

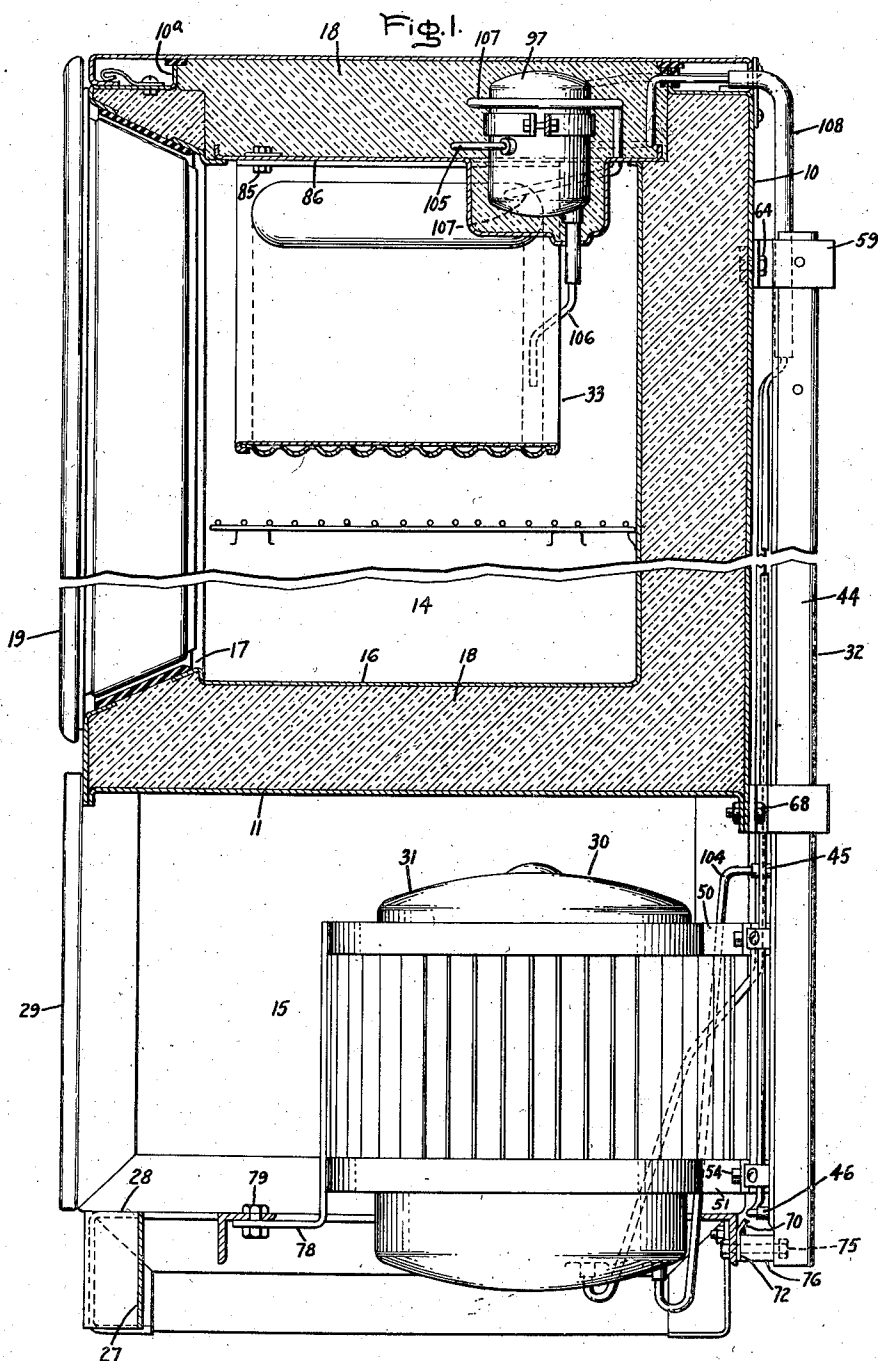
Feb. 16, 1937.

C. STEENSTRUP

2,071,182

REFRIGERATING MACHINE CONDENSER

Original Filed Jan. 26, 1935 2 Sheets-Sheet 1



Inventor:
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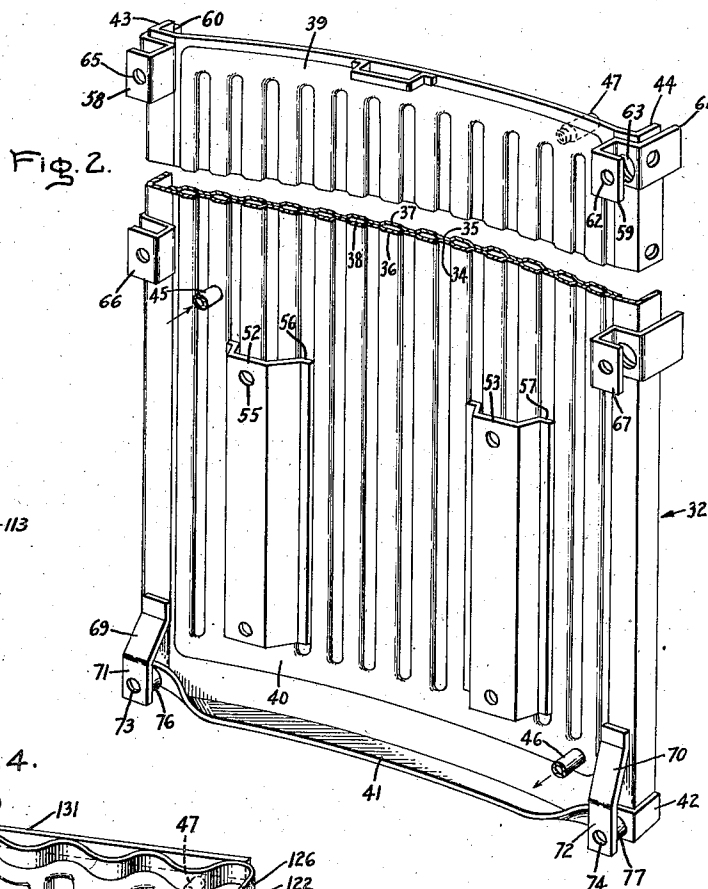
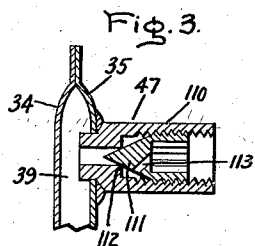
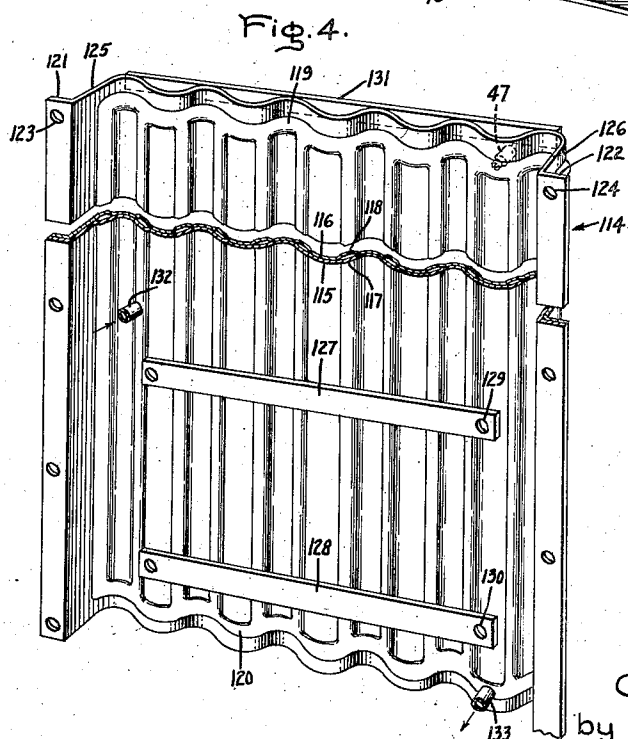
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REFRIGERATING MACHINE CONDENSER

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UNITED STATES PATENT OFFICE

2,071,182

REFRIGERATING MACHINE CONDENSER

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Original application January 26, 1935, Serial No.
3,624. Divided and this application September
24, 1935, Serial No. 41,929

5 Claims. (Cl. 257—36)

My invention relates to condensers and more particularly to air cooled condensers for use in refrigerating machines.

This application is a division of my application Serial No. 3,624 filed January 26, 1935, for improvements in "Refrigerators" and assigned to the General Electric Company, the assignee of my present invention.

It is an object of my invention to provide an improved air cooled condenser particularly adapted for use in refrigerating machines which occupies a minimum amount of space, which is made of relatively thin and inexpensive sheet metal.

Another object of my invention is to provide a sheet metal condenser which is sufficiently strong and rigid in construction to form a support for the refrigerant circulatory unit of a refrigerating machine without the use of an extra supporting frame, or the like.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

A better understanding of my invention may be had by reference to the accompanying drawings, in which Fig. 1 is a side elevation, partly in section, of a refrigerating machine provided with a condenser embodying my invention; Fig. 2 is a perspective view of the condenser of the refrigerating machine shown in Fig. 1; Fig. 3 is a detailed sectional view of the purging valve provided on the condenser shown in Fig. 2; and Fig. 4 is a perspective view of a modified form of condenser embodying my invention and which may be substituted for the condenser shown in Figs. 1 and 2.

Referring to the drawings, in Fig. 1 I have shown a refrigerator of the household type provided with an air cooled natural draft condenser embodying my invention. The refrigerator shown in Fig. 1 is provided with a cabinet and a separable refrigerating machine. The cabinet includes a rectangular outer sheet metal shell 10 having a rectangular opening in the top thereof and is provided with an imperforate horizontal sheet metal partition 11 therein, which extends entirely across the interior of the cabinet. The partition 11 divides the space within the rectangular shell 10 into an upper cooling or food storage compartment 14 and a lower machinery compartment 15, respectively. The cooling compartment 14 is provided with an open top rec-

tangular inner liner 16 which covers the bottom and side walls thereof and is provided with a rectangular door opening 17 in the front wall thereof. The inner liner 16 is surrounded by heat insulation 18 and the opening 17 in the front wall thereof is closed by a heat insulated door 19.

The cabinet described above is provided with a separable refrigerating machine including as its principal elements a refrigerant circulatory unit or compressor, a condenser, and a refrigerant expansion unit. In the present embodiment of my invention, the machine is of the compression type. This machine includes as an element a refrigerant liquefaction apparatus comprising a compressor unit 30 having a motor driven compressor contained in a cylindrical hermetically sealed steel casing 31 and also comprising an air cooled sheet metal condenser 32, embodying my invention, and arranged at the back of the cabinet. The other principal element of the machine is an evaporator 33 located within the cooling compartment 14. Gaseous refrigerant is compressed by the compressor unit 30 liquefied in the condenser 32 and vaporized in the evaporator 33 by the absorption of heat from the contents of the cooling compartment 14. The vaporized refrigerant is then returned to the compressor unit 30 and the cycle is repeated. The operation of the apparatus is described more in detail below. The provision of a refrigerating machine separable from a cabinet ordinarily used therewith and including an evaporator and a refrigerant circulatory unit supported on a sheet metal type condenser without the use of an additional reinforcing or supporting frame forms no part of my present invention, but is described and claimed in my copending application Serial No. 3,624, referred to above.

I have provided an air cooled condenser including a plurality of complementary sheet metal portions secured together, at least one of the sheet metal portions having indentations therein cooperating with the other sheet metal portion to form a refrigerant circulatory passage therebetween and the sheet metal portions having transversely extending reinforcing sections formed therein in order to form a relatively rigid and strong construction. In the form of my invention illustrated in Figs. 1 and 2, the air cooled condenser 32 extends over a major portion of the exterior side of the rear wall of the cabinet. I prefer to locate the condenser 32 on the rear wall of the cabinet as it is usually out of sight there and at the same time receives an adequate supply of cooling air. The condenser

32 is made of inner and outer portions or of sheets of metal 34 and 35, which are provided with a series of complementary vertical indentations formed therein, such as the indentations 36 and 37, best shown in Fig. 2. These vertical indentations form a series of vertical refrigerant circulatory passages 38, which are connected in parallel relationship at their upper and lower ends by manifolds 39 and 40, respectively. The manifolds 39 and 40 are formed by complementary horizontal indentations formed in the inner and outer sheets 34 and 35. The sheets 34 and 35 are joined together in face engagement by line welding, or by a series of closely spaced spot welds, extending about the peripheral edges thereof and along the contacting portions thereof between the indentations formed therein throughout the length of such indentations. The sheets 34 and 35 may be joined together by brazing or in some similar manner. The lower edge of the condenser 32 is bent inwardly forming a horizontal lower strengthening flange 41. The center of the condenser 32 is bowed outwardly thus giving the cross section of the central portion thereof an arcuate shape. The ends of the flange 41, such as the end 42 shown in Fig. 2, are bent upwardly against the adjacent portions of the condenser 32 and the vertical edges of the condenser are then bent outwardly forming beads or flanges 43 and 44, which constitute transversely extending reinforcing sections therein. The condenser 32 is thus formed with a channel shaped cross section, the central portion thereof being slightly arcuate in shape. The reinforcing flanges 41, 43, and 44, as well as the arcuate central portion of the condenser 32 insure a strong rugged construction which is particularly rigid with respect to lateral bending, even though the metal sheets 34 and 35 be made from comparatively light sheet metal stock. Consequently, it is unnecessary to provide the conventional strengthening frame for the condenser 32 and a substantial saving in material and weight is effected. The condenser is provided with a gaseous refrigerant inlet 45 communicating with one of the vertical passages therein in the lower portion of the condenser and a liquid supply connection or outlet 46 communicating with the lower manifold 40. A purge valve 47 is provided on the upper manifold 39. The construction of this purge valve is shown in Fig. 3.

The compressor unit 30 extends laterally from and is supported by the lower end of the condenser 32 and is rigidly secured thereto by a pair of upper and lower straps 50 and 51. These straps 50 and 51 each have a central arcuate portion which conforms to and is rigidly secured to the rings 48 and 49. The rearwardly extending feet of the straps 50 and 51 are secured to a pair of vertical channel irons 52 and 53 by bolts 54 which pass through suitable holes 55 formed near the upper and lower ends of the channel irons 52 and 53. Laterally extending feet 56 and 57 of the channel irons 52 and 53, respectively, are welded, or otherwise rigidly secured, to the front face of the condenser 32 between the indentations 36 formed therein.

The condenser 32 is supported on the exterior side of the rear wall of the cabinet shell 10 in spaced relation thereto by a series of supports which includes a pair of U-shaped brackets 58 and 59 located adjacent the top of the condenser and on each side thereof. The inner legs of the brackets 58 and 59 are welded, or otherwise secured, to the adjacent portion of the condenser

32. These brackets are provided with rearwardly extending portions 60 and 61, respectively, which act as bumpers and aid the flanges 43 and 44 in protecting the condenser 32 and spacing it from an adjacent wall or the like. As shown in Fig. 2, the bracket 59 is provided with a relatively small hole 62 in the outer leg thereof and a larger hole 63 in the inner leg thereof, the latter hole registering with a hole of the same size in the condenser 32. A machine screw 64, shown in Fig. 1, having a head of a smaller diameter than the hole 63, but larger in diameter than the hole 62 is inserted through the hole 63 and engages the rear wall of the shell 10, thus holding the upper end of the condenser 32 firmly in position on the cabinet. The bracket 58 is provided with a small hole 65 in the outer leg thereof which is in alignment with a larger hole formed in the inner leg of the bracket and a similar machine screw passes through the hole 65 and the bracket 58 and secures the same to the rear wall of the cabinet shell 10. A second pair of U-shaped brackets 66 and 67 are welded, or otherwise secured, to the sides of the condenser 32 intermediate its ends. The brackets 66 and 67 are provided with holes which are similar to those provided in the brackets 58 and 59, described above, and bolts 68 are inserted through these holes, the heads of the bolts engaging the rear wall of the shell 10 and the rear flange 43 of the partition 11 as shown in Fig. 1. The lower end of the condenser 32 is provided with a pair of brackets 69 and 70 having lower vertical offset portions 71 and 72, respectively. These offset portions are provided with bolt holes 73 and 74 therein. Bolts 75 pass through the condenser 32, cylindrical spacers 76 and 77, and the holes 73 and 74, and are secured to the removable angle iron 22. The condenser 32 is thus firmly secured to the exterior side of the rear wall of the cabinet and assists in supporting the laterally extending compressor unit 30 within the machinery compartment 15. The front end of the compressor unit 30 is supported by an L-shaped bracket 78 which is welded to the rings 48 and 49, the lower end of the bracket 78 being secured to the angle iron 21 by a bolt 79.

The refrigerant evaporator 33 is arranged in the cooling compartment 14 and, in the illustrative form of my invention, the evaporator is of the flooded type and is made of sheet metal, and secured by bolts 85 to the removable top liner 86 of the cabinet.

The refrigerant circuit of the refrigerating machine described above includes a conduit 104, which connects the discharge side of the compressor contained in the casing 31 with the inlet 45 of the condenser 32. A flexible conduit 105, made of copper tubing or the like, connects the outlet 46 of the condenser 32 with a float valve casing 97 and supplies liquid refrigerant thereto. A liquid line 106 connects an outlet of the float valve casing 97 with the refrigerant circulatory passages of the evaporator 33. A flexible suction conduit 107, made of copper tubing or the like, communicates with the header 82 of the evaporator 33 above the normal liquid level therein and with the inlet of the compressor contained in the casing 31. The conduits 105 and 107 thus provide a flexible connection between the evaporator 33 and the rigidly connected compressor and condenser. A flexible rubber sleeve 108 is arranged on the conduits 105 and 107 and extends from the upper portion of the condenser 32 over

the upper rear edge of the shell 10 in order to protect the conduits from abrasion.

It is desirable to locate the inlet 45 of the condenser 32 in the lower portion thereof, as illustrated, in order to minimize the length of the conduit 104 connecting the compressor in the casing 31 thereto. Since both the inlet 45 and outlet 46 of the condenser 32 are located near the bottom thereof and since the circulatory passages communicating therewith are connected in parallel relationship, there is danger that air, or other gas which is non-condensable at the operating pressures and temperatures ordinarily prevailing in the machine, will be trapped in the condenser 32. The purging valve 47 is, therefore, connected to the outer manifold 39 of the condenser 32. The purging valve 47 is of conventional design and, as shown in Fig. 3, includes a hollow cylindrical body 110 which is welded to the outer sheet 35 of the condenser 32. A tapered valve element 111 is threaded to the interior of the valve body 110 and the tapered portion of the valve element 111 is seated firmly against the seat 112 formed in the valve body 110. When the valve element 111 is unscrewed, gas may escape to the atmosphere past the valve seat 112 and through a passage 113 formed in the valve element 111. The passages of the condenser 32 may thus be purged of air or the like by opening the valve 47.

In the operation of the refrigerating machine, described above, gaseous refrigerant is compressed by the motor driven compressor contained in the casing 31, is discharged therefrom through the conduit 104, and enters the condenser 32 at the inlet 45. The compressed gaseous refrigerant in the condenser 32 is liquefied by the transfer of heat therefrom to the cooling air which passes over the surfaces of the condenser. It will be noted that the condenser 32 is mounted in spaced relation with respect to the rear wall of the cabinet in order that cooling air may readily pass over both the inner and outer surfaces of the condenser. Cooling air enters the machinery compartment 15 through the bottom thereof and the opening 28 formed in the front part of the maset portion 27 of the mopboard 26 and passes about the cooling fins 31a and the periphery of the compressor casing 31 absorbing heat therefrom. The air leaving the machinery compartment 15 then passes upwardly between the rear wall of the cabinet and the surface of the condenser 32 adjacent the rear wall of the cabinet. The rising warm air thus sets up a current of cooling air about the condenser 32 and the latter is sufficiently cooled by natural draft, it being unnecessary in the machine illustrated to provide a fan or other forced draft cooling apparatus. The circulation of cooling air over the surfaces of the condenser 32 is further facilitated in that the sides of the space between the condenser and the rear wall of the cabinet are left open so that air may circulate in a lateral direction there-through. The refrigerant in the condenser 32, which is thus liquefied by the transfer of heat therefrom to the surrounding cooling air drains by gravity to the lower manifold 40. The liquid refrigerant thus accumulated in the lower manifold 40 is forced through the outlet 46 by the pressure of high pressure refrigerant vapor in the condenser above the level of liquid refrigerant therein and through the conduit 105 to the float valve casing 97. The liquid accumulated in the float valve casing 97 is supplied to the evaporator 33 through the liquid line 106 in sufficient quan-

tity to maintain the header 82 about half full of liquid refrigerant. The refrigerant circulatory passages 83 are thus flooded with liquid refrigerant. The refrigerant, which is vaporized by the absorption of heat from the cooling compartment 14, is collected in the header 82 above the level of the liquid refrigerant contained therein and is drawn off to the compressor contained in the casing 31 through the suction conduit 107, and the cycle is repeated continuously during operation of the machine.

The refrigerating machine described may conveniently be removed from the cabinet in order to facilitate shipping or disassembly and repair thereof. When removing the machine from the cabinet, the bolts 68 and 75 are removed as are the machine screws 64, thus freeing the condenser 32 from the rear of the cabinet. The bolt 79 is removed, as well as the angle iron 22, in order that the refrigerant circulatory unit 30 may be swung backwardly out of the machinery compartment 15. Since the conduits 105 and 107 are flexible, it is possible to swing the condenser 32 and compressor unit 30, which are rigidly connected together, to the rear of the cabinet so that the compressor unit 30 is moved out of the machinery compartment 15. The top liner 36 and the evaporator and float valve structure which is secured thereto may then be moved vertically upward out of the cooling compartment 14. The entire refrigerating machine can be thus removed from the cabinet without the necessity of altering or breaking any of the refrigerant connections.

I have shown in Fig. 4 a modified form of air cooled condenser 114 embodying my invention which may be substituted for the condenser 32 in the refrigerating machine described above, the condenser 114 being of approximately the same size as the condenser 32. The condenser 114 is made up of inner and outer portions or sheets of metal 115 and 116 which are provided with a series of complementary vertical indentations therein, such as the indentations 117 and 118. These vertical indentations form a series of vertical refrigerant circulatory passages which are connected in parallel relationship at their upper and lower ends by manifolds 119 and 120, respectively. The manifolds 119 and 120 are formed by complementary horizontal indentations in the inner and outer sheets 115 and 116. The sheets 115 and 116 are joined together in face engagement by line welding, or by a series of closely spaced spot welding, extending about the peripheral edges thereof and along the contacting portions thereof between the indentations formed therein and throughout their length. The sheets 115 and 116 are then bent in a corrugated form, shown in Fig. 4, both in order to strengthen the condenser structure thus formed and in order to increase the surface area thereof without increasing its width. The corrugations formed in the condenser 114 constitute transversely extending reinforcing sections therein. The vertical edges of the condenser 114 are bent outwardly to form flanges 121 and 122 provided with holes 123 and 124 therein respectively. Bolts or other securing means may be inserted through the holes 123 and 124 to mount the condenser 114 on the exterior side of the rear wall of the cabinet. It will be noted that the sides 125 and 126 of the condenser 114 are somewhat longer than the depth of the corrugations formed therein and in this way space is provided for the circulation of cooling air between the rear wall of the cabinet

and the adjacent surface of the condenser, as described above in connection with the construction shown in Figs. 1 to 3, inclusive. The extended sides 125 and 126 of the condenser 114 give the condenser a channel-shaped cross section which is particularly strong and serve to reinforce the same. A pair of horizontal metal straps 127 and 128 are welded or otherwise secured to the tops of the corrugations on the front of the corrugated condenser 114, these straps being provided with holes 129 and 130, respectively, registering with similar holes extending through the condenser 114 through which bolts are inserted for rigidly supporting a compressor unit or the like thereon. The straps 127 and 128 also serve to strengthen the corrugated sheet metal structure. Other horizontal metal straps, such as the strap 131 arranged adjacent the top of the condenser, may be welded or otherwise rigidly secured to the rear side of the condenser 114 in order to further strengthen the same, as well as to protect the rear of the condenser from damage.

Compressed gaseous refrigerant enters the condenser 114 through an inlet 132 which communicates with one of the vertical refrigerant circulatory passages formed therein in the lower portion thereof. Condensed liquid refrigerant leaves the condenser 114 through an outlet 133 which communicates with the lower manifold 120. A purging valve 47 which is identical in construction with the purge valve 47 shown in Figs. 2 and 3 in connection with the condenser 32 communicates with the upper manifold 119 of the condenser 114. Any non-condensable gases accumulated in the condenser 114 may thus be removed therefrom through the purging valve 47.

It will thus be seen that I have provided an air cooled refrigerant condenser, illustrated by two specific embodiments of my invention, which is made of complementary sheets of relatively thin sheet metal and yet which is of such shape and form as to provide a rugged structure on which the remaining elements of the refrigerating machine may be conveniently and safely supported.

While I have shown two particular embodiments of my invention in connection with a household type refrigerating machine, I do not desire my invention to be limited to the particular constructions shown and described and I intend in the appended claims to cover all modifications within the spirit and scope of my invention.

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

1. An air cooled condenser including a plurality of complementary sheet metal portions, means for securing said sheet metal portions together, at least one of said sheet metal portions having indentations therein cooperating with the other

of said sheet metal portions to form therebetween manifolds at the top and bottom thereof respectively and passages between said manifolds and communicating therewith, said sheet metal portions having transversely extending reinforcing sections formed therein and extending through-out opposite edges of said condenser.

2. An air cooled condenser including a plurality of complementary sheet metal portions, means for securing said sheet metal portions together, at least one of said sheet metal portions having indentations therein forming a manifold in the lower portion of said condenser and a plurality of refrigerant circulatory passages communicating with said manifold and connected with each other in parallel relationship, a refrigerant outlet communicating with said manifold, a refrigerant inlet communicating with at least one of said passages in the lower portion thereof, and means including a purge valve communicating with the upper portion of at least one of said passages for removing non-condensable gas entrapped in said passages.

3. An air cooled condenser including a plurality of complementary sheet metal portions, means for securing said sheet metal portions together, at least one of said sheet metal portions having indentations therein cooperating with the other of said sheet metal portions to form manifolds at the top and bottom thereof respectively and passages between said manifolds and communicating therewith, said sheet metal portions being of channel-shaped cross section.

4. An air cooled condenser including a plurality of complementary sheet metal portions, means for securing said sheet metal portions together, at least one of said sheet metal portions having indentations therein cooperating with the other of said sheet metal portions to form manifolds at the top and bottom thereof respectively, and passages between said manifolds and communicating therewith, said sheet metal portions being of channel-shaped section and the center portion of said channel being bowed outwardly in the direction of the legs of said channel.

5. An air cooled condenser including a plurality of complementary corrugated sheet metal portions, means for securing said sheet metal portions together, at least one of said sheet metal portions having indentations therein cooperating with the other of said sheet metal portions to form manifolds at the top and bottom thereof, respectively, and passages between said manifolds and communicating therewith, at least one of said sheet metal portions having a supporting flange formed thereon.

CHRISTIAN STEENSTRUP.