Dec. 16, 1969 B. BERNSTEIN ET AL 3,484,864

COMBINED CONNECTOR AND RECTIFIER

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FIG.1

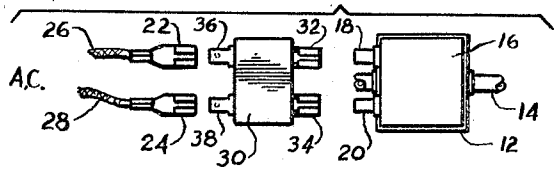

FIG.2

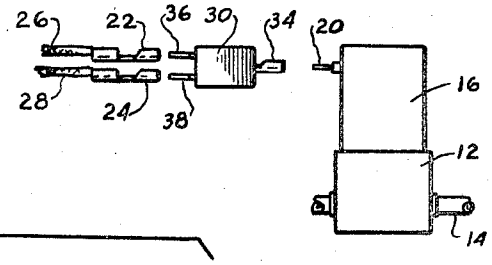

FIG.3

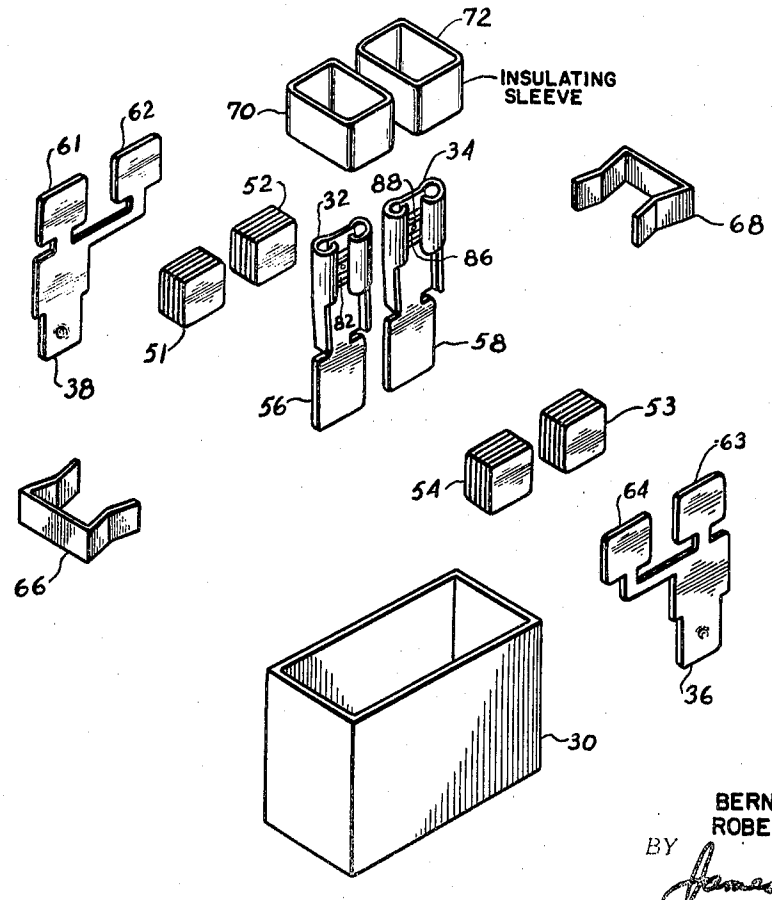

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FIG.4

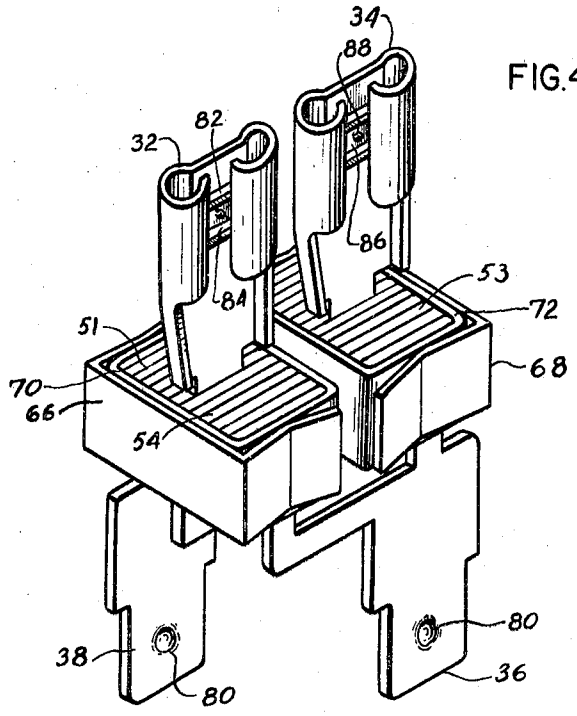


FIG.5

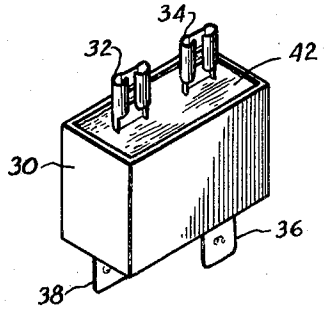


FIG.6

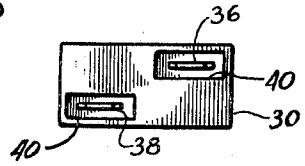
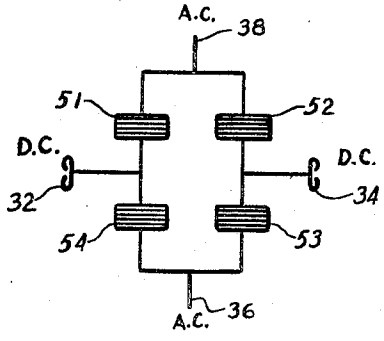


FIG.7



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United States Patent Office 3,484,864
Patented Dec. 16, 1969

3,484,864

COMBINED CONNECTOR AND RECTIFIER

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Filed Oct. 20, 1966, Ser. No. 588,143
Int. Cl. H01l 3/00, 5/00
U.S. Cl. 317—234 13 Claims

ABSTRACT OF THE DISCLOSURE

A combined connector and rectifier assembly is designed for slip-on insertion between a pair of flexible AC supply leads having female terminals, and a pair of male terminals on an electrical device. The rectifier includes a plurality of rectifier cells which in one embodiment include four stacks of selenium cells connected to form an electrical bridge for full wave rectification. The connector includes a female terminal integrally formed with a flat plate disposed between two of the cells, and another female terminal formed integrally with a flat plate disposed between two other stacks of cells. The female terminals project from their plates in one direction and the male terminals project from their plates in an opposite direction.

This invention relates to rectifiers, and more particularly to compact full wave rectifiers.

There are electrical devices which are operated by AC, but which would operate bettter on DC. This is particularly true of a solenoid, which may tend to chatter or hum when operated by AC. A common example is the solenoid operated water valves used widely in automatic clothes washers and dishwashers. The general object of the present invention is to overcome this difficulty, and to assure quiet positive operation, which is done by using a locally rectified DC supply instead of an AC supply.

A further and more specific object is to provide a small, inexpensive rectifier which is easily applied to the solenoid by means of slip-on terminals. In accordance with a further feature and object, the terminals are N.E.M.A. quick-disconnect terminals which have been standardized, and are in wide use on such solenoid-operated water valves. Still another object is to provide the desired DC connection at no cost other than the cost of the rectifier itself, this being readily added without change in the design or manufacture of the main appliance. Indeed, tte rectifier may be added readily to appliances which are already in use.

To accomplish the foregoing general object, and other more specific objects which will hereinafter appear, our invention resides in the rectifier elements and their relation one to another, and to the solenoid and AC supply terminals, as are hereinafter more particularly described in the following specification. The specification is accompanied by drawings in which:

FIG. 1 is a schematic plan view showing how the rectifier is designed for insertion between a pair of flexible AC supply leads, and a pair of terminals on the electrical device;

FIG. 2 is a schematic elevation of the parts shown in FIG. 1;

FIG. 3 is an exploded perspective view showing the parts of the rectifier;

FIG. 4 is a perspective view drawn to larger scale and assembled, but not yet in the housing;

FIG. 5 is a perspective view drawn to smaller scale and showing the assembly of FIG. 4 potted in its housing;

FIG. 6 is a bottom view of the rectifier shown in FIG. 5; and

FIG. 7 is an electrical diagram showing how the parts act as a full wave rectifier bridge.

Referring to the drawing, and more particularly to FIGS. 1 and 2, rectangle **12** schematically represents a valve in a water line **14**, typically in an automatic clothes washer or dishwasher. The valve **12** is operated by a solenoid schematically represented by rectangle **16**. The solenoid terminals are two flat metal blades **18, 20** which ordinarily receive female terminals **22, 24** at the ends of flexible wire leads **26, 28** in the appliance.

In general, the power supply is AC and the solenoid **16** is supplied with AC through leads **26, 28** and terminals **22, 24**, the latter being female terminals which are slid over the blade terminals **18, 20** with a snap fit. The terminals shown are N.E.M.A. "quick-disconnect" terminals, and in the particular case shown, the blades **18, 20** are 0.25 inch wide and 0.032 inch thick. The female terminals **22, 24** are essentially slip-on terminals, but in accordance with the N.E.M.A. standard, the parts engage with a snap fit.

With an AC supply there is a tendency to hum and chatter, but quiet positive action is obtained when using a DC supply. We have devised a small full-wave selenium rectifier which is so designed as to easily fit between the terminals **18, 20** of the solenoid **16**, and the terminals **22, 24** of the flexible leads in the appliance. The rectifier housing **30** contains rectifier cells, and has a pair of fixed female DC output terminals **32, 34** which fit with the standard snap engagement on the blades **18, 20**, and has a pair of male blades **36, 38** which receive the usual female terminals **22, 24** of the AC leads **26, 28** which were originally intended to fit on the male terminals **18, 20** of the solenoid **16**.

Referring now to FIGS. 5 and 6, the rectifier **30** is shown with the female terminals **32, 34** at one end, and the male terminals or blades **36, 38** at the other end. The housing **30** is molded out of a suitable plastics material, in this case a plastic known commercially as "Lexan," which is a polycarbonate plastic. The housing is open at one end, this being the upper end as viewed in FIG. 5, and it is closed at the other end except for windows or slots **40** (FIG. 6) through which the blades **36, 38** project. The housing is filled with a solid epoxy resin or potting compound **42**, which is visible at the top of FIG. 5, and which also appears in the windows **40** of FIG. 6.

Referring now to FIG. 3 of the drawing, the cells are flat selenium cells which most simply are square in outline. There are four stacks of cells marked **51, 52, 53, 54**. Female terminals **32, 34** are each formed integrally with a flat plate **56, 58** and the latter are disposed between stacks of cells in a manner which will be evident from inspection of the drawing, the plate **56** being held directly between the stacks **51** and **54**, and the plate **58** being held directly between the stacks **52** and **53**.

One male terminal **38** is formed integrally with two plates **61, 62** which are disposed at the outside of the adjacent two stacks **51, 52**, and the other male terminal **36** is formed integrally with two plates **63, 64** which are disposed against the outside of its adjacent two stacks **53, 54**. In the position shown, the terminals **32, 34** project upward, and the terminals **36, 38** project downward. Terminal **36** is offset to the right and is beneath plate **63**, while terminal **38** is offset to the left and is beneath plate **61**.

The parts are held resiliently in face-to-face engagement by means of spring clips **66** and **68**, but in order not to short circuit the parts of the rectifier, bands of insulation **70, 72** are first slid around the assembly. More specifically, the band **70** is placed around the left subassembly of plate **61**, stack **51**, plate **56**, stack **54** and

plate **64**, and the second insulating band **72** is placed around the right hand sub-assembly of plate **62**, stack **52**, plate **58**, stack **53** and plate **63**. The spring clip **66** then is sprung around the left sub-assembly with its sleeve **70**, and spring **68** is sprung around the right sub-assembly with its sleeve **72**.

The insulating band is preferably made of a vinyl plastic which shrinks when heated, and it is dimensioned so that it is readily applied, but then is subjected to heat to shrink the same tightly in position. This shrink sleeve helps hold the plates and stacks in face-to-face relation.

The internal assembly is shown in FIG. 4, the female terminals **32, 34** being disposed in a common center plane between the pairs of stacks; the terminal plate **38** being disposed toward the left rear, and terminal plate **36** being disposed toward the right front. The drawing also shows the insulating sleeves **70** and **72** in position around the left and right hand sub-assemblies respectively, with the spring clips **66** and **68** sprung into position outside the insulating sleeves **70** and **72**.

The assembly of FIG. 4 is then potted in the housing **30**, as previously described.

In FIG. 4 it will be seen that the male terminals **36, 38** are slightly indented at **80**. There is a similar indention on the opposite side, so that the female terminal being slid thereon may be inverted without loss of the desired snap engagement. Each female terminal has a pair of parallel slots **82, 84**, leaving a strap of metal **86** therebetween. This strap is indented on the outside to provide a small projection **88** on the inside, the said projection mating with the indentation **80** on the male terminal. These details are parts of and are standardized for the N.E.M.A. design for quick-disconnect terminals, and form no part of the present invention except to the extent that the rectifier is specifically designed to be applied directly to the male terminals **18, 20** (FIGS. 1 and 2) of the solenoids **16**, and to receive the female terminals **22, 24** of the flexible leads **26, 28**. Thus our device may be used by the manufacturer of the appliance without redesign of the appliance, and without cost other than the cost of the rectifier itself.

The way the parts form an electrical bridge is shown in FIG. 7, the female terminal **32** being connected between the stacks **51** and **54**; the female terminal **34** being connected between the stacks **52** and **53**; the male terminal **38** being connected between the stacks **51** and **52**; and the male terminal **36** being connected between the stacks **53** and **54**. As here used, the male terminals **36, 38** act as AC input trminals, and the female terminals **32, 34** act as DC output terminals. The female terminals **32, 34** are connected to two opposite corners of the bridge, and the male terminals **36, 38** are connected to the other two opposite corners of the bridge.

It should be noted that the female terminals are in a common plane. This is important because the blade terminals **18, 20** (FIGS. 1 and 2) of the solenoid **16** are in a common plane. The male terminals **36, 38** of our rectifier are not in a common plane, as will be seen in FIG. 6, but this is fully acceptable because what these terminals receive are the female tips or terminals **22, 24** (FIG. 1) at the ends of the two flexible leads **26, 28**.

In the particular rectifier here shown, each stack has five selenium cells, but it will be understood that a different number may be employed, and that they may be of different dimension and configuration than here shown, while retaining the unique assembly or relationship of parts here described. The separation of plate **61** from plate **62** (FIG. 3) and the separation of plate **63** from plate **64**, is important in order to receive the insulating sleeves **70** and **72** shown in FIGS. 3 and 4.

The epoxy potted construction here illustrated is capable of withstanding continuous exposure to high humidity conditions, as in a clothes washer or dishwasher cabinet.

It is believed that the construction, method of assembly, and method of use of our improved rectifier package, as well as the advantages thereof, will be apparent from the foregoing detailed description. It wil also be apparent that while we 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.

We claim:

1. A rectifier assembly designed for slip-on insertion between a pair of flexible AC supply leads having female terminals, a pair of male terminals on an electrical device adapted to receive the AC terminals but which it is desired to operate on DC, said rectifier comprising a case containing rectifier cells, a pair of fixed female DC output terminals dimensioned and spaced to fit directly on the male terminals of the aforesaid device, and a pair of male AC input terminals dimensioned like those on the aforesaid device and thereby adapted to receive the females terminals of the AC leads which were designed to fit on the male terminals of the device, in which there are four stacks of selenium cells connected to form an electrical bridge for full wave rectification, and the female terminals of the rectifier being connected to two opposite corners of the bridge, and the male terminals of the rectifier being connected to the other two opposite corners of the bridge.

2. A rectifier assembly as defined in claim **1**, in which one female terminal of the rectifier assembly is formed integrally with a flat plate which is disposed directly between two of the stacks of cells, and the other female terminal is formed integrally with a flat plate which is disposed directly between the remaining two stacks of cells, one male terminal formed integrally with two plates which are disposed at the outside of the other two stacks.

3. A rectifier assembly as defined in claim **2**, in which the female terminals project from their integral plates in one direction, and the male terminals project from their integral plates in opposite direction, one male terminal being offset to project from one of its two plates, and the other male terminal being oppositely offset to project from the other of its two plates.

4. A rectifier assembly as defined in claim **3**, in which an insulating member is disposed on each sub-assembly of male plate, stack, female plate, stack, and male plate, arranged in the recited order, and in which a spring clip is disposed around each insulating member and is so dimensioned as to hold said plates and stacks in snug-face-to-face engagement.

5. A rectifier assembly as defined in claim **3**, in which there is a space between two integral plates of each male terminal, and in which an insulating sleeve is disposed around each sub-assembly of male plate, stack, female plate, stack, and male plate, arranged in the recited order, and in which said sleeve fits tightly around the sub-assembly and helps to hold the said plates and stacks in snug face-to-face engagement

6. A rectifier assembly designed for slip-on insertion between a pair of flexible AC supply leads having female terminals, and a pair of male terminals on an electrical device adapted to receive the AC terminals but which it is desired to operate on DC, said rectifier comprising a case containing rectifier cells, a pair of fixed female DC output terminals dimensioned and spaced to fit directly on the male terminals of the aforesaid device, and a pair of male AC input terminals dimensioned like those on the aforesaid device and thereby adapted to receive the female terminals of the AC leads which were designed to fit on the male terminals of the device, in which the electrical device is the solenoid of a solenoid operated water valve, and in which there are four stacks of selenium cells connected to form an electrical bridge for full wave rectifications, the female terminals of the rectifier being connected to two opposite corners of the bridge, and male terminals of the rectifier being connected to the other two of said corners of the bridge, and in which one female terminal of the rectifier assembly is

formed integrally with a flat plate which is disposed directly between two of the stacks of cells, and the other female terminal is formed integrally with a flat plate which is disposed directly between the remaining two stacks of cells, one male terminal being formed integrally with two plates which are disposed at the outside of two of the stacks, and the other male terminal being formed integrally with two plates which are disposed at the outside of the other two stacks.

7. A rectifier assembly as defined in claim **6**, in which the female terminals project from their integral plates in one direction, and the male terminals project from their integral plate in opposite direction, one male terminal being offset to project from one of its two plates, and the other male terminal being oppositely offset to project from the other of its two plates.

8. A rectifier assembly as defined in claim **6**, in which an insulating member is disposed on each sub-assembly of male plate, stack, female plate, stack, and male plate, arranged in the recited order, and in which a spring clip is disposed around each insulating member and is so dimensioned as to hold said plates and stacks in snug face-to-face engagement.

9. A rectifier assembly as defined in claim **6**, in which there is a space between the two integral plates of each male terminal, and in which an insulating sleeve is disposed around each sub-assembly of male plate, stack, female plate, stack and male plate, arranged in the recited order, and in which said sleeve fits tightly around the sub-assembly and helps to hold the said plates and stacks in snug face-to-face engagement.

10. A rectifier assembly designed for slip-on insertion between a pair of flexible AC supply leads having female terminals, and a pair of male terminals on an electrical device adapted to receive the AC terminals but which it is desired to operate on DC, said rectifier comprising a case containing rectifier cells, a pair of fixed female DC output terminals dimensioned and spaced to fit directly on the male terminals of the aforesaid device, and a pair of male AC input terminals dimensioned like those on the aforesaid device and thereby adapted to receive the female terminals of the AC leads which were designed to fit on the male terminals of the device, in which one female terminal of the rectifier assembly is formed integrally with a flat plate which is disposed directly between two stacks of cells, and the other female terminal

is formed integrally with a flat plate which is disposed directly between two other stacks of cells, one male terminal being formed integrally with two plates which are disposed at the outside of two stacks, and the other male terminal being formed integrally with two plates which are disposed at the outside of the other two stacks.

11. A rectifier assembly as defined in claim **10**, in which the female terminals project from their integral plates in one direction, and the male terminals project from their integral plates in opposite direction, one male terminal being offset to project from one of its two plates, and the other male terminal being oppositely offset to project from the other of its two plates.

12. A rectifier assembly as defined in claim **10**, in which an insulating member is disposed on each sub-assembly of male plate, stack, female plate, stack, and male plate, arranged in the recited order, and in which a spring clip is disposed around each insulating member and is so dimensioned as to hold said plates and stacks in snug face-to-face engagement.

13. A rectifier assembly as defined in claim **10**, in which there is a space between the two integral plates of each male terminal, and in which an insulating sleeve is disposed around each sub-assembly of male plate, stack, female plate, stack and male plate, arranged in the recited order, and in which said sleeve fits tightly around the sub-assembly and helps to hold the said plates and stacks in snug face-to-face engagement.

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U.S. Cl. X.R.

307—112, 146; 339—154, 156, 258