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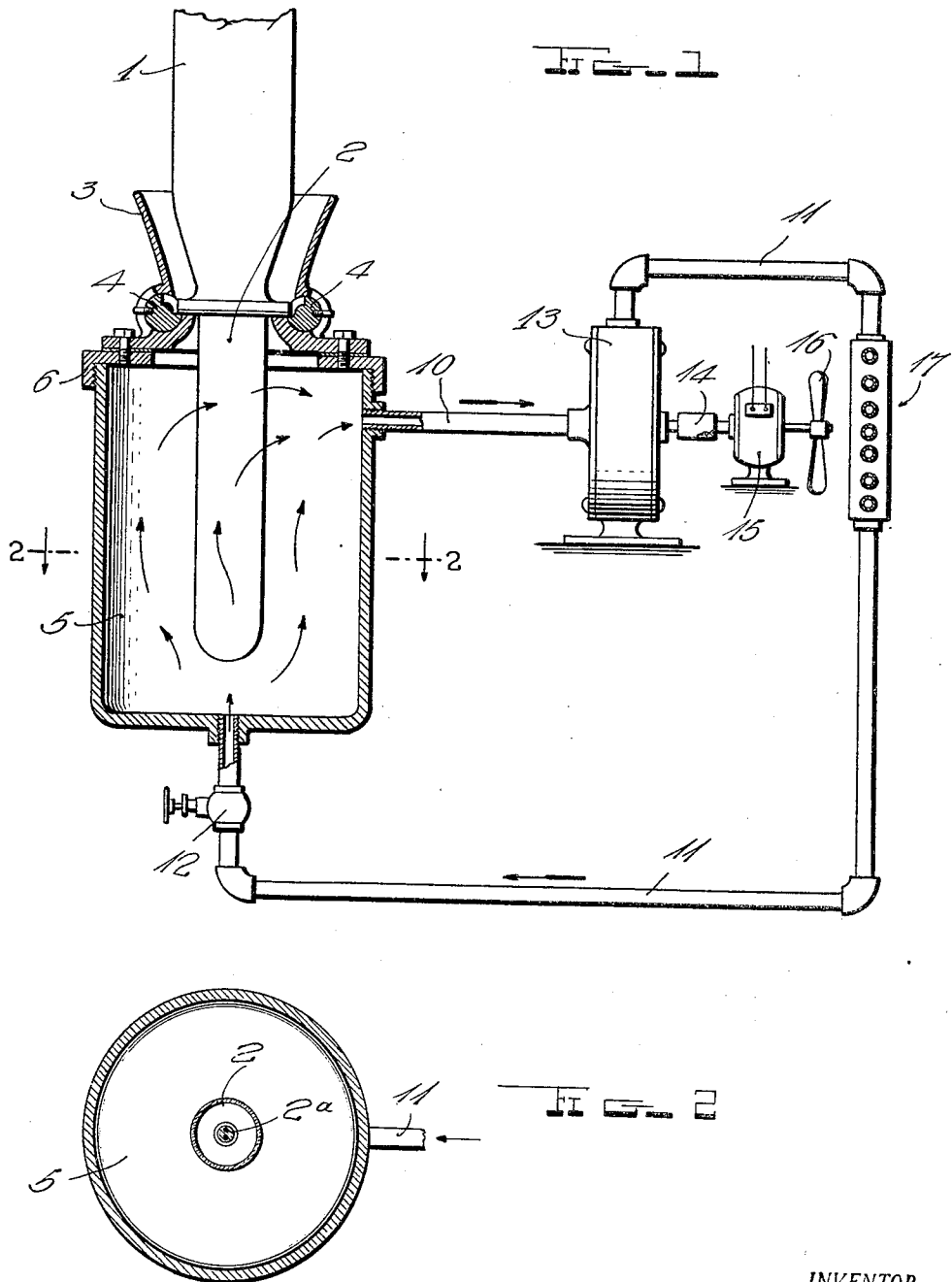
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COOLING SYSTEM FOR VACUUM TUBES

Filed Nov. 12, 1929

2 Sheets-Sheet 1



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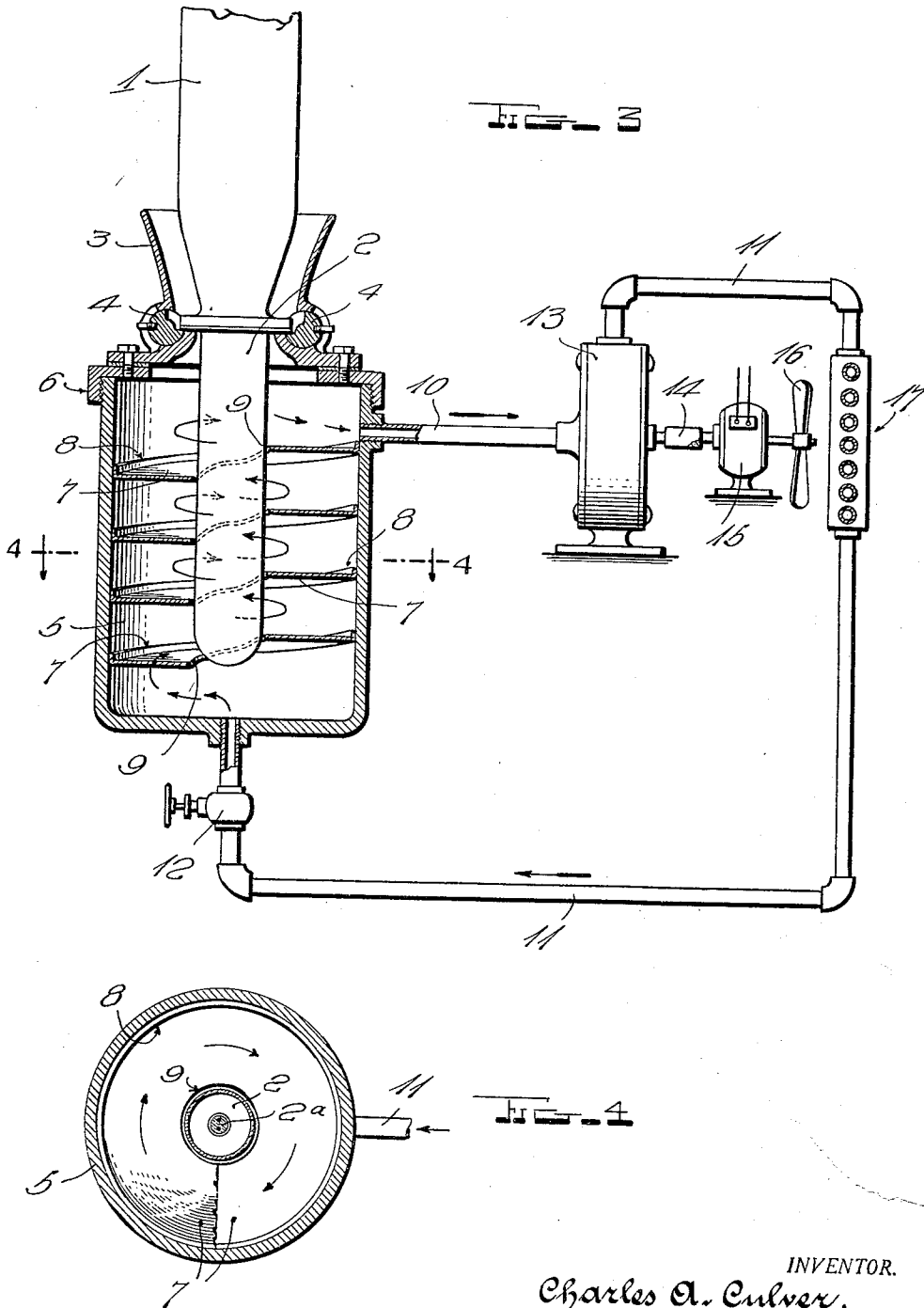
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UNITED STATES PATENT OFFICE

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COOLING SYSTEM FOR VACUUM TUBES

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My invention relates in general to electron discharge devices and in particular to the cooling of high power discharge devices of the exterior electrode type.

5 It is an object of my invention to effectively cool the anode of an electron discharge device and simultaneously insulate it from the ground and associated apparatus.

A further object of my invention comprises
10 producing a cooling system which is simple and compact and in which the degree of cooling may be definitely and accurately controlled.

A further object contemplated by my invention consists in providing a cooling system which is not subject to deterioration, eliminates corona effects and does not clog up.

In one form of cooling system for power
20 tubes, a rubber hose is connected to the upper and lower portions of a water jacket surrounding the anode of the tube and water is allowed to flow therethrough. Although this type of cooling is in quite general use, it is
25 not entirely satisfactory, especially when very high voltages are employed on the anode, due to the fact that the water column cannot conveniently be made long enough to provide a sufficiently high electrical resistance
30 to prevent loss of current at the operating voltage of the tube. Owing to this current leakage, the rubber hose is often subject to electrolysis, which causes a deposit on the inner wall of the hose and thus decreases the
35 electrical resistance of the water column. In addition to these disadvantages, corona discharges occur and cause pinhole perforations, producing leaks in the hose and further result in gradually hardening the hose so
40 that it develops cracks.

According to my invention, all of the above noted disadvantages are eliminated by providing a cooling system which may be maintained at the anode potential without loss
45 of current by being effectively insulated from the ground or other associated apparatus and in which a cooling medium, having a very high specific heat and one which cannot cause any deterioration of the cooling system, is
50 circulated by compression and expansion.

In the drawings accompanying and forming a part of this specification and in which like reference numerals designate corresponding parts throughout:

Fig. 1 illustrates a partially sectioned view 55 of one embodiment of my cooling system.

Fig. 2 is a view in section of a portion of the system taken on the line 2—2 of Fig. 1.

Fig. 3 is a partially sectioned view of an alternative form of my cooling system. 60

Fig. 4 is a view in section of a portion of the cooling system taken on the line 4—4 of Fig. 3.

Referring now particularly to Figs. 1 and 2, my invention essentially consists of a refrigeration plant utilizing an inert gas as the
65 working medium. I provide a chamber 5, of relatively large dimensions in order that the chamber may contain at all times sufficient weight of the medium to properly function,
70 provided with a cover 6, to which is attached in a gas tight manner a flange adapted to hold by means of the locks 4, usually provided for such purposes, a high powered thermionic tube 1. This tube is of the type employing
75 an external anode 2, formed of metal and containing the usual grid and filament 2a, as shown in Fig. 2. A pump 13, which may be of either the reciprocating or rotating type, is provided and connected by a conduit 10, to
80 the upper portion of the chamber 5. The outlet aperture of the pump 13, is connected by conduit 11, with some suitable type of radiator 17, the outlet of which is connected by conduit 11, through expansion or needle
85 valve 12, with the lower portion of the chamber 5. A motor 15, is provided for operating the pump and is coupled to the pump shaft by means of an insulating coupling 14. There is provided on the shaft of the motor
90 15, also a fan 16, maintained in a position to force air through the radiator 17, to assist in cooling the medium circulating therein. It will be seen that the chamber 5, the conduits 10 and 11, the pump 13, radiator 17,
95 and expansion valve 12, constitute a closed fluid circulatory system for the gaseous cooling medium. Any inert gas may be placed in this system under a pressure of two or three atmospheres preferably, although I
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prefer to utilize hydrogen as the working medium because it is not only inert chemically, but has a high specific heat, being approximately fourteen times that of air. The amount of the cooling medium necessary to perform the cooling function for any type of tube may be accurately determined and the pump operated at a speed sufficiently high to handle the required amount in the required time. Of course, if desired, a cooling medium may be selected having a relatively low point of vaporization and the compression of the medium by the pump be carried to a point where the medium is liquefied in the radiator. In this way, of course, advantage may be taken of the internal latent heat of the medium in cooling the anode. In this case the weight of the medium circulated in a given time would be reduced.

Referring now particularly to Figs. 3 and 4, I have shown an embodiment of my device which in all respects is similar to that just described with reference to Figs. 1 and 2, with the exception that there is inserted in the chamber 5, a helical baffle plate or fin, which is attached to the inner wall of the chamber 5, by means of the strips 7 and 8, and presents, as shown in Fig. 4, a central aperture through which the anode 2, of the discharge tube extends. This in effect produces a whirling action of the circulating medium and tends to increase the efficiency of the cooling of the anode.

From the above description it will be readily observed that the action of the pump 13, creates a relatively low pressure in the chamber 5, and a relatively high pressure in the cooling radiator 17. The cooled gaseous medium, therefore, expands through the expansion or needle valve 12, to absorb substantial quantities of heat from the anode and this thermal energy is carried away by the cooling medium as it is moved by means of the pump to the radiator 17 where it is radiated. It will be observed that the entire cooling system, with the exception of the motor, is maintained at the anode potential and is therefore not subject to current loss, corona effects, or electrolysis. It will be further observed that as the cooling system is a closed conduit circuit, there will be no accumulation of materials which would tend to clog the system and that the system is simple and effective in operation. Obviously also the degree of cooling may be definitely and accurately determined by the rapidity with which the cooling medium is circulated through the system and this, of course, may be easily regulated by the speed of the motor.

Having thus completely described my device, I claim:

1. A cooling system for electron discharge devices comprising, a chamber adapted to receive and enclose in a gas tight manner the anode of an electron discharge device, a heli-

cal baffle plate within said chamber and adapted to encircle the anode of the discharge device, a pump, a radiator, an expansion valve, a conduit connecting said chamber, pump, radiator and expansion valve to form a closed fluid circulating system, an inert gas constituting the sole cooling medium contained in said closed system, and means for operating said pump to cause a circulation of said gas in said closed system.

2. A cooling system for electron discharge devices comprising, a chamber adapted to receive and enclose in a gas tight manner the anode of an electron discharge device, a baffle plate within said chamber and adapted to encircle the anode of said discharge device, a pump, a radiator, an expansion valve, a conduit connecting said chamber, pump, radiator and expansion valve to form a closed fluid circulating system, an inert gas constituting the sole cooling medium contained in said closed system, and means for operating said pump to cause a circulation of said gas in said closed system.

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