

PATENT SPECIFICATION

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(19)



(54) MULTIPHASE FULL-WAVE RECTIFIER ASSEMBLY

(71) We, LUCAS INDUSTRIES LIMITED, a British Company of Great King Street, Birmingham, England, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:-

This invention relates to a multiphase full-wave rectifier assembly and also to an alternator incorporating such a rectifier assembly.

It is an object of the present invention to provide a multiphase full-wave rectifier assembly which is relatively simple to assemble.

According to one aspect of the present invention, there is provided a multiphase full-wave rectifier assembly comprising a first plate, a first set of diodes carried by the first plate, a second plate disposed substantially parallel to the first plate and having holes therein, a terminal of each diode of the first set extending through a respective one of the holes in the second plate, a second set of diodes carried by the second plate, an electrical connector electrically interconnecting said terminal of each diode of the first set with a respective diode of the second set and being adapted for connection to a respective phase to be rectified, a support structure including an electrically insulating body having recesses therein, a third set of diodes disposed in the recesses respectively, the recesses being shaped so as to hold the diodes of the third set in predetermined relative positions, each diode of the third set having a pair of terminals one of which is electrically connected to a respective one of the electrical connectors, and a common electrical connector electrically connecting together the other terminals of the diodes of the third set.

Each recess in the electrically insulating body preferably includes a first portion

which receives a body of the respective diode of the third set, and further portions which receive respectively the terminals of said respective diode, the further recess portions being shaped so as to hold said terminals in predetermined relative positions.

According to a second aspect of the present invention, there is provided an alternator comprising a housing, a rotor and a stator in said housing, said housing having an end wall, an end cap overlying the end wall to define a cavity between the cap and the end wall, a multiphase full-wave rectifier assembly as defined hereinabove disposed in the cavity, means securing the end cap to the rectifier assembly, and detachable fixing means engaging the first plate of the rectifier assembly and the end wall to secure detachably the rectifier assembly on the end wall whereby the end cap is supported on the end wall through the intermediary of the rectifier assembly.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a plan view of a multiphase full-wave rectifier assembly according to the present invention, for an alternator;

Fig. 2 is a cross-sectional view of part of the rectifier assembly shown in Fig. 1;

Fig. 3 is a front elevation of an insulating member forming part of the rectifier assembly shown in Figs. 1 and 2;

Fig. 4 is a cross-sectional view on the line 4-4 in Fig. 3;

Fig. 5 is a side elevation of the insulating member shown in Fig. 3;

Fig. 6 is an underneath view of the rectifier assembly shown in Fig. 1;

Fig. 7 is a side elevation of the rectifier assembly shown in Fig. 1;

Fig. 8 is a schematic exploded view of part of the rectifier assembly illustrated in Fig. 1, but showing the part in a different form to

that shown in Fig. 1;

Fig. 9 is a cross-sectional view of the part of the rectifier assembly shown in Fig. 8;

Fig. 10 is another view of part of the rectifier assembly shown in Fig. 1;

Fig. 11 is a plan view of a positive plate which forms part of the rectifier assembly shown in Fig. 1;

Fig. 12 is a side elevation of the positive plate shown in Fig. 11, with part of the plate being sectioned on the line 12-12 in Fig. 11;

Fig. 13 is a plan view of a cover forming part of an electrically insulating body of the rectifier assembly shown in Fig. 1;

Fig. 14 is a plan view of a negative plate of the rectifier assembly shown in Fig. 1;

Fig. 15 is a side elevation of the negative plate shown in Fig. 14, with part of the plate being shown in a section on the line 15-15 in Fig. 4;

Fig. 16 is an underneath plan view of part of the electrically insulating body of the rectifier assembly; and

Fig. 17 is a section on the line 17-17 in Fig. 16.

Referring to the drawings, the rectifier assembly is a three phase, full-wave rectifier assembly which is intended to be mounted on an end wall of an alternator for a motor vehicle, the alternator comprising a housing of which the end wall forms part, a stator (not shown), a rotor (not shown) and an end cap (also not shown) which overlies the end wall to define a cavity within which the rectifier assembly is located, in use.

The rectifier assembly comprises generally a negative plate 101 carrying three diodes 102, a positive plate 103 carrying another three diodes 104, and electrically insulating body 105 carrying a further three diodes 106, and three metal connectors 107.

The negative plate 101 has three apertures 108 therein (see particularly Figs. 14 and 15) formed by a plunging operation and each diode 102 is mounted in a respective one of the apertures 108 so that its anode terminal is electrically connected with the negative plate 101. The negative plate 101 also has a pair of further apertures 109 therethrough which serve to enable the plate 101 to be secured to the plate 103 and the body 105, as will be described hereinafter. The negative plate 101 further has a pair of apertures 110 and a slot 111 therein which enables the rectifier assembly to be mounted on the aforementioned end wall of the alternator housing, as will be described hereinafter. Each diode 102 has a cathode terminal 112 extending perpendicularly from the plate 101.

The positive plate 103 lies over the negative plate 101, extends parallel thereto and is electrically insulated therefrom by a thin electrically insulating layer 113 (see Figs. 9 and 10). The electrically insulating layer 113 is sufficiently thin that the positive plate 103

is in heat exchange relationship with the negative plate 101. The positive plate 103 is provided with three plunged apertures 114 therein (see particularly Figs. 11 and 12), each of which apertures 114 receives a respective one of the diodes 104 with its anode terminal electrically connected to the plate 103. The plate 103 is also provided with a pair of apertures 115 therein to enable the assembly of plates 101 and 103 and body 105 to be fastened together as will be described hereinafter. The plate 103 is further provided with a set of three apertures 116 therein. The apertures 116 are aligned with the diodes 102 when the plates 103 and 101 are secured together so that the cathode terminals 112 of the diodes 102 on plate 101 extend through the respective apertures 116 and are electrically isolated from the plate 103. Anode terminals 117 of the diodes 104 extend in parallel, spaced relationship with respect to each other and to the cathode terminals 112, and also extend perpendicularly with respect to the positive plate 103. The positive plate 103 is also formed with three pairs of integral posts 118 (see Figs. 10, 11 and 12 - the posts 118 in Fig. 10 are only shown very diagrammatically). The posts 118 in each pair define therebetween a recess 119 within which is engaged an electrically insulating member 120 (see particularly Figs. 1 to 5). Each insulating member 120 has a pair of opposed recesses 121 therein into each of which a respective post 118 is received. Each insulating member 120 is provided with an integral flange 122 having a rebated slot 123 therein. Each insulating member 120 also has a slit 124 therethrough, and a further slot 125, the latter slot 125 being provided for enabling deformation of the insulating member 120 to facilitate its mounting between the respective posts 118. The slit 124 receives part of a respective one of the metal connectors 107, as will be described hereinafter. The purpose of the rebated slot 123 will also be described hereinafter.

The insulating body 105 comprises an electrically insulating, synthetic plastics moulding 126 and an electrically insulating, moulded cover 127 (see Figs. 8, 13, 16 and 17 in particular). The moulding 126 is provided with three spaced recesses 128 which are each configured to receive the body and terminals 129 of a respective one of the diodes 106 so as to hold that diode 106 in the required position with the terminals 129 projecting upwardly from the moulding 126. The moulding 126 is also provided with another set of recesses 130 therein for receiving end portions 131 of the connectors 107, respectively. The moulding 126 also has a further recess 132 therein, said recess 132 receiving a common connector 133 for the diodes 106. The common connector 133 is

provided with three connector tags 134 which are disposed externally of the body 105 and which receive one of the terminals 129 of a respective one of the diode 106.

The moulded cover 127 is, by reason of the provision of recesses 135 and projections 136, shaped to permit said one of the terminals 129 of each diode 106 to project externally of the body 105 and also to trap the end portions 131 of the connectors 107 and the diodes 106 within the body 105 when the cover 127 is assembled on the moulding 126. One form of projection 136 is shown in Fig. 8, while another form thereof is shown in Fig. 13.

Each of the metal connectors 107 is provided with an intermediate portion 137 which is integrally connected with the end portion 131 via a cranked portion 138. On the opposite side of the intermediate portion 137 to the cranked portion 138, the intermediate portion 137 is integrally united with a tongue 139 via a further cranked portion 140. Each tongue 139 passes through the slit 124 in the respective insulating member 120 and on the opposite side of the insulating member 120 to the intermediate portion 137, is provided with a rebated slot 141. The intermediate portion 137 is provided with three plunged holes 142 therethrough. The middle hole 142 receives the other of the terminals 129 of the respective diode 106, whilst the outer holes 142 receive the cathode and anode terminals 112 and 117 of the diodes 102 and 104, respectively.

The arrangement of plates 101, 103, body 105, diodes 102, 104, and 106, and connectors 107 and 133 is such that the joints between the connectors 107 and diodes 102, 104 and 106, and between connector 133 and diodes 106 are all co-planar so that a flow soldering operation can be effected to solder the joints between the connectors and the diodes. This considerably facilitates manufacture of the rectifier assembly. Furthermore, before the soldering operation is effected, the connectors 107 are supported firmly in the desired position by reason of their engagement in the respective recesses 130 in the moulding 126 and by reason of their engagement in the respective slits 124 in the insulating members 120. Additionally, the common connector 133 is firmly retained in position by reason of its engagement in the recess 132 in the moulding 126. Additionally, the diodes 106 which, as can be seen from the drawings, are relatively small, are also retained with their terminals 129 in the desired position by reason of their engagement in the configurated recesses 128 in the moulding 126.

To assemble the plates 101 and 103 and body 105, the plate 103, with its diodes 104 in position, is placed over the plate 101 with its diodes 102 in position, with the insulating

layer 113 between the plates 101 and 103. The plates 101 and 103 are so mutually positioned that the terminals 112 of the diodes 102 pass with clearance through the apertures 116 in the plate 103 and so that the apertures 109 and 115 in the plates 101 and 103, respectively, are aligned. Then, the moulding 126 is placed over the plate 103 so that apertures 143 provided in the moulding 126 are aligned with the apertures 115, respectively. For the sake of convenience, the apertures 143 are not shown in Fig. 8. In the region of each aperture 143, the moulding 126 is provided with an integral bush 144 which, when the moulding 126 is assembled on the plate 103, passes into the respective aperture 115 in the plate 103. Following this, the diodes 106 are mounted in their respective recesses 128 in the moulding 126, and the common connector 133 and metal connectors 107 are mounted in position after the insulating member 120 have been engaged with their respective posts 118. After this, the cover 127 is fitted and the assembly of plates 101, 103, moulding 126 and cover 127 are secured together by means of eyelet rivets 145 passed through the apertures 143, 115 and 109. The provision of the bushes 144 ensures that each eyelet rivet 145, which is formed of metal and is therefore electrically conducting, does not become engaged with the plate 103 since it engages directly against the plate 101. With all the parts held firmly in the required positions, a flow soldering operation can be easily effected upon the joints between the connectors and the diode terminals.

When the rectifier assembly is to be mounted in the alternator, the end cap of the alternator is first mounted on the assembly by means of fixing screws (not shown) which pass through the eyelet rivets 145. Then, the end cap and rectifier assembly are mounted on the end wall of the alternator housing using fixing screws which pass through the apertures 110 in the plate 101 and engage in threaded holes in the end wall. The screws used to effect this operation have heads which abut directly against the plate 101, thus effecting a metal to metal contact which not only improves the necessary electrical connection between the plate 101 and the end wall of the alternator housing, but also ensures a firm mounting. It will thus be seen that the end cap of the alternator is mounted on the end wall of the alternator housing through the intermediary of the rectifier assembly. Apertures will be provided, of course, in alignment with the apertures 110 in the plate 101 to enable access to be gained to the fixing screws passing through said apertures 110. The end cap is also provided with further apertures therein to enable access to be gained to conductor leads from the phases of the stator to be rectified. There

are three such leads provided and insulated portions thereof are clipped into the respective rebated slots 123 of the members 120 whilst bared ends thereof are clipped into the rebated slots 141 in the respective tongues 139. The joints between the bared ends of the conductors and the tongues 139 is rendered permanent by means of a soldering operation.

It will be appreciated from the above that the multiwave rectifier assembly is relatively easy to manufacture because the connectors 107 and 133 are held in the desired positions, before a soldering operation is effected, by means of the insulating members 120 and the body 105.

The other parts of the rectifier assembly which have been illustrated in the accompanying drawings but which have not been described form no part of the present invention and therefore a description of such parts is deemed to be unnecessary.

WHAT WE CLAIM IS:-

1. A multiphase full-wave rectifier assembly comprising a first plate, a first set of diodes carried by the first plate, a second plate disposed substantially parallel to the first plate and having holes therein, a terminal of each diode of the first set extending through a respective one of the holes in the second plate, a second set of diodes carried by the second plate, an electrical connector electrically interconnecting said terminal of each diode of the first set with a respective diode of the second set and being adapted for connection to a respective phase to be rectified, a support structure including an electrically insulating body having recesses therein, a third set of diodes disposed in the recesses respectively, the recesses being shaped so as to hold the diodes of the third set in predetermined relative positions, each diode of the third set having a pair of terminals one of which is electrically connected with a respective one of the electrical connectors, and a common electrical connector electrically connecting together the other terminals of the diodes of the third set.

2. A rectifier assembly as claimed in Claim 1, wherein each recess in the electrically insulating body includes a first portion which receives a body of the respective diode of the third set, and further portions which receive respectively the terminals of said respective diode, the further recess portions being shaped so as to hold said terminals in predetermined relative positions.

3. A rectifier assembly as claimed in Claim 1 or 2, wherein the support structure also includes a cover having portions which overlie the recesses in the electrically insulating body, respectively, the cover portions being shaped so as to prevent disengagement of the diodes of the third set of the recesses but to permit said terminals thereof to project from the cover.

ject from the cover.

4. A rectifier assembly as claimed in Claim 3, wherein the cover is electrically insulating.

5. A rectifier assembly as claimed in any preceding claim, wherein the electrically insulating body is provided with further recesses therein for receiving one end of each electrical connector so that the electrical connectors are at least partially supported by the electrically insulating body.

6. A rectifier assembly as claimed in any preceding claim, wherein the electrically insulating body has another recess therein which receives and supports the common electrical connector.

7. A rectifier assembly as claimed in any preceding claim, wherein the first and second plates and the electrically insulating body are provided with mutually aligned apertures therein, and fixing means extends through the aligned apertures and secures the electrically insulating body, and the first and second plates together, the first and second plates being electrically insulated from each other.

8. A rectifier assembly as claimed in any preceding claim, wherein joints between said one terminals of the diodes of the third set and the electrical connectors are disposed substantially co-planarly with joints between said terminals of the diodes of the first set, the diodes of the second set and the electrical connectors, so as to facilitate a flow soldering operation thereon.

9. A rectifier assembly as claimed in any preceding Claim, further comprising electrically insulating support means by which the electrical connectors are at least partially supported, and carrier means disposed on at least one of the first and second plates and carrying the electrically insulating support means.

10. A rectifier assembly as claimed in according to Claim 9, wherein the electrically insulating support means comprises a separate electrically insulating support means for each electrical connector.

11. A rectifier assembly as claimed in Claim 10, wherein the carrier means comprises a plurality of pairs of spaced posts, between each of which a respective one of the support members is engaged.

12. A rectifier assembly as claimed in Claim 10 or 11, wherein each support member is provided with a slot therethrough, each electrical connector extends through the slot in the respective support member to be connectible, on one side of said support member, with the respective phase to be rectified and, on the other side of said support member, with said terminal of the respective diode of the first set and with the respective diode of the second set.

13. A rectifier assembly as claimed in Claim 10, 11 or 12, wherein each support

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are three such leads provided and insulated portions thereof are clipped into the respective rebated slots 123 of the members 120 whilst bared ends thereof are clipped into the rebated slots 141 in the respective tongues 139. The joints between the bared ends of the conductors and the tongues 139 is rendered permanent by means of a soldering operation.

It will be appreciated from the above that the multiwave rectifier assembly is relatively easy to manufacture because the connectors 107 and 133 are held in the desired positions, before a soldering operation is effected, by means of the insulating members 120 and the body 105.

The other parts of the rectifier assembly which have been illustrated in the accompanying drawings but which have not been described form no part of the present invention and therefore a description of such parts is deemed to be unnecessary.

WHAT WE CLAIM IS:-

1. A multiphase full-wave rectifier assembly comprising a first plate, a first set of diodes carried by the first plate, a second plate disposed substantially parallel to the first plate and having holes therein, a terminal of each diode of the first set extending through a respective one of the holes in the second plate, a second set of diodes carried by the second plate, an electrical connector electrically interconnecting said terminal of each diode of the first set with a respective diode of the second set and being adapted for connection to a respective phase to be rectified, a support structure including an electrically insulating body having recesses therein, a third set of diodes disposed in the recesses respectively, the recesses being shaped so as to hold the diodes of the third set in predetermined relative positions, each diode of the third set having a pair of terminals one of which is electrically connected with a respective one of the electrical connectors, and a common electrical connector electrically connecting together the other terminals of the diodes of the third set.

2. A rectifier assembly as claimed in Claim 1, wherein each recess in the electrically insulating body includes a first portion which receives a body of the respective diode of the third set, and further portions which receive respectively the terminals of said respective diode, the further recess portions being shaped so as to hold said terminals in predetermined relative positions.

3. A rectifier assembly as claimed in Claim 1 or 2, wherein the support structure also includes a cover having portions which overlie the recesses in the electrically insulating body, respectively, the cover portions being shaped so as to prevent disengagement of the diodes of the third set of the recesses but to permit said terminals thereof to pro-

ject from the cover.

4. A rectifier assembly as claimed in Claim 3, wherein the cover is electrically insulating.

5. A rectifier assembly as claimed in any preceding claim, wherein the electrically insulating body is provided with further recesses therein for receiving one end of each electrical connector so that the electrical connectors are at least partially supported by the electrically insulating body.

6. A rectifier assembly as claimed in any preceding claim, wherein the electrically insulating body has another recess therein which receives and supports the common electrical connector.

7. A rectifier assembly as claimed in any preceding claim, wherein the first and second plates and the electrically insulating body are provided with mutually aligned apertures therein, and fixing means extends through the aligned apertures and secures the electrically insulating body, and the first and second plates together, the first and second plates being electrically insulated from each other.

8. A rectifier assembly as claimed in any preceding claim, wherein joints between said one terminals of the diodes of the third set and the electrical connectors are disposed substantially co-planarly with joints between said terminals of the diodes of the first set, the diodes of the second set and the electrical connectors, so as to facilitate a flow soldering operation thereon.

9. A rectifier assembly as claimed in any preceding Claim, further comprising electrically insulating support means by which the electrical connectors are at least partially supported, and carrier means disposed on at least one of the first and second plates and carrying the electrically insulating support means.

10. A rectifier assembly as claimed in according to Claim 9, wherein the electrically insulating support means comprises a separate electrically insulating support means for each electrical connector.

11. A rectifier assembly as claimed in Claim 10, wherein the carrier means comprises a plurality of pairs of spaced posts, between each of which a respective one of the support members is engaged.

12. A rectifier assembly as claimed in Claim 10 or 11, wherein each support member is provided with a slot therethrough, each electrical connector extends through the slot in the respective support member to be connectible, on one side of said support member, with the respective phase to be rectified and, on the other side of said support member, with said terminal of the respective diode of the first set and with the respective diode of the second set.

13. A rectifier assembly as claimed in Claim 10, 11 or 12, wherein each support



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member includes a recessed portion which engages, in use, an electrical lead carrying the respective phase to be rectified, so that connection of a bared end of the electrical lead to the respective electrical connector is facilitated by the bared end supported by the recessed portion in a desired position relative to the respective electrical connector.

14. A rectifier assembly as claimed in Claim 9, wherein the carrier means is provided on only one of the first and second plates.

15. A rectifier assembly as claimed in Claim 14, wherein the carrier means is provided on the second plate only.

16. A rectifier assembly as claimed in Claim 9, wherein the first and second plates, the first and second sets of diodes, the electrical connectors and the support means are so located relative to each other that joints between the terminals of the diodes and the electrical connectors are disposed substantially co-planarly so as to facilitate a flow soldering operation thereon.

17. A rectifier assembly as claimed in Claim 9, wherein the electrically insulating body has further recesses therein, in each of which a portion of a respective one of the electrical connectors is engaged, such that each electrical connector is supported jointly by the electrically insulating body and by the support means in a desired position so as to facilitate the forming of joints between the

electrical connectors and the diodes of the first, second and third sets.

18. An alternator comprising a housing, a rotor and a stator in said housing, said housing having an end wall, an end cap overlying the end wall to define a cavity between the cap and the end wall, a multiphase full-wave rectifier assembly as claimed in any preceding claim, disposed in the cavity, means securing the end cap to the rectifier assembly, and detachable fixing means engaging the first plate of said rectifier assembly and the end wall to secure detachably the rectifier assembly on the end wall whereby the end cap is supported on the end wall through the intermediary of the rectifier assembly.

19. An alternator as claimed in claim 18, wherein said securing means also serves to secure together individual components of said rectifier assembly.

20. A multiphase full-wave rectifier assembly substantially as hereinbefore described with reference to the accompanying drawings.

21. An alternator substantially as hereinbefore described with reference to the accompanying drawings.

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