Oct. 31, 1944. A. A. McCORMACK 2,361,854

REFRIGERATING APPARATUS

Filed Dec. 27, 1940 2 Sheets-Sheet 1

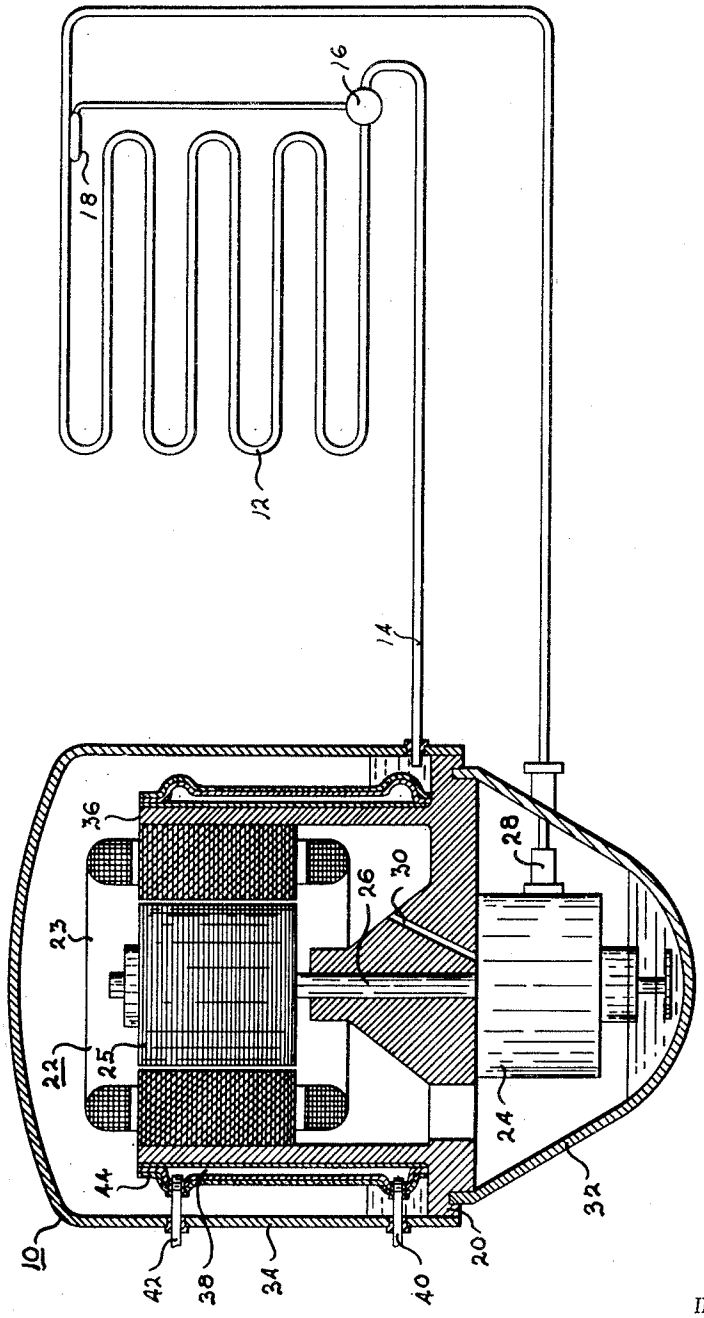


Fig. 1

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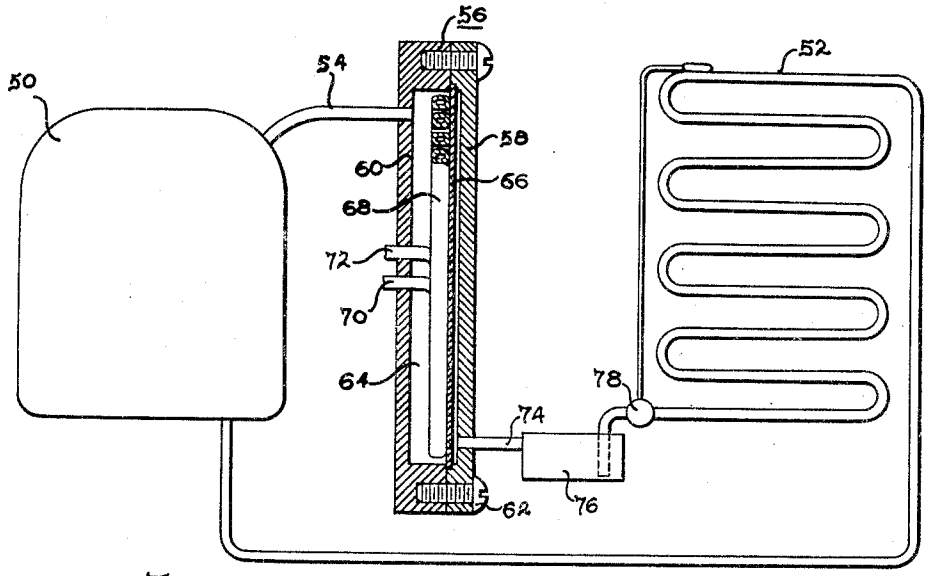


Fig. 2

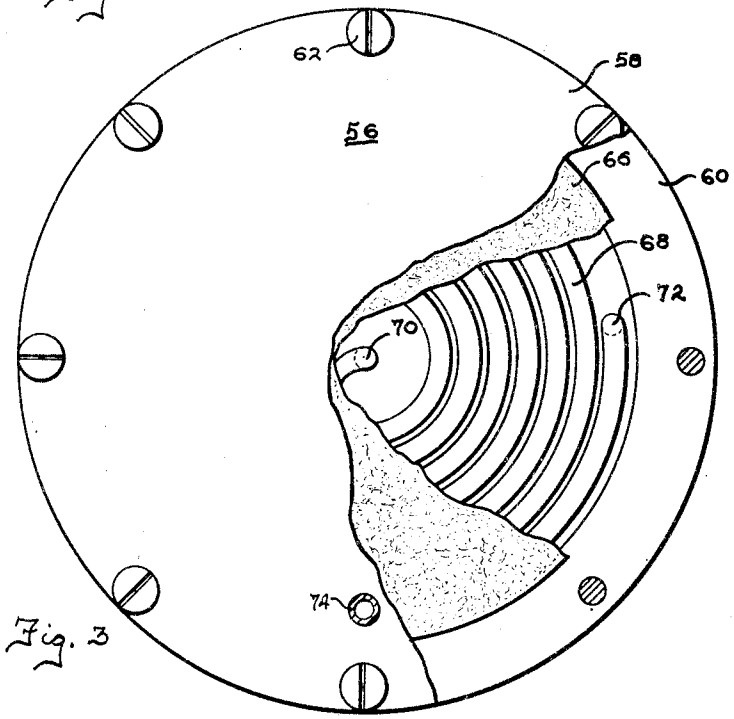


Fig. 3

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REFRIGERATING APPARATUS

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8 Claims. (Cl. 62—115)

This invention relates to refrigerating apparatus and more particularly to an improved arrangement for condensing the refrigerant.

An object of this invention is to increase the effective condensing surface without increasing the size of the condenser.

Another object of this invention is to utilize a filter element for increasing the effective condensing surface of a condenser.

One object of this invention is to materially increase the heat transfer surface of a condenser, or the like, without the use of a plurality of heat radiating fins.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a view partly in section showing my invention as applied to a volatile refrigerant system;

Fig. 2 is a view partly in section showing a modified arrangement; and

Fig. 3 is an elevational view, with parts broken away, of the condenser element shown in Fig. 2.

One of the problems in designing a refrigerant condenser is to provide a large enough surface in thermal exchange with both the refrigerant to be condensed and the cooling medium. In a water cooled condenser, for example, it is common practice to provide fins on the water coil but these fins require considerable room and are expensive to manufacture and assemble. I have found that a more practical means for increasing the effective condensing surface of a condenser without using the usual form of heat radiating fins is to place a thin sheet of sintered metal in the condensing chamber in contact with the water conduit.

Referring now to Fig. 1, in which I have shown one system employing my invention, the reference numeral 10 designates a sealed motor-compressor-condenser unit of the type which is adapted to withdraw refrigerant vapor from the evaporator 12 and supply refrigerant in liquid form to the evaporator 12. The flow of liquid refrigerant to the evaporator 12 is controlled by means of a conventional thermostatic expansion valve 16 located in the liquid line 14. This valve is provided with the usual form of thermostatic bulb 18 placed at the outlet of the evaporator and adapted to close off the flow of refrigerant to the evaporator when the liquid refrigerant reaches the outlet of the evaporator.

The motor-compressor-condenser unit 10 comprises a main frame 20 on which is mounted the motor 22 and the compressor 24. The compressor 24 is adapted to be driven by the motor 22 by means of the shaft 26 journalled directly in the main frame 20. The motor 22 is of conventional construction and includes a stator 23 and a rotor 25. The stator 23 is supported on the cylindrical flange 36 formed integrally with the main frame 20. The compressor 24 is a conventional rotary compressor which has an inlet 28 and a compressed refrigerant outlet 30.

A bell member 32 is secured to the frame 20 and serves as a lubricant reservoir from which lubricant is supplied to the compressor 24. A second bell member 34, also carried by the frame 20, surrounds the motor 22 and forms with the main frame a condensing chamber.

A water jacket 38 surrounds the motor frame 36. Cooling water is supplied to the water jacket 38 through the inlet 40 and leaves the jacket through the outlet 42. The compressed refrigerant discharged through the compressor outlet 30 flows upwardly between the stator 23 and the rotor 25 into the space surrounding the motor 22. When the compressed refrigerant strikes the outer surface of the water jacket 38 it condenses and drains into the lowermost portion of the pocket formed between the casing 34 and the water jacket 38. In order to increase the effectiveness of the exposed area of the water jacket 38, I have secured a thin sheet of porous sintered monel or bronze material 44 to the outer surface of the cooling water jacket 38. This sintered material may be brazed or otherwise secured to the outer surface of the jacket 38. If desired, the sintered material may be used without being bonded in any manner to the jacket 38. It is desirable, however, to have direct physical contact between the outer surface of the water jacket 38 and the material 44.

By virtue of the large amount of exposed surface provided by the sintered material 44 the refrigerant gas will condense very rapidly.

The material 44 may be made in the following manner: A homogeneous mixture of finely divided nickel and copper powders is prepared, having about 68% nickel and 30% copper therein. The degree of fineness of the metal powder determines to a large extent the degree of porosity of the final element. In constructing a porous sintered element such as 44 for use in a refrigerating system, it has been found that suitable porosity may be obtained when using powders which have been screened through a wire

mesh screen having approximately 40 or even less openings per linear inch. The mixture of nickel and copper powders is spread loosely on the hard smooth surface of a graphite mold to form a loose mass. The top of the powder is scraped off to a smooth level surface by any suitable means to form a loose uncompacted layer of powder having the desired depth. The mold and uncompacted powder layer thereon is then heated in a non-oxidizing reducing atmosphere in a suitable furnace at a temperature of 2025° F. for a short time, approximately eight minutes, to cause the nickel and copper particles to alloy or sinter together to form a highly porous metal sheet of an alloy having monel metal composition and which will resist corrosion to a high degree. After this sintering step is completed the porous metal sheet is cooled in a non-oxidizing or reducing atmosphere and then readily lifted from the hard graphite surface upon which it lay during sintering. This results in a highly porous sheet metal member which may be bent into the shape shown in Fig. 1.

While I have described specific metals in specific proportions, it is obvious that the proportions and the materials selected may be varied to form other alloys. In each case, the sintering temperature used being such as will cause the metal powders being used to alloy or sinter together without such melting as will destroy the high porosity of the final metal structure. In order to provide a highly porous metal bronze member, for example, any desired proportions of copper and tin metal powders may be used in the process described hereinabove. For example, from 90% to about 97% copper powder may be used with from 10% to 3% of tin powder. The sintering temperature for the copper-tin mixtures is approximately 1500° F.

In Figs. 2 and 3 of the drawings, I have shown a modified refrigerating system embodying my invention. In this modified form a conventional rotary motor-compressor unit 50 is provided which withdraws vaporized refrigerant from the evaporator 52 and discharges compressed refrigerant through the outlet line 54 leading to a water cooled condenser element 56. The condenser element 56 comprises a pair of plate members 58 and 60 which are secured together by means of cap screws 62. A condensing chamber 64 is provided between the plate members 58 and 60. Within this chamber there is mounted a porous sintered bronze or monel metal plate 66 to which is secured a spirally arranged water coil 68. Cooling water is introduced into the coil 68 at 70 and is discharged at 72. Referring to Fig. 2, it will be observed that the water pipes have been flattened so as to make it possible to arrange the spirals of the pipe close together and still leave room between adjacent spirals. The compressed refrigerant coming in contact with the water coil 68 and the porous metal plate 66 will be condensed and will drain into the lower portion of the chamber 64. The condensed refrigerant will leave the chamber 64 through the line 74, which conveys the condensed refrigerant to the receiver 76. While I have shown a separate receiver for the condensed refrigerant, it is obvious that the condenser 56 may be made large enough to serve as a combined condenser and receiver. The flow of refrigerant from the receiver 76 to the evaporator 52 may be controlled by any conventional means such as the thermostatic expansion valve 78. In the arrangement as shown in Fig. 2, all of the refrigerant flowing through the condenser 56 is required to flow through some portion or the other of the porous member 66. By virtue of this arrangement the member 66 serves as a filter for the refrigerant.

The elements 44 and 66 may all be made by the same general process. The coil 68 may be secured to its porous plate during the sintering process or may be secured thereto in a separate step by any conventional process of securing one metal member to another metal member. Preferably, however, the coil is secured to the porous plate during the sintering process. This may be done by placing the coil on top of the powder mixture before the sintering operation so that the coil is bonded to the material during the sintering process. If desired the coil may be imbedded in the material. The porosity and composition of the plates may be varied as explained hereinabove so as to suit the particular needs in each case.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In combination, an evaporator, refrigerant liquefying means for supplying liquid refrigerant to said evaporator, said refrigerant liquefying means comprising a motor-compressor unit, means for circulating a cooling medium in thermal exchange relationship with said unit, porous sintered metal means in contact with said last named means, and means for directing compressed refrigerant vapor in contact with said porous sintered metal so as to cool and condense said vapor prior to return to said evaporator.

2. In combination, an evaporator, refrigerant liquefying means for supplying liquid refrigerant to said evaporator, said refrigerant liquefying means comprising a motor-compressor unit, means for circulating a cooling medium in thermal exchange relationship with said unit, porous sintered metal means in contact with said last named means, and means for directing compressed refrigerant vapor in contact with said porous sintered metal so as to cool and condense said vapor prior to return to said evaporator, said porous sintered metal means comprising a jacket surrounding the motor portion of said motor-compressor unit.

3. In combination, an evaporator, refrigerant liquefying means for supplying liquid refrigerant to said evaporator, said refrigerant liquefying means comprising a motor-compressor-condenser unit enclosed within a sealed casing, means for circulating a cooling medium in thermal exchange relationship with said unit, and porous sintered metal means in contact with said last named means, said refrigerant liquefying means including means for directing compressed refrigerant vapor in contact with said porous sintered metal so as to cool and condense said vapor prior to return to said evaporator.

4. In combination, an evaporator, refrigerant liquefying means for supplying liquid refrigerant to said evaporator, said refrigerant liquefying means comprising a motor-compressor-condenser unit, enclosed within a sealed casing, means for circulating a cooling medium in thermal exchange relationship with said unit, and porous sintered metal means in contact with said last named means, said refrigerant liquefying means including means for directing compressed refrig-

erant vapor in contact with said porous sintered metal so as to cool and condense said vapor prior to return to said evaporator, said porous sintered metal means comprising a jacket surrounding the motor portion of said motor-compressor-condenser unit.

5. In combination, an evaporator, refrigerant liquefying means for supplying liquid refrigerant to said evaporator, said refrigerant liquefying means comprising a motor-compressor unit, means for circulating a cooling medium in thermal exchange relationship with said unit, porous sintered metal means in contact with said last named means, means for directing compressed refrigerant vapor in contact with said porous sintered metal so as to cool and condense said vapor prior to return to said evaporator, said porous sintered metal means comprising a jacket surrounding the motor portion of said motor-compressor unit, and having a portion projecting into the condensed refrigerant.

6. In combination, an evaporator, refrigerant liquefying means for supplying liquid refrigerant to said evaporator, said refrigerant liquefying means comprising a motor-compressor unit, a liquid refrigerant sump, and porous sintered metal means having one portion in said sump and having another portion arranged in thermal exchange with a portion of said motor-compressor unit.

7. A refrigerating system comprising in combination, an evaporator, a compressor and a condenser connected in refrigerant flow relationship, said condenser comprising a porous sintered metal plate member through which substantially all of the refrigerant flowing through said condenser is required to pass, and means for flowing a cooling medium in thermal exchange with said member and the refrigerant flowing through said member.

8. A refrigerating system comprising in combination, an evaporator, a compressor and a condenser connected in refrigerant flow relationship, said condenser comprising means forming a condenser cooling fluid passage and a prefabricated sheet of porous sintered metal arranged in physical contact with said means and serving to present a large continuous condensing surface to the compressed refrigerant gas in said condenser.

ALEX A. McCORMACK.