

July 24, 1962

C. A. E. BEURTHETER

3,046,429

HIGH FREQUENCY ENERGY INTERCHANGE DEVICE

Filed June 5, 1959

2 Sheets-Sheet 1

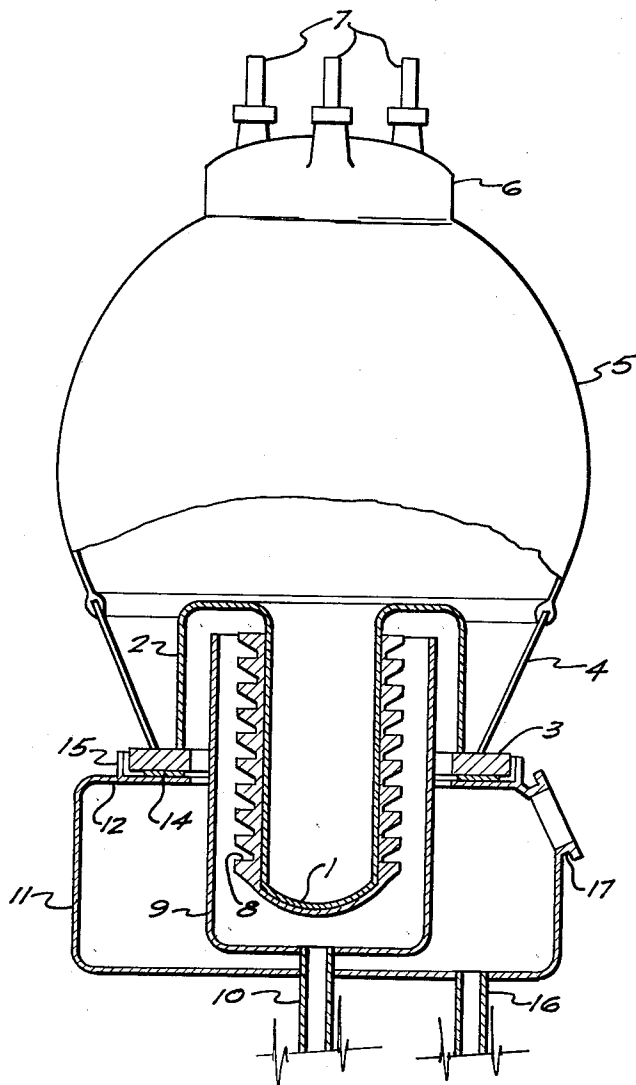


FIG. 1

CHARLES A.E. BEURTHETER

INVENTOR.

BY *Urban H. Fauson*

ATTORNEY

July 24, 1962

C. A. E. BEURTHETER

3,046,429

HIGH FREQUENCY ENERGY INTERCHANGE DEVICE

Filed June 5, 1959

2 Sheets-Sheet 2

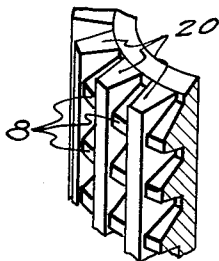


FIG. 2



FIG. 3

CHARLES A.E. BEURTHETER

INVENTOR.

BY *William H. Faubion*

ATTORNEY

1

2

3,046,429

HIGH FREQUENCY ENERGY INTERCHANGE DEVICE

Charles A. E. Beurtheret, Saint-Germain-en-Laye, France,
assignor to Compagnie Francaise Thomson-Houston,
Paris, France

Filed June 5, 1959, Ser. No. 818,440

Claims priority, application France June 6, 1958

3 Claims. (Cl. 313-12)

The present invention relates to vapor cooling apparatus for electric discharge devices and is particularly suited for providing cooling of electrodes of high power, high frequency discharge devices of the transmitting type. The present invention constitutes a further development of and improvement on the vapor cooling apparatus described and claimed in my copending applications Serial No. 232,188, filed June 28, 1951, now Patent No. 2,935,305, dated May 3, 1960, and Serial No. 273,813, filed February 28, 1952, now Patent No. 2,935,306, dated May 3, 1960.

In the above-identified copending applications, the advantages of vapor cooling as compared with liquid cooling are pointed out and suitable radiator or anode cooling structures and associated evaporators or boilers are described and claimed. The present invention relates particularly to improved radiator or electrode cooling structures suitable for such systems.

In the first of the two copending applications mentioned above (Serial No. 232,188), numerous designs of anodes suitable for cooling by vaporization and with a high output yield are illustrated and described. In all of these designs, part of the anode surface, which is usually cylindrical, is provided with radial extensions that are solid and rather long, so that the ends of the extensions that point away from the anode surface may be in contact with the liquid beyond the surface portion. Thus, the designs are such that the exchange of heat is vigorous enough to cause boiling adjacent the anode and there is a continuous temperature gradient from the anode to the opposite end of the projections. With these arrangements, the desired thermal exchange takes place by the boiling action of the liquid layer adjacent the projections and the continuous replacement of the vapor thus formed with liquid.

Usually the thick anode cooling structures so built have parallel vertical, horizontal or diagonal ducts between the solid projections through which the emulsion of liquid and vapor escapes. Such structures perform the desired function well. However, it will readily be understood that many of these structures are difficult to fabricate. The structures of the present invention perform eminently well in the environment described above and are very easily fabricated. For example, the proposed structures lend themselves quite readily to being cast in a mold made of demountable parts.

In carrying out the present invention, an electrode cooling structure is utilized which includes at least two sets of protruding solid ribs that intersect each other and define spaces that appear as separate cavities open towards the liquid coolant. Such devices present a waffle-like surface.

The novel features which are believed to be characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings in which:

FIGURE 1 is an elevational view partly in section of an

electric discharge device including a surrounding boiler and an electrode cooling structure utilized in describing the present invention;

FIGURE 2 is a perspective view of a segment of the electrode cooling structure illustrated in FIGURE 1; and

FIGURE 3 is a perspective view of a segment of another electrode cooling structure incorporating principles of the present invention.

Referring now to FIGURE 1 of the drawings, an electric discharge device is illustrated in order to place the cooling structures illustrated in a proper environment. The electric discharge device is of the type which includes an anode 1 forming a part of the envelope. As illustrated, the anode is of the reentrant type, which renders the discharge device particularly suited for moderately high frequency operation. The anode also includes a cylindrical portion 2 of larger diameter than the main portion of the anode 1 and which is formed as an integral part of the anode structure. This portion 2 is brazed to a heavy annular flange 3 which provides a support for the tube as a whole. The envelope of the discharge device is completed by a still larger circular collar 4 brazed to the flange 3 at its lower end and sealed at its upper end to a glass envelope 5. The upper end of the envelope is closed by a header 6 through which the conductors 7 for connection with the grid and cathode are sealed.

The discharge device is provided with a boiler or evaporator structure in accordance with the teachings of the copending application Serial No. 273,813, referred to above. An abbreviated description is included here to provide a complete understanding of the invention. The structure includes an inner cylindrical casing 9 which surrounds the anode cylinder 1 and is spaced from both the anode cylinder 1 and the surrounding portion of the anode 2 and terminates short of the connecting part of the anode between parts 1 and 2. This casing 9 is provided at its lower end with an inlet conduit 10. The boiler is completed by an outer surrounding casing 11 provided at its upper end with an opening of about the diameter of the inner edge of the annular flange 3 and defined by an inwardly directed flange 12 on which the annular ring 3 rests. The discharge device may be sealed to the radiator at this point by means of an interposed gasket 14 and also may be clamped in position, if desired, by suitable means (not shown). An upstanding flange 15 may also be provided around the annular ring 3 to center the tube in the evaporator. The casing 11 is provided with an outlet conduit 16 in the bottom thereof and with an upwardly directed conduit 17 extending from near the top of the side wall thereof. The conduit 17 provides a passage from which vapor generated by the cooling operation may be removed.

In the operation, cooling liquid such as water is supplied to the conduit 10 and to the inner casing 11 in sufficient quantity to at least maintain this receptacle full. The rate of supply of the liquid is much less than that required to prevent the formation of steam and in some installations it may be just sufficient to replace the liquid vaporized. In other installations, it may be desirable to supply a substantial amount of cooling liquid from the outlet conduit 16 in the outer casing 11. In such systems, the flow of water may be adjusted about $\frac{1}{10}$ of that required for normal liquid cooling without any formation of vapor. This will normally be in the order of ten times the amount of water required to merely replenish the liquid vaporized.

It will be appreciated that the anode is provided with a special surface designed to support the vapor cooling action. As will be appreciated by those skilled in the art, the special surface is in good heat transfer relation with the anode cylinder 1 by virtue of being formed

integrally therewith or bonded thereto by a layer of solder.

A particular structure is illustrated in FIGURES 1 and 2. From an inspection of these figures, it is seen that part of the surface is formed by providing outwardly extending tapered and relatively massive vertical ribs 20 and solid tapered outwardly extending horizontal ribs 8 which extend around the structure and in effect intersect the vertical ribs 20. Just by way of an example, the illustration shows these two sets of parallel projections as being of different lengths.

It should be well understood that one or both of the sets of ribs 8 and 20 may have teeth, over part of their height, of various descriptions so as to increase local turbulence and to improve the heat exchange between the liquid and the ends of the projections.

Other embodiments may readily be envisioned, for example, one such embodiment is illustrated in FIGURE 3. This arrangement also consists of two sets of intersecting ribs. However, the two sets of ribs 21 and 22 in this embodiment are spiral ribs wound in opposite directions so that they intersect to form truncated pyramids.

An important aspect of the configurations is that the dimensions of the intersecting ribs are selected so that a gap can never be completely filled with vapor before a bubble escapes, thus causing the liquid in the cavity to pulsate, with a resultant sweeping of the surfaces.

While particular embodiments of the invention have been illustrated, it will, of course, be understood that the invention is not limited to these embodiments, since many modifications may be made. It is contemplated that the appended claims will cover any such modifications as fall within the true spirit and scope of the invention.

What I claim is new and desire to secure by Letters Patent of the United States is:

1. In a high frequency energy interchange device having electrodes, cooling means associated with an electrode of the device for cooling said electrode by vaporization of a cooling liquid, and means for immersing at least a portion of said cooling means in cooling liquid, said cooling means including a generally cylindrical member having at least two sets of substantially unbroken solid rib members protruding from said electrode and tapering with distance therefrom, said rib members intersecting to

present a surface having a waffle-like appearance and define separate cavities having the shape of truncated pyramids.

2. In combination in a high frequency energy interchange device having electrodes, a generally cylindrical cooling means for an electrode of the device which performs the cooling operation by vaporization of a cooling liquid, and means for immersing at least a portion of said cooling means in the cooling liquid, said cooling means having at least two sets of substantially unbroken intersecting ribs, one of said sets of ribs including vertical tapered and circumferentially spaced, relatively massive members, another one of said sets of ribs including annular members extending around the circumference of said anode and intersecting said one set of ribs whereby a waffle-like surface with a multiplicity of individual cavities having the configuration of truncated pyramids is formed.

3. In a high frequency energy interchange device having electrodes, cooling means associated with an electrode of the device for cooling said electrode by vaporization of a cooling liquid, and means for immersing at least a portion of said cooling means in cooling liquid, said cooling means including a generally cylindrical member having at least two sets of substantially unbroken solid rib members protruding from said electrode and tapering with distance therefrom, said two sets of rib members each comprising spirally wound rib members extending around said electrode, each of said sets being wound in opposite senses whereby truncated pyramids are formed at intersections and a multiplicity of individual unconnected cavities having the configuration of truncated pyramids are formed therebetween.

References Cited in the file of this patent

UNITED STATES PATENTS

1,511,023	Brown	Oct. 7, 1924
1,997,502	Von Seld et al.	Apr. 9, 1935
2,440,245	Chevigny	Apr. 27, 1948
2,873,954	Protze	Feb. 17, 1959

FOREIGN PATENTS

1,051,297	Germany	Feb. 26, 1959
-----------	---------	---------------