Dec. 24, 1946. C. A. KOTTERMAN 2,412,989

MULTIPLE RECTIFIER COOLING SYSTEM

Filed July 3, 1942 4 Sheets-Sheet 1

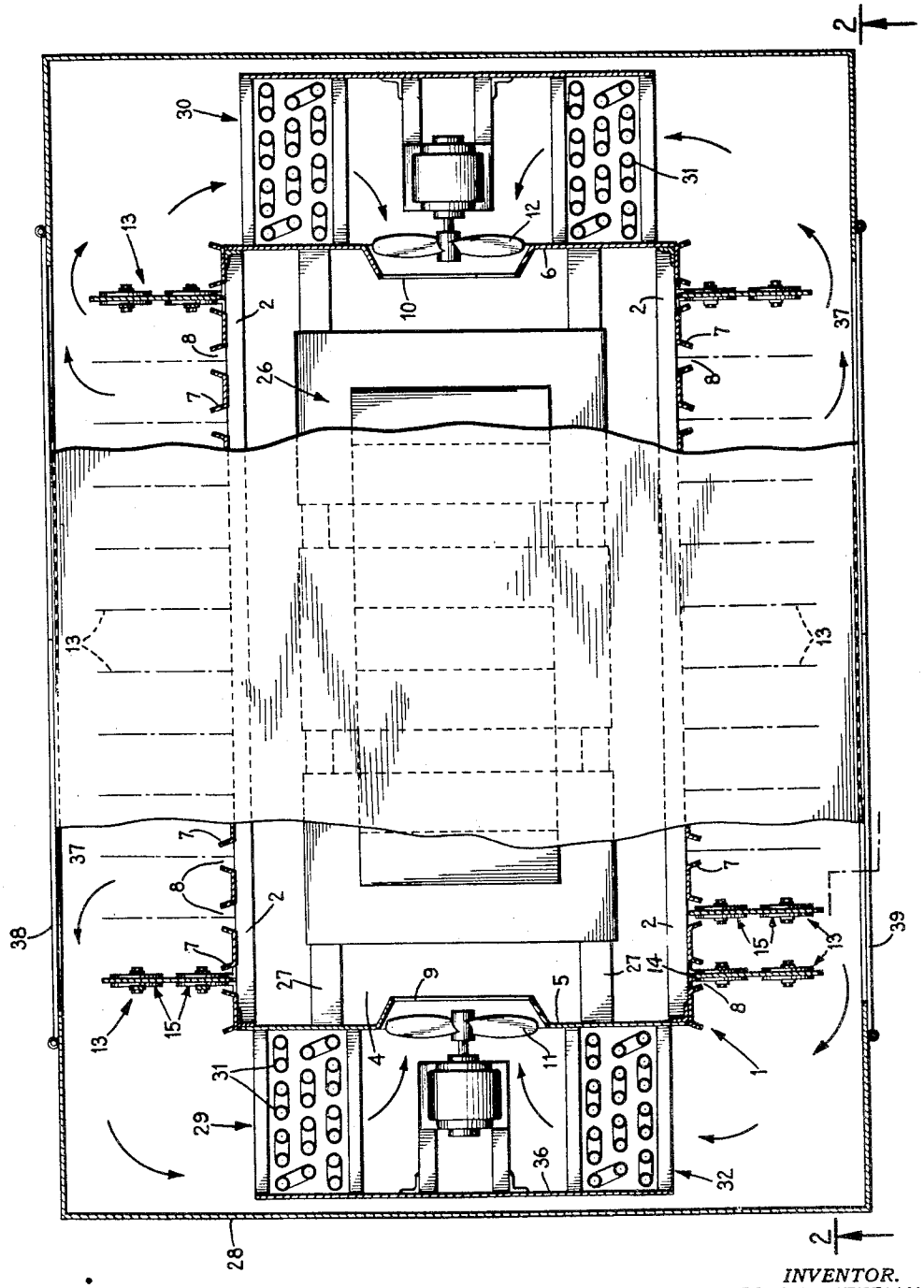


FIG.1.

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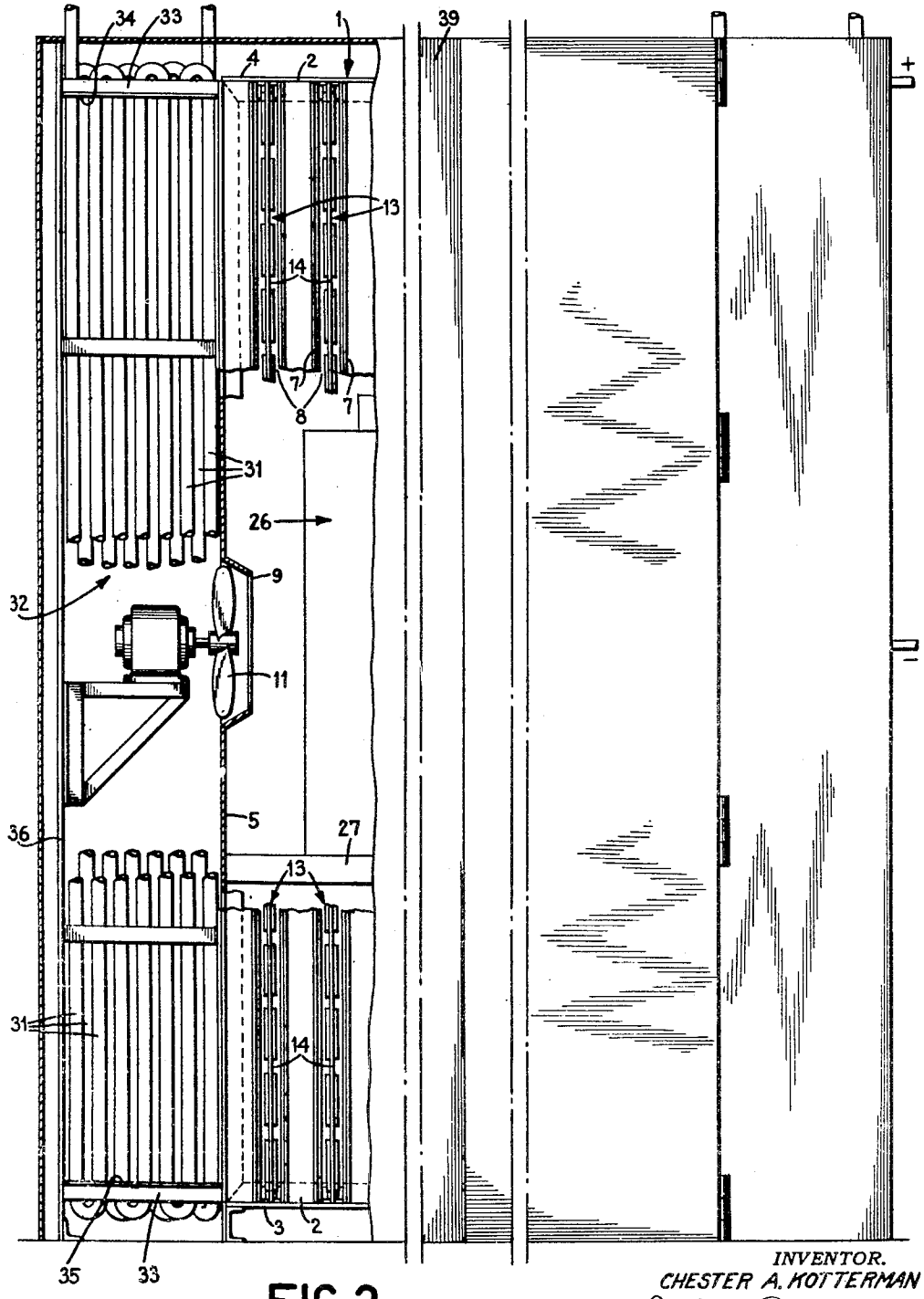


FIG. 2.

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MULTIPLE RECTIFIER COOLING SYSTEM

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FIG. 3.

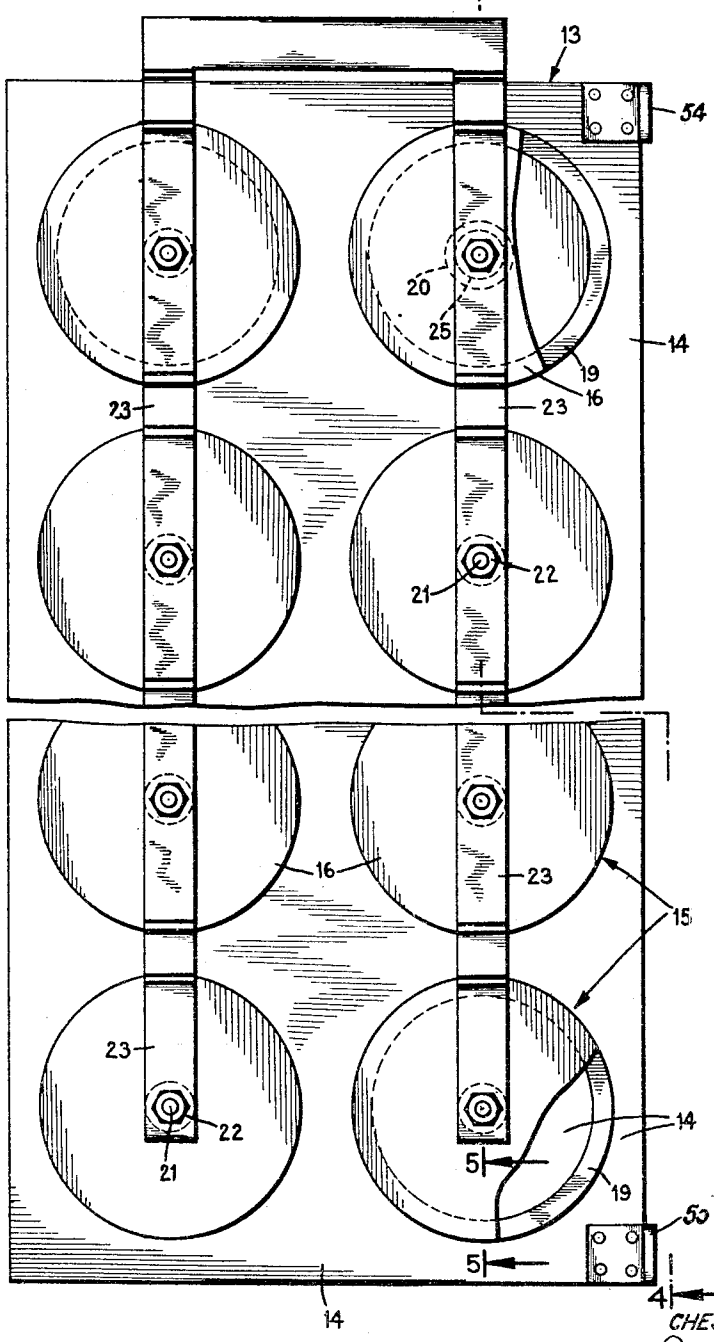
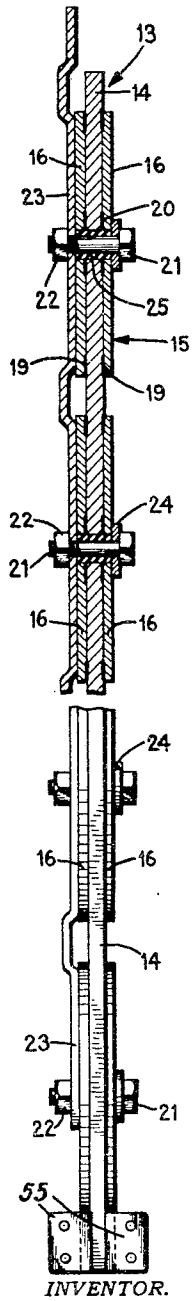


FIG. 4.



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FIG.6.

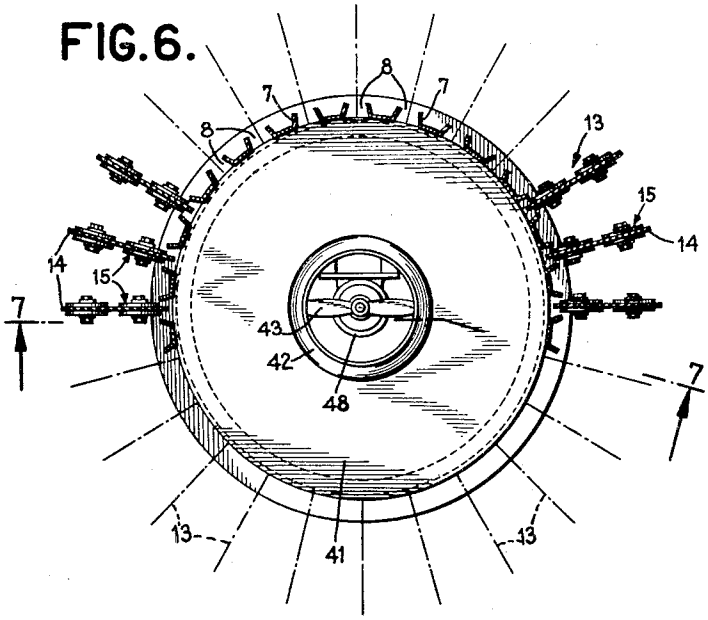


FIG.5.

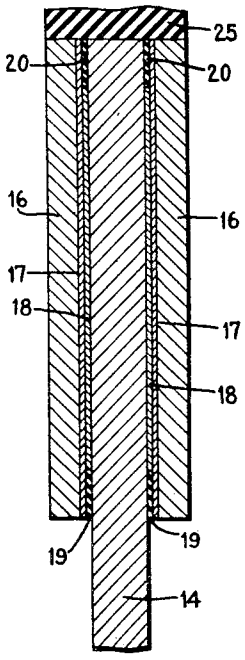
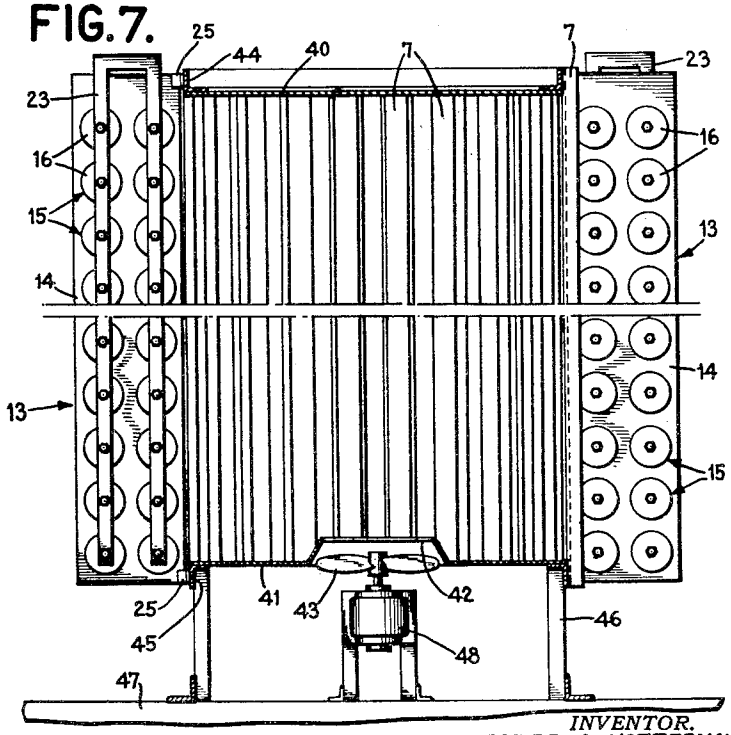


FIG.7.



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UNITED STATES PATENT OFFICE

2,412,989

MULTIPLE RECTIFIER COOLING SYSTEM

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Application July 3, 1942, Serial No. 449,582

11 Claims. (Cl. 175—366)

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This invention relates to rectifiers of the metal plate type and particularly to a unitary arrangement for cooling a number of such rectifiers.

The object of the present invention is to provide a compact arrangement for passing a flow of cooling fluid such as air over the surface of the rectifiers.

This object is carried out in accordance with this invention by arranging the rectifier units edgewise at narrow outlets from a compartment in which the cooling fluid pressure is built up so as to be forced through the outlets against the edges and over the surfaces of the rectifier units. The invention will be better understood from the following detailed description and the accompanying drawings of which:

Fig. 1 is a plan view partially in section of a rectifier cooling arrangement according to this invention;

Fig. 2 is an elevation view, partially shown in section taken at line 2—2 of Fig. 1;

Fig. 3 is a side view of a rectifier unit containing a number of rectifier elements;

Fig. 4 is a section taken at line 4—4 of Fig. 3;

Fig. 5 shows a detail of the arrangement of the rectifier elements in Figs. 3 and 4;

Fig. 6 shows a plan view in section of a different form of cooling arrangement according to this invention; and

Fig. 7 shows a longitudinal section taken at line 7—7 of Fig. 6.

Referring to Figs. 1 and 2, the cooling arrangement is centered on a cubicle 1 in the form of a prism formed by four parallel corner strips 2 which may be angle pieces. The top and bottom of the prism are closed by solid walls 3 and 4 respectively and the ends are closed by end walls 5 and 6 respectively. The two remaining walls, these being the side walls, are formed by a plurality of channel members 7 having a generally U-shaped cross section. The adjacent walls of adjacent channel members preferably converge toward each other as shown. The members 7 extend vertically between the respective upper and lower members 2 to which they are attached in any suitable manner as by bolts. The members 7 are spaced apart at intervals which are preferably uniform so as to form a plurality of vertical slits 8 in the side walls.

The end walls 5 and 6 contain openings 9 and 10 respectively, preferably circular, in which are placed respective motor driven fans 11 and 12 which blow air into the cubicle to build up a pressure in it and thereby cause air to be forced out through the slots 8.

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The individual rectifier units 13 to be cooled are placed edgewise at the respective slots 8 as shown. This invention is not concerned with the particular construction of the rectifier units, as any form which can be shaped to fit the construction may be used. Examples of such rectifying units are described in my copending application Ser. No. 436,711, filed March 28, 1942. One of the units in the form shown in Figs. 1 and 2 is illustrated in greater detail in Figs. 3, 4 and 5. In this form, each unit comprises a supporting plate 14, which may for example be of steel or aluminum, and carries on its two sides rectifier elements 15 shown in the form of discs 16 such as steel, coated in a well-known manner with a semi-conducting layer 17 such as selenium. When the rectifier is of the selenium type, it will have over the selenium layer a metallic counter-electrode layer 18 which is placed into contact with the supporting plate 14. Insulating rings 19 and 20 should preferably be placed around the internal and external peripheries of the counter-electrode to keep the selenium and the base plate 16 out of contact with plate 14. These rings 19 may be of any suitable insulating material such as paper, or they may be composed of an application of varnish, which may be made to cover not only the exposed parts of the selenium layer but also the adjacent portions of the counterelectrode layer. The rectifier elements 15 are fastened to the plate 14 by bolts 21 passing through the elements and the plate and tightened by nuts 22. A suitable bus bar 23 is fastened under the nuts 22 to make contact. Washers 24 should be of conducting material so that the base plates 16 on both sides of plate 14 are connected to each other, but insulating bushings 25 around the bolts keep the bolts out of contact with supporting plate 14. The bus bars constitute one terminal of the parallel connected rectifying elements 15 and plate 14 constitutes the other terminal. It will be understood that the rectifier elements 15 need not be arranged exactly as shown; for example they might be placed on only one side of plate 14.

The rectifying units 13 are connected in position with relation to cubicle 1 by means of brackets 54 and 55 which fasten to the respective corner strips 2 of the cubicle. The corner strips should preferably be of an insulating material such as Bakelite; or if the strips 2 are of conducting material the plates 14 should ordinarily be insulated from these strips so that all of plates 14 will not be connected together. This will allow for different connection arrangements be-

tween different rectifier units. In the case of a single arm type of rectifier connection wherein all the rectifier units are in parallel, it would not matter whether plates 14 are electrically connected together, but usually in a rectifier all of the units will not be connected in parallel.

The arrangement shown permits a considerable space within the cubicle within which an operating transformer 26 of the rectifier may be placed as shown if desired; and this may be mounted upon suitable supports 27.

In the operation of the cooling system as thus described the fans 11 and 12 will blow air into the cubicle and will pass out through the slits 8 between strips 7, the adjacent converging walls of adjacent strips 7 serving to direct the air from each slit against the edge of the corresponding plate 14 and over the surfaces of plate 14 and rectifying elements 15 thereof. The direction of air flow is indicated by the arrows in Fig. 1. Preferably, the combined area of openings 9 and 10 should be equal to or greater than the combined area of the slits 8.

An efficient arrangement is one in which the cubic 1 bearing the rectifier units 13 is placed within an enclosure 28 which completely contains all of the circulating air or fluid. In such construction, the circulating air or fluid should be cooled by heat exchangers 29 and 30 before the hot air or fluid from the rectifiers reaches the fans again. The heat exchangers shown comprise fluid cooled pipes 31 arranged in a supporting housing 32 attached over the walls 5 and 6 of the cubicle. The housing 32 is composed of struts 33 projecting from the walls 5 and 6 to which are attached partitioning walls 34 and 35 closing the top and bottom of the housing. The wall 36 serves to close the front of the housing. As there are no side walls extending between the top and bottom walls 34 and 35, the only path for entry of air into the housing is through the spaces between cooling pipes 31. By this arrangement the air blown out of the cubicle 1 over the rectifier elements returns to the fans through the spaces 37 between the ends of the rectifier units and the enclosure 28 and through the heat exchangers. Cooled fluid circulated through pipes 31 provides the cooling. For convenience the walls of enclosure 1 may be made removable as indicated at 38 and 39 to allow access to the interior.

Figs. 6 and 7 illustrate a somewhat different modification wherein the enclosure in which the air pressure is built up is in the form of a cylinder or drum around which the rectifier units are fastened. The drum is formed by a pair of circular end pieces 40 and 41, the latter having a circular cutout 42 to permit access of cooling fan 43. To the circular end members 40 and 41 there are fastened circular hoops 44 and 45 respectively which may be channel shaped in cross section as shown. Extending vertically between the hoops are the spaced strips 7 of U-shaped cross section as in Fig. 1 and having the spaces or slots 8 between them. The rectifier units 13 are fastened by their brackets 25 to the hoops 44 and 45 as shown so that the plates 14 are located in the slots 8 between adjacent strips 7 as in the case of Fig. 1. This drum arrangement is preferably operated so the plates 14 lie in a vertical plane as shown, and for this purpose, a suitable stand or legs 46 may be fastened to a base member 47 to which the fan motor 48 may also be attached.

Although in this embodiment only one fan is shown, it will be understood that a fan may be placed at both ends as in Fig. 1 instead of only at one end. Furthermore, in the construction shown in Figs. 6 and 7 there is shown no heat exchanger nor outer enclosure as in Fig. 1 as in this case the air of the atmsophere is cooling the rectifiers. A suitable heat exchanger and enclosure could of course be provided in a manner similar to Figs. 1 and 2 if desired.

What I claim is:

1. In a multiple rectifier, a casing, a plurality of plates each carrying a plurality of rectifier elements each mounted in direct heat transfer relation on at least one of its faces, a mounting for said plates holding them side by side within said casing, and means for circulating cooling fluid in said casing between said plates and causing it to strike the edges of said plates and flow over the surfaces thereof, and the rectifier elements thereon.

2. In a multiple rectifier, a casing, a plurality of plates each carrying a plurality of rectifier elements on its two faces, a mounting for said plates holding them within said casing substantially parallel with one another, and means for circulating cooling fluid in said casing between said plates and causing it to strike the edges of said plates and flow over the surfaces thereof, and the rectifier elements thereon.

3. In a multiple rectifier, a casing, a plurality of plates each carrying a plurality of rectifier elements each mounted in direct heat transfer relation on at least one of its two faces, a mounting for said plates holding them within said casing spaced from one another and substantially at right-angles to the side walls, and means for circulating cooling fluid in said casing between said plates past said rectifier elements.

4. In a multiple rectifier, a casing having end and side walls, a plurality of plates each carrying a plurality of rectifier elements on its two faces, a mounting for said plates holding them within said casing uniformly spaced parallel with one another and substantially at right-angles to the side walls but spaced therefrom, a heat exchanger at each end wall, and a blower centrally located in the casing near each end wall and circulating cooling fluid over the associated heat exchanger, between said plates past the rectifier elements thereon and back through the space between the plates and the casing to the heat exchanger.

5. In a multiple rectifier, a cylindrical casing, a plurality of plates each carrying a plurality of rectifier elements on at least one of its faces, a mounting for said plates holding them within said casing spaced with respect to the side walls but separated therefrom, a heat exchanger at each end of the casing, and a blower centrally located in the casing near each end and circulating cooling fluid over the associated exchanger between said plates past the rectifier elements thereon and back through the space between the plates and the casing to the heat exchanger.

6. In a multiple rectifier, a cylindrical casing, a plurality of plates each carrying a plurality of rectifier elements on its two faces, a mounting for said plates holding them within said casing uniformly spaced radially with respect to the side walls but separated therefrom, a heat exchanger at each end of the casing, and a blower centrally located in the casing near each end and circulating cooling fluid over the associated heat exchanger, between said plates past the rectifier elements

thereon and back through the space between the plates and the casing to the heat exchanger.

7. A rectifier cooling system comprising a chamber, an opening in said chamber, a fan at said opening to blow air into said chamber, slots in said chamber with means at the slots for directing the flow of air therethrough, said air-directing means at the slots being formed by spaced strips having adjacent walls which converge toward each other in the direction of air flow, and a rectifier unit placed edgewise at each slot so as to receive on its edge from said directing means air blown through the slot from inside said chamber, whereby the air divides at the edge and blows over both surfaces of said rectifier unit.

8. A rectifier cooling system, comprising means forming a chamber having a relatively large opening and a plurality of slots therein, wall means on opposite edges of each slot extending outwardly from said chamber and converging toward one another, a rectifier placed edgewise between the converging walls at each slot in a plane parallel to the longitudinal edge of the slot,

and means blowing a cooling fluid into said chamber through said opening, whereby said cooling fluid passes outwardly of said chamber through said slots and between said converging walls, and over both sides of the rectifier units.

9. The combination according to claim 8, in which said wall means comprise integral extensions of said chamber-forming means.

10. A rectifier cooling system, comprising means forming a chamber having a relatively large opening and a plurality of slots therein, wall means on opposite edges of each slot, extending outwardly from said chamber, a rectifier placed edgewise between the walls at each slot in a plane parallel to the longitudinal edge of the slot, and means blowing a cooling fluid into said chamber through said opening, whereby cooling fluid passes outwardly of said chamber through said slots and between said walls, and over both sides of the rectifier units.

11. The combination according to claim 10, in which said wall means comprise integral extensions of said chamber-forming means.

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