Oct. 7, 1947. H. A. ROSE 2,428,587

VAPOR-ELECTRIC DEVICE

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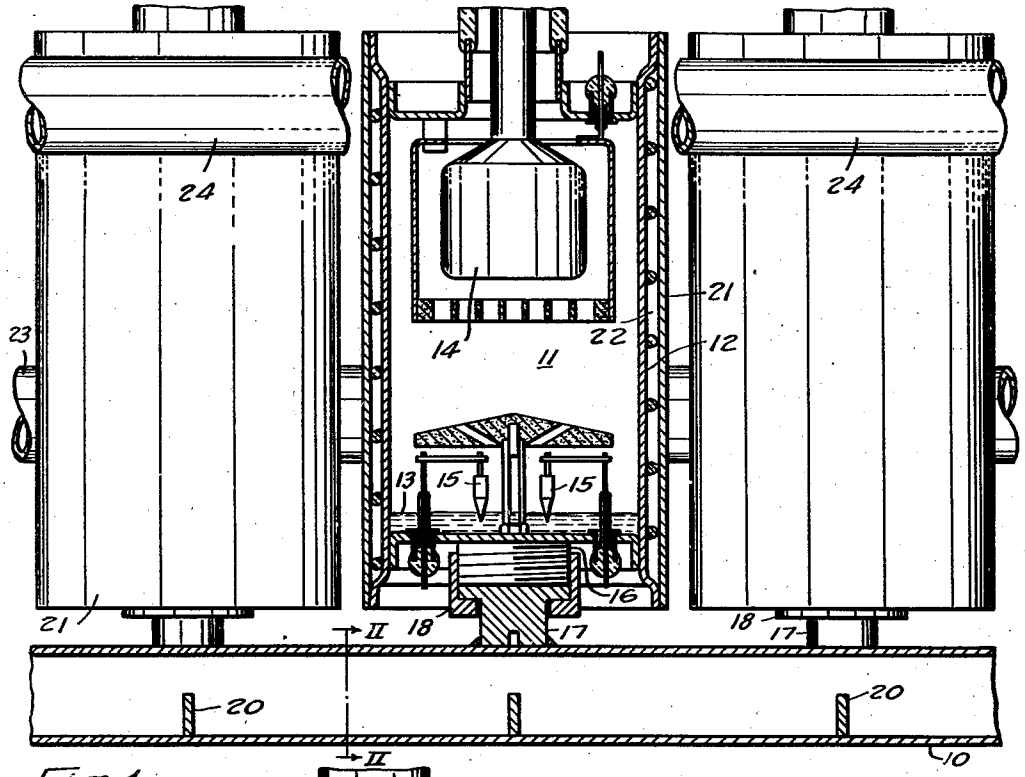


Fig. 1.

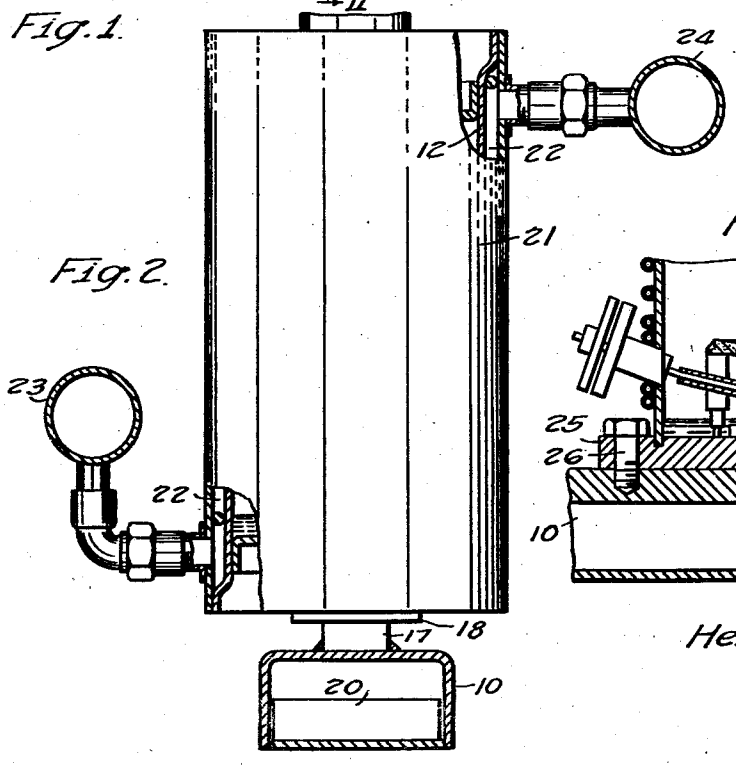
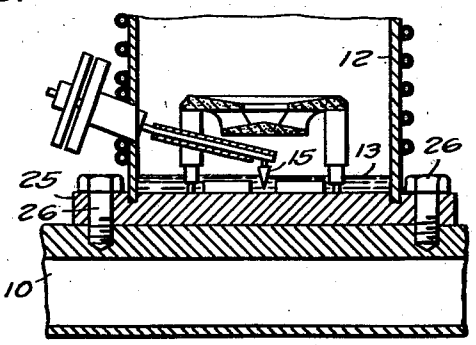


Fig. 2.

Fig. 3.



INVENTOR

Herbert A. Rose.

BY S. A. Strickett

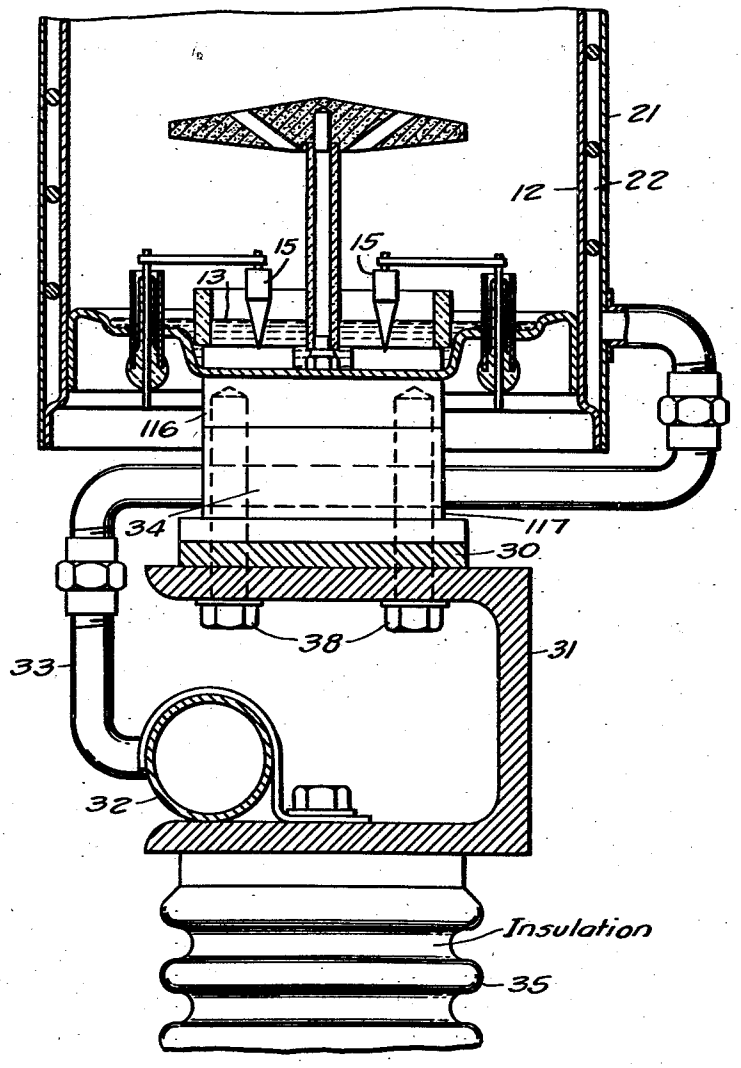
ATTORNEY

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Fig. 4.



WITNESSES:

E. A. McSlaskey.

Wm. C. Groome

INVENTOR

Herbert A. Rose.

BY S. A. Stickler

ATTORNEY

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UNITED STATES PATENT OFFICE

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VAPOR-ELECTRIC DEVICE

Herbert A. Rose, Pittsburgh, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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10 Claims. (Cl. 250—27.5)

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My invention relates to a vapor electric device and, particularly, to an improved method of cooling the cathodes of such devices.

In the operation of vapor-electric devices, such as mercury arc rectifiers, a great deal of heat is evolved at the cathodes of the devices. In order to maintain proper operating conditions in the devices, it is necessary to remove the heat so generated. Heretofore this has been accomplished by providing cooling elements integral with the devices themselves either in the form of cooling coils immersed in the cathode material or cooling elements attached to the exterior of the cathode container. The provision of such cooling device is not only inherently expensive but provides further elements of danger to the tubes in that the inclusion of interval cooling coils greatly adds to the danger of leakage in the tube, and the exterior coils unless constructed of expensive materials not only add to the cost of construction of the tube and increase the danger of leakage, but are liable to be clogged by scale or impurities in the water and thus render the tube inoperative before the tube would otherwise reach the end of its useful life.

According to my invention, I provide the cooling element in the cathode bus or other cathode connection and provide a cathode terminal in good heat and electrical connection with the container of the cathode and couple the cathode terminal in good thermal and electrical conducting relation with the cathode bus so that by cooling the cathode bus or the cathode connection, the heat may be withdrawn from the cathode of the device. In this manner it is possible to provide a relatively inexpensive tube which may be coupled to a cooling element which of itself may be relatively inexpensive because it is possible to clean and recondition the cooling element without in any manner disturbing the construction of the tube itself.

In usual rectifier arrangements the cathode of a plurality of valves are connected to a common cathode bus, and by making this cathode bus either in the form of a cooling element or providing cooling elements attached to the bus, it is possible to greatly reduce the overall expense of the installation while providing satisfactory cooling.

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It is, accordingly, an object of my invention to provide a cooling system for a plurality of tubes without the necessity of self-contained cathode coolers.

It is a further object of my invention to provide a common cooling element for a plurality of cathodes.

It is a further object of my invention to provide an arc discharge device having a separable cathode cooler.

Other objects and advantages of my invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

Figure 1 is an elevation partly in section of a portion of a converter according to my invention;

Fig. 2 is a cross section along line II—II of Fig. 1 through a cathode cooler showing the connection of a valve thereto and the manner of cooling the side walls of the device; and

Fig. 3 is a view similar to Fig. 2 showing a modified connection; and

Fig. 4 is a view similar to Fig. 2 showing a cross-section through a preferred construction according to my invention.

In the exemplary embodiment of my invention according to Fig. 1, a cathode bus 10 is constructed in the form of a cooling element such as a water box through which passes the cooling fluid for the cathodes 13 of a plurality of vapor-electric valves 11. Each of the valves 11 of the device comprises an evacuated container 12 having a pool 13 of vaporizable reconstructing cathode material such as mercury. Cooperating with the cathode 13 is an anode 14 maintained in spaced insulated relation thereto, and at least one and preferably a plurality of exciting electrodes 15 which may or may not be of similar construction. In order to remove the heat generated at the cathode 13, the cathode 13 is provided with a terminal block 16 preferably brazed or welded in good electrical and heat conducting contact with the cathode container.

In order to connect the cathode terminal 16 to the cathode bus 10, a connection is provided on the bus 10 preferably in the form of an upstanding block 17 secured to the bus 10 in good electrical and heat conducting relation preferably

by means of welding, brazing, or by mechanical connection thereto. The cathode terminal 16 is placed in contact with the contact block 17 and secured thereto preferably by means of a mechanical connection such as a threaded nut 18.

Because of the machining irregularities which are always present both on the contact block 17 and on the cathode terminal 16, it is frequently desirable to use some means such as a sheet of metal foil or a coat of heat conducting paint between the cathode terminal 16 and the cathode block 17 in order to facilitate the transfer of heat from the cathode 13 to the common cooling means 10.

It is frequently desirable to cause a rapid flow of the cooling medium at or adjacent the connecting block 17, as a rapidly flowing cooling medium transfers the heat with less thermal drop at the liquid cooled surface. For this reason I prefer to provide a baffle or obstruction 20 in the cooling element 10 such that it will produce a rapid flow of cooling fluid such as water adjacent the point of connection of the connecting block 17.

It is usually desirable to liquid cool the side walls of the container 12, and for this purpose I have shown a water jacket 21 providing a spiral channel 22 around the exterior of the container wall 12.

Cooling fluid is circulated through this water jacket 21 from a header 23 as shown or if desired from the bus box 10 and discharged to a header 24 where the water may either be discharged or recirculated as conditions may require.

In the operation of the system according to my invention, a cooling fluid is circulated through the cathode bus 10 and cools the connecting block 17 which, in turn, withdraws heat through the cathode terminal 16 to maintain the desired temperature of cathode 13.

In high current device where large quantities of heat must be removed from the cathode 13, the cathode plate 25 may be placed directly in contact with the cooled bus 10 and secured in intimate contact therewith by a plurality of fasteners 26 as shown in Fig. 3.

In the embodiment of my invention illustrated in Fig. 4, a cathode bus 30 is supported on a member 31, such as an angle or channel iron which may be mounted on insulators 35, and a cooling element 34 is provided in the connecting blocks 117 thereof instead of being applied to the bus in general. Preferably the header 32 for the cooling medium is mounted within or adjacent the bus support 31 and connections 33 are taken off of the header 32 to the cooling coil 34 in each of the cooling blocks 117 and from the cooling blocks 117 passed on in series relation to the water jacket 21 of the container 12. In this modification I have shown instead of a connecting nut 18 a plurality of screws 38 extending through the bus 30, the connecting block 117, and into the cathode terminal 116 for drawing the parts into good heat and electrical conducting relation.

While for purposes of illustration I have shown and described specific embodiments of my invention, it will be apparent that changes and modifications can be made therein without departing from the true spirit of my invention.

I claim as my invention:

1. A cooling system for arc discharge devices comprising a cathode bus, means for mounting a plurality of arc discharge devices on said bus, a cathode for each of said devices, means for securing good thermal contact between the cathodes of said devices and said bus and means for cooling said bus.

2. An electric conversion system comprising a plurality of arc discharge devices, each of said discharge devices including an envelope containing a pool of cathode material, an anode cooperating with the cathode, and means for exciting the cathode, a cathode terminal for each of said devices, said terminal being connected in good electrical and heat conducting relation to the cathode, a bus forming a common cathode connection to all of said devices, means for securing the cathode terminals in good electrical and heat conducting relation to said bus and means for cooling said bus.

3. A vapor-electric device comprising a container, a pool type cathode in said container, a terminal block connected to said container in good thermal conducting relation to said cathode, a cathode connector detachably connected in good thermal conducting relation to said terminal block and means for cooling said connector for controlling the temperature of said cathode.

4. A vapor-electric device comprising a container, a pool type cathode in said container, a terminal block connected to said container in good heat conducting relation to said cathode, a cathode connector detachably connected in good thermal contact to said terminal, a cooling element for said connector and means for passing cooling fluid through said cooling element.

5. A vapor-electric device comprising a container, a pool type cathode in said container, a terminal block connected to said container in good thermal conductivity to said cathode, a cathode connector detachably connected to said terminal, a cooling element applied to said connector, a cooling jacket applied to said container and means for passing cooling fluid through said cooling element and said cooling jacket in series.

6. A cathode cooling system for the cathode of a plurality of vapor-electric devices comprising a cathode terminal on each of said devices, said terminal being in good heat conducting relation to its cathode, a cathode bus, means for detachably connecting said cathode terminal in good heat conducting relation to said bus and means for cooling said connecting means.

7. An electric current conversion system comprising a plurality of vapor-electric valves, a liquid cathode in each of said valves, a cathode terminal in good heat conducting relation to said cathode, a common cathode bus including connecting blocks on said bus, means for securing said cathode terminals to said connecting blocks in good thermal conducting relation and means for cooling said blocks.

8. An electric current conversion system comprising a plurality of vapor-electric valves, a liquid cathode in each of said valves, a cathode terminal in good heat conducting relation to said cathode, a common cathode bus including connecting blocks on said bus bar, means for securing said cathode terminals to said connecting blocks in good heat conducting relation, cooling elements associated with said blocks and means for transmitting cooling fluid through said cooling elements.

9. An electric converter comprising a plurality of electric valves, each of said valves having an internal electrode to be cooled, an external block cooperating thermally with said internal electrode said block being connected in good thermal contact with a fluid cooled bus.

10. An electric valve containing a liquid elec-

trode, said liquid being in thermal contact with the base of said valve, a fluid cooled member in thermal contact with said base for removing heat from said liquid, said fluid cooled member forming an electrical terminal and support for said valve.

HERBERT A. ROSE.

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