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BLOCKING-LAYER RECTIFIER

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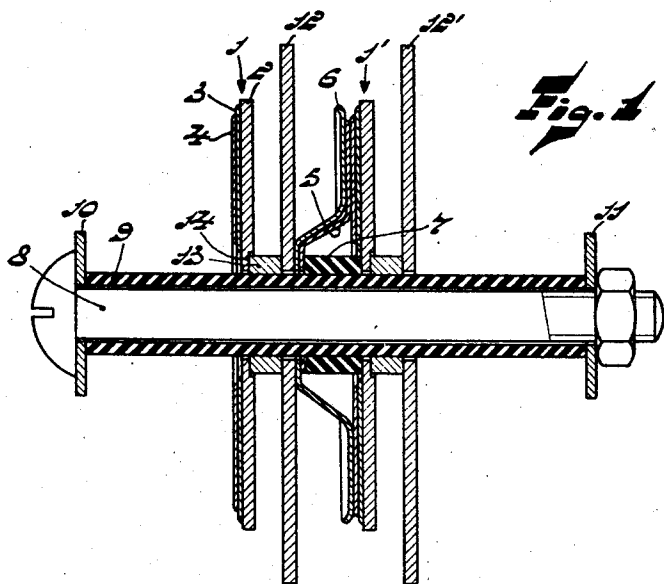


Fig. 1

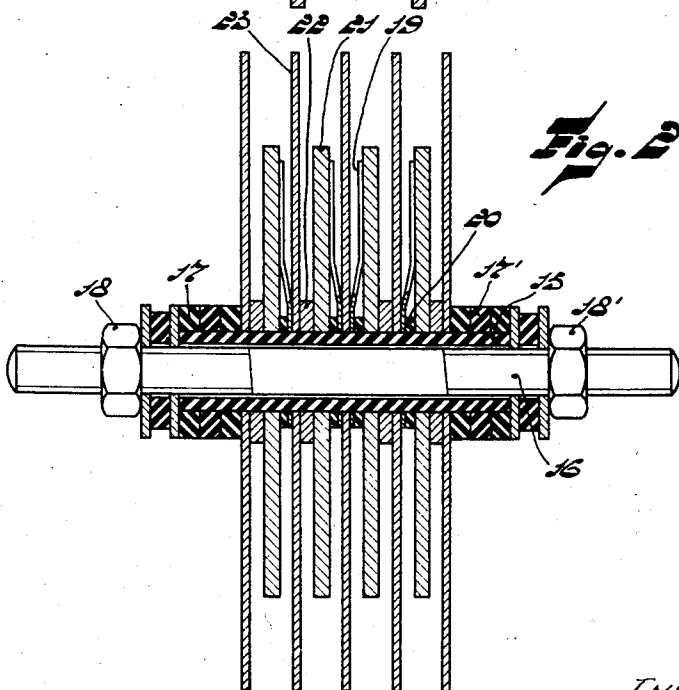


Fig. 2

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BLOCKING-LAYER RECTIFIER

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6 Claims. (Cl. 175-366)

This invention relates to a blocking-layer rectifier in which the blocking-layer system is mounted on a metal plate and for dissipation of heat, a separate cooling plate is used which is in heat-conducting contact with the metallic carrier plate.

In building up blocking-layer rectifiers from a number of blocking-layer systems connected in series or in parallel the latter are very often assembled in a single carrying member in which the blocking-layer systems arranged in a row are forced against one another. The electric contact between the successive systems is established, for example, by means of interposed contact pieces, whereas insulating members are arranged at those points at which the blocking-layer systems have to be always insulated from each other.

In addition it is known to cool such rectifiers by means of separate cooling plates of large surface area, at least one cooling plate of the kind being generally forced against the carrier plate of each blocking-layer system. In this case the above-mentioned intermediate pieces of insulating or conducting material serve to ensure the requisite spacing between the various systems so that satisfactory cooling is enabled. They consequently constitute spacers. In so far as such spacers were used hitherto they were therefore arranged between the cooling plate of one system and the good conducting electrode of the next system. It was deemed desirable that the cooling plate should be forced directly against the carrier plate in order to ensure optimum heat transmission.

It has surprised us to find that a substantial improvement in dissipation of heat can be obtained by departing from this principle and additional advantages are obtained as will become evident from the following.

Indeed, according to the invention the heat-conducting contact with the carrier plate is brought about by means of a contact piece which is arranged between the cooling plate and the carrier plate and leaves the greater part of the surface of the cooling plate and the carrier plate uncoated.

Due to this manner of arrangement the heat contact appears to be established over a much smaller surface area than in the usual construction. Nevertheless it is found that the dissipation of heat has much improved. This advantage may be due to the fact that a cooling plate engaging directly with the carrier plate is never so smooth as to engage with a considerable surface. On the contrary a layer of air or another

heat-insulating material will remain over by far the greater part of the surface, said layer greatly hampering the heat transmission. Moreover, the cooling plates are made comparatively thin for the purpose of saving in weight and material and they can therefore be acted upon only locally. At the points not acted upon the cooling plate bends away from the carrier plate. In addition, the conclusion of impurities can be avoided with difficulty with the result that the above-mentioned disadvantage is increased. If, at the point at which they are acted upon, the plates are cleaned, for example by a mechanical treatment such as sandblasting or milling, material is removed at the said point so that compression causes increased bending of the plate.

In the use of the invention the contact piece is preferably arranged opposite the central part of the carrier plate so that the additional advantage is obtained that the heat is just conducted away from the point from which it otherwise can be conducted away with the greatest difficulty.

In choosing the material for the contact piece the invention permits of selecting such material which is a good-heat conductor, whereas the cooling plates can nevertheless be made of a material with which the low price and the low weight are essential (for example aluminum or iron). In an advantageous form of construction the contact piece is made of copper.

As is apparent from the above the use of the words "contact piece" in the specification and claims primarily suggests a heat-conducting contact and does not primarily suggest an electric contact.

In order that the invention may be clearly understood and readily carried into effect it will now be described more fully with reference to the accompanying drawing, in which

Fig. 1 is a basic drawing showing a cross-sectional view of two blocking-layer rectifiers arranged on a central stud.

Fig. 2 shows a more complete construction.

Although the arrangement on a central stud is here described by way of example it is obvious that the invention can also be used if other means of forcing the various systems against one another are employed. In this arrangement the contact piece is constituted by a ring slid on the stud and preferably carried in an annular recess in the carrier plate.

The blocking-layer rectifiers of Fig. 1 are designated by 1 and 1' respectively and are each constituted by a carrier plate 2, for example of

aluminum, on which the semi-conductor 3 and the blocking layer are arranged. The electrode constituted by a semi-conductor may be made of selenium. The blocking layer which is itself very thin so that it is not shown on the drawing has a layer 4 of an alloy of bismuth cadmium, and tin formed on it by deposition so as to constitute the complementary electrode, a templet being used to ensure that centrally and at the edge of the plate a part remains uncoated. A free edge offers the advantage of an extended leakage path for the current from the electrode constituted by a semi-conductor to the electrode constituted by a good conductor. The advantage of the central recess will be adverted to hereinafter.

For the flow of current from the electrode 4 the latter has secured to it by soldering a strip 5 which has a hood 6 arranged on it in order that the current-conducting circuit may be increased and if the rectifier becomes overheated to prevent the soldering point from becoming loosened by melting and the contact from being removed. A ring 7 of insulating material ensures correct spacing between the rectifiers plate 1' and the next unit 1, it being also avoided that when the stud 8 (which is insulated from the rectifier units by means of an insulating tube 9, for example, of glazed card board) is screwed more tightly the pressure of the contact hoods 5 exerted on the rectifier plates clamped between the discs 10 and 11 may vary. This would be particularly detrimental if the pressure were increased since in this case the blocking layer may be pressed through at the point at which the hood engages with the complementary electrode so that a short-circuit between the two electrodes in a unit would arise. It is found that the blocking voltage of the rectifier is independent of the pressure exerted by the stud. Since the complementary electrode is not continued as far as the centre of the plate the complementary electrode is prevented from pressing the blocking layer through when the stud 8 is screwed more tightly by the ring 7 at the point at which the latter engages the rectifying plate so that the risk of short circuit is also avoided at this point.

For the purpose of cooling the rectifier plates each plate has arranged adjacent it a plate 12 of aluminium or of tin-plated iron which is in thermal contact with the rectifier plate 1 by means of a nickel ring 13. In order to ensure optimum heat transmission from the ring 13 to the plate 12 the ring is made satisfactorily smooth laterally and the surface 14 of the plate 1 is worked upon for example by milling or similarly so that both surfaces engage each other accurately.

The rings 13 ensure that the correct spacing between the rectifying plates and their cooling plates is maintained and they also ensure correct heat transmission due to correct engagement on both sides. The rings 7 also serve for adjustment of the correct spacing between the cooling plate of one unit and the rectifier plate of the next unit, the advantages mentioned above also resulting. Since the cooling plates are arranged on both sides at a given spacing from the adjoining rectifier plates the surfaces of these plates, which are subjected for example to the cooling action of air flowing along, are cooled to the optimum extent.

In this figure a series-connection is shown for the plates 1 and 1' but it is also possible to insulate the two plates from each other by arranging an

insulating ring between the hood 6 and the cooling plate 12.

Fig. 2 shows an arrangement for a rectifier in which the four rectifier plates are arranged in "Grätz" connection. As before, these plates and also their cooling plates are slid on a stud 16 insulated by means of an insulating tube 15 and are clamped between two nuts 18 and 18' with the interposition of insulating rings 17 and 17'. For the sake of simplicity the contact hoods shown in Figure 1 are omitted from this figure. In this embodiment the current for each unit is received by a strip 19 which is also maintained at a given spacing from the rectifier plate 21 by means of an insulating disc 20. In this case the complementary electrode again extends on the plate in such manner that the pressure of the ring 20 is not exerted on the complementary electrode. As before, a nickel ring 22 is arranged on the partially operated rear side of the rectifier plate and establishes a thermal contact with the cooling plate 23 on the other side.

As shown in Fig. 1 the recess in the rectifier plates may be cylindrical but it is also possible to make it annular. If the thickness of the carrier plate is too low at the point at which it is milled out plates may be initially used which locally exhibit a thickening which is after-treated.

In order to enable electric connection to an outer circuit contact strips may be inserted at the requisite points. It is, however, also possible to apply the connections to the exterior directly to the cooling plates since in the arrangement shown in this figure the latter plates are in direct electric contact with the various units.

What we claim is:

1. A blocking-layer rectifier comprising a metallic carrier plate, a blocking-layer system carried by said plate, a cooling plate spaced from said carrier plate and adjacent thereto, said plates being adapted to be cooled by a cooling fluid, and a contact member of heat-conducting material between said plates with its ends in good heat-transmitting relationship with said plates while leaving a major part of each side surface of the plates exposed to the cooling medium.

2. A blocking-layer rectifier comprising a metal carrier plate, a blocking-layer system carried by said plate, a cooling plate spaced from said carrier plate and adjacent thereto, said plates being adapted to be cooled by a cooling fluid, and a contact member of a good heat-conducting material having its ends in good heat-transmitting relationship with only a central portion of each of said plates, a major part of each side surface of the plates being exposed to the cooling fluid.

3. A blocking-layer rectifier comprising a metal carrier plate, a blocking-layer system carried by said plate, a cooling plate spaced from said carrier plate and adjacent thereto, said plates being adapted to be cooled by a cooling fluid, and a copper heat-transferring member having its ends in good heat-transmitting relationship with only a portion of said plates, a major part of each side surface of the plates being exposed to the cooling fluid.

4. A blocking-layer rectifier comprising a metal carrier plate, a blocking-layer system carried by said plate and including a blocking layer and an outer electrode layer on only a portion of the surface of the blocking layer, a cooling plate spaced from said carrier plate and adjacent thereto, said plates being adapted to be cooled by a cooling fluid, and a contact member of heat-conducting material between said plates with its ends in

direct and good heat-transmitting contact with only small portions of said cooling plates and said blocking layer, a major part of each side surface of the plates being exposed to the cooling fluid.

5. A blocking-layer rectifier comprising a metal carrier plate, a blocking-layer system carried by said plate, a cooling plate spaced from said carrier plate and adjacent thereto, said plates being adapted to be cooled by a cooling fluid, and a contact member of a good heat-conducting material having its ends in direct and good heat-transmitting contact with only a small portion of each of said plates, a major part of each side surface of the plates being exposed to the cooling fluid. 15

6. A blocking-layer rectifier system comprising a central mounting stud, a plurality of rectifier units mounted on said stud and each including a metal carrier plate, a blocking-layer system carried by said plate, a cooling plate spaced from said carrier plate and adjacent thereto, said plates being adapted to be cooled by a cooling fluid, and a tubular metal heat-transferring member mounted on said stud with its ends in good heat-transferring relationship with only a small portion of each of said plates, a major part of each side surface of the plates being exposed to the cooling fluid. 10

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