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ROTATING COOLING APPARATUS

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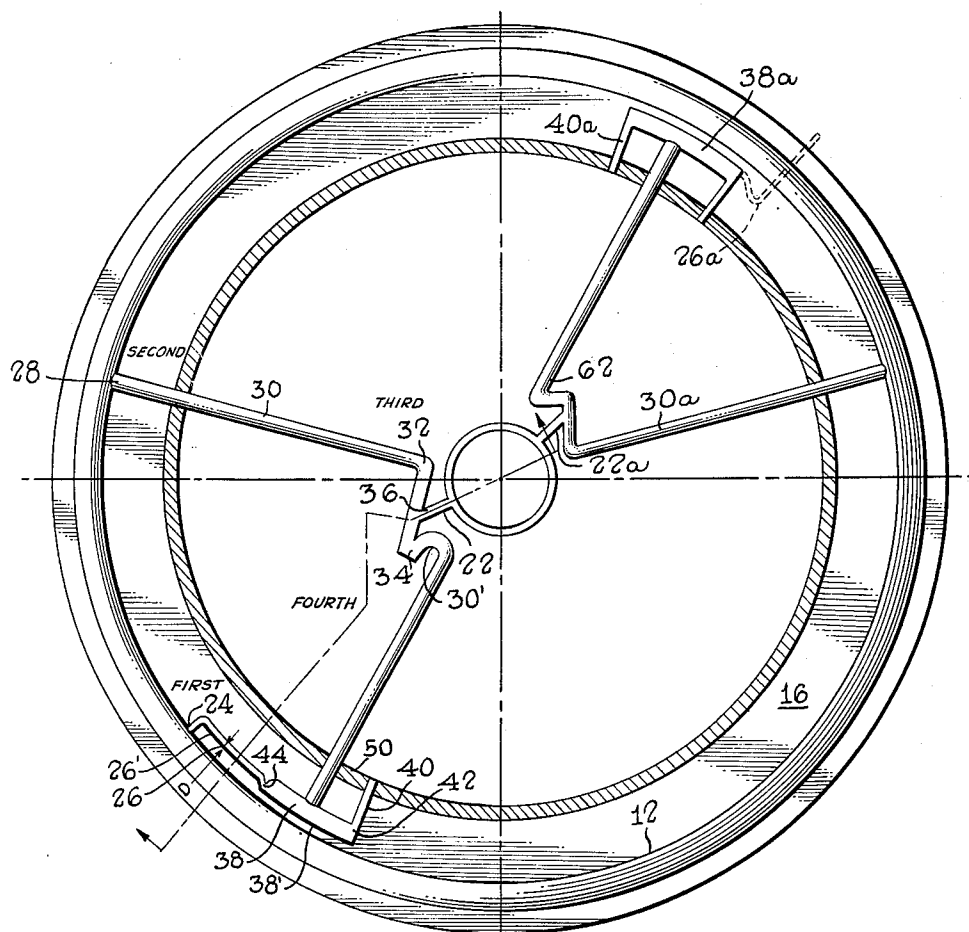


Fig. 1

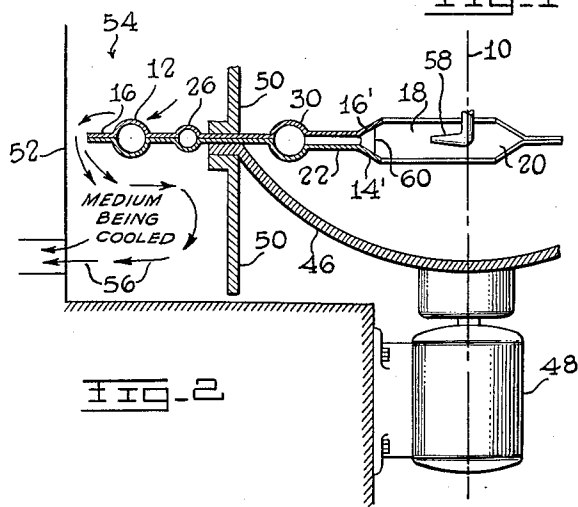


Fig. 2

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8 Claims. (Cl. 62-499)

This invention relates to rotating cooling apparatus wherein centrifugal forces are employed to extract heat by reason of vaporization of a liquid.

In accordance with the invention a chamber means is swung about an axis to force liquid therein, while concurrently vapor is removed. Reduction of the vapor pressure enhances vaporization within the chamber, and heat is thus extracted from the remaining liquid and the surrounding structure.

It is, therefore, a primary object of the invention to provide a rotary cooling apparatus.

It is a further object of the invention to provide apparatus as aforesaid made of two plied sheets of material such as sheet metal.

Further objects and the entire scope of the invention will become fully apparent from the following detailed description of an illustrative embodiment, and from the appended claims. The illustrative embodiment of the invention can be best understood by reference to the accompanying drawings, wherein:

FIGURE 1 shows a plan view of an illustrative embodiment of the invention.

FIGURE 2 shows a partial cross-section of the structure of FIGURE 1, taken substantially along line 1-1.

As shown in the figures, the apparatus may be most conveniently made by use of plied sheet metal members having certain zones separated one from the other to form conduits. This type of construction can be formed, for example, by welding the two plates together in all regions except those to form conduits, and then supplying fluid under high pressure in the manufacturing process, to force apart those areas. Other modes of construction may be employed, however.

In accordance with the invention, an axis 10 is to be established in some suitable way, preferably vertical, and about this axis as center is to be rotated structure comprising a concentric cooling conduit or chamber 12. As shown in the figures, chamber or conduit 12 is formed by expansion in a given zone of sheet metal members 14 and 16, the upper member 16 being viewed in FIGURE 1, which is a top plan view. At the central region of the members 14 and 16 is an opening 18 therein having an annular channel 20 formed by outwardly flaring portions 14' and 16' of the sheet metal members 14 and 16. At one point about the annular channel 20 a conduit of given size 22 is formed, for passing liquid therein from the annular channel 20.

At a point along the cooling conduit 12, which will be termed a first point of communication, designated 24 on the drawings, a further conduit 26 opens into conduit 12. At a position in the conduit 12 which will be determined a second point 28, a still further conduit 30 communicates with cooling conduit 12. The conduit 30 extends inwardly toward the axis 10 to a point which will be determined a third point, here designated 32 which is closer to the axis 10 than the first point 24 or the second point 28. The conduit 30 proceeds to a further point which will be designated as a fourth point, here designated 34 which is further from the axis 10 than the third point 32. Between the third and fourth points the conduit 22 empties as at 36 into the conduit 30. The conduit 30 is further characterized by means between the third point 32 and first point 24 for entrapping vapor between slugs of liquid passing to said first point. This means in the illustrative

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embodiment is a U-shaped portion of the conduit 30 which establishes a crest point 30' closer to the axis 10 than the fourth point 34.

The structure further includes a means in the conduit 30 between the entrapping means and the first point 24, for removing vapor and venting same while permitting entry of liquid into the cooling chamber or conduit 12. This latter means in the illustrative embodiment includes a chamber 38 with a vapor discharge passage 40 extending from the inner side thereof as at 42. The conduit 26 communicates with the outer edge of chamber 38 as at point 44. However, the outermost extremity 26' of conduit 26 lies at a distance d radially inwardly of the outermost extremity 38' of the chamber 38.

It should be understood that the cross-sectional area and therefore the capacity of conduit 26 should be the same as or in suitable ratio to conduit 22, and conduit 30 between point 36 and chamber 30 must have greater capacity than conduit 22.

The structure made up of the plied sheets 14 and 16, with the various conduits therein, may be mounted in any convenient fashion for rotation about the axis 10. A suggested structure is shown in FIGURE 2, where a generally bowl-shaped member 46 can be affixed to the rotating structure made up of sheets 14 and 16, and at a central point may be driven from the shaft of a motor 48. It will also be desirable to provide a wall member 50, which may rotate with the other rotating structure, so as to provide between this wall, and a stationary wall 52, a passage 54 wherein the medium to be cooled, such as air, may be circulated as suggested by the arrows 56 in FIGURE 2.

Suitable means such as a nozzle 58 is to be provided, mounted within the opening 18 at the center of the rotating structure. Liquid such as water from a convenient source is to be introduced into the nozzle 58 which may extend within the annular channel 20.

In operation, supply of water through nozzle 58 will cause water to stand with a substantially vertical surface 60 when the motor 48 is energized and the structure rotated at considerable speed. Water in this fashion delivered into the channel 20 will pass through the conduit 22 and into the conduit 30. After sufficient water has passed through conduit 22 to fill the conduit 30 to the crest point 30', the liquid will then siphon over and dump into the chamber 38. As the cross-section of conduit 30 is greater than that of conduit 22, the liquid will siphon over in slugs, and entrap vapour between the slugs. In this way vapour in the main cooling chamber of conduit 12 will be sucked through the opening at 28 and delivered to the chamber 38. The chamber 38 will serve to separate the vapour from the liquid, because the vapour will collect at the radially inner surface and be discharged through the conduit 40, while liquid in chamber 38, upon increasing in radial depth the distance d , will pass through the conduit 26 and enter the cooling chamber or conduit 12 at 24. Liquid entering the conduit 12 at 24 will vapourize therein, thus extracting heat from the surroundings and permitting the cooling of the medium moving through the passage 54. The vapourization will be enhanced due to the low vapour pressure created in the conduit 12 because of the extraction of vapour through conduit 30 at point 28.

To increase the rate of vapourization of liquid delivered at 24, by further reduction in the vapour pressure, one or more auxiliary vapour pump arrangements may be positioned about the structure. For example, in FIGURE 1 there is shown an auxiliary conduit 30a into which liquid is fed by use of conduit 22a leading from the annular channel 20 which feeds into channel 30a just above another liquid-vapour slug pumping structure, here designated for convenience generally by reference character 62. The liquid-vapour slugs are delivered into a separating cham-

ber 38a, vapour from which is discharged through conduit 40a. The liquid discharged therefrom through conduit 26a is simply wasted. However, without being entered into the conduit or cooling chamber 12. Thus it will be seen that when one or more of the units just described, also serving to extract vapour from the cooling chamber 12, even still lower pressures will be achieved at the liquid-vapour interface within the conduit 12, the vapourization will be thus enhanced, and additional cooling effected.

It is to be understood that the foregoing detailed description of an illustrative embodiment of the invention has been given only for purposes of illustration, and the true scope of the invention is to be determined from the appended claims.

What is claimed is:

1. Means defining a cooling chamber, means for rotating said chamber means about an axis, a conduit communicating with the chamber means at first and second spaced apart points and extending to a third point closer to said axis than said first point, means for entering liquid into the conduit at a point between said first and third points, means in said conduit between said first and third points for entrapping vapour between slugs of liquid passing to said first point, and means in said conduit between said entrapping means and said first point for removing said vapour and venting same while permitting entry of said liquid into said chamber means, the arrangement being such that during rotation of the structure about said axis liquid passing into said chamber means removes vapour therefrom to reduce the vapour pressure in said chamber thusly aiding evaporation of the liquid within the chamber means.

2. Apparatus as in claim 1 wherein said vapour entrapping means is a siphon device with its crest point toward said axis.

3. Apparatus as in claim 1 wherein said vapour removing means is in the form of a collecting chamber having

a liquid outlet and a vapour outlet, the latter closer to said axis than said liquid outlet.

4. Apparatus as in claim 1 and further including at least one additional conduit communicating with said chamber means at one end and a venting outlet at the other end and intermediate its ends having a point closer to said axis than said venting end, means between the just mentioned point and said venting end for entering liquid into said additional conduit, and means between said entering means and venting end for entrapping vapour from said chamber between slugs of liquid, the arrangement being such that vapour pumping in said additional conduit further reduces the vapour pressure in said chamber to further facilitate vapourization of liquid therein.

5. Apparatus as in claim 1 comprising an inwardly open container spaced from said axis, means intercommunicating said container with said liquid entering means, and means for projecting liquid into said container from a supply outlet closer than said channel to said axis.

6. Apparatus as in claim 4 comprising an inwardly open container spaced from said axis, means intercommunicating said container with said liquid entering means, and means for projecting liquid into said container from a supply outlet closer than said channel to said axis.

7. Apparatus as in claim 1 constructed of two plied sheets sealed together except in expanded areas forming said chamber, conduit liquid entering, liquid entrapping and vapour separating means.

8. Apparatus as in claim 4 constructed of two plied sheets sealed together except in expanded areas forming said chamber, conduit liquid entering, liquid entrapping and vapour separating means.

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