Inventor:
Charles A. E. Beurtheret,
by Merton & Moore
His Attorney.
Inventor:
Charles A.E. Beurtheret,
by Morton S. Morse
His Attorney.
The present invention relates to vapor cooling apparatus for electric discharge devices and is particularly suited for cooling 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 application Serial No. 232,188, filed June 28, 1951.

In the above-identified copending application, 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 boilers suitable for such systems and it is an object of this invention to provide such improvements as offer advantages with respect to the separation of the vapor and the cooling liquid, and the circulation of a predetermined small amount of liquid in excess of that actually vaporized which may be used to advantage to cool other apparatus associated with the discharge devices, such as the inductance coils connected with the anode circuit.

Further objects and advantages will become apparent as the following description proceeds reference being had to accompanying drawings and its scope will be pointed out in the appended claims.

In the drawings, Fig. 1 is an elevational view of an electric discharge device including a surrounding boiler embodying my invention; Fig. 2 is an elevational view partially in section of a modified form of my invention and Fig. 3 illustrates my invention applied to a cooling system including the anode inductances associated with the discharge device being cooled.

Referring now to Fig. 1 of the drawing, I have shown my invention applied to an electric discharge device of the type including an anode 1 forming a part of the envelope. As illustrated, the anode is of the reentrant type, which renders the discharge device particular 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 collar 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.

In the operation of this embodiment of the invention, 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 to about ¼ 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.

In Fig. 2, I have shown a modified form of my invention in which the evaporator is made up of three concentrically arranged cylindrical casing members. Referring now to Fig. 2, the discharge device there illustrated includes an anode 18 to which are secured good heat conducting relation thereto at a plurality of tapered massive outwardly projecting 18a. The anode radiator includes an outwardly flared portion 19 at its upper end which cooperates with the outer cylindrical casing 20 of the evaporator to support the electric discharge device. As illustrated, the flared portion 19 rests on an inwardly directed flange 21 of the casing 20 and is sealed thereto by means of an interposed gasket 22.

The remainder of the evaporator includes an inner casing 23 open at its upper end and terminating at a level corresponding to the desired liquid level around the anode radiator. The casing 23 is provided at its lower end with an inlet conduit 24 through which the cooling liquid is introduced. Intermediate between casings 20 and 23 is a third casing 25 which extends upwardly beyond the inner casing 23 but terminates below the upper portion of the flared collar 19. The upper end of the casing 25 is curved inwardly as shown at 27 to aid in separating the entrained moisture from the vapor generated as will be described in more detail at a later point in the specification.

The three casings are joined together at their lower ends and provided with suitable outlet conduits 28 and 29 extending from the space between the inner and intermediate casings 23 and 25 and the intermediate and outer casings 25 and 20 respectively. As illustrated at 30, a passage is provided at the lower end of the space between the intermediate and outer casings to permit the return of liquid to the outlet conduit 28.

In order to prevent rotation of the liquid in the area next to the anode radiator 18 and to direct the vapor
What I claim as new and desire to secure by Letters Patent of the United States is:

1. A vapor cooling system comprising a plurality of baffles extending in a generally vertical direction both above and below the liquid level. The baffles are being over a generally circumferential direction as shown at 32 to direct the vapor and entrained moisture in a generally upward and helical path as shown at 33. As the vapor and entrained liquid strike the inwardly directed flange 27 on, the liquid drops in the space between the inner and intermediate casings. This area also receives the overflow of liquid from the space between the inner casing and the anode radiator. As will be readily appreciated, the vaporized liquid is exhausted through the passage 29 from the space between the outer and intermediate casings 20 and 25.

In Fig. 3, I have shown my invention applied to a cooling system for a high frequency transmitter which embodies my invention and which, in the interest of simplification, shows only a single discharge device. In Fig. 3, I have shown a discharge device and evaporator which may be considered to be the same as that described in detail in connection with the Fig. 2 and the same parts have been designated by the same reference numerals. In Fig. 3, the inlet conduit 24 for the water or other liquid is connected through one anode inductance 34, a section of insulating conduit 35 to the bottom of a supply reservoir 36. The liquid outlet conduit 28 is connected through another anode inductance 37, an insulating conduit 38, conduit 39 to the inlet of a pump 40 which may be driven by a suitable electric motor 41. The outlet of the pump returns liquid to the reservoir through a conduit 42. The vapor outlet conduit 29 is connected through an insulating section 29a and U-shaped conduit 29b to a condenser illustrated schematically at 43. Condensate from the condenser 43 is returned to a reservoir 44 through a conduit 45. A conduit 46 also returns condensate to the reservoir 44 that may collect in a U-shaped conduit 29b. Liquid from the reservoir 44 is returned to the pump 40 by means of conduit 47 under the control of a float valve illustrated schematically at 48. The level of liquid in reservoir 44 is maintained at a level that always covers the ends of conduits 45 and 46.

The level of liquid in supply reservoir 36 is controlled by means of a suitable float switch illustrated schematically at 49. As will be understood by those skilled in the art, the switch may be used to control the supply of water to this reservoir by means of a suitable solenoid valve (not shown).

As will be readily appreciated by those skilled in the art, the inductances 34 and 37 are maintained at the same positive direct current voltage and to this end are connected together by conductor 50 and to a source of positive direct current supply line 51. The level of the condenser system is maintained at ground potential as illustrated.

The desired rate of flow may be determined by the elevation of the reservoir 36 with respect to the discharge devices being cooled and the size of the conduit communicating with the inlet conduit 24. As a matter of further control, a suitable throttle valve 52 may be provided in the supply conduit if desired. As indicated earlier in this specification, where water cooling of auxiliary apparatus is contemplated, as in the system of Fig. 3, the flow of water is adjusted to a valve approximately ten times that required for replenishing the vaporized liquid. This is usually only about ½ the flow required for normal water cooling.

While I have described the particular embodiments of my invention, it will be apparent to those skilled in the art that changes and modifications may be made without departing from my invention in its broader aspects and I aim therefor in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.
tor, said intermediate casing terminating at a point between the upper end of said inner casing and the upper wall of said chamber, said casing forming an inwardly directed baffle at the upper edge thereof, means for introducing cooling liquid into said inner casing to produce a flow of liquid over the upper edge thereof and into the space between said inner and intermediate casings, a fluid outlet in said intermediate casing, and means connected with said outer casing to provide for the withdrawal of vapor from said outer casing.

5. A vapor cooling system comprising an electric discharge device having a cylindrical anode forming a part of the envelope of the device and including a radiator having a plurality of tapered massive projections extending outwardly therefrom and an evaporator including a pair of concentrically arranged casings surrounding said anode and spaced from one another and from said radiator, the outer casing cooperating with said discharge device to provide a chamber for collecting vaporized liquid produced by cooling of said device, said inner casing terminating below the upper wall of said chamber and at a point corresponding generally to the upper end of said radiator for maintaining a supply of liquid in vaporizing contact with said radiator, and a plurality of baffles including straight portions extending above and vertically above and below the upper end of said inner casing in the region between said inner casing and said radiator for minimizing horizontally rotary turbulence of liquid between said radiator and inner casing, and helically extending portions disposed above said inner casing for directing vapor from said liquid in a helical path.

6. A vapor cooling system comprising an electric discharge device having a cylindrical anode forming a part of the envelope of the device and including a radiator having a plurality of longitudinally spaced rows of outwardly extending tapered massive projections and an evaporator including a pair of concentrically arranged casings surrounding said anode and spaced substantially from one another and from said radiator, the outer casing cooperating with said discharge device to provide a chamber enclosing said radiator for collecting vaporized liquid produced by cooling of said device, said inner casing terminating below the upper wall of said chamber and at a point corresponding generally to the uppermost row of said projections, said inner casing being adapted for cooperating with said device to maintain a supply of liquid in vaporizing contact with said projections.

7. A vapor cooling system comprising an electric discharge device having a cylindrical anode forming a part of the envelope of the device and including a radiator having a plurality of longitudinally spaced rows of outwardly extending tapered massive projections and an evaporator including a pair of concentrically arranged casings surrounding said anode and spaced substantially from one another and from said radiator, the outer casing cooperating with said discharge device to provide a chamber enclosing said radiator for collecting vaporized liquid produced by cooling of said device, said inner casing terminating below the upper wall of said chamber and at a point corresponding generally to the uppermost row of said projections, said inner casing being adapted for cooperating with said device to maintain a supply of liquid in vaporizing contact with said projections and means for replenishing said supply of liquid in said inner casing just sufficiently to maintain liquid in vaporizing contact with said radiator but insufficiently either to prevent vaporization or to fill said outer casing.

8. A vapor cooling system comprising an electric discharge device having a cylindrical anode forming a part of the envelope of the device and including a radiator having a plurality of tapered massive projections extending outwardly therefrom, said projections being effective for agitating boiling liquid coolant in contact therewith, thereby to dislodge any vapor bubbles tending to adhere to said radiator, an evaporator including a pair of concentrically arranged casings surrounding said anode and spaced from one another and from said radiator, the outer casing cooperating with said discharge device to provide a chamber enclosing said radiator for collecting vaporized liquid produced by cooling of said device, said inner casing terminating below the upper wall of said chamber and at a point corresponding generally to the upper end of said radiator for maintaining a supply of liquid in vaporizing contact with said radiator, and a plurality of baffles including straight portions extending above and vertically above and below the upper end of said inner casing in the region between said inner casing and said radiator for minimizing horizontally rotary turbulence of liquid between said radiator and inner casing, and helically extending portions disposed above said inner casing for directing vapor from said liquid in a helical path.

References Cited in the file of this patent

UNITED STATES PATENTS

545,296 Kintner ------------ Aug. 27, 1895
1,639,051 Munday ------------ Aug. 16, 1927
2,046,020 Gargan et al. ------ June 30, 1936
2,110,774 Privett ------------ Mar. 8, 1938
2,235,669 Marks et al. ------ Mar. 18, 1941
2,312,920 Litton ------------- Nov. 14, 1944
2,362,911 Litton ------------- Apr. 27, 1948
2,440,245 Chevigny --------- June 27, 1950
2,513,255 Smith ----------- May 6, 1952
2,595,685 Mallory --------- May 6, 1952

FOREIGN PATENTS

773,705 France ---------- Nov. 24, 1934