

Oct. 12, 1965

A. P. COLAIACO
HIGH VOLTAGE RECTIFIER

3,211,969

Filed Nov. 15, 1961

4 Sheets-Sheet 1

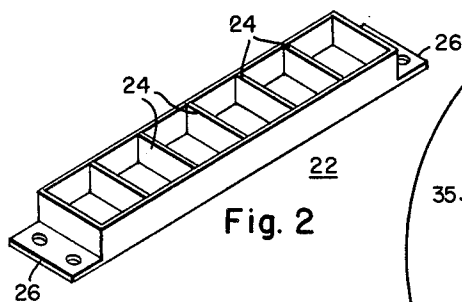


Fig. 2

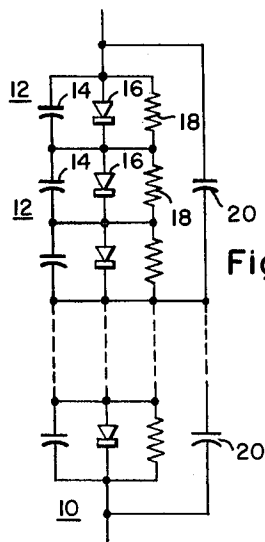


Fig. 1

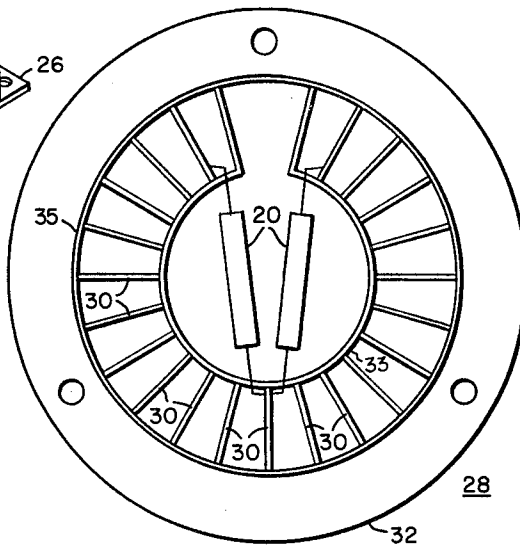


Fig. 3

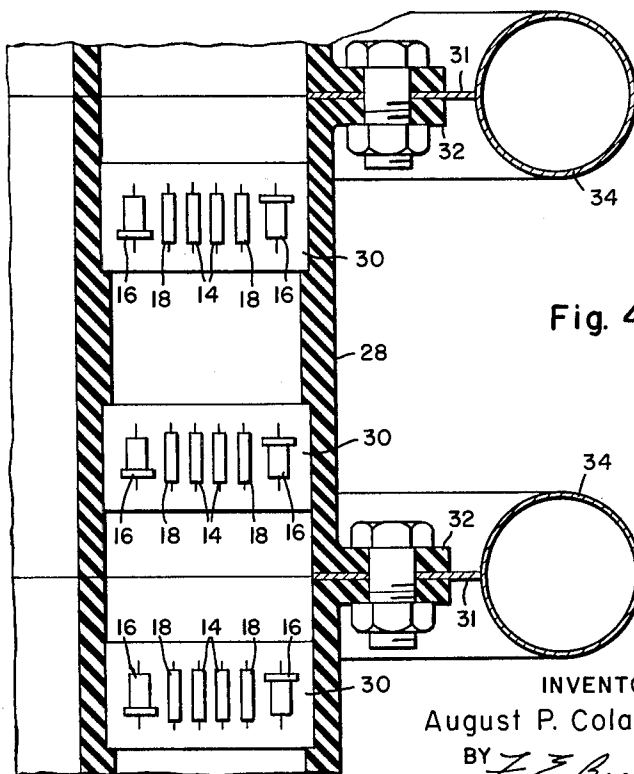


Fig. 4

WITNESSES

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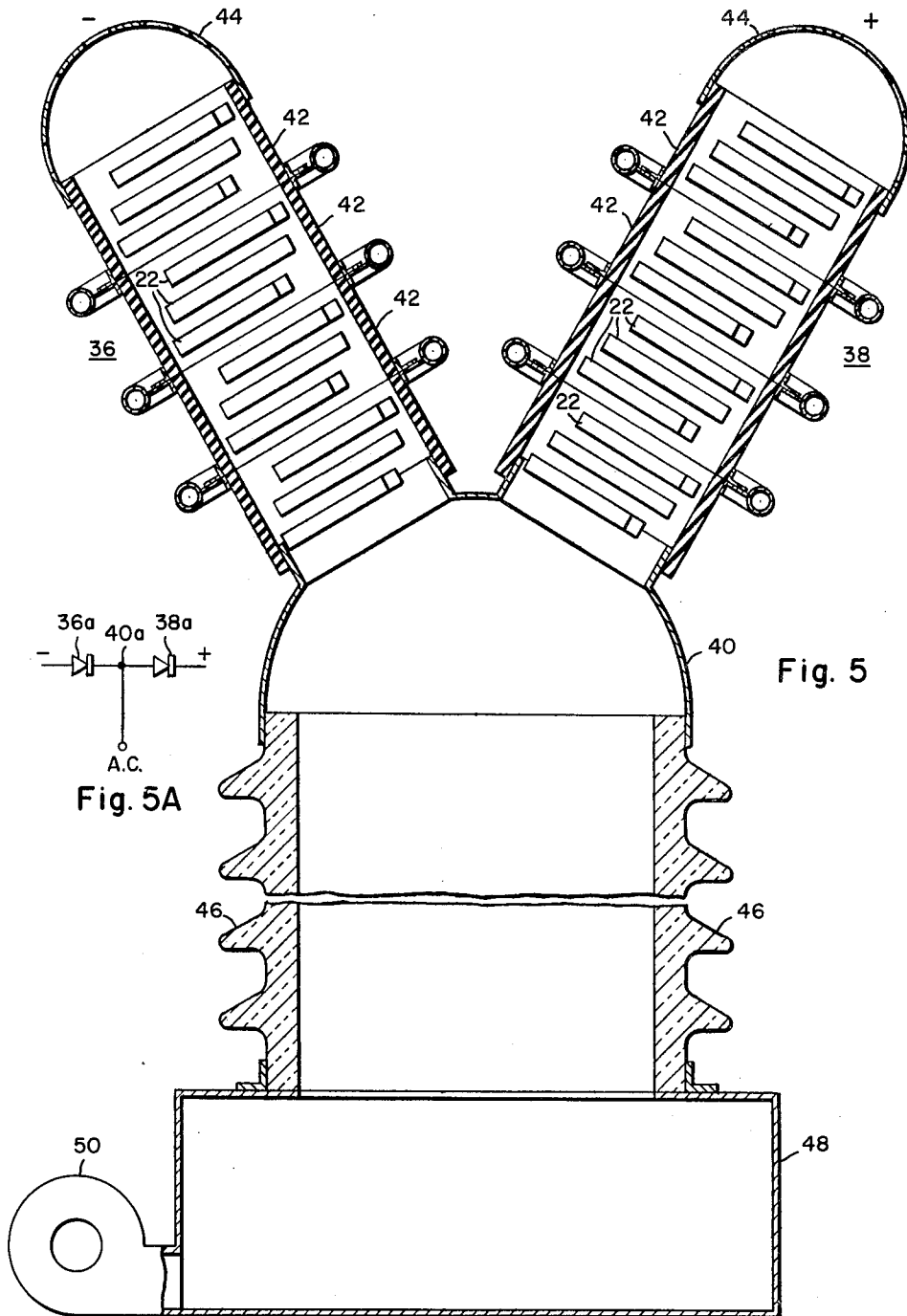
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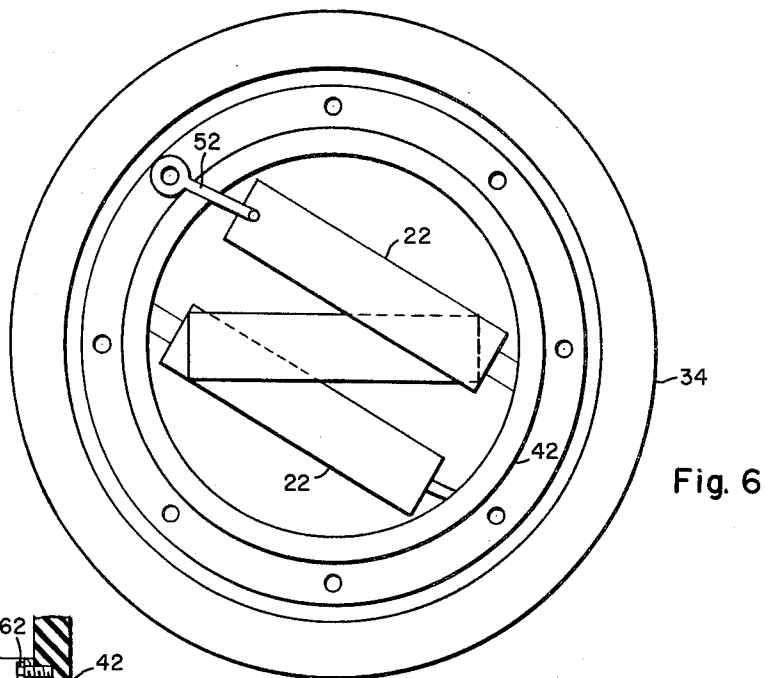


Fig. 6

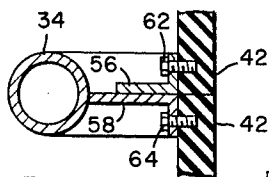


Fig. 8

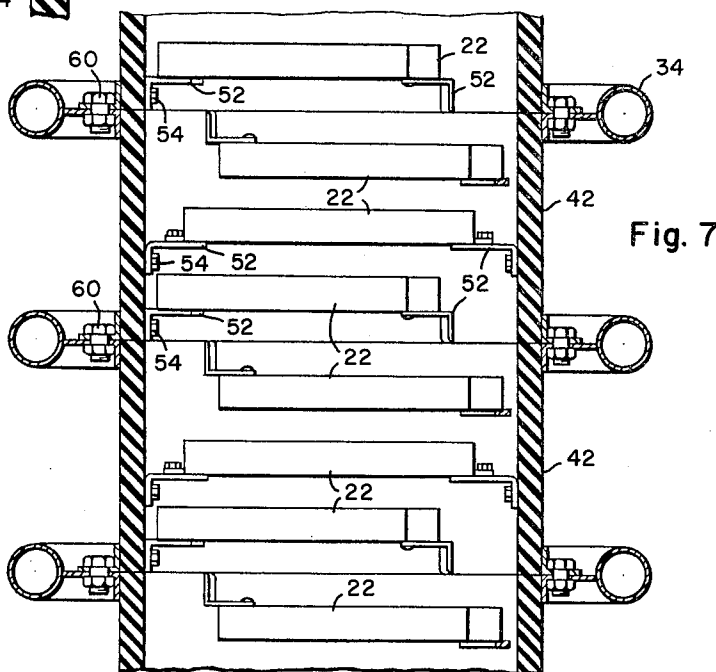


Fig. 7

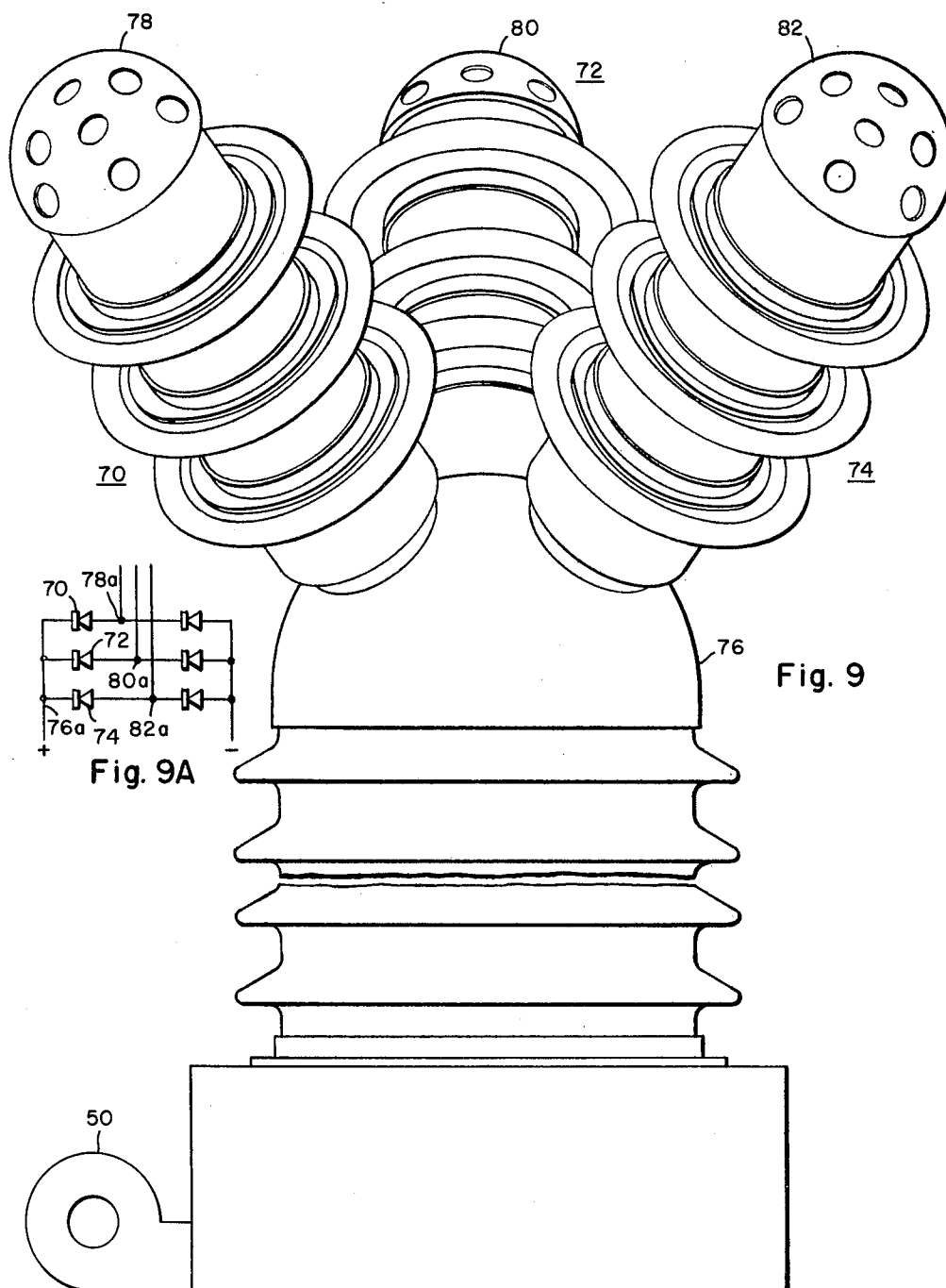
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HIGH VOLTAGE RECTIFIER

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Filed Nov. 15, 1961, Ser. No. 152,384

6 Claims. (Cl. 317-234)

This invention relates in general to rectifiers and more particularly to very high voltage rectifier assemblies.

High voltage rectifiers of the prior art are conventionally assembled by placing a plurality of trays of rectifier cells on a frame made from steel and the necessary insulating material. As the voltage requirements are increased the frame becomes large and unwieldy because the physical separation of the trays must be increased to give the voltage clearance required to prevent flashover between the trays. At very high voltages effective electrostatic shielding for corona and flashover suppression becomes very difficult. It is also very difficult to effectively force-cool the rectifiers when the trays are widely separated as required for the high voltage clearance.

Accordingly, it is the general object of this invention to provide a new and improved high voltage rectifier assembly.

It is a more particular object of this invention to provide a new and improved high voltage rectifier that is easily electrostatically shielded and easily and effectively cooled.

Briefly, the present invention accomplishes the above-cited objects by providing an assembly whereby a plurality of arms, made from hollow insulating tubes, each having a plurality of rectifier cells mounted therein, are mounted on an electrically conductive dome-shaped metallic cap of an insulating bushing in such a manner that a blower will force cooling air through the bushing and arms mounted thereon to cool the rectifiers inside the arms. The arms are mounted on the dome-shaped cap so that they extend from the cap in divergent relationship with each other. The serially connected rectifiers mounted in the arms are electrically connected to the dome cap, which serves as one of the rectifier terminals, so there is no potential difference between the rectifiers located at the end of the arms connected to the electrically conductive dome cap. Since the base of the arms are at the same electrical potential they can be in close proximity to each other. However, a very high potential difference exists between the rectifiers at the terminal of the arms. The manner of attachment of the tubes to the dome cap so the physical separation of the arms increases as the distance from the base increases provides the required voltage clearance between the arms.

Other objects and advantages of the invention will become apparent as the following description proceeds and features of novelty which characterize the invention will be pointed out in particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the invention, reference may be had to the accompanying drawings in which:

FIG. 1 is a schematic diagram of a high voltage rectifier circuit;

FIG. 2 is a perspective view of a rectifier tray;

FIG. 3 is a view of an annular rectifier tray;

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FIG. 4 is a partial sectional view of the rectifier tray of FIG. 3;

FIG. 5 is a sectional view of a high voltage rectifier assembly of this invention;

5 FIG. 5a is the schematic diagram of the rectifier assembly of FIG. 5;

FIG. 6 is a top view of one of the arms of the assembly of FIG. 5;

10 FIG. 7 is a partial sectional view of the arm of FIG. 5;

FIG. 8 is a partial sectional view of an electrostatic shielding ring and its mounting;

FIG. 9 is a view of an assembly of this invention; and, FIG. 9a is a schematic diagram of a rectifier.

The schematic diagram of FIG. 1 is the circuit diagram of the rectifier stack used in conjunction with the trays of FIGS. 2 and 3. The stack 10 is a plurality of serially connected parallel circuits 12. Each parallel circuit 12 is comprised of a parallel connected capacitor 14, a diode 16 and a resistor 18. The resistor 18 and the capacitor 14 are provided to equalize the reverse voltage across the individual diodes 16. The capacitors 20 are provided to further equalize the reverse voltage distribution across the entire stack.

The stack 10 of FIG. 1 is mounted in the tray 22 of FIG. 2. The upright members 24 of the tray 22 are insulating mounting boards and the capacitors 14, diodes 16 and resistors 18 are mounted thereon. The capacitors 20 are mounted outside the tray 22. The tray 22 has a projection 26 extending from the end to provide a mounting means for the tray 22. A plurality of trays 22 are serially connected and mounted inside one of the arms of the assembly of FIG. 5 to provide one leg of a rectifier circuit.

FIG. 3 shows another type of rectifier tray 28. The schematic diagram of FIG. 1 also represents the circuit of the rectifier stack mounted in this tray 28. The tray 28 has an inside cylindrical member 33 and an outside cylindrical member 35. The plurality of insulating mounting plates or boards 30, which carry the diodes and associated resistors and capacitors, are fixed radially between the cylinders. The capacitors 20 of FIG. 1 are shown mounted in the center opening of the annular tray 28. The tray 28 is made from insulating material and provided with a mounting foot 32 at both the top and bottom ends of the outside cylinder 35. A plurality of the trays 28 of FIG. 3 can be easily bolted together in end to end relationship, as shown in FIG. 4, to form an arm of the assemblies of FIGS. 5 and 9. As shown in FIG. 4, the tray 28 has two rows of the insulating plates 30. Each plate or mounting board 30 carries two of the parallel circuits 12 of FIG. 1. That is, two diodes 16, two resistors 18 and two capacitors 14 are mounted on each insulating plate or board 30. The mounting feet 32 provide a means of fastening a plurality of the trays 28 together in end-to-end relationship and also provide a means of mounting electrostatic shielding rings 34. The shielding rings 34 have a bracket 31 which is placed between the flanges or feet 32 of the trays 28 when they are fastened together to thereby secure the shield 34 in place. The shielding rings 34 are smooth metallic tubular rings, electrically connected to the rectifier stack thereby reducing the voltage stress which causes flashover and corona formation. Of course, a coolant fluid such as

air, oil or sulfur hexafluoride (SF_6) can be forced through the hollow central duct of the tray 28, formed by the inside cylinder 33 and also through the area between the two cylinders 33 and 35 to thereby effectively cool the rectifier cells mounted therein.

FIG. 5 is a sectional view of a high voltage rectifier assembly with two rectifier arms 36 and 38. The arms 36 and 38 are mounted on a dome-shaped metallic cap 40. The cap 40 serves as a common electrical terminal for the alternating current connection shown at point 40a in FIG. 5a. The arms 36 and 38 are shown as a plurality of insulating tubes 42, such as micarta tubes, with each tube 42 having three rectifier trays 22 (as illustrated in FIG. 2) mounted therein. The trays 22 are connected in series circuit relationship and, of course, as many tubes 42 as required for the voltage desired may be used. Of course, the maximum voltage difference between the arms is at the terminals and due to the method of mounting the arms on the cap 40 the arms diverge as the length of the arm increases so that the greater the voltage required the longer the arms are and the greater the physical separation of the terminals becomes. The last or uppermost tube 42 has a metallic cover 44 with holes provided to exhaust the cooling fluid. The cover 44 being electrically connected to the rectifier cells within the arm provides a means of electrically connecting the rectifier stack to the external circuit. That is, one of the covers 44 is the negative terminal of the rectifier and the other cover 44 is the positive terminal. The covers 44 are hemispherical in shape to thereby reduce the voltage stress and suppress the corona formation and flashover from one arm to the other. The dome-shaped cap 40 is carried by an insulating tube 46, shown as a porcelain bushing. The insulating tube 46 is mounted on a hollow support member 48 which is connected to a blower 50. Of course, the blower 50 and the support member 48 are at electrical ground potential and provide the cooling fluid to the rectifiers mounted in the arms 36 and 38.

FIGS. 6, 7 and 8 show the details of the arms 36 and 38 of FIG. 5. The top view of the arms as shown in FIG. 6 shows the location of the trays 22 in the tube 42. The trays 22 are in staggered relationship with each other to provide more effective cooling of the trays and rectifiers therein. An electrical connector 52 is shown connecting one tray 22 to the shielding ring 34.

FIG. 7 is a partial sectional view of a plurality of tubes 42 fastened together in end to end relationship. The trays 22 are held in place in the tubes 42 by the brackets 52 fastened to the inside wall of the tube 42 and to the foot 26 provided on the trays 22. For example, the tube wall may be drilled and tapped and a stud 54 provided to hold the bracket 52 to the tube 42. As many tubes 42, as required by the voltage desired, are fastened in end-to-end relationship by angle members 56 and 58 as shown in FIG. 8. The angle members 56 and 58 are fastened together to form a T member, for example, by a bolt 60 as shown in FIG. 7. The T member is then attached to the abutting ends of the two tubes 42 with an electrostatic shielding ring 34 fastened to the foot of the T member. The T member would be attached by any convenient means, for example, by studs 62 and 64 screwed into the tubes 42 as shown in FIG. 8.

FIG. 9 is a view of a rectifier assembly like that shown in FIG. 5 except having three rectifier arms 70, 72 and 74. The arms 72, 70 and 74 are either the tubes with the trays therein, as shown in FIG. 7, or the circular trays as shown in FIGS. 3 and 4.

The assembly of FIG. 9 provides half the three-phase bridge rectifier shown schematically as FIG. 9a. The cap 76 of FIG. 9 is the positive terminal 76a of the rectifier of FIG. 9a. The rectifiers mounted within arms 70, 72 and 74 of FIG. 9 are represented by rectifiers 70a, 72a and 74a of FIG. 9a. The covers 78, 80 and 82 on

the arms of FIG. 9 provide the alternating current terminals 78a, 80a, and 82a of FIG. 9a. Two of the rectifier assemblies as shown in FIG. 9 would be required to provide the bridge rectifier shown as FIG. 9a.

While there have been shown and described what are at present considered to be the preferred embodiments of the invention, modifications thereto will readily occur to those skilled in the art. It is not desired, therefore, that the invention be limited to the specific arrangement shown and described and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

I claim as my invention:

1. A high voltage rectifier assembly comprising an insulating support member, a substantially dome-shaped electrically conductive member disposed on said insulating support member, means for mounting at least two hollow cylindrical arms in divergent relationship with each other on said electrically conductive member, said arms having rectifier means disposed therein, electrostatic shielding means disposed around the outer periphery of said arms, electrically conductive means disposed on the free ends of said arms, said rectifier means being connected in circuit relation with said dome-shaped electrically conductive member and said electrically conductive means, and means for force-cooling said rectifier means.

2. A high voltage rectifier assembly comprising an insulating support member, an electrically conductive substantially dome-shaped cap mounted on said support member, a plurality of insulating hollow cylindrical arms disposed on said cap in divergent relationship with each other, said arms having a plurality of serially connected semiconductor rectifier cells disposed therein, electrically conductive covers disposed over the ends of said arms, said dome-shaped cap and said electrically conductive covers providing electrical terminal means for said rectifier cells.

3. A rectifier assembly comprising, a blower, an insulating support member, an electrically conductive dome-shaped cap carried by said support member, said cap providing a means for disposing a plurality of hollow cylindrical arms in divergent relationship with each other, said hollow arms having a plurality of serially connected semiconductor rectifier cells disposed therein, electrically conductive covers disposed over the ends of said arms, said dome-shaped cap and said electrically conductive covers providing electrical terminal means for said rectifier cells, and duct means including said hollow arms and said support member for directing cooling fluid from said blower over said semiconductor rectifier cells.

4. A rectifier assembly comprising, a blower, an insulating support member, an electrically conductive dome-shaped cap carried by said support member, said cap providing a means for disposing a plurality of hollow cylindrical arms in divergent relationship with each other, each of said hollow arms having a plurality of serially connected semiconductor rectifier cells disposed therein, electrostatic shielding means disposed on the periphery of said arms, hemispherical covers disposed on said arms to provide electrostatic shielding, said covers having holes therein to provide exhaust means for a cooling fluid provided through duct means by said blower, said cap and said covers providing electrical terminal means for said rectifier cells.

5. An annular tray for mounting a plurality of semiconductor rectifier cells comprising an inside and an outside cylinder, said tray being made from an insulating material, a plurality of mounting boards disposed at spaced intervals between said inside and said outside cylinders extending in a radial direction, a top and a bottom flange having holes provided therein extending from said outside cylinder for fastening a plurality of said trays in end-to-end relationship, said inside and outside cylin-

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ders coinciding to form continuous ducts when said annular trays are disposed in end-to-end relationship.

6. An annular tray for mounting a plurality of semiconductor rectifier cells comprising, an inside and an outside cylindrical member, means for disposing a plurality of semiconductor rectifier cells radially between said inside and said outside cylinders, a flange provided at the ends of the outside cylinder, said flange having holes provided therein for fastening a plurality of said annular trays in end-to-end relationship for very high voltage rectifiers, said inside and outside cylindrical members coinciding to form continuous ducts when said trays are disposed in end-to-end relationship, and means including said flange for fastening an electrostatic shield around said tray.

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