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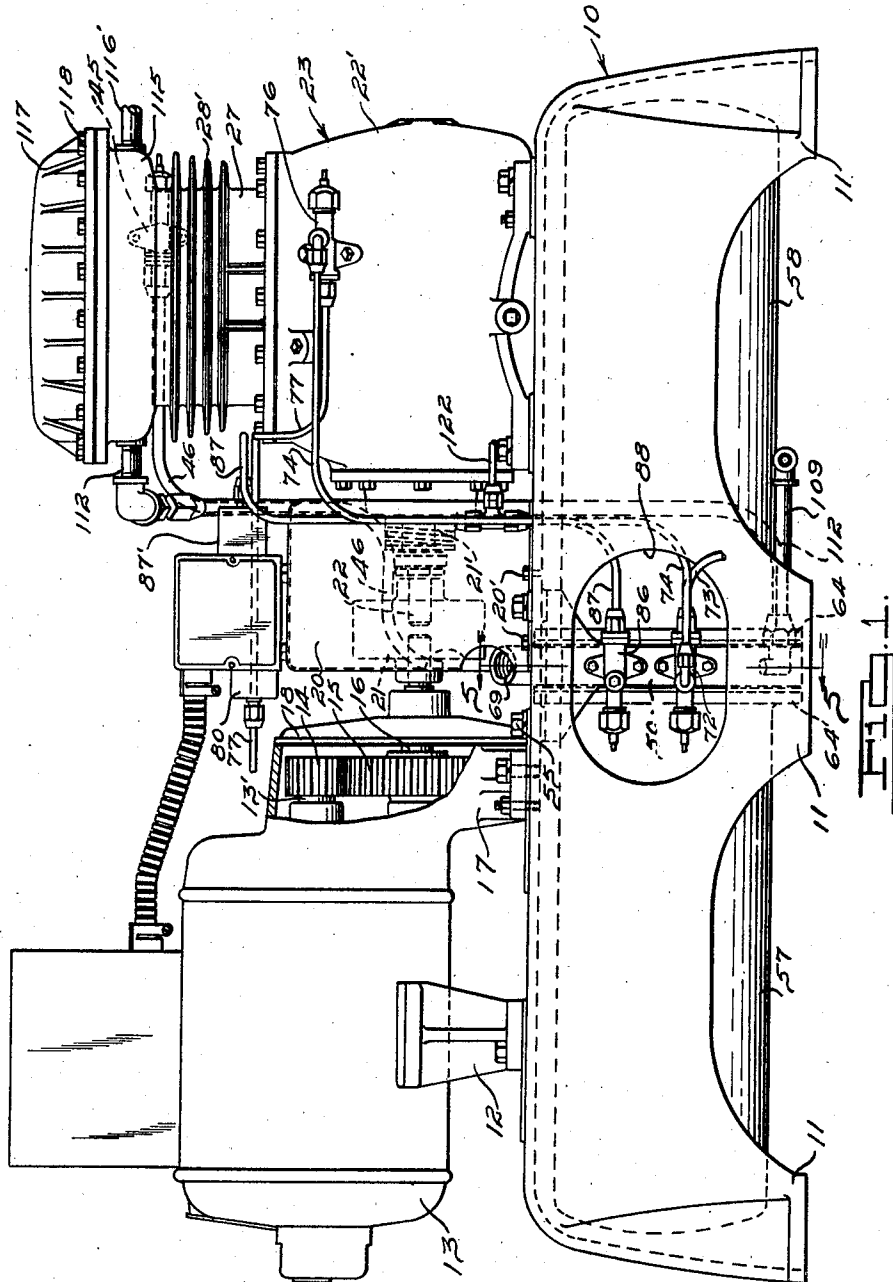
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REFRIGERATING MECHANISM

Filed Dec. 26, 1931

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

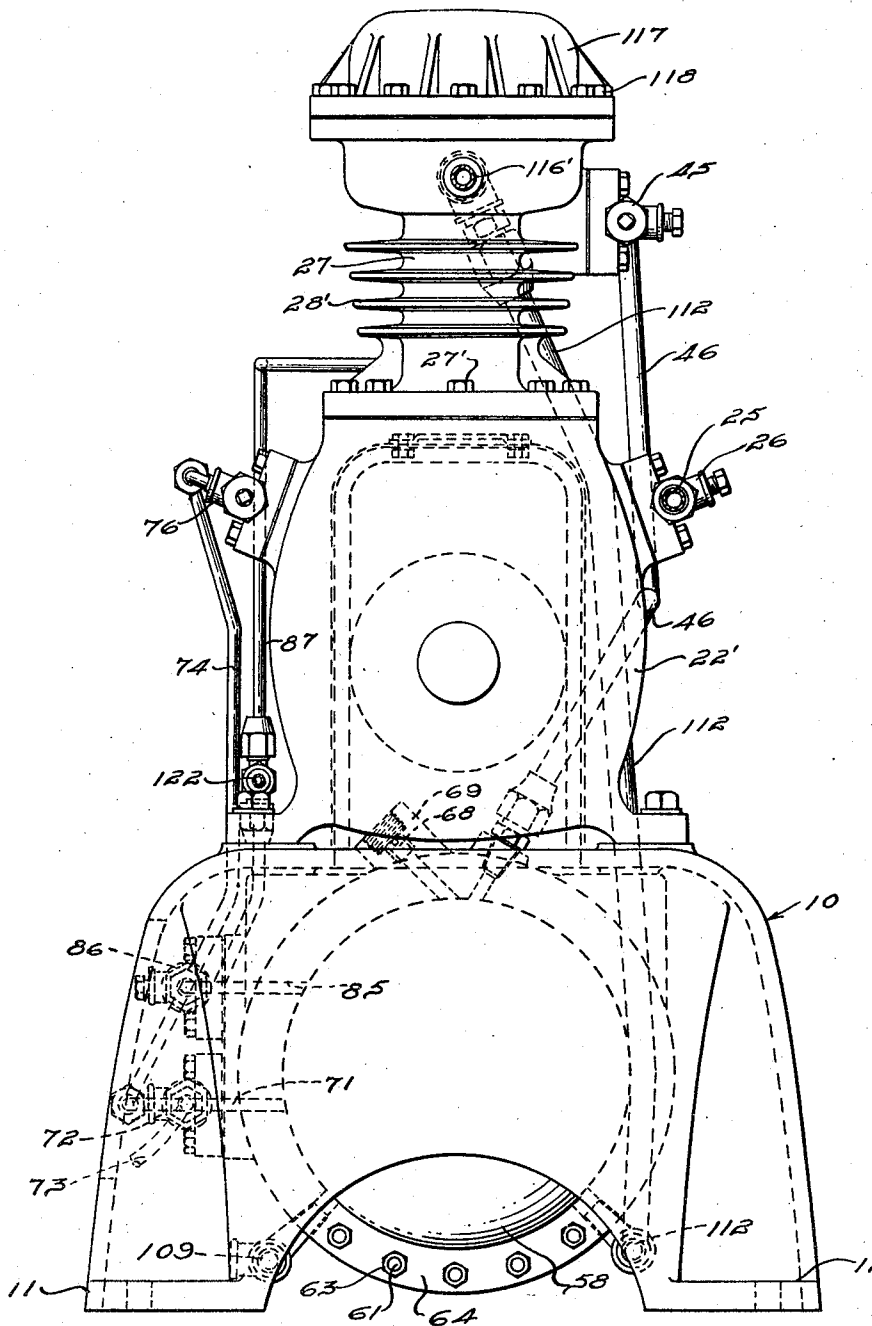


FIG. 2.

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4 Sheets-Sheet 3

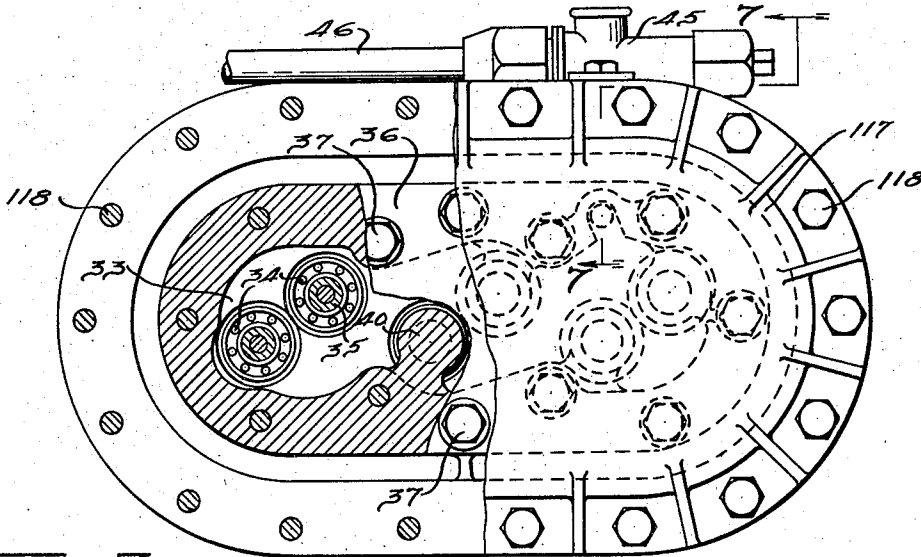


FIG. 3.

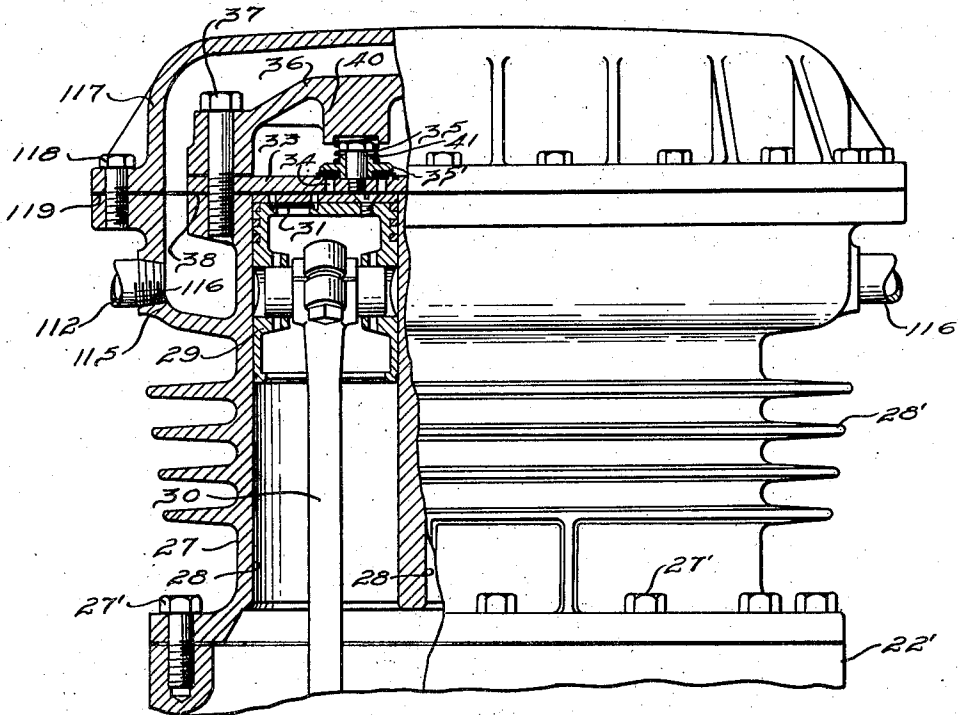


FIG. 4.

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4 Sheets-Sheet 4

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UNITED STATES PATENT OFFICE

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REFRIGERATING MECHANISM

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Application December 26, 1931
Serial No. 583,230

10 Claims. (Cl. 62-115)

The invention relates to refrigerating systems and it has particular relation to improvements in a condensing unit ordinarily forming a part of a system of this character.

5 The principal objects of the invention are to provide an improved condensing unit for a mechanical refrigerating system, which operates more efficiently for cooling the compressed gaseous refrigerant and reducing it to a liquid state; to
10 provide an improved condensing unit by means of which heat in the gaseous refrigerant at the high pressure side of the compressor is rapidly and more completely removed, thereby increasing the rapidity of reduction of the gas to a
15 liquid; to provide an improved condensing unit in which water or other cooling medium is used in a novel manner for absorbing heat from the gaseous refrigerant at the high pressure side of the system; to provide a condensing unit in which
20 the relatively warm gas at the high pressure side of the system, and a cooling medium such as water, are circulated respectively, in such relation that maximum heat is absorbed by the water from the gas and the reduction of the gas to a
25 liquid is thereby rendered easier with consequent reduction in power losses; to provide an improved compressor forming a part of the condensing unit, which permits circulation of a cooling medium around the compressed gas in the head
30 of the compressor; to provide a compressor for the above mentioned purpose, which is so constructed that the gas receiving head is a unit distinct from that part of the compressor through which the cooling medium circulates; and to pro-
35 vide a novel condenser so constructed and arranged that the parts thereof can be manufactured and assembled less expensively and in a more efficient manner.

It will of course be understood that refrigerating systems of the mechanically operated type
40 ordinarily comprise a compressor operating to compress the gaseous refrigerant removed from the evaporator, a condenser employed for reducing the compressed gaseous refrigerant to a liquid state, an evaporator in which the liquid refrigerant is allowed to evaporate and a metering device between the condenser and evaporator.
45

The instant invention relates particularly to the condensing unit which normally is understood
50 to include the compressor and condenser or in other words that part of the system utilized to reduce or change the gaseous refrigerant removed from the evaporator, to the liquid state.

For a better understanding of the invention,
55 reference may be had to the accompanying draw-

ings, forming a part of the specification wherein:
Figure 1 is an elevational view illustrating a condenser unit constructed according to one form of the invention;

Fig. 2 is an elevational view on a larger scale, 60 illustrating the construction shown by Fig. 1 as seen from the right end thereof;

Fig. 3 is a plan view of the head of the compressor, with certain parts removed and with other parts shown in cross section, for the pur- 65 pose of illustrating more clearly the construction of the compressor;

Fig. 4 is a fragmentary side elevational view of the compressor, with certain parts shown in cross section to illustrate particularly the con- 70 struction of the compressor head;

Fig. 5 is a cross sectional view on a larger scale taken substantially along the line 5-5 of Fig. 1;

Fig. 6 is a cross sectional view taken substantially along the line 6-6 of Fig. 5; 75

Fig. 7 is a fragmentary cross sectional view of the compressor, taken substantially along the line 7-7 of Fig. 3.

Referring to Figs. 1 and 2 particularly, an elongated hollow base 10 is provided which has 80 a plurality of legs 11 for securing the base to a floor or other suitable support. At one end and on the upper side thereof, the base 10 is provided with a mounting bracket 12 for a motor 13 utilized for operating the condensing unit. 85 The motor is provided with a shaft 13' having a pinion 14 which meshes with a larger pinion 15 mounted on a shaft 16 journaled at one end in the motor housing below the shaft 13'. For enclosing the pinions as well as serving as a 90 support for the shaft 16, the motor casing is extended beyond the pinions, and also is provided with a downwardly projecting portion 17 which is secured by means of bolts to the base 10. A cover plate 18 secured to the extended 95 part of the motor casing closes the latter and also serves as a bearing support for the shaft 16 which projects through it.

Beyond the cover 18, the shaft 16 projects into a housing 20 secured to the base 10 by bolts 100 20', and in such housing, the shaft is secured by means of a coupling 21, to a second shaft 22 extending through a sealing device 21' into the base 22' of a compressor 23, which is secured by means of bolts to the base 10 at the end there- 105 of opposite that end supporting the motor 13. The base 22' of the compressor is hollow and of course closed and serves as a receiver for gaseous refrigerant withdrawn from the discharge side of an evaporator (not shown). Gaseous 110

refrigerant from the discharge side of the evaporator, is conducted to the base 22' of the compressor by means of a pipe 25 (Fig. 2) and from the compressor end of the pipe, the gas is conducted into the base of the compressor through a service valve indicated at 26.

As best shown by Fig. 4, the compressor is provided with a cylinder block 27 secured to the base 22' by bolts 27', which in the particular construction shown has three cylinders 28. Preferably, as shown, the cylinder block is provided with heat radiating fins 28' for facilitating the dissipation of heat from the block during operation of the compressor. A piston 29 is mounted in each of the cylinders for reciprocatory movement therein, and each piston is connected in a conventional manner to a connecting rod 30 in turn eccentrically connected to the shaft 22 extending into the base of the compressor. The upper end wall of each piston is provided with a conventional disc type of valve 31 which upon downward movement of the piston permits a free flow of gaseous refrigerant from the base of the compressor through such upper wall of the piston, but which upon upward movement of the piston closes tightly for the purpose of allowing the piston to compress the gas above it. A valve plate 33 covers the upper end of the cylinder block 27 and hence each of the cylinders, and during upward movement of the piston serves as a gas confining means to allow the pistons to compress the gas between the plate and the upper wall of the pistons. Over each of the cylinders, the plate 33 is provided with apertures 34 to allow the gas to escape through the plate after it has been compressed to the desired degree. A valve structure indicated generally at 35 is employed in conjunction with each cylinder for permitting the flow of gas in one direction only through the apertures 34. The head 36 is hollow and receives the compressed gas from the cylinders and is secured to the margins of the cylinder block by means of bolts 37. These bolts also serve to secure the margin of the valve plate 33 to the cylinder block, and between the head and the valve plate and between the latter and the cylinder block, sealing gaskets 38 are provided to prevent the escape of the compressed gaseous refrigerant. Adjacent each of the valves 35, the head 36 is provided with a projection 40 which serves as retaining means for the upper end of a secondary spring 41 associated with the valve backing member 35'. The construction of the valve forms no part of this invention but it is desired to state that the valve includes a spring disc plate normally closing the apertures 34 and which opens ordinarily when the pressure of the gas in the cylinder becomes sufficient to open the disc against the back pressure in the head. The spring 41 permits a wider opening of the valve to permit slugs of liquid refrigerant for example to pass into the head.

From this description it will be apparent that gaseous refrigerant at a relatively low pressure is received from the discharge side of the evaporator, into the base of the compressor, and then during the downward strokes of the pistons, such gas flows through the valves 31 into the space above the pistons and between them and the valve plate 33. Then on the upward strokes of the pistons the valves 31 automatically close and the gas thus confined is compressed until the valves 35 automatically release and allow the compressed gas to flow into the hollow head 36 above the valve

plate. It is of course to be understood that as soon as the gas ceases to flow through the valves 35 and into the hollow head 36, the valves immediately close and the compressed gas in the head 36 is then prevented from flowing back into the cylinders.

For removing the compressed gas in the head 36, the valve plate 33 at one marginal point, as shown by Fig. 7, is provided with an aperture 41' which communicates with an aperture 42 in the side wall of the cylinder block, that extends downwardly a considerable distance below the valve plate. At its lower end, the aperture 42 communicates with a laterally disposed aperture 43 extending through an offset portion 44 of the cylinder block, and on said offset portion, and in registry with the opening 43, a valve connection 45 is provided which as best shown by Fig. 2, is connected to a pipe 46 extending downwardly to the central part of the base 10. The pipe 46 extends through an opening in the hollow base 10 at this point and is there connected to a drum condenser which will now be described.

Referring to Figs. 5 and 6 particularly, a ring 50 is provided within the hollow base 10, centrally thereof, which at its upper side has oppositely disposed projecting portions 51 and 52 located in the plane of the ring which terminate in transversely projecting arms 53 and 54. These arms are secured against the under side of the upper wall of the base 10 by means of bolts 55 and consequently the latter suspend the ring from the upper wall of the base. Between the bolts securing the arms 53 and 54 to the base, the latter is provided with an opening 56 which allows the ring 50 to partially project through the upper wall of the base and also permits ingress of the pipe 46 into the latter. The condenser is secured to this ring and as shown by Figs. 1 and 6, comprises shells 57 and 58 extending respectively from opposite sides of the ring to points adjacent the respective ends of the base 10 and in spaced relation to the walls thereof and to the floor. The shells are closed except for open ends adjacent the ring 50 and at the open ends thereof are provided with annular, outwardly directed flanges 59 and 60 respectively, which abut the opposed sides of the ring. These flanges and hence the shells 57 and 58 are secured to the ring by means of a series of circumferentially spaced bolts 61 extending through the ring and through the flanges. One end of each bolt is provided with an integral head 62 and the other end thereof is provided with a removable nut 63, and between the flanges 59 and 60 and the heads 62 and nuts 63, spacer rings 64 are provided on the bolts for the purpose of more securely clamping the flanges to the ring. The spacer rings also force the flanges tightly against the ring entirely around the periphery thereof and hence more positively seal the shells at their points of connection with the ring. Sealing rings 64' are used between the flanges and the ring 50 to secure a more perfect seal.

The pipe 46 extending from the compressor 36 is connected to a nipple 65 threaded into that part of the ring 50 projecting through the opening 56 in the base 10, and from the nipple, an aperture 66 extending through the ring operatively connects the pipe to the interior of the condenser and hence the interior of the assembled shells 57 and 58. Adjacent the nipple 65, a second aperture 67 is provided in the ring 50 in communication with the interior of the condenser and which at its outer end is sealed by a fusible plug 68 for releasing the refrigerant in the con-

denser should the latter become excessively heated or the temperature become excessive around the condenser. Around the plug 68, the ring 50 is provided with a threaded boss 69 and ordinarily

a pipe (not shown) will be so connected to the boss and extended to the exterior of the building in which the refrigerator mechanism is located that the refrigerant when released by the plug 68 may escape to the exterior of the building.

Liquid refrigerant is removed from the condenser by means of a tube 70 secured at one end in an aperture 71 extending through the ring 50 between the flanges 59 and 60 on the shells 57 and 58, and which at its other and inner end is so bent downwardly to a point adjacent the bottom wall of the condenser that the lower extremity of the tube normally will be submerged in the liquid refrigerant. The outer end of aperture 71 is in registry with a valve connection 72 secured to the ring 50 and from such valve connection as shown by Fig. 1, a pipe 73 extends to an evaporator expansion valve (not shown). From the same valve, a pipe 74 shown by Figs. 1 and 5, extends to a valve connection 76 mounted on the base 22' of the compressor which operatively connects the pipe to the interior of the compressor base upon opening of the valves for this purpose. The valve 72 is so constructed that the pipe 73 extending to the evaporator expansion valve may be closed to the interior of the condenser, and the pipe 74 extending to the base of the compressor opened, or the valve may be operated to close the pipe 74 to the condenser while maintaining pipe 73 open to the latter. Normally, pipe 74 will be closed to the interior of the condenser and pipe 73 left open and also valve 76 will be so operated that the pipe 74 will be closed to the interior of the compressor. The pipe 74 is utilized primarily for evacuating the condenser of liquid refrigerant, as it is sometimes desirable to remove the refrigerant from the condenser by heating the latter for example, and desirable that it be conducted through the base of the compressor into a suitable container.

From the valve 76, a pipe 77, which normally is in communication with the interior of the compressor, extends into a pressure controlled electric switch box indicated at 80 in Fig. 1. Since the pipe 77 normally will communicate with the interior of the compressor base and hence with the low pressure side of the system, the low pressure gas will be utilized to control the switch 80. When the pressure of the gaseous refrigerant in the compressor base becomes too high, the switch 80 will automatically operate to close the electrical circuit through the motor and hence initiate operation of the refrigerating system, and when the gas pressure in the compressor base becomes sufficiently low, the switch 80 will operate to interrupt the motor circuit and hence interrupt operation of the system.

Referring to Figs. 1 and 5 again particularly, the ring 50 is provided with a second aperture 85 located above aperture 71, which also communicates with the interior of the condenser and normally with that space above the liquid refrigerant. A valve connection 86 on the ring 50 above the valve connection 72 and in registry with the opening 85, has a pipe 87 extending therefrom and to a high pressure cutout bellows 87' embodied in the pressure controlled switch 80. Normally the cut out bellows 87' will not function to interrupt operation of the motor and system, but in the event that the pressure of the refrigerant in the condenser becomes excessive, the cutout bellows 87'

will operate to interrupt operation of the system. Adjacent the valves 72 and 86, the side wall of base 10 has an opening 88 to permit ready access to the valves for manipulation purposes.

The foregoing description has related entirely to the circulation of the refrigerant through the compressor and condenser. In condensing gaseous refrigerant however considerable heat is generated during compression of the gas, and to reduce the highly compressed gas to a liquid in the condenser, it is desirable to remove the heat as quickly as possible to accelerate liquefaction. In the instant invention this is effected both by absorbing heat from the highly compressed gas in the compressor head 36 and by absorbing heat from the gas in the condenser and particularly this is effected by a water circulating system which will now be described.

Referring to Figs. 5 and 6, it will be noted that the ring 50 on its inner periphery and adjacent its upper side is provided with an inwardly offset yoke 90 which, has an aperture that permits the entrance of the refrigerant from pipe 46 into the condenser. This yoke serves as a support for an elongated channel member 91 secured thereto by bolts 92, and which extends through the ring 50 and to opposite ends of the condenser and hence to points adjacent the ends of the shells 57 and 58. Within the shell 57, the member 91 serves as a support for a coil 93 extending substantially throughout the length of the shell, while similarly in shell 58 the member 91 serves as a support for a coil 94. The coil in each of the shells spirals longitudinally around the member 91 until it is adjacent to the outer end of the shell, and then is reversely spiraled in a spiral of larger diameter around the periphery of the first coil as indicated at 95. Preferably both of the coils in each shell constitute a single length of pipe and the open ends of the pipe are located adjacent the ring 50.

Arranging the coils in the condenser in the manner described is advantageous because heat is absorbed uniformly from the refrigerant, throughout the length of the coils. The temperature of the water in the inner coils will gradually increase from the inlet, to the outer ends thereof, and then continue to increase gradually in the outer coils to the outlet thereof. Hence the high and low water temperatures are at one point in the coils, while along the latter toward the outer ends of the condenser, the temperature increases in one coil while decreasing in the other. At any point along the coils, the average temperature of the water in both coils will be about the same.

The outer coil 95 is supported by a member 96 extending over the inner coil and longitudinally of the member 91, and which at opposite ends of the coil is secured by means of bolts 98 and spacing members 99 to the member 91 but in spaced relation thereto. The outer coil is maintained in position by means of a strap 100 extending longitudinally thereof and over the coil, which at opposite ends is also secured to the member 96 by means of the bolts 98. As an additional means for supporting the member 91, channel shaped members 101 secured to opposite ends of the member 91 by means of the bolts 98, extend obliquely and downwardly toward the ring 50 and are secured at their lower ends to the ring by means of bolts 102.

The ends of the inner coils in the respective shells extend from opposite sides of the ring 50 into an opening 105 (Fig. 5) formed in a projection 106 on the inner periphery of the ring and

such aperture intermediate its ends communicates with a second aperture 107, extending to the outer periphery of the ring. A nipple 108 threaded into the aperture 107 and connected at its outer end to a water inlet pipe 109 serves as a means for conducting water into the inner coils. The ends of the outer coils and hence the exit ends of the water circulating system in the condenser, are connected similarly to a projection 110 on the inner periphery of the ring which has similar apertures operatively connected to a nipple 111 on the outer periphery of the ring which is connected in turn to a water discharge pipe 112. Consequently, water flows through the pipe 109, through the inner coils to the remote ends of the shells 57 and 58 and then flows reversely through the outer coils again to the ring 50 and then through the discharge pipe 112. This circulating water serves as a means for absorbing heat in the highly compressed refrigerant in the condenser and hence accelerates liquefying the refrigerant.

For circulating water around the head 36 of the compressor, the cylinder block 27 is provided with an offset annular wall 115 (Fig. 4), providing a space into which water may flow from the pipe 112 which is connected to such offset wall of the cylinder block as indicated at 116. The wall 115 extends to a point flush with the upper surface of the cylinder block, and supports a second head 117 spaced from the head 36 to provide a space for the circulating water. The head 117 is secured to the wall 115 by means of bolts 118 and preferably a gasket 119 is provided between the wall and the head to prevent the escape of the water. At a point substantially opposite the entrance of pipe 112 through the wall 115, the latter is provided with a water discharge pipe 116'. Water entering the space between the wall 115 and the wall of the cylinder block inwardly thereof, flows through this space as well as between the heads 36 and 117 and absorbs considerable heat from the highly compressed gaseous refrigerant within the head 36 as well as heat from the cylinders. It should be understood from this description that water entering the pipe 109 flows through the coils in the condenser, absorbing heat from the refrigerant therein, and then flows through the spaces provided therefor in the compressor head and then is discharged through pipe 116'. It is desired to call attention to the fact that the apertures through which the gaseous refrigerant flows from the compressor head 36, are entirely located in parts of the compressor separate of the water head 117. This arrangement permits removal of the water head without disturbing the refrigerant circulating system and at the same time obviates extending any pipes or other connecting means through the water space. In other words, the water passages in the compressor head are entirely separate of refrigerant passages.

Having the water flow through the condenser first and through the compressor head last avoids a flow of relatively cold inlet water initially around the head, and thereby eliminates the possibility of the undesirable condition of condensing refrigerant within the head. In other words, this condition is avoided by having the water flow through the condenser first, during which its temperature is increased by the absorption of heat from the refrigerant within the condenser. This is particularly important when the flow of water to the condenser is governed by the temperature of the water at the discharge end of the water circulating system, or by substan-

tially equivalent control means such as the pressure or temperature of the refrigerant in the condenser.

For effecting control of the amount of water circulating through the condensing unit in proportion to the pressure of the gaseous refrigerant, for example, and hence the temperature of the refrigerant, a pipe 122 shown by Fig. 1, may be connected to the high pressure refrigerant pipe 87 which extends to a pressure controlled valve in the discharge water line 116' although this pressure valve and its connection to the water line are not shown. As the pressure of the refrigerant in pipe 87 increases, the pressure of the refrigerant in pipe 122 also increases, and the valve in the water line is so constructed that as the refrigerant pressure increases, more water is allowed to flow through the water circulating system. Conversely, as the pressure in pipes 87 and 122 decreases, the valve operates to decrease the amount of water flowing through the water circulating system. This arrangement not only promotes uniformity and efficiency of operation of the refrigerating system but also reduces the amount of water required.

The condensing unit described and illustrated is extremely efficient in operation and the parts are so constructed and arranged that they can be manufactured inexpensively, and assembled and disassembled readily and without difficulty. Constructing the compressor head so that the space for the gaseous refrigerant is entirely separate of the space for the circulating water is advantageous because it eliminates refrigerant passages through the water space and hence avoids problems of sealing one space from the other that otherwise would be encountered if gaseous refrigerant had to pass through the water space from the compressor to the condenser. Moreover, the arrangement permits removal of the water head on the compressor without altering the gas receiving head and it would even be possible to operate the compressor without the water head. As a matter of fact, in the entire condensing unit it would be possible to remove the water circulating system without altering the arrangement of the refrigerant circulating system. Controlling the amount of water flowing through the water circulating system by the pressure of the gaseous refrigerant in the unit is advantageous because it promotes efficiency and uniformity of operation of the mechanism as well as reduces the amount of water required. Constructing the condenser of two parts, namely, the opposed shells, and connecting the adjacent ends of the shells by means of a ring suspended from the supporting base, is advantageous because it permits removal of the condenser from the base quickly and without difficulty. Also, by constructing the condenser in this manner, the expense involved in its manufacture is reduced considerably. Also, constructing the condenser of two shells disposed in end-to-end relation, permits assembling the water circulating coils on each side of the condenser supporting ring, and securing the coil supporting frame work to the ring, prior to assembling the shells and securing them to the ring.

In assembling the unit, it is only necessary to support the water circulating coils on the ring, and then slip the shells over the coils and secure them to the ring, and these operations may be performed prior to suspending the ring from the upper wall of the supporting base. After the condenser is assembled, it may be disposed within

the base and the ring secured to the upper wall in the manner described previously, and then the connections between the compressor and condenser made without difficulty. It is apparent that the open construction of the base between the supporting legs 11, and the openings 56 and 88 adjacent the refrigerant valve connections on the condenser, readily permit making all connections between the exterior circulating pipes for the water and refrigerant and the condenser. This open construction of the base also permits cooling air to circulate around the condenser thereby further increasing the dissipation of heat therefrom.

It will be noted that the entire unit is mounted on the base and hence of compact nature, and this arrangement facilitates positioning it wherever desired. While the parts are arranged compactly as mentioned and mounted on a single base, it is apparent that repairs, replacements and adjustments of parts can readily be made because of the fact that the construction enables ready access to all parts.

Although only one form of the invention has been illustrated and described in detail, it will be apparent to those skilled in the art that various modifications may be made without departing from the scope of the appended claims.

I claim:

1. In a refrigerating system, a condenser, a compressor, and optional means connecting the condenser to the low pressure side of the compressor for discharging refrigerant from the condenser to such low pressure side of the compressor.

2. In a refrigerating system, a condenser, a compressor, optional means connecting the condenser to low pressure side of the compressor for discharging refrigerant from the condenser to such low pressure side of the compressor, and valve means for opening or closing such means.

3. In a refrigerating mechanism, a base, a drum condenser under the base, a motor on the upper side of the base, a compressor on the upper side of the base, means connecting the motor and compressor, a ring portion on the condenser, and refrigerant connections between the condenser and compressor and communicating with the interior of the condenser through such ring portion.

4. In a refrigerating mechanism, a base, a drum condenser under the base, a motor on the upper side of the base, a compressor on the upper side of the base, means connecting the motor and compressor, cooling medium circulating means in the condenser, a ring member on the condenser, refrigerant connections between the condenser and compressor, and connections for allowing cooling medium to flow into and out of the circulating means therefor, all of such connections being mounted on the ring member and communicating with the interior of the condenser therethrough.

5. In a refrigerating system, a condenser, a compressor, means for conducting refrigerant from the condenser to an evaporator, and optional means for evacuating the refrigerant in

the condenser to the low pressure side of the compressor.

6. In a refrigerating system, a condenser, a compressor, means for conducting refrigerant from the condenser to an evaporator, means for evacuating the refrigerant in the condenser to the low pressure side of the compressor, and a single valve control means connecting both of the conduction means to the condenser, said valve control means being of such character that optionally the refrigerant may be conducted to the evaporator or evacuated into the low pressure side of the compressor.

7. In a refrigerating mechanism, a hollow base, a drum condenser within the base, a motor on the upper side of the base, a compressor on the upper side of the base, means connecting the motor and compressor, a member suspending the condenser from the upper portion of the base, and means extending through said member for conducting refrigerant between the compressor and the condenser.

8. In a refrigerating mechanism, a hollow base, a drum condenser within the base, a motor on the upper side of the base, a compressor on the upper side of the base, means connecting the motor and the compressor, a member on the condenser substantially midway between its ends and communicating with the interior thereof, and refrigerant conducting means between the condenser and compressor and extending through an opening in the central portion of the base and through the member.

9. In a refrigerating mechanism, a hollow base, a drum condenser within the base, a motor on the upper side of the base, a compressor on the upper side of the base, means connecting the motor and compressor, a member on the condenser intermediate its ends and communicating with the interior thereof, a control for the motor, means for conducting refrigerant between the compressor and the condenser, refrigerant conducting means between the condenser and the control, and means for conducting refrigerant from the condenser to an evaporator, all of said refrigerant conducting means communicating with the interior of the condenser through said member.

10. In a refrigerating mechanism, a hollow base, a drum condenser within the base and including shells and a member between the ends of the shells which is composed of relatively heavy gauge metal as compared to the metal in the shells, a motor on the upper side of the base, a compressor on the upper side of the base, means connecting the motor and compressor, refrigerant conducting means between the compressor and the condenser, means for conducting refrigerant from the condenser to an evaporator, a control for the motor, means for conducting refrigerant from the condenser to said control, and means on said member for connecting all of the refrigerant conducting means to the interior of the condenser.

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