranged parallel to each other and joined at the top and bottom by U-shaped tube formations, the said precooler coils being in one continuous length of tubing and discharging into the upper part of said motor housing, all of said precooler coils having their lower U-shaped portions mounted on said motor compressor housing in heat conducting relation with said housing to raise the temperature of said precooler coils by heat conduction from the motor housing to an elevated temperature for more efficiently radiating heat to the surrounding air, the said precooler coils being fixedly clamped to said motor housing at their lower ends and having their upper ends free for limited vibration and dissipation of noise, the said precooler coils being arranged in two sections with the section that receives the refrigerant first from the compressor having alternate passes clamped to the motor housing, and the section that receives refrigerant last from the motor compressor having all of its vertical passes clamped to the motor housing, so that the last part of the precooler tubing which needs the most heat conduction to bring it up to an efficient radiating temperature has a maximum area in contact with said motor housing.

3. In a household refrigerator, the combination of an insulated cabinet having a back panel, a transverse frame member carried by said back panel, and having an outwardly extending central portion for passing about a motor compressor housing, a motor compressor having an external housing, spring means engaging said frame member and supporting said motor compressor housing, and a precooler coil comprising a plurality of vertical passes joined by U-shaped bends, said coils having their lower ends secured in heat conducting relation with an upper part of said motor compressor housing, for maintaining all parts of the pre-cooler coil at an elevated temperature for efficiently radiating heat from the pre-cooling coils to the surrounding atmosphere, the pre-cooler coils being welded to one portion of a substantially cylindrical band extending about said motor housing, the other portion of said band being secured in heat conducting relation with said motor compressor housing, the said coils being arranged in former and latter sections, with the latter sections having a greater heat conducting contact area between the coils and band and motor compressor housing.

4. A motor compressor and pre-cooler unit comprising a housing having an upper portion enclosing a motor and a lower portion forming an oil sump communicating with the upper portion and surrounding a compressor directly driven by said motor, a pre-cooler coil having its inlet directly connected through the wall of said lower part of said housing to the compressor outlet to remove the hot compressed gas immediately from the compressor, said pre-cooler unit being mounted upon and extending upwardly from said motor compressor housing in heat conducting relation with said housing to raise the temperature of said pre-cooler coils by heat conduction from the motor housing to an elevated temperature, for efficiently radiating heat to the surrounding air, the other end of said pre-cooler coils being connected to discharge into a top portion of said motor housing, the said pre-cooler coils being welded to a metal band, and the said band having heat exchanging contact with substantially half of the periphery of said motor housing, the coils engaging over substantially the other half of the motor housing.

5. A motor compressor and pre-cooler unit comprising a housing having an upper portion enclosing a motor and a lower portion forming an oil sump communicating with the upper portion and surrounding a compressor directly driven by said motor, a pre-cooler coil having its inlet directly connected through the wall of said lower part of said housing to the compressor outlet to remove the hot compressed gas immediately from the compressor, said pre-cooler unit being mounted upon and extending upwardly from said motor compressor housing in heat conducting relation with said housing to raise the temperature of said pre-cooler coils by heat conduction from the motor housing to an elevated temperature, for efficiently radiating heat to the surrounding air, the other end of said pre-cooler coils being connected to discharge into a top portion of said motor housing, the said pre-cooler coils being welded to a metal band, and the said band having heat exchanging contact with substantially half of the periphery of said motor housing, the coils engaging over substantially the other half of the motor housing, the said coils comprising a plurality of vertical passes joined by U bends, and said coils comprising a first portion and a second portion, the said second portion having all of the legs of said coils between said band and said motor housing for more effectively raising the temperature of the latter portion of the pre-cooling coil.

6. A motor compressor and pre-cooler unit comprising a housing having an upper portion enclosing a motor and a lower portion forming an oil sump communicating with the upper portion and surrounding a compressor directly driven by said motor, a pre-cooler coil having its inlet directly connected through the wall of said lower part of

said housing to the compressor outlet to remove the hot compressed gas immediately from the compressor, said pre-cooler unit being mounted upon and extending upwardly from said motor compressor housing in heat conducting relation with said housing to raise the temperature of said pre-cooler coils by heat conduction from the motor housing to an elevated temperature, for efficiently radiating heat to the surrounding air, the other end of said pre-cooler coils being connected to discharge into a top portion of said motor housing, the said pre-cooler coils being welded to a metal band, and the said band having heat exchanging contact with substantially half of the periphery of said motor housing, the coils engaging over substantially the other half of the motor housing, the said coils comprising a plurality of vertical passes joined by U bands, and said coils comprising a first portion and a second portion, the said second portion having all of the legs of said coils between said band and said motor housing for more effectively raising the temperature of the latter portion of the pre-cooling coil, and the first portion of said coils having alternate legs of said vertical passes located between the said band and motor housing for a diminished conduction of heat from motor housing to coils in this portion.

7. In a refrigeration apparatus, the combination of an insulated cabinet having its rear wall provided at its lower end with a cavity for receiving substantially half of a motor compressor unit, a transverse frame member carried by said rear wall and bulging outwardly at its central portion to provide room for the motor compressor, a motor compressor unit carried by said transverse frame member and having substantially half of its volume in said cavity and the other half projecting rearwardly outside said rear wall, and a pre-cooler condenser comprising a plurality of vertical passes joined by U bends carried by said motor compressor on its outwardly projecting portion, the said pre-cooler coils extending upwardly outside of said rear wall and above said cavity by virtue of their arrangement on the outer part of said motor compressor housing in the

stream of air moving upward by convection from said motor compressor housing, said pre-cooler coils being welded adjacent their lower ends to a metal band, and said band clamping the welded portions of said coils against said motor housing.

8. In a refrigeration apparatus, the combination of an insulated cabinet having its rear wall provided at its lower end with a cavity for receiving substantially half of a motor compressor unit, a transverse frame member carried by said rear wall and bulging outwardly at its central portion to provide room for the motor compressor, a motor compressor unit carried by said transverse frame member and having substantially half of its volume in said cavity and the other half projecting rearwardly outside said rear wall, and a pre-cooler condenser comprising a plurality of vertical passes joined by U bends carried by said motor compressor on its outwardly projecting portion, the said pre-cooler coils extending upwardly outside of said rear wall and above said cavity by virtue of their arrangement on the outer part of said motor compressor housing in the stream of air moving upward by convection from said motor compressor housing, said pre-cooler coils being welded adjacent their lower ends to a metal band, and said band clamping the welded portions of said coils against said motor housing, the said band itself engaging the motor housing over the major portion of its periphery for conducting heat through the band to said coils from said motor compressor housing.

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