

F. B. RILEY.
REFRIGERATION APPARATUS.
APPLICATION FILED FEB. 5, 1917.

1,277,124.

Patented Aug. 27, 1918.

3 SHEETS—SHEET 1.

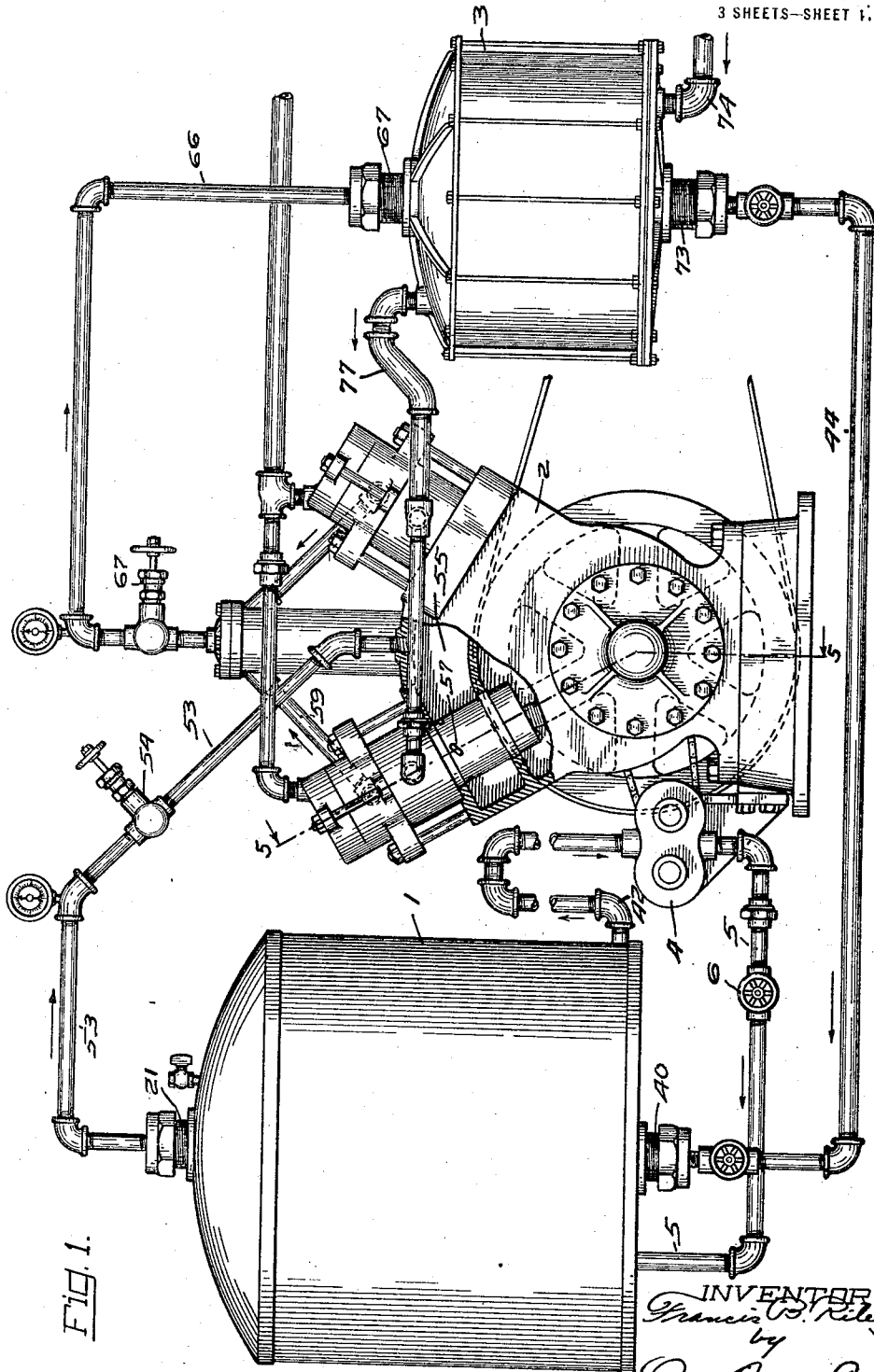


FIG. 1.

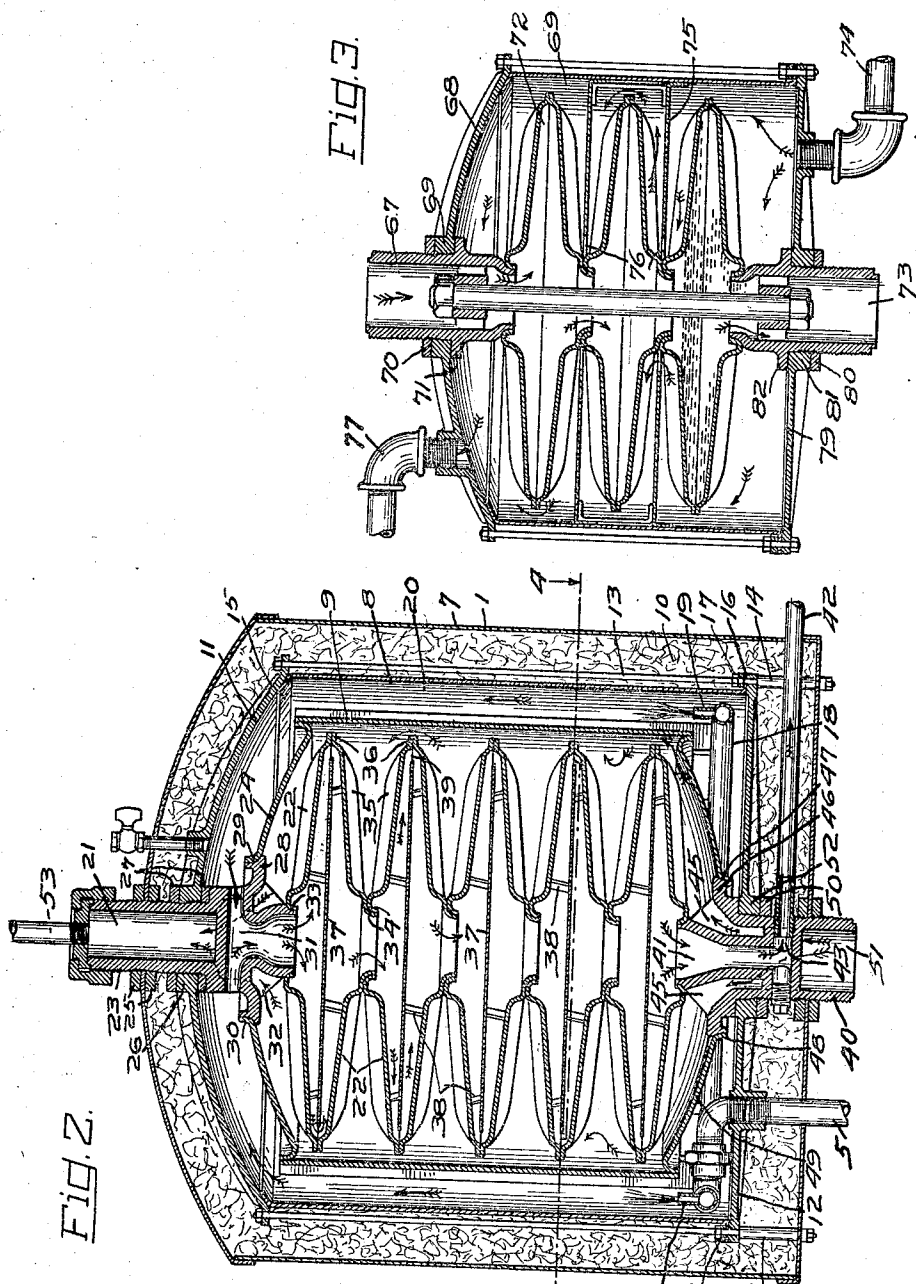
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3 SHEETS—SHEET 2.

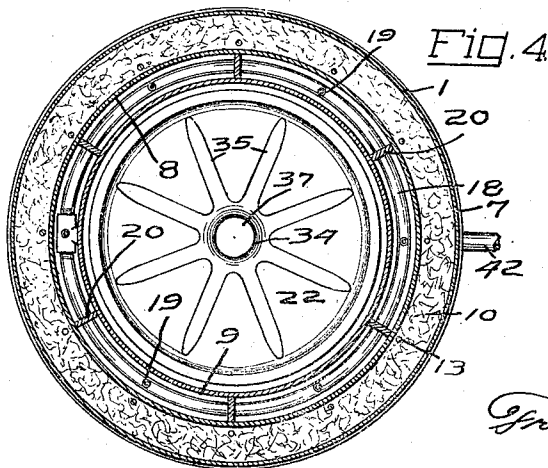
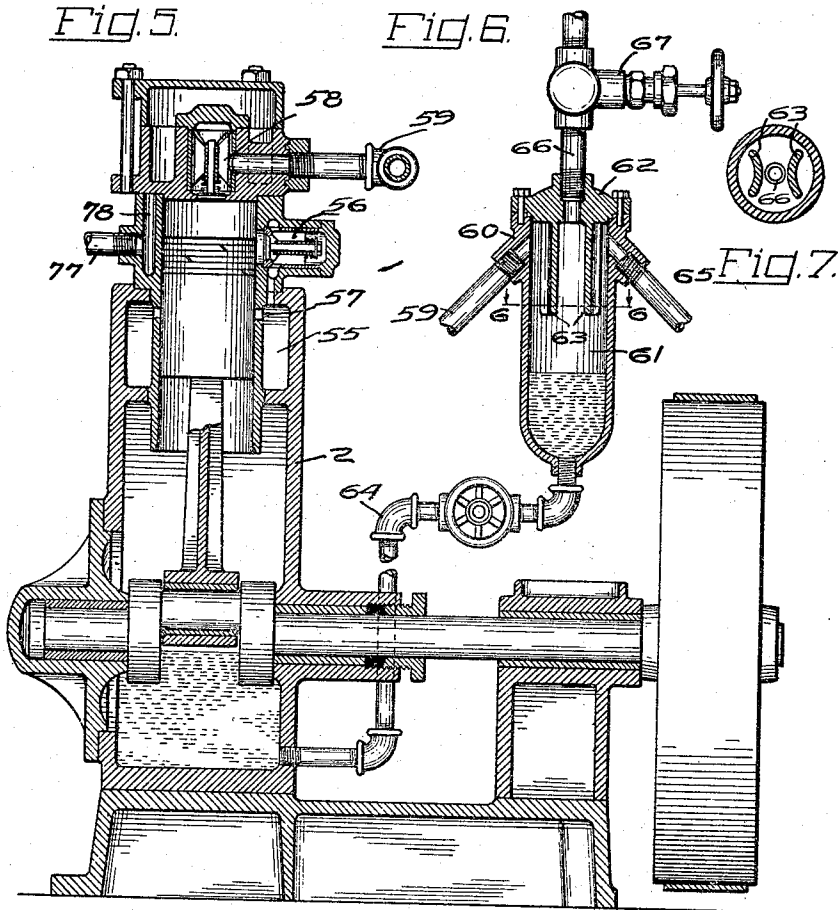


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3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE.

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REFRIGERATION APPARATUS.

1,277,124.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, FRANCIS B. RILEY, a citizen of the United States, and a resident of Toledo, in the county of Lucas and State of Ohio, have invented a certain new and useful Refrigeration Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings and to the characters of reference marked thereon, which form a part of this specification.

My invention relates to refrigeration apparatus and it has for its object to produce an efficient refrigeration machine or apparatus which may be readily constructed and assembled at a low cost of production. It also has for its object to produce an efficient liquid cooling means and an efficient condenser. It also has for its object to produce a connector having flaring passageways and located intermediate the condenser and the cooler for efficiently transmitting heat from one fluid to another as they pass through the connector. It also has for its object to provide a plurality of lens-shaped drums of maximum strength to withstand the pressure of the gas liquefied by the compression and cooling operation in the refrigeration process. Other features and advantages will appear from the drawings and from the description thereof.

For purposes of illustration I have selected an apparatus containing the invention to show its practicability and the operation of an embodiment of the invention. The particular combination of devices and the devices themselves may be greatly modified by those skilled in the art without departing from the spirit of the invention. The apparatus selected is shown in the drawing.

Figure 1 of the drawings illustrates a side view of the parts forming the apparatus and the interconnections between the said parts. Fig. 2 illustrates a sectional view of the liquid cooler. Fig. 3 illustrates a sectional view of the condenser. Fig. 4 illustrates a horizontal sectional view of the liquid cooler illustrated in Fig. 2. Fig. 5 illustrates a sectional view through the pump. Fig. 6 is a sectional view of an oil separator. Fig.

7 illustrates a sectional view taken on the line 6—6 indicated in Fig. 6 showing the oil separator.

1, Fig. 1, is the liquid cooler. 2 is the engine and pump for pumping the expanded refrigerant from the liquid cooler into the condenser 3. 4 is a pump for pumping the brine or other liquid into the liquid cooler 1 and drawing it from the pipes or other device in which the temperature is to be reduced by the apparatus.

The liquid passes from the brine pump 4 through a pipe 5 having a regulating valve 6 into the liquid cooler 1. The liquid cooler is provided with a shell 7 and a plurality of drums 8 and 9. In the form of the invention shown the drums are coaxial and are located one within the other and in spaced relation. Intermediate the shell 7 and the outer drum 8 the space is filled with a suitable heat insulating material 10 to prevent the outside atmosphere from warming the liquid which passes into the drum 8 through the pipe 5.

The drum 8 has its heads 11 and 12 connected together by tie bolts 13. The tie bolts extend through the insulating packing 10 to the outside of the shell 7. To space the head 12 from the lower end of the shell 7 sleeves 14 may be located on the tie rods 13. The upper edge of the side wall of the drum 8 is provided with an inwardly turned flange 15, and the lower edge is provided with an outwardly turned flange 16. The inwardly turned flange 15 fits the head 11 of the drum 8, which is lens-shaped, and by being drawn to the edge of the side wall of the drum 8 a tight fit is formed between the upper edge of the side wall of the drum and the head 11. If desired, these parts may be welded together to seal the interior of the drum. The outwardly turned flange 16 may likewise be welded to the head 12. It will also be secured by the nuts 17 which clamp the flange 16 and the head 12 against the sleeves 14.

The pipe 5 is connected with a ring pipe 18 having nipples 19. The nipples direct the brine into compartments which are formed by partitions or strips 20 located intermediate the side walls of the drums 8 and 9, and thus the brine is directed in a constant stream upward, and local eddies or rotation of the brine is avoided. The stream

from the nipples rises in a steady current to the top of the drum 8. Thence it flows through an opening formed in a cross-drum connector 21 and downwardly into a plurality of lens drums 22. The drum connector is provided with a threaded neck 23. It extends through the top of the shell 7, the head 11 of the drum 8 and the head 24 of the drum 9, and is connected to the uppermost of the lens drums 22. Nuts 25 are threaded onto the neck and clamp the edge of the opening in the top of the shell 7 through which the neck 21 extends. The center of the head 11 of the drum 8 is provided with a boss 26 through which the neck 23 extends. The boss 26 is clamped by the nuts 27 which are threaded onto the neck 23. The connector 21 is secured to the uppermost of the drums 22 by welding. It is provided with a flange 28 which has a flaring surface 29 that fits a flange 30 formed on the edge of the opening of the head 24 through which the connector 21 extends. By the weight of the drum 9 and by drawing the drum downward a tight fit is produced between the head 24 and the connector 21. The connector, however, may also be welded to the head 24 along the flaring surface of the flange 28. The connector 21 is provided with a passageway 31 which extends transversely through the connector 21 and communicates with the drums 22. It is also provided with a passageway 32 which connects the interior of the drum 9 with the exterior of the shell 7, and thus the communications or passageways cross within the connector 21.

The drums 22, which are connected with the connector 21, are provided with central openings which establish communication between the drums and thus connect the drums in series. The connector 21 and the drums 22 are each provided with curved surfaces 33 which fit and thus form a large contact area whereby the drums may be sealed and, if desired, welded together. The surfaces 33 of the drums 22 are formed on curved flanges 34 which are turned downward in the direction of the movement of the liquid, and which moreover seal the drums together. The drums 22 are provided with radiating corrugations 35 which greatly strengthen the drums and prevent them from collapsing or from altering their shape. On account of the area, the lens shape of the drums and the pressure to which the exterior of the drums is submitted, they would ordinarily be subject to change of shape, but the corrugations withstand the compression action on the exterior of the drums and permit the drums to be formed of a much lighter stock. This also permits a ready transfer of the heat in cooling the brine. Furthermore, the corrugations extend the area of contact of the brine and consequently extend the area of the surface in which the heat is transferred,

The drums are each formed of two parts having outwardly extending flanges 36 which may be sealed or welded together. A baffle plate 37 is located between the halves of each drum and spaced with reference to the drums by fingers 38 which are turned transverse to the plates 37 to yieldingly engage the halves of the drum in which the baffle plate is located. The fingers 38 are elastic and yieldable, and consequently they may be readily located in their position in the center of the lens-shaped drum. The baffle plates 37 are provided with openings 39 or each baffle plate may be made smaller than the diameter of the interior of the drum 22 and spaced from the edge of the lens-shaped drum 22 to allow movement of the brine which is directed through the connector 21 and into the drums 22.

The lowermost drum 22 is connected to a second cross-passageway drum connector 40. The connector 40 is provided with a passageway 41 through which the brine passes to a pipe 42 which is connected to a connector and communicates with the passageway 41 through a transverse passageway 43 into which the pipe 42 may be threaded.

In order to cool the brine which passes through the drums 8 and 22 and around the baffle plates 37, a refrigerant is condensed and under pressure is directed from the condenser 3 through the pipe 44 into the cross-connector 40 to which pipe 44 is connected by a suitable coupler threaded onto the neck 51 of the connector 40. The liquid ammonia enters the connector 40 and passes up through the connector 40 and through flaring openings 45 located around the central opening 41. As the liquid passes into the flaring trumpet-shaped openings 45 the liquid changes to a gas, expanding upon its point of entrance into the drum 9. The passageway 41 is surrounded by the passageways 45 and is the point of exit of the brine as it leaves the last of the lens-shaped drums 22. This produces an intense coldness about the brine at the time of its exit from the cooling member of the apparatus and at the time when the brine has been cooled as much as possible during its passage through the various drums forming the cooling part of the apparatus.

The connector 40 is also provided with a flaring flange 46 having a flaring surface 47 which fits into a flange 48 formed about the opening in the head 49 of the drum 9. The connector 41 may be drawn outward by the nut 50 which is threaded onto the neck 51 of the connector 40 and which at the same time clamps a boss 52 of the head 12 of the drum 8 through which the connector extends. In drawing the head of the connector 40 against the boss 52 the head 24 of the drum is pulled against the flaring flange 28 of the connector 21 and also the flange 61 of the

connector 41 is pulled against the flange 48. The connector 40 is connected to the lowermost drum 22 in the same way that the connector 21 is connected to the uppermost drum 22, the bottom of the shell 7 is clamped and held in position in part by nuts located on the neck 51 of the connector 40.

The refrigerant such as ammonia entering the drum 9 through the passageways 45 passes in and around the corrugated lens drums 22 and by reason of the thinness of the stock of the metal of which the drums 22 are composed and the large area of surface, extended in part by the corrugations that are formed in the metal of which the drums are formed, the brine passing through the drums 22 is rapidly cooled. Also, the brine passing through the annular partitioned chamber formed between the drums 8 and 9 receives its initial cooling, so that when the brine has been cooled to a substantial amount it passes into the drums 22. A more intimate relation here exists between the gas and the brine, and consequently additional heat is removed from the brine. As the brine progresses through the drums and is kept in constant and close contact with the surface of the drums 22 by reason of the action of the baffle plates 37, it is cooled more and more as it progresses through the drums 22, while at the same time the ammonia gains heat. The ammonia, however, gives its first intense coolness at the point of exit of the brine and while the ammonia is in intimate contact with the brine.

The ammonia passes up through the passageways 32 and through the connector 21 and the pipe 53, thence it passes into the pump 2. A valve 54 may be located in the pipe 53 for regulating the flowing of the ammonia. The pipe 53 is connected with a chamber 55. The chamber 55 is connected through a valve controlled passageway 56 to the cylinder of the pump. When the piston is moved below the passageway 56 the ammonia passes into the cylinder through the passageway 56. It also passes into the cylinder through the passageway 57, when the piston is drawn down low enough in its cycle of operations. The piston rising closes the passageway 57 and by the valve action also closes the valve in the passageway 56 and forces the ammonia out through the valve controlled passageway 58. Thence it passes through the pipe 59 to an oil separator. The engine is oiled by any suitable means, such as by the dash of the crank shaft or piston rod, and the oil works up along the piston in the cylinder to above the piston. If any is carried over by the ammonia being forced out of the cylinder, it will be separated in the separator 60.

The oil separator 60 may be formed of a cylindrical container 61 having a head 62. Two depending arcuate plates 63 are sup-

ported on and form a part of the head 62. The pipe 59 is located at an angle to the axis of the container 60 and directs the gas from the pump 2 at an angle to one of the plates 63 and toward the head 62. The oil spreads over the concave plate and drips to the bottom of the container. Thence it may be directed through the pipe 64 to the casing of the pump 2.

The pump may be a suitable cylinder pump, as shown in the drawing, and a similar connection 65 may be made with the other cylinder of the pump 2, which connection directs the gas and any oil that may be carried over by the gas upward and against the other plate 63.

The gas then passes out through the pipe 66 to the condenser 3. The pipe 66 may be provided with a valve 67 for controlling the flow of the gas.

The gas is necessarily heated from the compression action of the pistons of the pump 2, and when cooled somewhat under the pressure that is exerted by the pump 2, turns to liquid. The cooling and condensing operation is performed in the condenser 3. The gas enters the connector 67, which is secured in the head 68 of the drum 69. The drum 69 is constructed like the drum 8 of the refrigerator 1. The connector 67 extends through a boss formed in the head 68, and the boss is clamped between a nut 70 threaded on the connector 67 and a flange 71.

Lens-shaped drums 72 having the same form as the lens-shaped drums 22 are located in the drum 69. A plurality of the drums are connected together in the same way that the drums 22 are connected together, and moreover they are connected to the connectors 67 and 73 in the same way that the drums 22 are connected to the connectors 21 and 40. The gas entering the corrugated drums expands somewhat, but it is also cooled by water which is directed into the container 69 through the pipe 74. Circulation is produced by the water passing through the drum 69 which is provided with baffle plates 75 having openings 76, which directs the water along the corrugated surfaces and radially with respect to the axes of the drums 70 and 69. It passes out through the pipe 77, thence it may pass through the jackets 78 of the pump 2. The gas being cooled and being under the pressure produced by the pump 2 liquefies in the bottom of the condenser 3. Thence it passes through the connector 73, which is secured in the head 79 by means of the nut 80, which clamps the boss 81 through which the connector passes between itself and the flange 82 formed on the connector 73. Thence the liquid gas passes through the pipe 44 to the connector 40, where it expands as it leaves the flaring passageway

45 and while the brine is leaving the refrigerator through the passageway 41.

I claim:

1. In a refrigeration apparatus, the combination of a plurality of lens-shaped drums connected in series and having thin metal walls, the walls having corrugations disposed radially and means for directing fluids along the walls both within and without the drums.

2. In a refrigeration apparatus, the combination of a plurality of lens-shaped drums connected in series and having corrugated walls, a drum surrounding the first-named drums, cross connectors connecting the first of the series of the first-named drums to the exterior of the last-named drum and connecting the last of the series of the first-named drums to the exterior of the second-named drum, and means for directing fluids through the drums and connectors.

3. In a refrigeration apparatus, the combination of a plurality of lens-shaped drums connected in series, a drum surrounding the first-named drums, cross connectors connecting the first of the series of the first-named drums to the exterior of the last-named drum and connecting the last of the series of the first-named drums to the exterior of the second-named drum, and means for directing fluids through the drums and connectors.

4. In a refrigeration apparatus, the combination of a plurality of lens-shaped drums connected in series, a drum surrounding the first-named drums, cross connectors connecting the first of the series of the first-named drums to the exterior of the last-named drum and connecting the last of the series of the first-named drums to the exterior of the second-named drum, the connector connected to the last of the series of the first-named drums having flaring openings, the walls of the openings surrounding the passageway in the connector communicating with the first-named drums, means for directing a volatile liquid through the flaring openings, means for directing a fluid

through the drums, and the connector having the flaring openings.

5. In a refrigeration apparatus, the combination of a plurality of lens-shaped drums connected in series, a drum surrounding the first-named drums, cross connectors connecting the first of the series of the first-named drums to the exterior of the last-named drum and connecting the last of the series of the first-named drums to the exterior of the second-named drum, the connector connected to the last of the series of the first-named drums having flaring openings, the walls of the openings surrounding the passageway in the connector communicating with the first-named drums, means for directing a volatile liquid through the flaring openings, and means for directing a fluid through the first-named drums and then through the connector having the flaring openings.

6. In a refrigeration apparatus, the combination of a plurality of lens-shaped drums having corrugated walls and connected in series, baffle plates located within the drums, a drum for containing the first-named drums, a drum surrounding the said drums, a circular pipe having a plurality of openings located in the last-named drum, partitions for separating the space between the two outermost drums into chambers, cross-connectors, one connecting the chambers with the interior of the first-named drums and connecting the interior of the second-named drum with the exterior of the last-named drum, the other connecting the interior of the first-named drums with the exterior of the last-named drum and connecting the exterior of the last-named drum with the interior of the second-named drum, and means for directing fluids to the circular pipe and to the passageway of the last-named connector communicating with the second-named drum.

In testimony whereof, I have hereunto signed my name to this specification.

FRANCIS B. RILEY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."