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H. B. CONANT

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METALLIC RECTIFIER CONSTRUCTION

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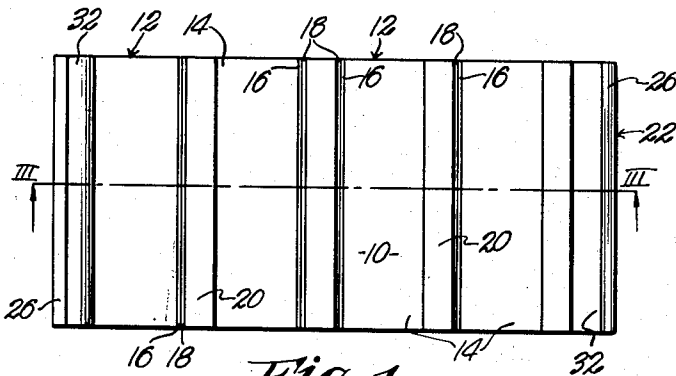


Fig. 1.

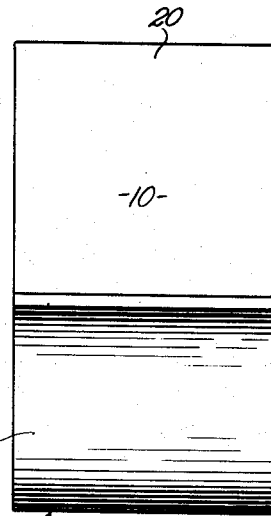


Fig. 2.

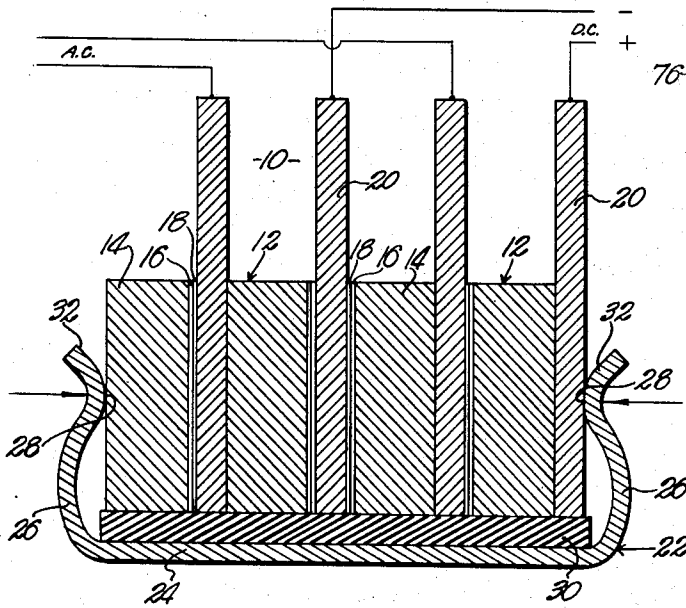


Fig. 3.

INVENTOR.
Harold B. Conant
BY *[Signature]*
ATTORNEY.

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METALLIC RECTIFIER CONSTRUCTION

Harold B. Conant, Lincoln, Nebr.

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5 Claims. (Cl. 317-234)

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This invention relates to a device for holding a number of superimposed members together with uniform pressure throughout the proximal interengaging faces of the individual separate members.

More particularly, this invention has to do with electrical devices of the kind having a number of relatively flat, separate parts, all of which must be held together in a stacked unit under pressure and contemplates, therefore, the provision of a unitary, relatively inexpensive, highly efficient clip of resilient material capable of imparting the uniform pressure desired.

It is the primary object of the present invention to provide a clip for holding a stack of plates in clamped relationship, the plates forming a part of the usual type of dry plate rectifier and including, for instance, the alternating composite copper-copper oxide plates or discs chosen and arranged to present uni-directional electrical conductivity.

One of the most important objects of this invention is to provide a spring clip to hold the individual elements of a rectifier stack in place under predetermined physical pressure and to maintain such pressure at all times during use irrespective of variations in ambient or operating temperatures.

Another object hereof is the provision of a rectifier clip taking the form of an external resilient member so formed and disposed that its resiliency is not materially affected by protecting coatings which are customarily applied to protect the rectifying elements from moisture and/or fungus growths.

It is another important object of the present invention to provide a dry plate rectifier having a simple, fully effective, clamping means to hold the conductive cells, contact plates, terminal lugs and the like, all forming a part of the rectifier, together in an assembled relationship to reduce the cost of manufacture not only from the standpoint of saving of time, but of the materials necessary to the manufacture of the electrical device.

Another important object of the present invention is the provision of a holding clip for rectifiers capable of maintaining a constant and uniform pressure between the cooperating, engaging faces of the assembled stack, irrespective of wide variations that may occur not only in operating temperatures but in those that surround the rectifier itself.

A still further object of this invention is the provision of a U-shaped, unitary clip of resilient

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material formed to present a pair of elongated ribs in line contact with proximal ends of the rectifier stack, remote from the principal points of contact between the operating plates of the rectifier.

Other more minor objects will be made clear or become apparent as the following specification progresses, reference being had to the accompanying drawing, wherein:

Figure 1 is a top plan view of a dry plate rectifier having operably associated therewith, a holding clip or pressure imparting member made pursuant to my present invention.

Fig. 2 is an end elevational view thereof; and Fig. 3 is a sectional view through the rectifier shown in Fig. 1 and taken on line III-III thereof.

It is to be understood that the rectifier chosen for illustration may take several forms, but for the most part, dry plate electrical rectifiers in common use today, have similar characteristics. They each include a plurality of stacked side-by-side or superimposed elements which must be held together under pressure during use.

The rectifier chosen for illustration is broadly designated by the numeral 10 and may include a plurality of composite rectifier cells 12 made of copper oxide, selenium and the like. As illustrated, each cell 12 includes, for example, a copper disc 14, a layer of cuprous oxide 16 and a conductive contact coating 18. In addition, the rectifier 10 is provided with a plurality of terminal lugs 20 in the usual manner.

Rectifiers of this character are usually, if not exclusively, provided with a bolt and nut assembly together with the necessary end washers and the like to hold the cells 12 in assembled relationship and with the proximal interengaging faces thereof in pressure contact. The bolt passes through all of the cells 12 and, accordingly, each of the component parts thereof must be provided with a bolt-receiving perforation. This construction is replete with disadvantages not only from the standpoint that proper pressure is not imparted to the component parts of the rectifier, but because of the fact that the same is rendered expensive to manufacture, not only from the standpoint of time consumed in the assembling steps but from the standpoint of cost of the materials and expense necessary to manufacture.

This invention contemplates elimination of all conventional means for holding the various parts of the rectifier stack together, thereby eliminating screw-threaded members and permitting the

utilization of imperforate cells and contact plates.

The holding means hereof comprises a unitary clip broadly designated by the numeral 22 and taking the form preferably as illustrated in the drawing. Clip 22 is made from an initially flat strip of resilient material preferably metallic and is bent or formed into the shape of a U, as shown most clearly in Fig. 3, while maintaining the bight 24 thereof substantially straight and flat. There is, therefore, presented a pair of substantially parallel legs 26 of identical nature extending laterally from one face of the bight portion 24 and integral with each end respectively thereof.

The legs 26 of resilient clip 22 are biased toward each other as indicated by the two arrows in Fig. 3 and are substantially S-shaped in cross-section whereby to present a continuous inwardly facing rib 28 extending the full width of each leg 26 respectively. Consequently, the legs 26 are concavo-convex adjacent the free ends thereof remote from the bight 24. The distance between the innermost faces of the legs 26 adjacent the rib 28 is greater than the over-all length of the rectifier 10 and when the latter is interposed between legs 26 in the manner illustrated by the drawing, the line contact is presented between the ribs 28 and the proximal faces of the rectifier 10.

It is to be appreciated that when the rectifier 10 is in the operable position with respect to clip 22, a constant and uniform pressure is directed to the units 12, thereby holding the interengaging faces of the stack of plates in spring pressure contact at all times.

If desired, a block 30 of suitable insulating material may be interposed between the rectifier 10 and the inner faces of bight 24. Through formation of the legs 26 in the manner illustrated and just above described, there is presented a pair of outwardly-flared lips 32 to facilitate the assembly of rectifier 10 within clip 22. It is contemplated that the spring clip 22 be inserted into a suitable jig capable of spreading the legs 26 apart a sufficient distance and holding the same in such position while the rectifier 10 is assembled in place between ribs 28. Suitable guides may be provided as a part of the jig for directing the rectifier stack into place, whereupon the spring tension of legs 26 is released and the entire assembling operation is complete.

Manifestly, clip 22 may be made of steel, beryllium, copper or virtually any material capable of meeting the spring pressure requirements hereof. The size of clip 22 and shape thereof, together with the amount of tension to be exerted by legs 26, will vary according to the nature of the rectifier to be assembled, as well as other manufacturing requirements. In rectifier stacks employing cells of large area, it will be desirable to provide relatively heavy end plates between the stack proper and ribs 28 to adequately distribute the pressure exerted by the legs 26. Such end plates may preferably be indented to receive the ribs 28 to more effectively secure the stack 10 in the clip 22.

So far as assembly is concerned, the necessity of individually placing each part of the rectifier over an insulated bolt, placing of a nut on the bolt, transferring the device to a positioning jig, and finally tightening the nut, are all eliminated. It is noteworthy that virtually all rectifiers of this character are highly sensitive to variations in the pressure that is applied to the active faces

thereof. The differentials between the thermal expansion coefficients of the component parts of the stack and those of the fixtures that are used to hold the cells under optimum pressures greatly affect the electrical characteristics of the rectifier proper, since there is always present wide variations in ambient and operating temperatures.

It is clear that the clip 22 hereof adequately compensates for such differentials in thermal expansion to maintain optimum pressure upon the active faces of the cells 12, thereby obviating the disadvantage that is presented when protective paint coatings are used on conventional rectifier stacks employing internal resilient members. By virtue of the fact that spring pressure is applied to the stack externally thereof, resiliency of the clip 22 is not affected by such paint coatings applied to the stack itself.

Oftentimes, particularly in cases of rectifiers of relatively large area, it has been found desirable, if not absolutely essential, to space the individual cells whereby to allow for circulation of a coolant such as air, oil and the like. There has heretofore been no practical means to apply optimum pressure over the active areas of the rectifier when such spacing became necessary.

Therefore, the relatively thin metallic film on the active face of each cell is employed to conduct current to and from areas of the cell remote from the usual central point of contact, and these remote areas are under zero pressure. In such spaced cell construction, a metallic contact plate may be held with optimum pressure against the remote areas of the active faces of large area cells, thereby increasing the current capacity of the cell by placing a plurality of suitably formed clips around the periphery of the large cell. Such construction facilitates cooling of the rectifier by presenting more surface to and deflecting the flow of the cooling medium.

It is seen that the use of clip 22 eliminates the objectionable feature of conventional construction, since the semi-rigid bolts or external frame structure usually used do not conform precisely to the thermal expansion characteristics of the rectifier stack that is held in position thereby. Through use of such conventional assemblies, the physical pressures on the component elements of the rectifier stack are subjected to wide variations as a consequence of variable ambient and operating temperatures.

Conventional assemblies are further objectionable because at either hot or cold temperatures the elements of the rectifier are subjected to extreme pressures tending to cold-flow to relieve the pressure. When the rectifier returns to the opposite temperature extreme, the pressure becomes lower than that necessary for proper operation.

Finally, it is important to not overlook the facts that the simple and efficient spring clip construction eliminates a number of expensive machined structural members, materially reduces the number of assembly operations and rectifiers constructed according to the present invention occupy less space, are lighter in weight and operate more efficiently than equivalent rectifiers constructed by conventional means.

It should be understood that the form of the spring clip shown at Fig. 3 is illustrative and not restrictive. The clip 22 may be made in an infinite number of forms without departing from the scope of this invention. Furthermore, mechanical considerations may require the use of

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more than one clip on the same rectifier stack, and it will usually be desirable to integrally form thereon or attach thereto a suitable bracket for mounting purposes. Or it may be desirable to form stiffening ribs on the bight 24. All of these modifications of the illustrative form of the clip do not alter its basic design or function.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In combination, an electrical device having a stack of separate, dry plates adapted for uni-directional conductivity including a pair of opposed, outermost plates and a number of intermediate plates; means adapting at least one of said intermediate plates for electrical connection to an external circuit; and means for maintaining spring-pressure contact between the plates of said stack and for electrically interconnecting said outermost plates, said means including a pair of electrically interconnected, opposed, resilient, conductive members, yieldably biased together, said device being between the members, said members each being in contact with a respective outermost plate of said stack.

2. In combination, an electrical device having a stack of separate, dry plates adapted for uni-directional conductivity including a pair of opposed, outermost plates and a number of intermediate plates; means adapting at least one of said intermediate plates for electrical connection to an external circuit; and means for maintaining spring-pressure contact between the plates of said stack and for electrically interconnecting said outermost plates, said means including a pair of integrally interconnected, opposed, resilient metallic members, yieldably biased together, said device being between the members, said members each being in contact with a respective outermost plate of said stack.

3. In combination, an electrical device having a stack of separate, dry plates adapted for uni-directional conductivity including a pair of opposed, outermost plates and a number of intermediate plates; means adapting at least one of said intermediate plates for electrical connection to an external circuit; and means for maintaining spring pressure contact between the plates of said stack and for electrically interconnecting said outermost plates, said means comprising a U-shaped body of resilient, conducting material having a pair of substantially parallel legs, each of said legs being provided with a conducting rib on the innermost face thereof, said legs being yieldably biased together, said device being between the legs, said legs each being in contact with a respective outermost plate of said stack.

4. The invention, as set forth in claim 3 wherein said legs are S-shaped to present said ribs, and the bight of said body is flat.

5. A metallic rectifier comprising a plurality of aligned, asymmetrically conductive, dry disc

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type, metallic rectifier cells, each of said cells respectively having a plurality of stacked, aligned, successively inter-engaging layers including a first outermost layer formed of metallic material, an intermediate layer formed of material electrically asymmetric with said metallic material and a second outermost layer of conductive material, each of said outermost layers of each cell respectively having an outermost contact face; a plurality of metallic, terminal lug elements, each of said elements respectively having a pair of opposed, contact surfaces, one of said surfaces of a first of said lug elements being in inter-engagement with said face of said second outermost layer of a first of said cells and the other surface of said first lug element being in inter-engagement with said face of said first outermost layer of a second of said cells, one of said surfaces of a second of said lug elements being in inter-engagement with said face of said second outermost layer of said second cell and the other surface of said second lug element being in inter-engagement with said face of said second outermost layer of a third of said cells, one of said surfaces of a third of said lug elements being in interengagement with said face of said first outermost layer of said third cell and the other surface of said third lug element being in inter-engagement with said face of said second outermost layer of a fourth of said cell, one of said surfaces of a fourth of said lug elements being in inter-engagement with said face of said first outermost layer of said fourth cell, said first and third lug elements being adapted for coupling with an external, alternating current, input circuit, said second and fourth lug elements being adapted for coupling with a direct current, output circuit; and a unitary, metallic, conducting, U-shaped clip, having a pair of opposed, resilient legs, said legs being yieldably biased toward each other, said cells and said lug elements being between said legs with one of said legs in inter-engagement with said face of said first outermost layer of said first cell and the other of said legs in inter-engagement with said other surface of said fourth lug element, whereby to yieldably bias the layers of said cells and the lug elements together and to provide an electrical connection between said first outermost layer of said first cell and said other surface of said fourth lug element to present a bridge-type rectifying unit.

HAROLD B. CONANT.

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