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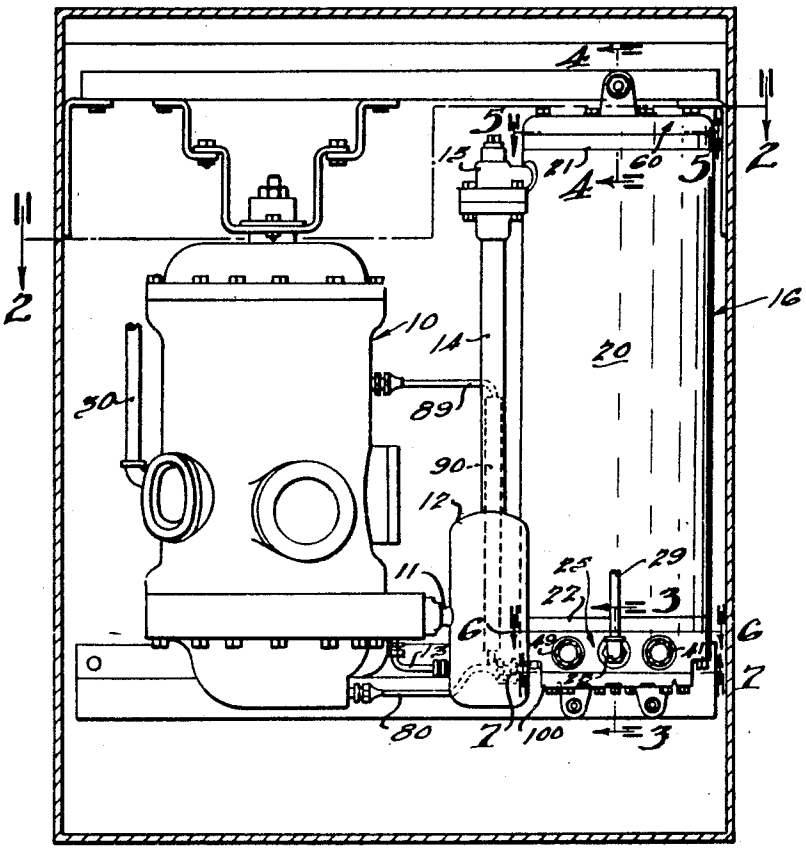
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Dec. 28, 1943. C. P. RUSSELL 2,337,624

CONDENSING UNIT

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FIG. 1.



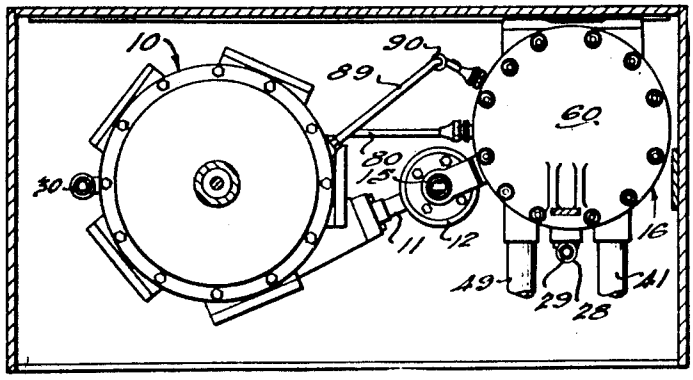


FIG. 2.

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Filed May 4, 1942 3 Sheets-Sheet 2

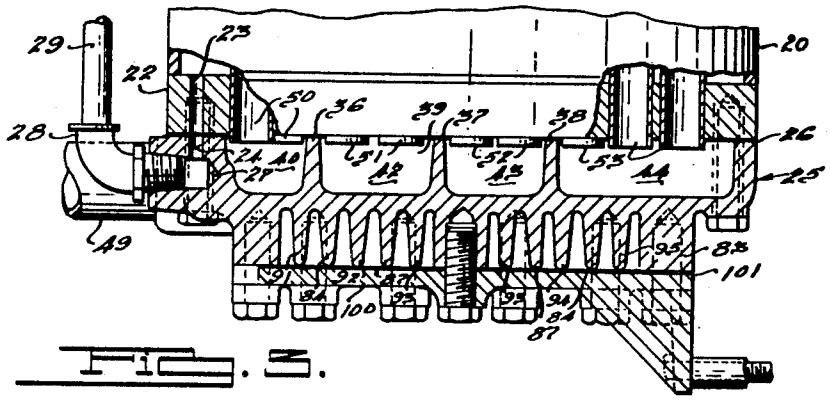


Fig. 3.

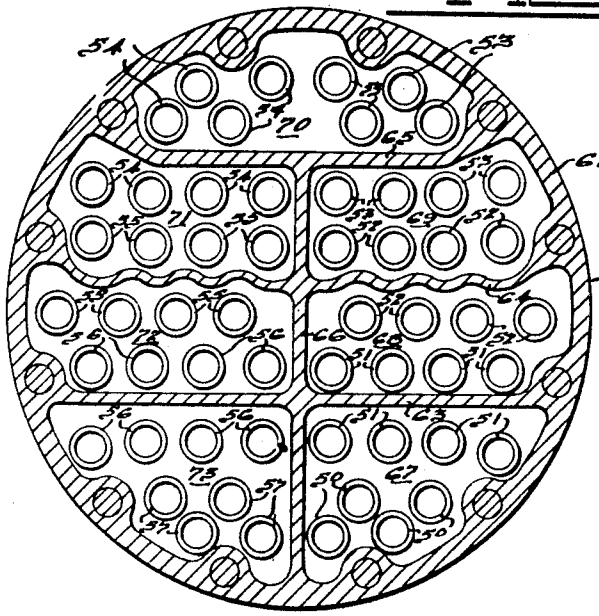


Fig. 5.

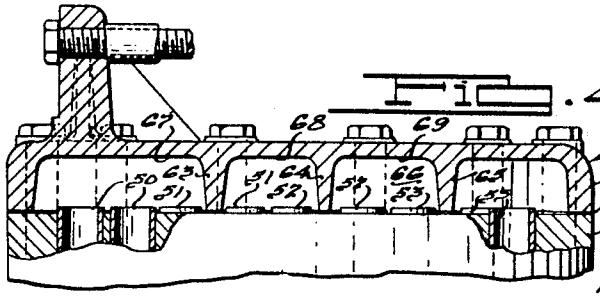


Fig. 4.

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CONDENSING UNIT

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Fig. 6.

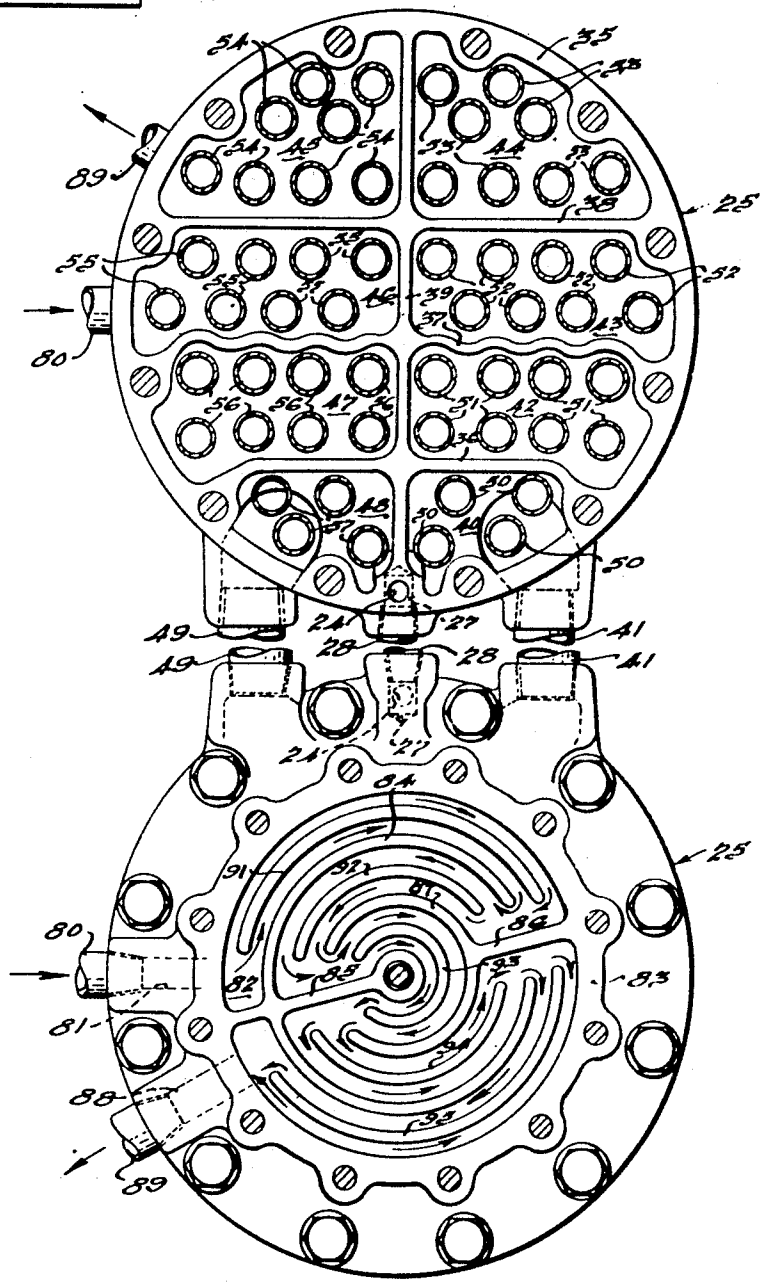


Fig. 7.

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2,337,624

CONDENSING UNIT

Charles P. Russell, Dayton, Ohio, assignor to Chrysler Corporation, Detroit, Mich., a corporation of Delaware

Application May 4, 1942, Serial No. 441,701

9 Claims. (Cl. 62—115)

My present invention comprises an improvement in a condensing unit for a refrigeration system, whether the refrigeration system be used for commodity cooling, air conditioning, or any other purpose. The invention comprises an improvement in the condenser and in the compressor cooling apparatus whereby greater efficiency with the use of a lesser number of parts, more easily machined than those heretofore known, may be accomplished.

The primary object of the present invention is to reduce the number of parts required for condensing refrigerant in a compressor-condenser-expander system of refrigeration, and for conveying heat from the compressor of the system.

A further object of the present invention is to provide a condenser and lubricant apparatus which may be fabricated from materials not on the critical list of materials at the present time, the entire apparatus, outside of gaskets, comprising parts made of steel or cast iron.

A further object of the present invention is to provide a condenser having a lubricant cooling device at one end thereof, the lubricant cooling device being formed as an integral portion of an end bell of a cylindrical condenser. An advantage of the foregoing is that the lubricant may be efficiently cooled by heat transfer to the condenser cooling water without permitting the lubricant at any time to come in contact with relatively thin surfaces or joints between lubricant-conveying and water-conveying portions through which water could enter the refrigerant.

These and other objects and advantages of the present invention will be more readily apparent from an inspection of the following specification and drawings wherein like numerals refer to like parts throughout.

In the drawings,

Fig. 1 discloses a condensing unit including the present invention;

Fig. 2 is a horizontal section taken substantially along line 2—2 of Fig. 1;

Fig. 3 is a vertical section through a portion of the present invention taken substantially along line 3—3 of Fig. 1;

Fig. 4 is a vertical section through a portion of the present invention taken substantially along line 4—4 of Fig. 1;

Fig. 5 is a horizontal section taken through the top end bell of the condenser substantially along line 5—5 of Fig. 1;

Fig. 6 is a horizontal section taken at the joint between the body and the lower end bell of the condenser substantially along line 6—6 of Fig. 1; and

Fig. 7 is a horizontal section taken at the joint between the lubricant passage portion of the lower end bell and the cover plate therefor substantially along line 7—7 of Fig. 1.

The present invention is shown in the form of a condensing unit including a hermetically sealed motor-compressor unit 10 of the type disclosed in the patent to Neeson, No. 2,225,228, issued December 17, 1940; but it will be obvious from the following that any mechanically driven compressor may be connected to a condenser and lubricant cooler of the present invention. Refrigerant which is compressed by the compressing unit passes through discharge pipe 11 into an oil separator 12 from which oil is returned to the compressor through connection 13, as disclosed in the patent to Neeson, No. 2,173,285, issued September 19, 1939. The heated gas from which the oil has been separated passes through the upright pipe 14 and valve 15 and is discharged into the interior of the condenser 16.

The condenser 16 comprises a cylindrical shell 20, to the ends of which are welded identical tube receiving sheets 21 and 22, the tube sheets being provided with a plurality of perforations through which a plurality of straight tubes are passed as shown, the ends of the tubes being sealed into the tube receiving sheets, as is well-known in the art, to provide an enclosed space traversed by the tubes and in which the refrigerant may be condensed. It is to be appreciated that the tube receiving sheets may be welded inside of the ends of the shells or otherwise affixed thereto, the present disclosure being of a simple form of many possible forms well-known in the art. Refrigerant which has been condensed by the action of water or other cooling medium flowing through the tubes drops to the bottom of the condenser and passes through an opening 23 drilled transversely through the lower tube receiving sheet 22 and into an aligned opening 24 in a lower end bell 25 which is bolted to the outer surface of the tube receiving sheet 22 and sealed thereto by a gasket 26. The opening 24 passes into a horizontal, threaded opening 27 into which is threaded an elbow 28 having a liquid tube 29 connected thereto. The liquid tube 29 passes to the expanding device (not shown) of the refrigerating system, from which the expanded refrigerant is returned to the compressor through the suction pipe 30.

The lower end bell 25 comprises a peripheral ridge 35 and a plurality of lateral ridges 36, 37 and 38 joined by a diametrical ridge 39. The ridges are machined to the same level so as tightly to abut portions of the gasket 26 and to seal the pockets formed by the ridges from each other. The ridges 35, 36 and 39 form a water entrance pocket 40 to which is connected a water inlet pipe 41. The ridges 35, 36, 37 and 39 form a water return pocket 42, and similarly other sections of the ridges form other water return pockets 43, 44, 45, 46 and 47. Portions of the ridges 35, 36 and 39 form a water outlet pocket 48 adjacent the water inlet pocket 40 and to which is connected a water outlet pipe 49.

The water tubes of the condenser are formed as straight tubes with their ends projecting into the pockets 40, and 42 to 48, inclusive, so that ordinary steel tubing may be used if desired. An equal number of tubes project into each of the pockets 40 and 48 while twice as many tubes project into each of the pockets 42 to 47, inclusive. Thus, the tubes 50 projecting into the pocket 40 are four in number; tubes 51 projecting into pocket 42 are eight in number; tubes 52 projecting into pocket 43 are eight in number; tubes 53 projecting into pocket 44 are eight in number; tubes 54 projecting into pocket 45 are eight in number; tubes 55 projecting into pocket 46 are eight in number; tubes 56 projecting into pocket 47 are eight in number; and tubes 57 projecting into pocket 48 are four in number.

The top end bell 60 is provided with a peripheral ridge 61 which is bolted to the rim of the top tube receiving sheet 21 and sealed thereagainst by a gasket 62. The top end bell is provided with a plurality of transverse ridges 63, 64, and 65 and a diametrically extending ridge 66 which extends from one side of the peripheral ridge 61 to the last transverse ridge 65 only. The ridges form a plurality of pockets 67, 68, 69, 70, 71, 72 and 73, all of which are return pockets and so arranged as to enclose the ends of an equal number of tubes, twice the number of tubes enclosed in the entrance and exit pockets 40 and 48. Thus, pocket 67 encloses the ends of tubes 50 and the ends of half of the tubes 51; pocket 68 encloses the ends of the other half of the tubes 51 and the ends of half of the tubes 52; and so on, until pocket 73 encloses the ends of half of the tubes 56 and all of the tubes 57. Water which is admitted through the entrance pipe 41 thus flows upward from pocket 40 through pocket 67, down into pocket 42, back again into pocket 68, and so on until it flows downward from pocket 73 into pocket 48 and the exit pipe 49. The water is thus caused to flow back and forth through the condenser shell in the volume accommodated by four tubes through a path fourteen times as long as the condenser shell. The water which enters the condenser shell in a Freon system is preferably at a temperature below 60° F., and the number of passages is so chosen with respect to the size of the system that the water which leaves the condenser is preferably below 80° F. in temperature. Accordingly, the number and size of the tubes, the length of the condenser, and the number of tubes accommodated by the condenser may be varied in relation to the size of the refrigerating system and the temperatures desired and still remain within the teachings of my invention.

The compressor as disclosed in the aforesaid Patent No. 2,225,228 comprises a pressure lubricating system. Details of the pressure lubricating system are not of the essence of the invention and any compressor having any type of pressure lubricating system therein may be cooled according to the teachings of my invention. Cooling of the compressor is accomplished by tapping into the pressure lubricating system at any convenient point and conveying heat from the compressor to the water flowing through the condenser. The heat of compression of a modern refrigerating system in the example given above would be perhaps 150° F. In addition to this, there is the heat generated by the mechanically moving parts which, if allowed to accumulate in a hermetically sealed compressor, might dangerously overheat the lubricant sealed into the compressor lubricating system.

In order to cool the lubricant I provide a tube 80 which receives lubricant under pressure at any convenient point in the lubrication system and which leads to an entrance opening 81 for the cooling device. The opening 81 communicates with a passageway 82 formed by externally projecting ridges on the bottom of the end bell 25. The ridges include a peripheral ridge 83 substantially concentric with the cylindrical condenser, a second, concentric ridge 84 which extends throughout an arc of approximately 350°, a radial ridge 85 extending from ridge 83 to the center of the cooler and bisecting ridge 84, a radial ridge 86 which extends from a point diametrically opposite from the beginning of ridge 85 to a point substantially halfway between the rim 83 and the center, and a concentric ridge 87 which comprises substantially equal arms extending from the edge of radial ridge 86 to points spaced from the radial ridge 85. The open passageway thus forms a labyrinthine passage covering the central portion of the bottom of the end bell 25. The passage 82 terminates in communication with an outlet opening 88 closely adjacent the inlet opening 81 and on the other side of radial ridge 85, which opening communicates with a tube 89 leading back to some convenient point in the pressure lubrication system of the compressor. An oil filter 90 may be inserted in the line 89 in order to catch any chips, core sand, or the like, which may be carried along by the lubricant.

In order to increase the surface area with which the lubricant is brought in contact and thus increase the ability of the end bell to absorb heat, the passage 82 may be subdivided by concentric ridges 91, 92, 93, 94 and 95, or other projections which would decrease the free area and increase the surface area of the passageway. The crests of the ridges are machined level and a cover plate 100 is bolted to the crests of the ridges, the ridges being sealed against the cover plate by a gasket 101 so as to provide a continuous labyrinthine, enclosed passageway in which the lubricant is confined on its way from tube 80 to tube 89. The lubricant is thus caused to flow in thermal relation to the condenser cooling water flowing through the pockets 40, and 42 to 48, inclusive.

It will be noted from an inspection of Figs. 6 and 7 that the inlet to the passage 82 lies beneath the ridge 37 between the pockets 46 and 47. The first course of the passage 82 provided by the ridges 83 and 84 crosses beneath the pockets 46, 47, 48, 40 and 42. The lubricant then reverses beneath the inner corner of pocket 42 and crosses over to a point beneath the inner corner of pocket 46. The lubricant then traverses the extreme inner corners of pockets 46, 47, 42, 43 and 46 in the order named. Then the lubricant flows be-

neath the inner corner of pockets 46, 45, 44 and 43 and finally flows beneath the middle of pocket 43 and the inner portion of pockets 44 and 45 to reach the exit opening 88. It will be noted from this that the major portion of the path of the lubricant is beneath pockets in the end bell through which flows water which has traversed less than two-thirds of the water coursing through the tubes of the condenser, in order to take advantage of as great a differential as possible between the temperature of the water and the temperature of the lubricant to be cooled. In any event the final temperature of the water, being in the neighborhood of 80° F. is far less than the temperature of the lubricant leaving the compressor so that substantial heat transfer is obtained and the lubricant flows back to the compressor at a temperature which will permit cooling of the compressor.

Having described a preferred embodiment of the present invention it should be apparent to those skilled in the art that the same permits of variations in arrangements and detail. All such modifications as come within the scope of the following claims are considered a part of my invention.

I claim:

1. A refrigerant condensing unit comprising a compressor including a pressure lubricating system, a water-cooled condenser arranged in refrigerant flow relation with said compressor, said condenser comprising a plurality of water tubes, a shell enclosing said water tubes and a pair of end bells having water passages communicating with the ends of said water tubes, a plurality of externally projecting ridges formed on the outer surface of one of said end bells and integral therewith, said ridges being arranged to form a continuous, labyrinthine groove, a cover plate engaging the crests of all of said ridges to convert said groove into an enclosed passageway, and connections between the pressure lubricating system of said compressor and the ends of said passageway whereby heat is transferred from the compressor by conduction through said one end bell from lubricant coursing through said passageway to the cooling water coursing through said condenser.

2. A refrigerant condensing unit comprising a compressor including a pressure lubricating system, a water-cooled condenser arranged in refrigerant flow relation with said compressor, said condenser comprising a plurality of water tubes, a shell enclosing said water tubes and a pair of end bells having water passages communicating with the ends of said water tubes, a plurality of externally projecting ridges formed on the outer surface of one of said end bells and integral therewith, said ridges being arranged to form a continuous, labyrinthine groove, a plurality of projections within said groove for increasing the surface area between the crests of said ridges, a cover plate engaging the crests of all of said ridges to convert said groove into an enclosed passageway, and connections between the pressure lubricating system of said compressor and the ends of said passageway whereby heat is transferred from the compressor by conduction through said one end bell from lubricant coursing through said passageway to the cooling water coursing through said condenser.

3. A refrigerant condensing unit comprising a compressor including a pressure lubricating system, a water-cooled condenser arranged in refrigerant flow relation with said compressor, said condenser comprising a plurality of water tubes, a shell enclosing said water tubes and a pair of end bells having water passages communicating with the ends of said water tubes, a plurality of externally projecting ridges formed on the outer surface of one of said end bells and integral therewith, said ridges being arranged to form a continuous, labyrinthine groove, a plurality of secondary ridges extending longitudinally of said groove and subdividing said groove into a plurality of smaller grooves, a cover plate engaging the crests of all of said ridges to convert said groove into an enclosed passageway, and connections between the pressure lubricating system of said compressor and the ends of said passageway whereby heat is transferred from the compressor by conduction through said one end bell from lubricant coursing through said passageway to the cooling water coursing through said condenser.

4. A refrigerant condensing unit comprising a compressor including a pressure lubricating system, a water-cooled condenser arranged in refrigerant flow relation with said compressor, said condenser comprising a shell and a pair of end bells attached to said shell and having spaces therein for directing water through the condenser in heat transferring relation with the refrigerant, a plurality of externally projecting ridges formed on the outer surface of one of said end bells and integral therewith, said ridges being arranged to form a continuous, labyrinthine groove, a cover plate engaging the crests of all of said ridges to convert said groove into an enclosed passageway, and connections between the pressure lubricating system of said compressor and the ends of said passageway whereby heat is transferred from the compressor by conduction through said one end bell from lubricant coursing through said passageway to the cooling water coursing through said condenser.

5. A refrigerant condensing unit comprising a compressor including a pressure lubricating system, a water-cooled condenser arranged in refrigerant flow relation with said compressor, said condenser comprising a shell and a pair of end bells attached to said shell and having spaces therein for directing water through the condenser in heat transferring relation with the refrigerant, a plurality of externally projecting ridges formed on the outer surface of one of said end bells, said ridges being arranged to form a continuous, labyrinthine groove, a plurality of projections within said groove for increasing the surface area between the crests of said ridges, a cover plate engaging the crests of all of said ridges to convert said groove into an enclosed passageway, and connections between the pressure lubricating system of said compressor and the ends of said passageway whereby heat is transferred from the compressor by conduction through said one end bell from lubricant coursing through said passageway to the cooling water coursing through said condenser.

6. A refrigerant condensing unit comprising a compressor including a pressure lubricating system, a water-cooled condenser arranged in refrigerant flow relation with said compressor, said condenser comprising a shell and a pair of end bells attached to said shell and having spaces therein for directing water through the condenser in heat transferring relation with the refrigerant, a plurality of externally projecting ridges formed on the outer surface of one of said end bells, said ridges being arranged to form

a continuous, labyrinthine groove, a plurality of secondary ridges extending longitudinally of said groove and subdividing said groove into a plurality of smaller grooves, a cover plate enging the crests of all of said ridges to convert said groove into an enclosed passageway, and connections between the pressure lubricating system of said compressor and the ends of said passageway whereby heat is transferred from the compressor by conduction through said one end bell from lubricant coursing through said passageway to the cooling water coursing through said condenser.

7. A refrigerant condenser comprising a cylindrical shell, a pair of tube receiving sheets attached to the ends of said cylindrical shell and provided with a plurality of perforations extending transversely therethrough, a pair of end bells attached to said tube receiving sheets, a plurality of straight tubes extending through the perforations of said tube receiving sheets and having their ends terminating within said end bells, a water inlet and a water outlet communicating with the interior of one of said end bells, and a plurality of ridges on each of said end bells dividing the interior of each of said end bells into a plurality of enclosed pockets, one of said pockets communicating with said water inlet and the other of said pockets communicating with said water outlet, each of said pockets communicating with a plurality of said tubes and said pockets being arranged so that an equal number of tubes terminate in the pockets having communication with said water inlet and said water outlet and every other one of said pockets communicates with twice the number of tubes as communicate with said inlet or said outlet in return-bend relation whereby the water is directed longitudinally through said shell a plurality of times in order to reach said outlet from said inlet; in combination with a compressor having refrigerant flow communication with the interior of said shell, a pressure lubricating system for said compressor, and an oil cooler included in the flow path of the lubricant circulated through the pressure lubricating system comprising a labyrinthine passageway having walls integrally formed on the outer surface of one of said end bells.

8. A refrigerant condenser comprising a cylindrical shell, a pair of tube receiving sheets attached to the ends of said cylindrical shell and provided with a plurality of perforations extending transversely therethrough, a pair of end bells attached to said tube receiving sheets, a plurality of straight tubes extending through the perforations of said tube receiving sheets and having their ends terminating within said end bells, a water inlet and a water outlet communicating with the interior of one of said end bells, and a plurality of ridges on each of said end bells dividing the interior of each of said end bells into a plurality of enclosed pockets, one of said pockets communicating with said water inlet and the other of said pockets communicating with said water outlet, each of said pockets communicating with a plurality of said tubes and said pockets being arranged so that an equal number of tubes terminate in the pockets having communication with said water inlet and said water outlet and every other one of said pockets communicates with twice the number of tubes as communicate with said inlet or said outlet in return-bend relation whereby the water is directed longitudinally through said shell a plurality of times in order to reach said outlet from said inlet; in combination with a compressor having refrigerant flow communication with the interior of said shell, a pressure lubricating system for said compressor, and an oil cooler included in the flow path of the lubricant circulated through the pressure lubricating system comprising a labyrinthine passageway having walls integrally formed on the outer surface of one of said end bells, said passageway being arranged with respect to said pockets so that the passageway is in heat transferring relation with a preponderance of said pockets having water therein which has traversed less than two-thirds of the length of the water course provided by said tubes and end bells.

9. A refrigerant condenser comprising a cylindrical shell, a pair of tube receiving sheets attached to the ends of said cylindrical shell and provided with a plurality of perforations extending transversely therethrough, a pair of end bells attached to said tube receiving sheets, a plurality of straight tubes extending through the perforations of said tube receiving sheets and having their ends terminating within said end bells, a water inlet and a water outlet communicating with the interior of one of said end bells, and a plurality of ridges on each of said end bells dividing the interior of each of said end bells into a plurality of enclosed pockets, one of said pockets communicating with said water inlet and the other of said pockets communicating with said water outlet, each of said pockets communicating with a plurality of said tubes and said pockets being arranged so that an equal number of tubes terminate in the pockets having communication with said water inlet and said water outlet and every other one of said pockets communicates with twice the number of tubes as communicate with said inlet or said outlet in return-bend relation whereby the water is directed longitudinally through said shell a plurality of times in order to reach said outlet from said inlet; in combination with a compressor having refrigerant flow communication with the interior of said shell, a pressure lubricating system for said compressor, and an oil cooler included in the flow path of the lubricant circulated through the pressure lubricating system comprising a labyrinthine passageway having walls integrally formed on the outer surface of one of said end bells, said ridges being concentrically arranged around the axis of the condenser and being so positioned with respect to the pockets of said end bell that the lubricant flows adjacent pockets containing water which has traversed less than two-thirds of the total number of said tubes.

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