

April 5, 1966

B. BERNSTEIN

3,243,867

RECTIFIER EDGES COATED WITH THIXOTROPIC EPOXY

Filed June 19, 1962

2 Sheets-Sheet 1

FIG. 1

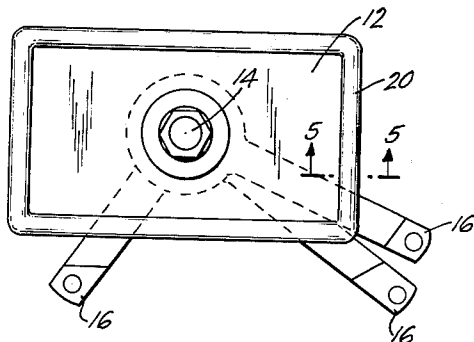


FIG. 2

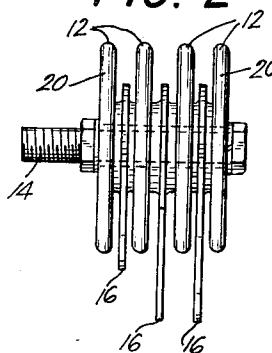


FIG. 3

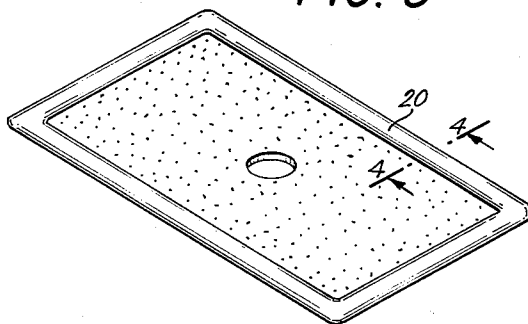


FIG. 4

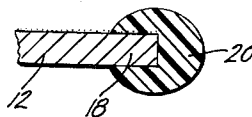


FIG. 5

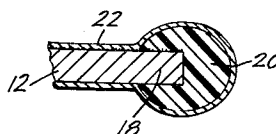


FIG. 6

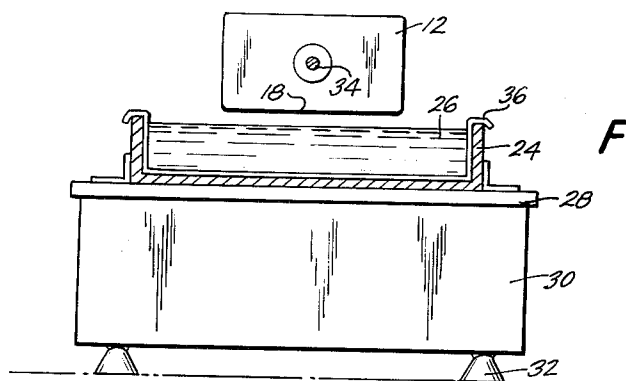
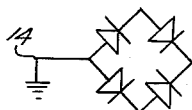


FIG. 7



INVENTOR
BERNARD BERNSTEIN
BY *James and Franklin*
ATTORNEYS

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FIG. 8

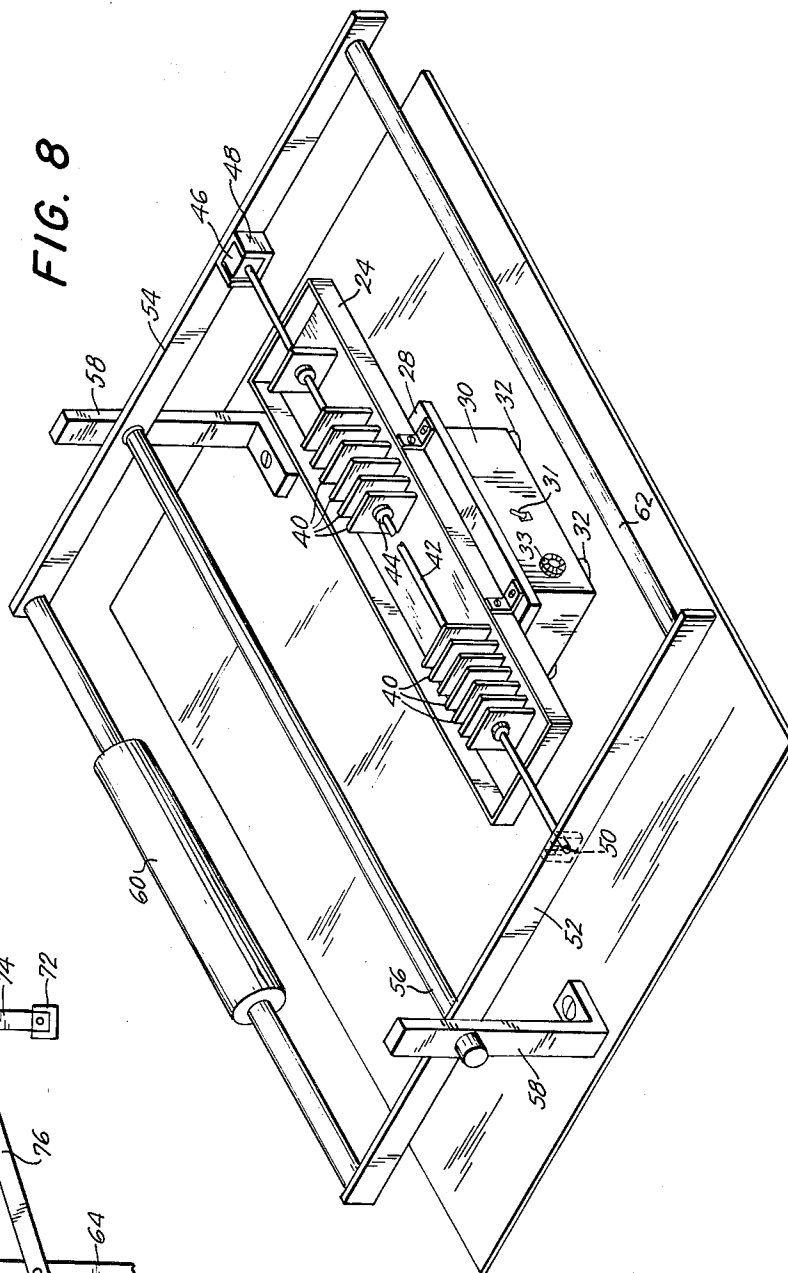
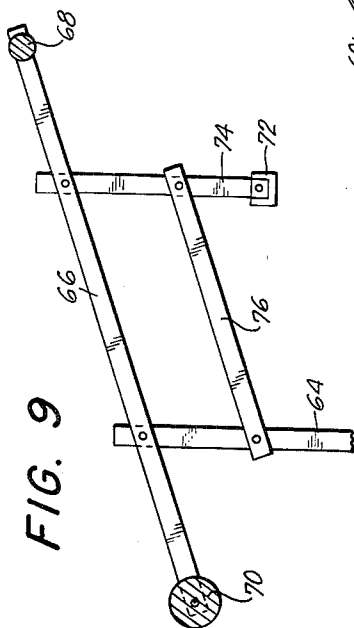


FIG. 9



INVENTOR.

BERNARD BERNSTEIN

BY

James and Franklin

ATTORNEYS

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3,243,867

RECTIFIER EDGES COATED WITH THIXOTROPIC EPOXY

Bernard Bernstein, Brooklyn, N.Y., assignor to General Instrument Corporation, Newark, N.J., a corporation of New Jersey

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4 Claims. (Cl. 29—155.5)

This invention relates to rectifiers, and more particularly to selenium rectifier plates which are to be used in an exposed position.

Selenium rectifier cells in plate form may be exposed for air cooling. A typical rectifier may be used for charging a storage battery used with an internal combustion engine for ignition and electric lighting, as on a boat or automobile. A popular system uses an engine driven alternator instead of a D.C. generator, and a bridge type full wave rectifier having four selenium cells spaced apart on a threaded bolt. The assembly is dipped in paint, and in use is exposed for cooling. When used with an out-board engine the rectifier often is subjected to salt or fresh water spray.

Although coated with paint for protection, the coating is thinnest at the outer edges, and these are the most likely to be accidentally struck and the paint chipped away. The selenium coating is hygroscopic, and readily absorbs moisture which spreads into the cell and destroys it.

The general object of the present invention is to overcome the foregoing difficulty. This is done by the provision of a relatively heavy rounded bead of protective material around the outer edges of the cell before the usual protective paint is applied. It is not enough to simply increase the viscosity of the material used around the edges, because even a viscous material will "tear drop" or flow away from an upper edge. Accordingly, another general object is to provide a well rounded and strongly adherent protective edge for maximum protection.

To accomplish the foregoing general objects, and other more specific objects which will hereinafter appear, my invention resides in the improved rectifier cell manufacture, as are hereinafter described. The specification is accompanied by drawings in which:

FIG. 1 is an end view of a full wave rectifier to which my improvement has been applied;

FIG. 2 is a side elevation of the same;

FIG. 3 is a perspective view of a single cell;

FIG. 4 is a fragmentary section, drawn to enlarged scale, and taken approximately in the plane of the line 4—4 of FIG. 3;

FIG. 5 is a similar section after final coating;

FIG. 6 is a schematic section explanatory of the manufacture of the improved cell;

FIG. 7 shows the bridge arrangement of the cells in FIGS. 1 and 2;

FIG. 8 is a perspective view showing apparatus for protecting the edges of the cells; and

FIG. 9 is a fragmentary view explanatory of a modification of the apparatus.

Referring to the drawing, and more particularly to FIGS. 1 and 2, the rectifier assembly there shown comprises four selenium cells 12 mounted in spaced-apart

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relation on a threaded bolt 14. There are three terminal strips 16 distributed between the cells 12.

The four cells may form a full wave rectifier bridge, as shown in FIG. 7. The bolt 14 acts as a common ground between the outside of the outermost cells, and the terminals 16 in FIGS. 1 and 2 correspond to the three corners of the bridge in FIG. 7. In such an arrangement the two plates at each side have their selenium coatings facing towards the center. It will be understood that there is an insulation sleeve around the bolt 14, and conductive spacing washers between the cells and the terminals, the cells, terminals and washers being received outside the insulation sleeve. The bolt 14 acts as a mounting bolt and also as a common ground connection for the two outermost cells.

As heretofore manufactured, the parts were first assembled and then dipped in a protective paint. This served well at the washers, because the paint tends to thicken or "fillet" at an inside corner. It also served well on the large flat faces of the cells. However, at the outside edges, particularly the corner edges of the periphery, the paint tends to thin or draw away. These edges, however, are the exposed edges which are most likely to be accidentally struck, with consequent chipping away of the paint and eventual destruction of the cell because of moisture absorption through any break in the seal.

Referring now to FIG. 4, in accordance with the present invention, the edge 18 of the cell is protected by a rounded bead 20 of protective material. This is applied prior to the coating operation, and FIG. 5 shows how a coat of protective paint 22 is applied around the bead 20 as well as the cell 12. FIGS. 1, 2 and 3 show the resulting thick rounded protective bead 20, which is in contrast with the usual thin and relatively unprotected edges.

The protective material used is preferably an epoxy resin because of its very high degree of adhesion to metal. However, an ordinary epoxy resin will not produce the well rounded edge here shown. It is not sufficient to simply increase the viscosity of the material. Even if viscous, the material will flow. A bottom edge will tend to draw into a tear drop shape, and at a top edge the material will flow downward from the edge of the cell.

I have found that this problem may be solved by using a thixotropic epoxy material. Such a material may be subjected to vibration in a tank or tray, in order to maintain its fluidity. The edges of a cell may be dipped in the fluid material and removed, and by avoiding vibration of the cell after dipping and during setting of the material, there is no tendency to flow. On the contrary, because of the high molecular attraction or surface tension of the material, it draws itself into a well rounded head.

An example of a suitable material is "G-06 Fire Retardant Epoxy Dip Coating Resin" made by Mitchell-Rand Manufacturing Corp., of 51 Murray Street, New York, N.Y., and sold under the trademark "Randac." This is supplied in two components, one being called "R-4075 Resin," and the other being called "Activator #32." The components are used in equal parts and thoroughly mixed. The material may be thinned by vibration. It gels in three to five hours and attains final cure in one to two days. The cure may be hastened by increased temperature up to 85° C.

Referring to FIG. 6 of the drawing, a tray 24 of a thixotropic epoxy resin 26, is mounted on a vibrator table 28, the mechanism of which is housed at 30. The housing is preferably carried by vibration insulators 32.

The cells 12 are mounted in spaced relation on a rod 34, which may be raised or lowered to bring the edge 18 of the cell into the material 26. When the cells have been dipped and raised, the rod is turned ninety degrees and the cells then again dipped, and so on, until all four edges have been protected. The tray 24 is preferably lined with an expendable lining 36 made, for example, of polyethylene in thin sheet form. This lining is removed with any residue of the epoxy material after its "pot life" time has expired. A new lining and a new charge of the thixotropic epoxy resin system is then loaded into the tray.

One simple form of apparatus which may be used is shown in somewhat schematic form in FIG. 8 of the drawing. This shows how the tray 24 is mounted on a vibrator table 28 carried over vibrator mechanism 30 mounted on vibration insulators 32, all as previously described. The front of casing 30 includes an on-off switch 31 and a control 33 for the degree of vibration. The selenium cells 40 here shown are square, and both the square and rectangular forms are in common use. The cells are mounted on a rod 42, with appropriate spacers 44 therebetween, and are clamped axially to prevent rotation relative to the rod. One end of the rod has a square indexing block 46, received in a mating socket 48 which is open at the top. The other end of the rod is received in a bearing 50 which also is open at the top.

The parts 48 and 50 are carried on arms 52 and 54 pivoted on a rod 56 carried by pedestals 58. The arms may be counterbalanced by suitable counterweight 60 at the rear, and are extended forwardly to a bar 62 which acts as a handle, so that the rod 42 with its cells may be raised or lowered. When the lower edge has been dipped and the cells raised, the rod 42 is lifted out of its bearings and turned ninety degrees, whereupon the handle 62 is again moved down against the force of the counterweight to dip the next edge of the cells, and so on, until all four edges have been dipped. The rod with its cells is then removed and transferred elsewhere for drying and setting, while another rod loaded with another supply of cells is loaded into the bearings 48 and 50 for its dipping operation.

The arrangement shown in FIG. 8 introduces some angularity as the cells are raised or lowered. This is not significant when the arms 52 and 54 are long. This angularity may be avoided, if desired, by using a parallel motion, illustrated schematically in FIG. 9, in which the pedestal 64, arm 66, handle 68, counterweight 70, and open-topped square bearing 72 all correspond to like parts previously described (with different reference numerals in FIG. 8). However, in this case another arm 76 is used in parallel to the arm 66, and the bearing 72 is carried on an upright movable support 74, which is parallel to the pedestal 64.

It will be evident that in this modification there is no change of angle of the plates as they are raised and lowered.

One manufacturing procedure may be described as follows: The cells to be edge-dipped are loaded into one of a number of square-end spindles 42, 46 (FIG. 8), with thick spacing washers disposed between each cell. The cells are lined up evenly with the flats of the square end of the spindle, and the end nut tightened. The loaded spindle then is mounted in the open-top bearings of the dipping fixture.

The counterbalanced dipping fixture is normally raised. It is preferably so positioned that the loaded spindle can be lowered parallel to the dipping trough. Manual pressure overcomes the counterweight. The trough (mounted on a vibrating table) is filled with a thixotropic epoxy material. The dipping fixture is lowered until the edges of the cells are immersed in the epoxy material to a point

beyond the masked border of the cells, that is, beyond or at least up to the edge of the counterelectrode (alloy) of the cells.

The loaded spindle then is slowly raised from the epoxy trough, permitting the vibration to remove any excess epoxy material. The spindle is then indexed 90° preparatory to dipping the next set of cell edges. The previously dipped edges are not under vibration, and the material contracts to a well rounded shape.

After all four edges of the cells have been dipped, the loaded spindle is removed and carefully placed on a drying rack. At this point, extraneous vibrations are avoided in order to prevent the epoxy material from shifting. A twenty-four hour room temperature cure is required. To hasten the cure, the cells can be placed in a 60° C. oven for one hour, after an initial eight hour cure at room temperature.

When the epoxy edges have been cured, the edges of cells have an effective seal against moisture. The cells are removed from the rods. When the four-cell rectifier stacks have been assembled on threaded bolts as shown in FIGS. 1 and 2, they are dip-painted. The stacks then are fully capable of withstanding adverse atmospheric conditions. They are also well fortified against edge damage.

It is believed that my improved rectifier plate, as well as the manufacture of the same for protection of the edges of the cells, and the advantages thereof, will be apparent from the foregoing detailed description. It will also be apparent that while I have shown and described the invention in a preferred form, changes may be made without departing from the scope of the invention, as sought to be defined in the following claims.

I claim:

1. The method of protecting the edges of a rectifier plate which is to be used in an exposed position, which includes vibrating a body of a thixotropic epoxy material, dipping each edge of the plate in the thixotropic epoxy material and removing the plate while vibrating the material, and drying the material after all edges have been dipped.

2. The method of protecting the edges of a rectifier plate which is to be used in an exposed position, which includes vibrating a body of a thixotropic epoxy material, dipping each edge of the plate in the thixotropic epoxy material and removing the plate while vibrating the material, drying the material after all edges have been dipped, assembling the rectifier plates permanently in spaced relation, and dipping the assembly in a suitable liquid to protectively coat the same.

3. The method of protecting the edges of a selenium rectifier plate which is to be used in an exposed position, which includes vibrating a body of a thixotropic epoxy material, dipping each edge of the plate in the thixotropic epoxy material and removing the plate while vibrating the material, and drying the epoxy material without vibration after all edges have been dipped.

4. The method of protecting the edges of a selenium rectifier plate which is to be used in an exposed position, which includes vibrating a body of a thixotropic epoxy material, dipping each edge of the plate in the thixotropic epoxy material and removing the plate while vibrating the material, drying the epoxy material without vibration after all edges have been dipped, assembling the rectifier plates permanently in spaced relation, and dipping the assembly in paint to protectively coat the same.

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RICHARD D. NEVIUS, *Primary Examiner.*

JAMES D. KALLAM, *Examiner.*

JOSEPH B. SPENCER, A. M. LESNIAK, A. GOLIAN,
Assistant Examiners.