

# (12) UK Patent Application (19) GB (11) 2 068 177 A

(21) Application No 8101288

(22) Date of filing  
16 Jan 1981

(30) Priority data

(31) 3001522

(32) 17 Jan 1980

(33) Fed Rep of Germany  
(DE)

(43) Application published  
5 Aug 1981

(51) INT CL<sup>3</sup> H01H 85/04  
H02K 11/00

(52) Domestic classification  
H2G DA  
H2A JH TT

(56) Documents cited

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(58) Field of search  
H2G

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## (54) An electrical connection system for rectifiers

(57) Rectifier diodes can only be operated up to a maximum current without failure and attempts have been made to protect diodes by fuses or electronic protective arrangements. However, the former require the provision of holders which precludes minaturisation of the assembly and the latter are too expensive for general use.

The invention provides an electrical connection in which a conductor (22) which receives the phase terminal connection (12) and which connects the positive and negative diodes (15, 17) has a portion (28) which is cooled to a lesser extent than the remainder of the conductor. In one embodiment the conductor is embedded in a plate-shaped insulating body (23) which has an

opening (27) at which the said portion (28) is exposed. In another embodiment the said portion (28) has a smaller cross-sectional area than the remainder of the conductor. The said portion (28) fuses in the event of over-loading of the connection.

Fig.1

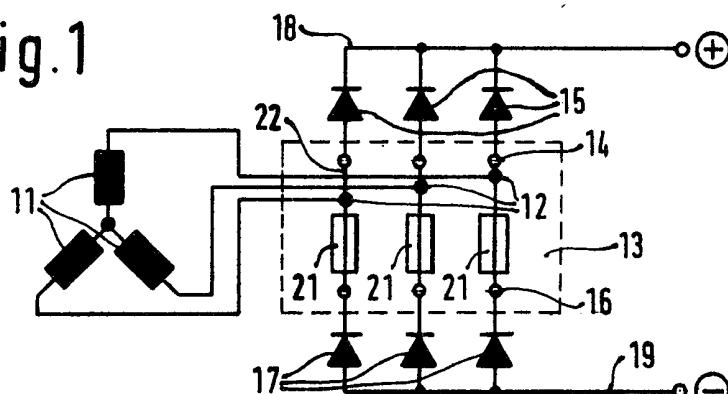
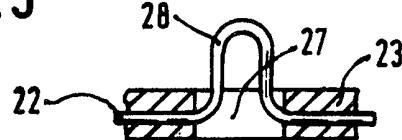


Fig.3



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Fig.1

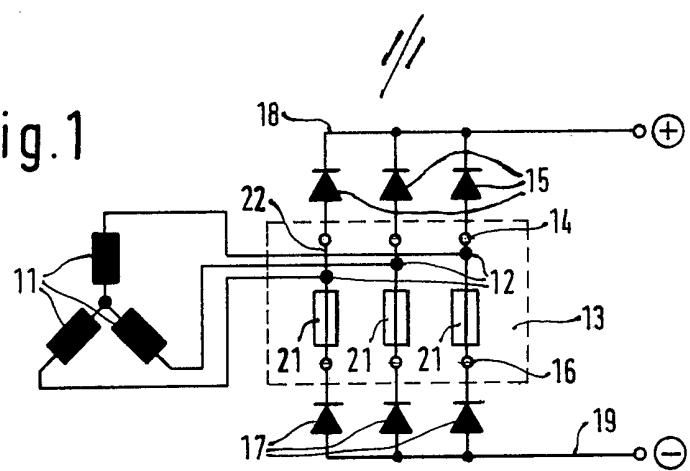


Fig. 2

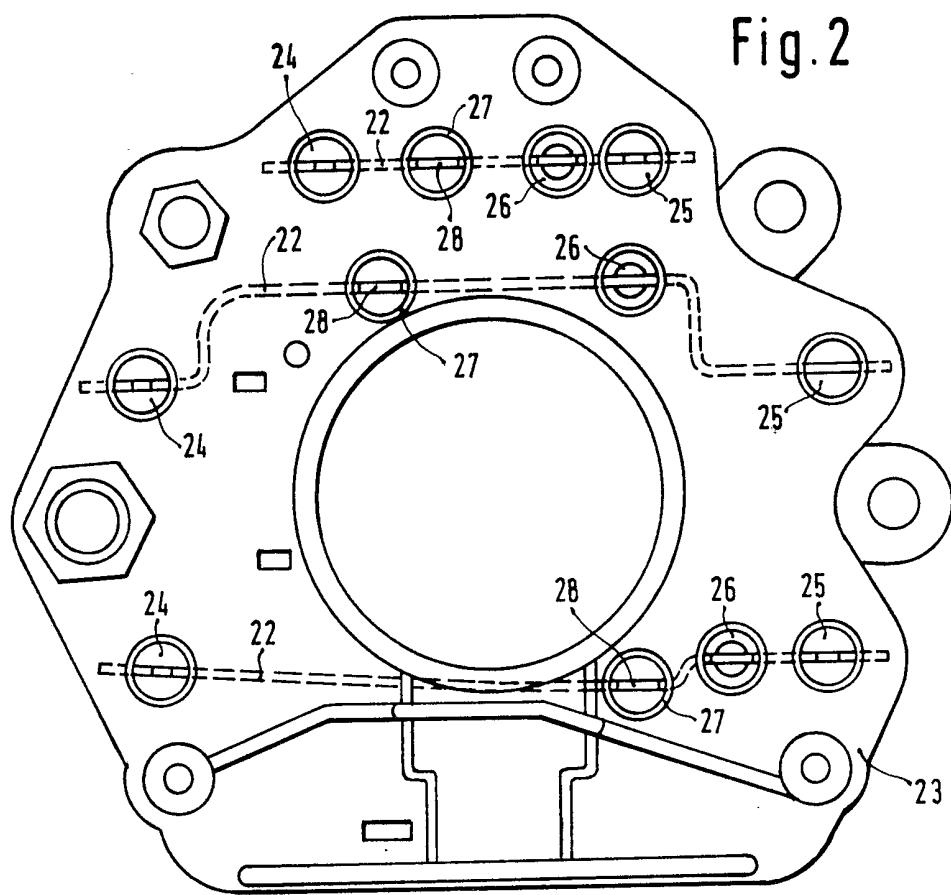
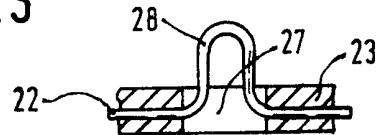


Fig. 3



## SPECIFICATION

**An electrical connection system for rectifiers**

5 The invention relates to an electrical connection system for rectifiers and in particular to three phase bridge rectifiers for generators for motor vehicles.

10 In dependence upon their construction and their heat sink, rectifier diodes can only be operated up to a maximum current. The diodes are destroyed if the maximum current is exceeded. Destruction of this kind frequently occurs in battery charging systems in motor vehicles when the battery to be charged is connected with incorrect polarity. In this case, the power diodes of the rectifier are switched in the forward direction, and a relatively high current flows which generally destroys the diodes. Attempts have already been made to protect the diodes by fuses. However, fuses require additional space, thus precluding miniaturisation of the components. Furthermore,

15 20 25 30

holders for fuses are not suitable for the unfavourable operating conditions in the engine compartment. Electronic protective arrangements have also been developed. However, arrangements of this kind are too expensive for general use.

According to the present invention there is provided an electrical connection system for a.c. rectifiers, having conductors for connecting the phase terminals to the associated terminals of the rectifier diodes, in which at least one of the conductors has a portion whose surface is cooled to a lesser extent than the remainder of the conductor.

40 In contrast to the prior art, the electrical connection system in accordance with the invention has the advantage that additional components are not required. Nevertheless, the power diodes are fully protected. The system at the same time indicates whether a 45 rectifier malfunction has been caused by an inadmissibly high current, or whether failure of a diode as a result of a flaw in its manufacture may be responsible.

50 The system can be mounted on the rectifier and in the generator in a rapid manner susceptible to a minimum amount of trouble by embedding the system, in accordance with the invention, in a printed circuit board. Thus, an indication function is provided in addition 55 to the protective function. The repairer can readily detect whether one of the safety loops has fused. Finally, it is even possible to effect a temporary repair simply by soldering the ends of the safety loops together after a fault 60 has occurred. The connection system in accordance with the invention is compatible, that is to say, it is interchangeable with a system already existing.

65 The present invention will now be described further, by way of example only with refer-

ence to the accompanying drawings, in which:—

Figure 1 is an electrical circuit diagram, Figure 2 shows a printed circuit board in

70 accordance with the invention, and

Figure 3 shows a detail, that is to say, a construction of the fuse and indicator wire.

The diagram of Fig. 1 shows in the first instance the star-connected phase system 11 75 of a three-phase generator. The ends of the windings are connected to the phase terminals 12 of a rectifier system which are disposed on a circuit board 13. The circuit board 13 includes further connection points 14 for the 80 anode terminals of positive diodes 15 and connection points 16 for the cathode terminals of negative diodes 17. The cathodes of the positive diodes 15 are connected to a positive terminal 18 such as a positive heat sink, and the anode terminals of the negative diodes 17 are connected to a negative terminal 19 such as a negative heat sink. The arrangement described up to this point is known. The novel features are the safety 90 elements 21 which constitute portions of conductors 22 which inter-connect the connection points 14 and 16.

Fig. 2 shows the actual construction of the invention. The conductors 22 are embedded 95 in a printed circuit board 23 made from insulating material. The printed circuit board 23 incorporates a number of known openings and a number of novel openings. By way of example, the openings 24 in which the conductors 22 extend are known. After the final 100 assembly of the printed circuit board, the anode terminals of the positive diodes 15 extend into the openings 24, and the anode terminals are connected to the associated conductor 22 at these locations by, for example, welding. Furthermore, openings 25 are known which serve for connecting the cathode terminals of the negative diodes 17 to the associated conductor 22. Finally, openings 26 105 110 115 120

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which is remote from the diodes 15, 17.

Alternatively, the portion 28 can be guided linearly through the further opening 27 instead of in the form of a loop. In addition, it 5 may be advantageous for the portion 28 to have a smaller cross section than the other portions of the conductor 22. The cross section of the portion 28 is dimensioned such that the portion 28 can carry, without destruction, the normal maximum current occurring 10 during operation of the rectifier 15, 17, although it fuses at a current value exceeding the predetermined maximum current.

## 15 CLAIMS

1. An electrical connection system for a.c. rectifiers, having conductors for connecting the phase terminals to the associated terminals of the rectifier diodes, in which at least 20 one of the conductors has a portion whose surface is cooled to a lesser extent than the remainder of the conductor.
2. A connection system as claimed in claim 1, in which the conductors are embedded 25 in a substantially plate-shaped insulating body which serves to cool the conductors and which body has openings by means of which the conductors are connectible to terminals of the rectifiers, and/or the phase terminals, and that a further opening is provided 30 for each of the said portions of the conductors at which the said portions are exposed.
3. A connection system as claimed in claim 2, in which the said portions of the 35 conductors are guided rectilinearly through the further openings.
4. A connection system as claimed in claim 2, in which said portions of the conductors are bent to project out of the further 40 openings in a loop-shaped manner.
5. A connection system as claimed in any of the preceding claims, in which the said portion of the conductors has a smaller cross-sectional area than the other portions of the 45 conductors.
6. A connection system as claimed in claim 4 or 5, in which the loop-shaped portions of the conductors are disposed on that side of the printed circuit board which is 50 remote from the rectifier diodes.
7. An electrical connection system as claimed in any preceding claim for a three-phase bridge rectifier for generators useable in motor vehicles.
- 55 8. An electrical connection system constructed and arranged and adapted to operate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.