

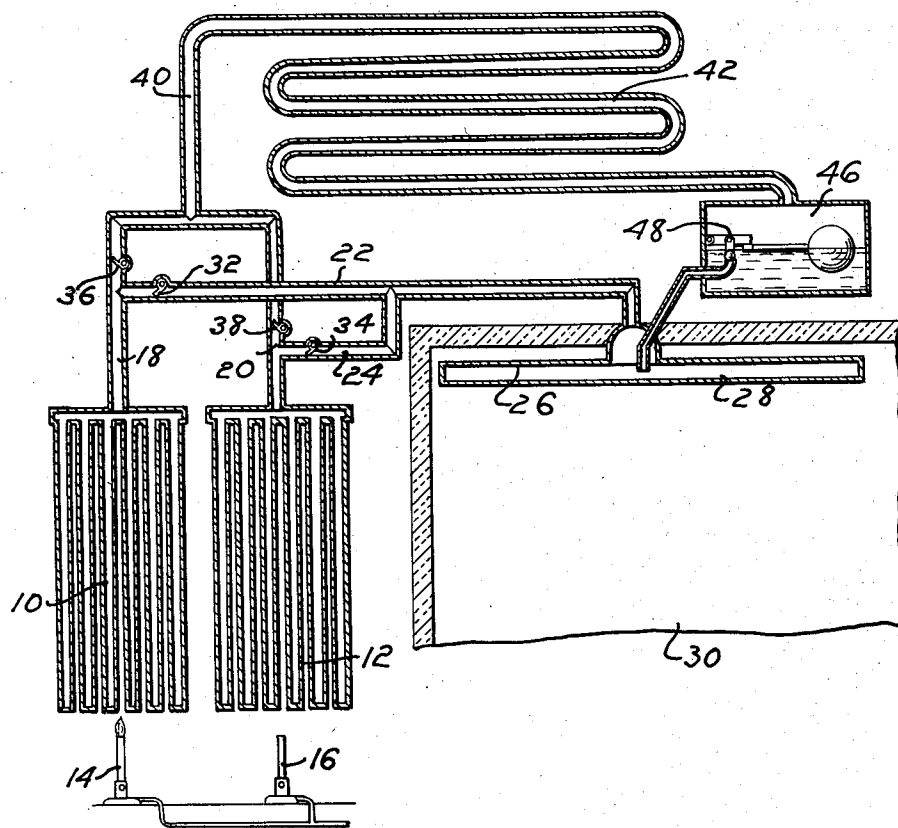
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REFRIGERATION

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REFRIGERATION

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8 Claims. (Cl. 62-179)

This invention relates to refrigeration, and is described as carried out in an apparatus operating on an absorption cycle. An object is to provide for absorption refrigeration in an apparatus which is compact and simple, so that (for example) it is suitable for use in house trailers and the like.

In the arrangement illustrated, the absorber consists of a body of metal, which is usually copper, preferably in a finely divided state, and the refrigerant consists of nitrogen peroxide (which is a mixture of NO_2 and N_2O_4 , the proportions depending on temperature and pressure). In place of copper, cobalt and nickel and barium and silver and iron, and various mixtures of these metals, can be used.

The above and other objects and features of the invention, including various novel combinations and desirable particular arrangements, will be apparent from the following description of the process as carried out in the apparatus illustrated in the accompanying drawing, in which:

The figure is a diagram of the apparatus used.

In the illustrated apparatus, the metal (usually copper) is caused in any desired manner to adhere to the inner surfaces of two absorbers 10 and 12, arranged to be heated alternately by two sources of heat such as burners 14 and 16. Preferably the metal is in finely divided form to increase the surface area, but it will be understood that metal plate or sheets could be used. These absorbers are connected, by conduits 18 and 20, with communicating connecting conduits 22 and 24 leading from the top of an evaporator 26 containing the refrigerant 28 spread out to provide a large evaporating surface. The evaporator 26, being the cooling medium, is arranged within and at the top of the space 30 to be cooled.

While we prefer to use finely divided copper as the metal in the absorbers 10 and 12, it is possible to use cobalt, nickel, barium, silver, or iron, or a mixture of these metals. The refrigerant 28 is preferably nitrogen peroxide, which is a mixture (varying according to the temperature and pressure) of NO_2 and N_2O_4 .

Check valves 32 and 34 permit the refrigerant vapor to pass from the evaporator 26 to the absorber 10 or 12 (whichever one at the time is not being heated), but prevent any return of the vapors directly to the evaporator during the heating phase of the cycles of the absorbers.

Other check valves 36 and 38 open upwardly, to operate during the heating of the absorber 10 or 12 to direct the gaseous nitrogen peroxide through a conduit 40 to a condenser 42, whence

it is delivered as liquid to a reservoir 46. A submerged float-operated valve 48 feeds excess liquid from the reservoir 46 to the evaporator 26, without allowing the passage of any vapor.

In operation, one of the absorbers (the one indicated at 12 as shown in the diagram) is cool, and its metal absorbent takes up nitrogen peroxide vapor through conduits 20 and 22, thereby reducing the pressure in evaporator 26 and causing evaporation of some of the refrigerant 28, and causing the desired lowering of temperature in the space 30, which must supply the heat absorbed by the evaporating refrigerant.

The nitrogen peroxide combines with the metal in the absorber 12 to form an unstable compound usually referred to as a nitro-metal. In forming this compound, the group NO_2 behaves as a monad radical, being called nitroxyl. In the next phase of the cycle, the nitrometal is decomposed by heat from the burner 16, while at the same time since burner 14 is extinguished the absorber 10 is taking up nitrogen peroxide.

For example copper nitroxyl breaks down above 90°C . into metallic copper and nitrogen peroxide vapor, thus: $\text{Cu}(\text{NO}_2)_2 \rightleftharpoons \text{Cu} + 2\text{NO}_2$. The dark brown NO_2 changes partially into colorless N_2O_4 , the exact proportion being dependent on the temperature and pressure. N_2O_4 has a melting point of -9.3°C . and a boiling point of 21.3°C ., above which it decomposes almost completely into NO_2 with the absorption of heat, thus: $\text{N}_2\text{O}_4 + 5.571 \text{ kilogram calories} \rightleftharpoons 2\text{NO}_2$.

The cooling phase of the absorbers 10 and 12 can be substantially longer than the heating phase, so that the cooling phases of the two absorbers overlap.

While one particular process and apparatus has been described, it is not our intention to limit the scope of the invention by that description, or otherwise than by the terms of the appended claims.

We claim:

1. That method of cooling which comprises plating a body of refrigerant comprising an oxide of nitrogen having an extended evaporative surface, in communication with a body of metal selected from the group consisting of copper, cobalt, nickel, barium, silver, and iron, whereby the metal will absorb said refrigerant to form a compound of the metal and an oxide of nitrogen, then decomposing the compound by heat and driving off the refrigerant as a gas, condensing said gas, and returning the condensed gas to said body of refrigerant.

2. That method of cooling which comprises

placing a body of refrigerant, consisting of nitrogen peroxide (mixture of NO_2 and N_2O_4), and having an extended evaporative surface, in communication with a body of metal selected from the group consisting of copper, cobalt, nickel, barium, silver, and iron, whereby the metal will absorb said refrigerant to form a compound of the metal and the nitrogen peroxide, then decomposing the compound by heat and driving off the refrigerant as a gas, condensing said gas, and returning the condensed gas to said body of refrigerant.

3. That method of cooling which comprises placing a body of refrigerant comprising an oxide of nitrogen having an extended evaporative surface, in communication with a body of metal consisting mainly of copper, whereby the metal will absorb said refrigerant to form a compound of the metal and an oxide of nitrogen, then decomposing the compound by heat and driving off the refrigerant as a gas, condensing said gas, and returning the condensed gas to said body of refrigerant.

4. That method of cooling which comprises placing a body of refrigerant, consisting of nitrogen peroxide (mixture NO_2 and N_2O_4), and having an extended evaporative surface, in communication with a body of metal consisting mainly of copper, whereby the metal will absorb said refrigerant to form a compound of the metal and the nitrogen peroxide, then decomposing the compound by heat and driving off the refrigerant as a gas, condensing said gas, and returning the condensed gas to said body of refrigerant.

5. Refrigerating apparatus comprising absorption means consisting of a body of metal selected from the group consisting of copper, cobalt, nickel, barium, silver, and iron, a body of re-

frigerant comprising an oxide of nitrogen having its surface in communication with the absorption means, means for driving off refrigerant as a gas from said body of metal, and means for condensing the gaseous refrigerant and returning it to the body of refrigerant.

6. Refrigerating apparatus comprising absorption means consisting of a body of metal consisting mainly of copper, a body of refrigerant comprising an oxide of nitrogen having its surface in communication with the absorption means, means for driving off refrigerant as a gas from said body of metal, and means for condensing the gaseous refrigerant and returning it to the body of refrigerant.

7. Refrigerating apparatus comprising absorption means consisting of a body of metal selected from the group consisting of copper, cobalt, nickel, barium, silver, and iron, a body of refrigerant consisting of nitrogen peroxide (mixture NO_2 and N_2O_4) and having its surface in communication with the absorption means, means for driving off refrigerant as a gas from said body of metal, and means for condensing the gaseous refrigerant and returning it to the body of refrigerant.

8. Refrigerating apparatus comprising absorption means consisting of a body of metal consisting mainly of copper, a body of refrigerant consisting of nitrogen peroxide (mixture of NO_2 and N_2O_4) and having its surface in communication with the absorption means, means for driving off refrigerant as a gas from said body of metal, and means for condensing the gaseous refrigerant and returning it to the body of refrigerant.

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