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(71) Applicant: **Meccanotecnica Codognese S.p.A.**
26845 Codogno (Lodi) (IT)

(72) Inventor: **Falchetti, Antonio**
26845 Codogno (LO) (IT)

(74) Representative: **Simino, Massimo et al**
Perani Mezzanotte & Partners
Piazza S. Babila, 5
20122 Milano (IT)

(54) An improved high-current protection device

(57) A high-current protection device (1) comprises a single conductive plate (5) formed in a single piece of a first conductive material and having an input conductive portion (6) connected to an output conductive portion (7) by means of a fuse portion (8), and fuse means (15) made of a second conductive material which are fixed to the conductive plate (5) and are in electrical communication therewith. In particular, the first conductive material has an electrical conductivity greater than the electrical conductivity of the second conductive material.

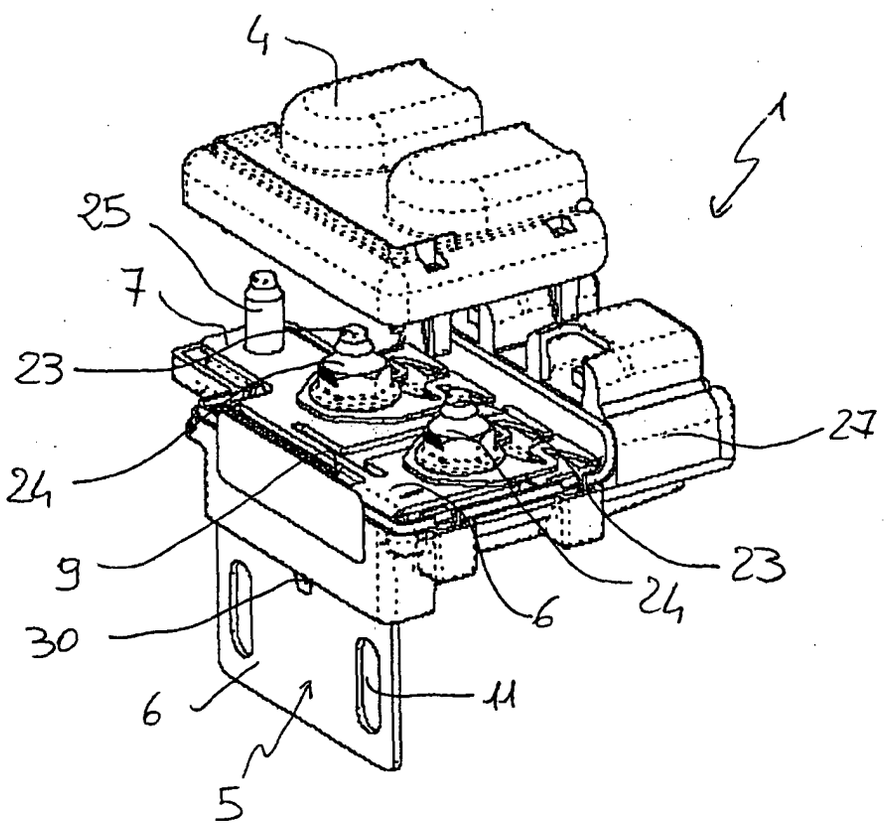

Fig.2

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Description

[0001] The present invention relates to a high-current protection device according to the preamble to Claim 1.

[0002] More particularly, the present invention relates to an improved high-current protection device for use in the automotive industry.

[0003] The term "high current" used herein relates to currents greater than or equal to 40 A.

[0004] As is known, motor cars are provided with fuses for protecting the supply lines of the electrical user devices. In particular, alongside the conventional use of low-power and medium-power fuses which are arranged for protecting the auxiliary electrical services of the motor vehicle, the use of power fuses has been introduced to protect the primary users such as, for example, ABS device, air-conditioning, plugs for diesel engines, alternator, electronic injection, radiator fans, automatic gearbox, electronic control units, petrol pump, etc...

[0005] Generally, the power fuses that are used mostly are those having nominal currents of between 20 and 100 A, although it may sometimes be necessary to use power fuses having higher nominal currents, for example, of the order of 400 A.

[0006] In contrast with low-power and medium-power fuses, power fuses do not in practice need to be replaced during the whole life cycle of the motor vehicle, except after particular events such as, for example, serious electrical short-circuits. In this situation, overload currents are caused to flow through the portion of the fuse having a small conductive cross-section, leading to considerable heating which causes that portion to melt.

[0007] An example of a high-current protection device is described, for example, in patent application EP-A-924734. This protection device comprises an input conductive portion which is connected electrically to a plurality of output conductive portions by means of respective fuse elements so as to form a single conductive plate which is produced in a single piece from a conductive-metal plate. The conductive plate is housed inside a protective housing or a fuse-holder box, both to prevent dangerous leakages of molten material and to ensure suitable thermal insulation.

[0008] If one of the fuse elements melts, the supply to the corresponding user is interrupted but the users that are protected by the remaining fuse elements remain usable. This situation may sometimes be unsatisfactory or even dangerous, for example, when the event has occurred in a primary user of considerable importance. In this case, it may be necessary also to interrupt the supply to other users, for example, for reasons connected with vehicle and driver safety. There is therefore a need to have available a high-current protection device which permits selective control of the users connected thereto.

[0009] The most important primary electrical user is generally the alternator which has to be protected by power fuses having nominal currents of up to 400 A. The other primary electrical users, on the other hand, are protected by medium-power fuse elements to which nominal current values of between 40 and 80 A are attributed, that is approximately one order of magnitude less than the nominal current value of the power fuse.

[0010] However, it is difficult to produce power and medium-power fuses on the same conductive plate in view of the high ratio, that is 1 to 10, between the nominal current value attributed to the power fuse and that of the medium-power fuses. This ratio between the currents in fact translates into an almost identical ratio between the cross-sections of the fusible portions of the fuse elements. It should also be borne in mind that, as the surface area of the fusible portion is increased, the heat dissipation also increases, as does the drop in electrical potential. In comparison with the typical dimensions of the cross-sections of fuses having nominal currents of 40-80 A, that is 2-3 mm, it would be necessary to have fuses with cross-sections of 25-35 mm to achieve nominal currents of 400 A. Naturally, fusible portions of these dimensions would be unsatisfactory from the points of view of reducing the space occupied by the fuse-holder box and of limiting heat dissipation.

[0011] There is therefore a great need to have available a high-current protection device which can selectively protect fuses having markedly different nominal currents.

[0012] The object of the present invention is to provide a high-current protection device having structural and functional characteristics such as to satisfy the above-mentioned needs and at the same time to prevent the problems mentioned with reference to the prior art.

[0013] This problem is solved by a high-current protection device according to Claim 1.

[0014] Further characteristics and the advantages of the protection device according to the present invention will become clear from the following description of a preferred embodiment thereof which is given by way of non-limiting example with reference to the appended drawings, in which:

Figure 1 is a schematic, perspective view of a high-current protection device-according to the invention,

Figure 2 is a partially-exploded, schematic view of the device of Figure 1,

Figure 3 is a schematic view of the device of Figure 1,

Figure 4 is a partially-sectioned, schematic view of the device of Figure 1,

Figure 5 is a schematic, perspective view of the conductive plate of the device of Figure 1,

Figure 6 shows the flat blank of the plate of Figure 5 prior to trimming and bending,

Figures 7 and 8 are schematic views of the conductive plate of Figure 5,

Figure 9 is a schematic plan view of the fuse means of the device of Figure 1, and

Figure 10 is an electrical diagram of use of the device of Figure 1.

[0015] With reference to the above-mentioned drawings, a high-current protection device according to the present invention is generally indicated 1.

[0016] The protection device 1 comprises a protective casing 2, preferably made of plastics material, and a metal conductive plate 5 made of conductive material.

[0017] The protective casing is formed by a support base 3 and by a cover 4, partially associated therewith. A slot 9 is formed along one side of the support base 3 to constitute a seat for the insertion of a portion of the metal conductive plate 5.

[0018] The conductive plate 5 comprises an input conductive portion 6 and an output conductive portion 7. In particular, as shown in Figures 5 and 6, the input conductive portion 6 has a first, substantially rectangular conductive portion 6a connected, by means of a connecting portion 6b, to a second, substantially square conductive portion 6c.

[0019] The output conductive portion 7 is connected electrically to the input conductive portion 6 by means of a fuse portion 8 having a cross-section of reduced width. In the embodiment shown, the fuse portion 8 is connected to the connecting portion 6b.

[0020] The fuse portion 8 constitutes the power fuse element of the device 1 of the present invention which is heated until it melts as a result of the circulation of currents of predetermined intensity. The electrical continuity between the input conductive portion 6 and the output conductive portion 7 is consequently interrupted. The width of the fuse portion 8 is calibrated in dependence on the nominal current attributed to the power fuse element.

[0021] According to a preferred embodiment, the nominal current of the fuse portion 8 is between 300 and 400 A. By way of indication, the width L of the fuse portion 8 is between 1,6 mm and 2,0 mm for currents having nominal values within the range between 300 and 400 A. In the embodiment described the width L is 1,8 mm.

[0022] The conductive plate 5 may advantageously be formed in a single piece by blanking from a plate of metal suitable for the production of power fuses with high nominal currents, for example, copper (Cu) or copper covered with a layer of tin (Sn). By way of indication, the overall thickness of the conductive plate 5 is 1,2 mm.

[0023] The conductive plate 5 is shaped by means of bending and subsequent trimming operations to adopt the shape shown in Figure 5.

[0024] Figure 6 shows the flat blank of the conductive plate 5 before the bending and trimming operations are performed. The plate 5 is -advantageously provided with a stiffening bridge 10 which connects the output portion 7 and the second portion 6c of the input portion 6.

[0025] In order to adopt the shape shown in Figure 5, the plate 5 is bent in the vicinity of the bend lines X-X and X'-X' so that the output conductive portion 7, together with the fuse portion 8 and the second conductive portion 6c, are substantially at right angles to the first conductive portion 6a.

[0026] The bridge 10 stiffens the structure, enabling the bending operation to be performed without the risk of causing bending or even breakage of the fuse portion 8.

[0027] The bridge 10 is then removed by a simple trimming operation and the conductive plate 5 is fitted in the base 3 by the insertion of the first portion 6a in the slot 9. The conductive plate 5 is advantageously provided with a retaining tooth 30 for snap-engaging a portion of the side of the base 3 in which the slot 9 is formed. This prevents the conductive plate 5 from accidentally being displaced from its seat, when it is correctly housed in the base 3, for example, as a result of a thrust exerted on the first portion 6a.

[0028] The input conductive portion 6 and the output conductive portion 7 are provided with respective means for connection to electrical terminals. According to a preferred embodiment, the connection means of the input portion 6 comprise a pair of openings, generally indicated 11, each of which is arranged to be associated with means (not shown in the drawings) for clamping to a terminal of a battery 12.

[0029] The connection means of the output portion 7 comprise an opening 14 suitable for receiving a screw 25 and a respective nut (not shown in the drawings) for the fixing of an electrical terminal of a supply cable coming, for example, from the alternator and from the starter motor.

[0030] The protection device 1 comprises fuse means which are fixed to the conductive plate 5 and are in electrical communication therewith. The fuse means are made of a second conductive material having an electrical conductivity lower than the electrical conductivity of the conductive material of the conductive plate 5.

[0031] The fuse means preferably comprise a fuse plate 15 formed in a single piece by blanking from a plate of metal suitable for the production of power fuses with nominal fusing currents of between 40 and 80 A, for example, zinc (Zn) or tinned zinc. By way of indication, the overall thickness of the conductive plate 5 is 1,2 mm.

[0032] The fuse plate 15 has an input portion 16, an output portion, and a fuse portion suitable for connecting the input portion 16 and output portion to one another electrically. In the embodiment described, there are two fuse portions, indicated 17 and 18, which connect the input portion 16 to two respective output portions 19, 20.

Basically, the two fuse portions 17 and 18 are in parallel with one another and protect two distinct medium-power primary users.

[0033] In order for the fuse elements to be of a suitable length whilst remaining compact, the fuse portions 17, 18 are S-shaped but may also be formed with a different composite-line shape.

[0034] The fuse plate 15 advantageously has means for fixing to the conductive plate 5 and means for connection to an electrical terminal (not shown in the drawings). The means for connection to the electrical terminal comprise an electrical connector 26 to be coupled with a complementary electrical connector (not shown in the drawings).

[0035] In the embodiment described, each of the output portions 19, 20 of the fuse plate 15 is shaped so as to form, at one of its ends, a male electrical connector 26 to be coupled with a complementary female electrical connector.

[0036] In the region of each electrical connector 26, the support base 3 of plastics material has a tubular protector 27 which extends from the cover 4 and has a front opening 28 for the insertion of the electrical connector 26 which extends inside the tubular protector 27. Similarly, the complementary electrical connector will be housed in a tubular protector (not shown in the drawings) suitable for achieving a form fit with the tubular protector 27. For this purpose, the tubular protector 27 is provided with engagement means 29 suitable for snap-engaging corresponding engagement means of the tubular protector of the complementary electrical connector.

[0037] The means for fixing to the conductive plate 5 comprise a circular opening 22 which is formed in the input portion 16 of the fuse plate 15 and which is provided for the insertion of the shank of a screw 23 which is in engagement with a corresponding opening formed in the conductive plate 5. A nut 24 in threaded engagement with the screw 23 secures the fuse plate 15 to the conductive plate 5.

[0038] The head of the screw 23 is advantageously housed in a seat in the plastics base 3, which prevents its rotation.

[0039] In view of the large range of temperatures reached inside the protective casing 2 during the use of the device 1, the nut 24 for the fixing of the fuse plate 15 and the nut for the clamping of the terminal of the cable coming from the alternator are preferably made of a material with a high thermal-expansion coefficient, for example, steel. The clamping force of the nut on the respective screw thus increases as the temperature rises.

[0040] The nominal fusing current of the fuse portion 17 is advantageously different from the nominal fusing current of the fuse portion 18. It is thus possible to protect primary users with different nominal fusing currents.

[0041] The nominal fusing current of each of the fuse portions 17 and 18 of the fuse plate 15 is preferably within the range of between 40 and 80 A. by way of indication, the width l_1 of the fuse portion 17 and the width l_2 of the fuse portion 18 are between 1,2 and 2,2 mm for currents having nominal values within this range. In the embodiment described, the nominal fusing current of the fuse portion 17 is 70 A, which corresponds to a width l_1 of about 2,0 mm, whereas the nominal current of the fuse portion 18 is 60 A, which corresponds to a width l_2 of about 1,55 mm. These values are given purely by way of indication and for a fuse plate 15 having a thickness of about 0,8 mm.

[0042] According to a first embodiment, the fuse plate 15 is fixed to the input portion 6 of the conductive plate 5, in particular to the second conductive portion 6c. For this purpose, the second conductive portion 6c has an opening 21 for receiving the shank of the screw 23 extending through the opening 22 formed in the fuse plate 15 so as to enable it to be clamped by means of the nut 24.

[0043] In this first configuration, melting of the fuse portion 8 brings about interruption of the supply from the alternator to the input conductive portion 6, that is, to the users that are connected thereto by means of the fuse plate 15, and interruption of the supply from the battery to the starter motor.

[0044] The users that are connected to the input conductive portion by means of the fuse plate 15, on the other hand, nevertheless continue to be supplied by the battery 12 and are thus usable, in spite of the absence of the supply coming from the alternator. The users that are connected to the output portions 17 and 18 are, for example, the central electrical unit of the engine and the electric power-steering device.

[0045] According to a second embodiment, the fuse plate 15 is fixed to the output portion 7 of the conductive plate 5. For this purpose, the output portion 7 is provided with an opening 13 for receiving the shank of the screw 23 extending through the opening 22 formed in the fuse plate 15 so as to enable it to be clamped by means of the nut 24. The fuse plate 15 is thus disposed downstream of the power fuse element 8, with respect to the terminal for connection to the battery 12. In other words, as can be seen from the electrical diagram shown in Figure 10, when the fuse plate 15 is fixed to the output conductive portion 7 of the conductive plate 5, its fuse portions 17 and 18 are in series with the power fuse element 8.

[0046] In this second configuration, melting of the fuse portion 8 brings about interruption of the supply from the battery 12 to the output conductive portion 7. The supply to the starter motor and to the electrical users that are connected to the output conductive portion 7 by means of the fuse plate 15 is consequently interrupted.

[0047] In this case, the users that are connected to the output portions 17 and 18 of the fuse plate are, for example, the medium-low power fuse-holder box and the central electrical unit of the engine.

[0048] According to a third embodiment, the fuse means comprise first fuse means fixed to the output por-

tion 7 and second fuse means fixed to the input portion 6, particularly to the second portion 6c. In the embodiment described, the first and second fuse means take the form of two fuse plates 15 fixed to the output portion 7 and to the input portion 6, respectively.

[0049] In this case, as can be seen from the electrical diagram shown in Figure 10, the fuse plate 15 which is fixed to the output conductive portion 7, downstream of the power fuse element 8 with respect to the terminal for connection to the battery 12, is in parallel with the fuse plate 15 which is fixed to the input conductive portion 6.

[0050] Naturally, the two fuse plates 15 may differ from one another both in terms of the number of output terminals and in terms of the nominal fusing currents of the fuse portions 17, 18. There may also be more than two fuse plates 15 and there may be different numbers of fuse plates 15 for the input portion 6 and for the output portion 7.

[0051] In this third configuration, melting of the fuse portion 8 brings about interruption of the supply from the battery 12 to the output conductive portion 7 and from the alternator to the input conductive portion 6.

[0052] Although the supply to the users that are connected to the output conductive portion 7 by means of the fuse plate 15 is interrupted, the users that are connected to the input portion 6 continue to be supplied by the battery 12 and are thus usable in spite of the absence of a supply from the alternator.

[0053] Naturally, the above-mentioned electrical users have been given purely by way of indication and can be selected from the group comprising ABS device, air-conditioning, plugs for diesel engines, alternator, electronic injection, radiator fans, automatic gearbox, electronic control units, petrol pump, etc.

[0054] In dependence on the selection of the configuration of use of the device and of the electrical users associated with the fuse means, the power fuse can be used as a selective element in the event of its melting.

[0055] As can be appreciated from the foregoing description, the high-current protection device according to the present invention satisfies the needs and overcomes the problems mentioned with reference to the prior art in the introductory portion of this description.

[0056] An advantage resulting from the use of the present invention is that it is possible to provide a protection device having fuse elements with associated nominal currents which differ from one another by one order of magnitude.

[0057] The protection device of the present invention also performs a selective function in the event of melting of the power fuse element, interrupting the supply to some electrical users whilst maintaining the supply from the battery to other electrical users which can be selected in dependence on the requirements of the user of the device.

Claims

1. A high-current protection device (1) comprising an input conductive portion (6), an output conductive portion (7), and a fuse portion (8) suitable for connecting the input conductive portion (6) and the output conductive portion (7) to one another electrically, wherein the input conductive portion (6), the output conductive portion (7), and the fuse portion (8) form a single conductive plate (5) made of a first conductive material and formed in a single piece, **characterized in that** the device comprises fuse means (15), made of a second conductive material, which are fixed to the conductive plate (5) and are in electrical communication therewith, wherein the first conductive material has an electrical conductivity greater than the electrical conductivity of the second conductive material.

2. A protection device (1) according to Claim 1 in which the fuse means (15) are fixed to the input conductive portion (6) of the conductive plate (5).

3. A protection device (1) according to Claim 1 in which the fuse means (15) are fixed to the output conductive portion (7) of the conductive plate (5).

4. A protection device (1) according to Claim 1 in which the fuse means (15) comprise first fuse means fixed to the output conductive portion (7) of the conductive plate (5) and second fuse means fixed to the input conductive portion (6) of the conductive plate (5).

5. A protection device (1) according to any one of claims 1 to 4 in which the fuse means (15) comprise at least one fuse plate (15) formed in a single piece and having an input portion (16) and at least one output portion (19, 20) and one corresponding fuse portion (17, 18) suitable for connecting the input portion (16) and the output portion (19, 20) to one another electrically.

6. A protection device according to Claim 5 in which the input portion (16) of the at least one fuse plate (15) comprises means (22) for fixing to the conductive plate (5).

7. A protection device (1) according to Claim 5 or Claim 6 in which the output portion (19, 20) of the fuse plate (15) comprises means (26) for connection to an electrical terminal.

8. A protection device (1) according to any one of Claims 1 to 7 in which the output conductive portion (7) comprises means (14) for connection to an electrical terminal.

9. A protection device according to any one of Claims 1 to 8 in which the first conductive material is copper.

10. A protection device (1) according to any one of Claims 1 to 9 in which the second conductive material is zinc.

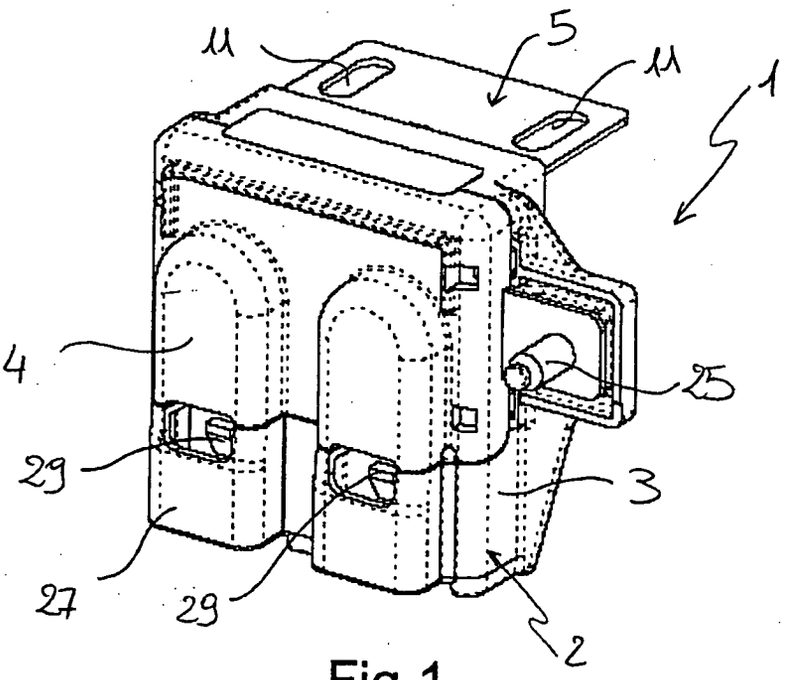


Fig.1

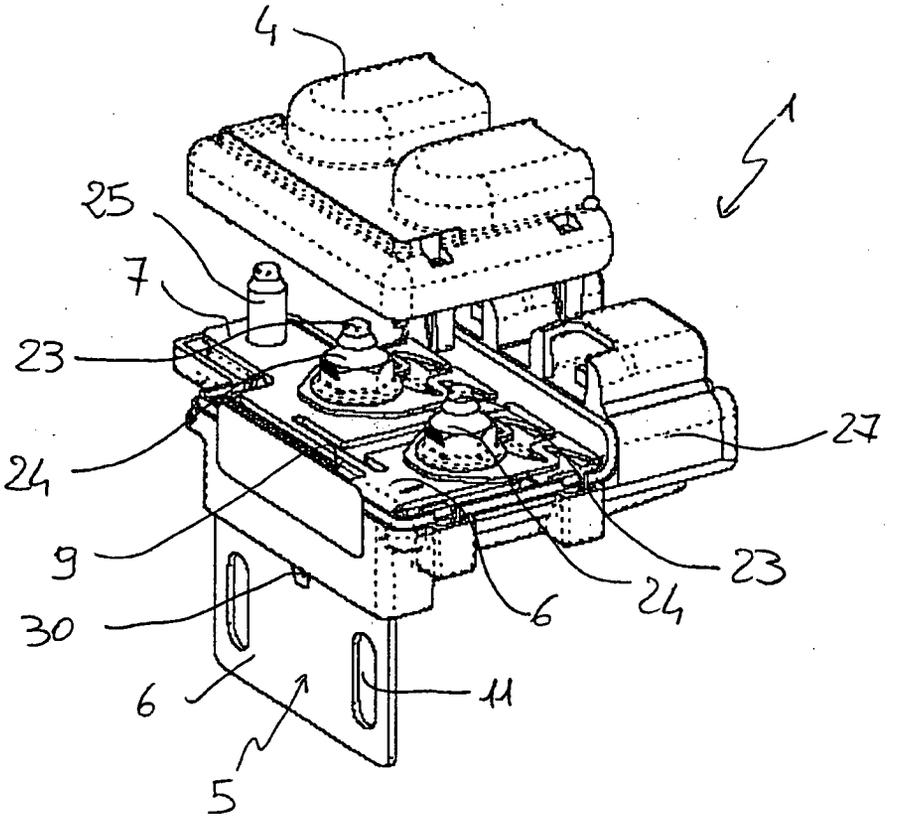


Fig.2

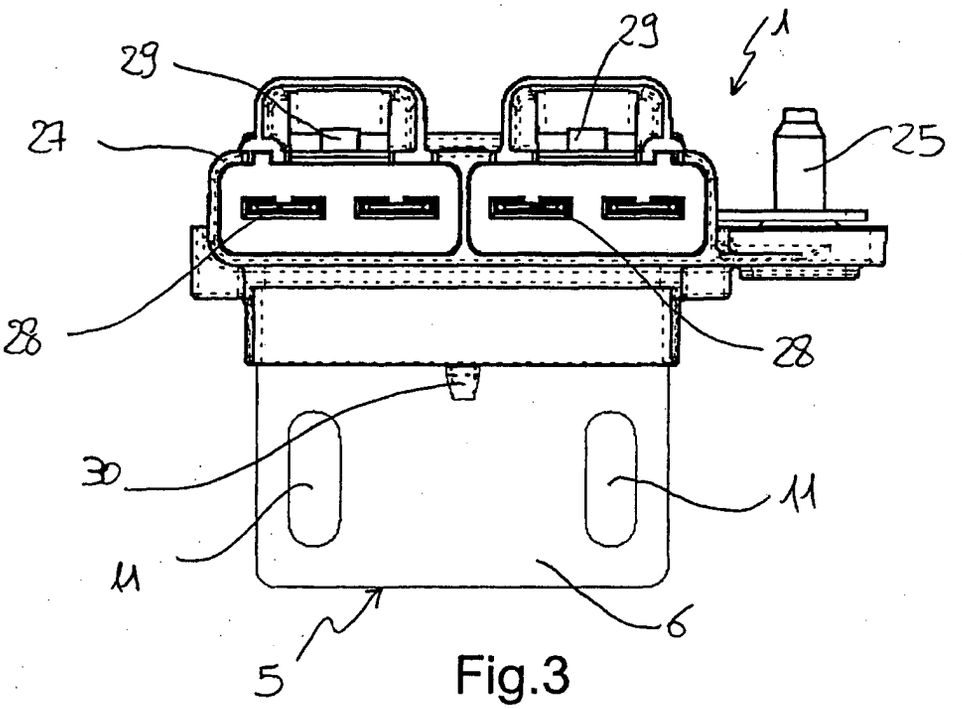


Fig.3

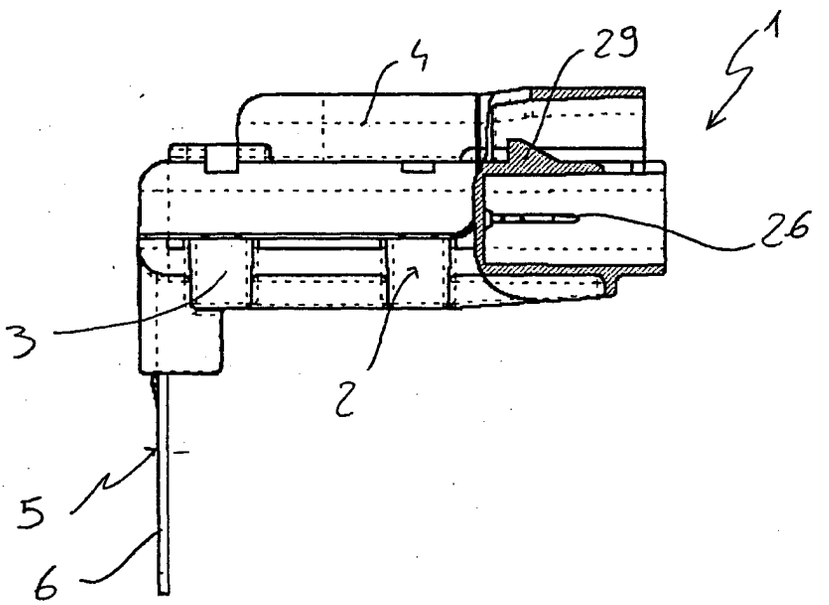
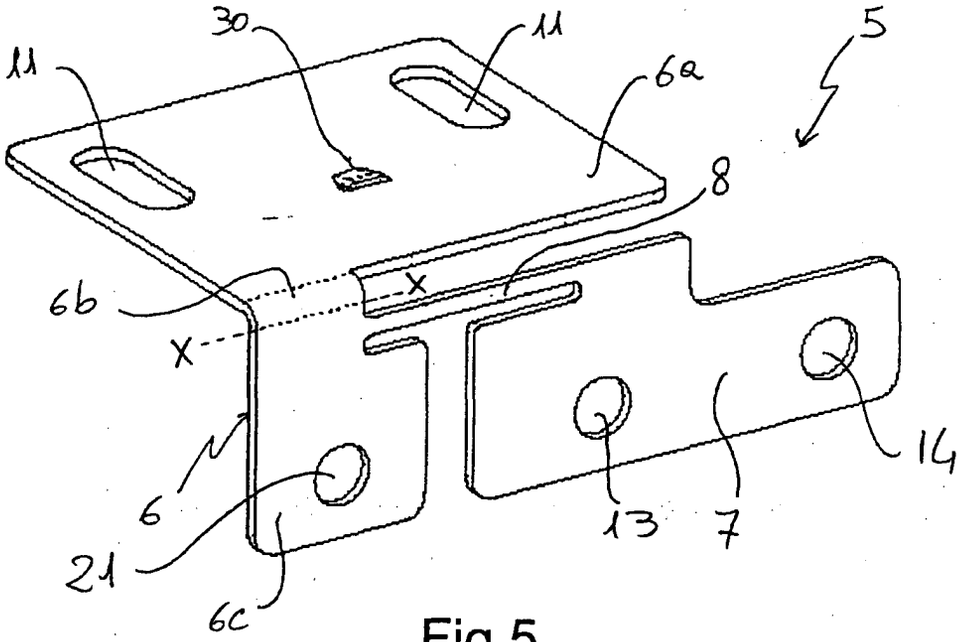


Fig.4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6b
X
X
6
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6c
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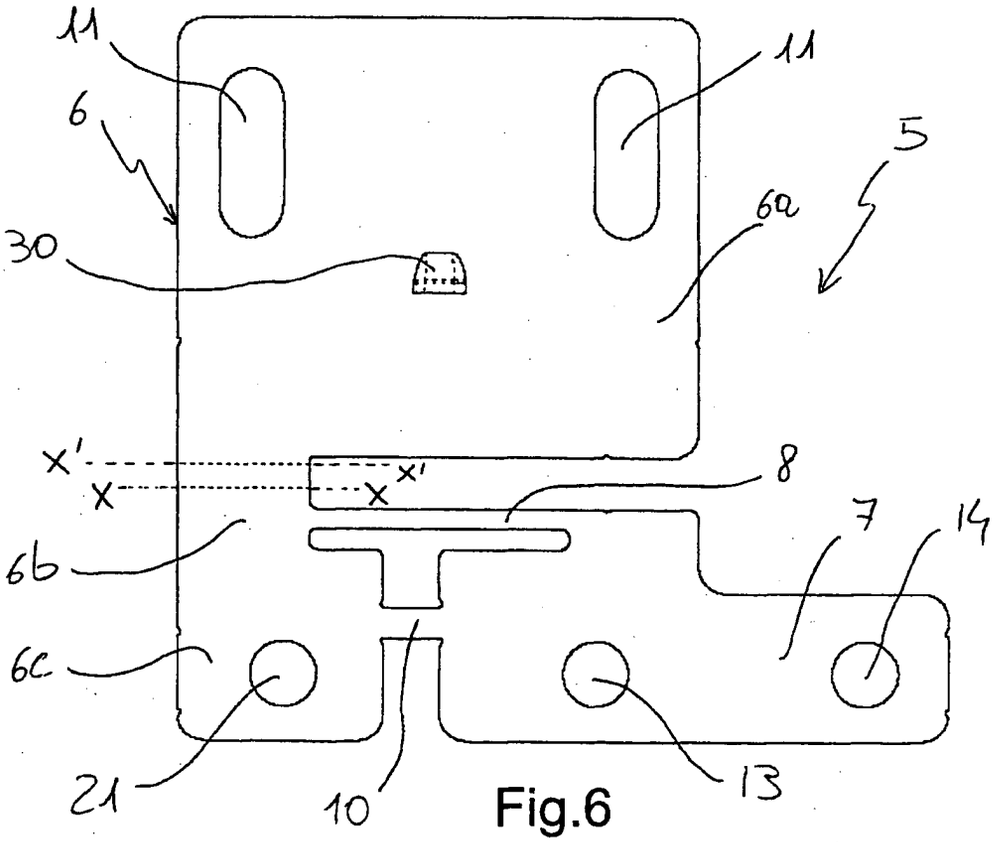
7
14

Fig.5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6a
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X'
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8
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6b
6c
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10
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Fig.6

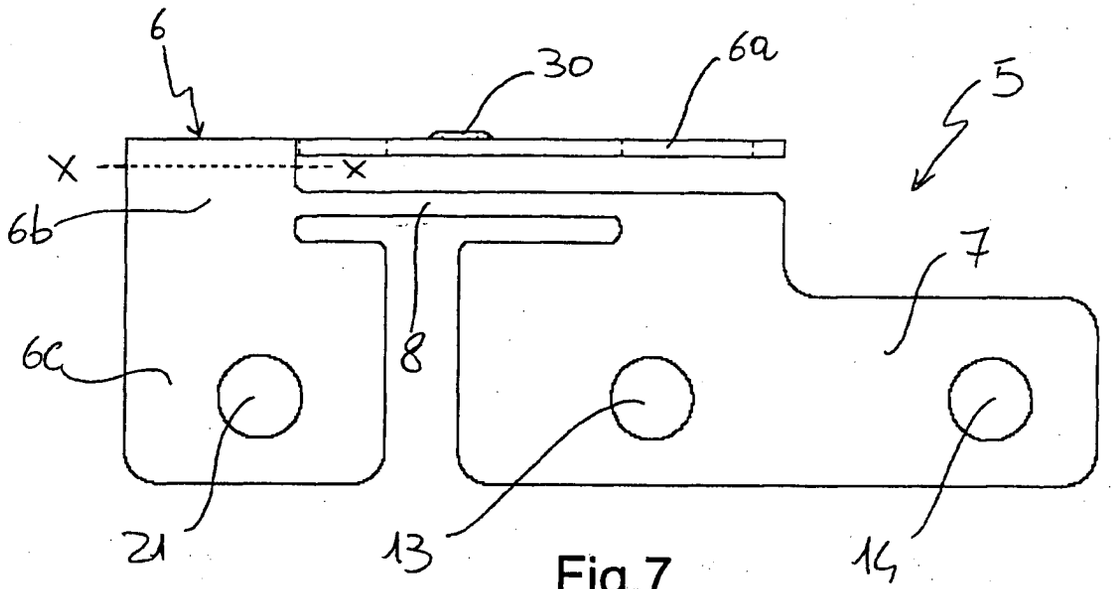

Fig.7

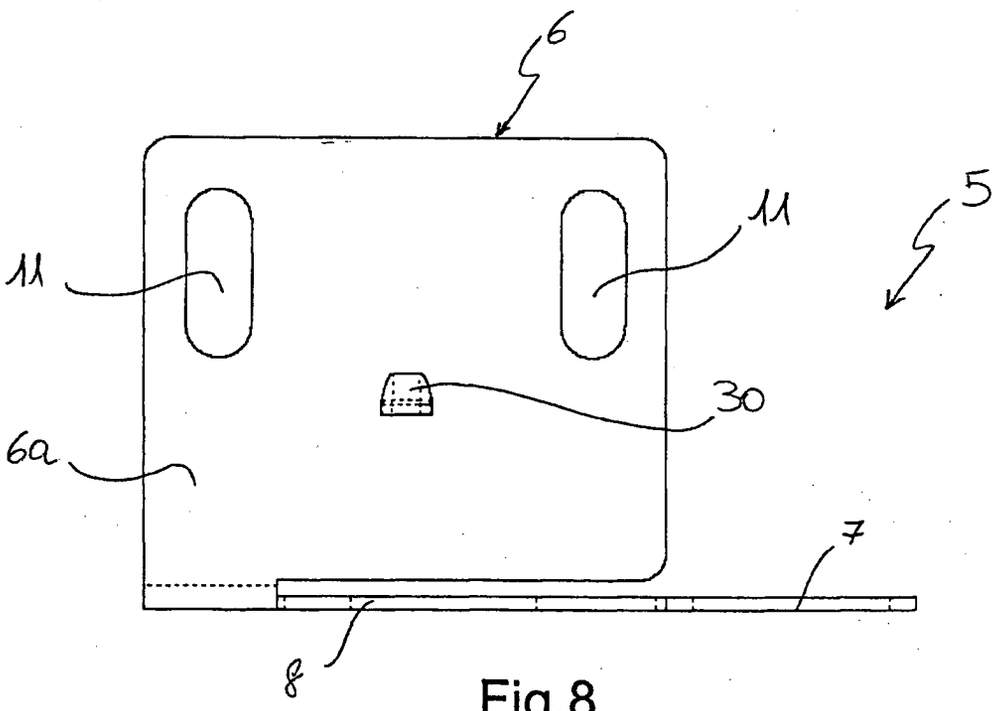

Fig.8

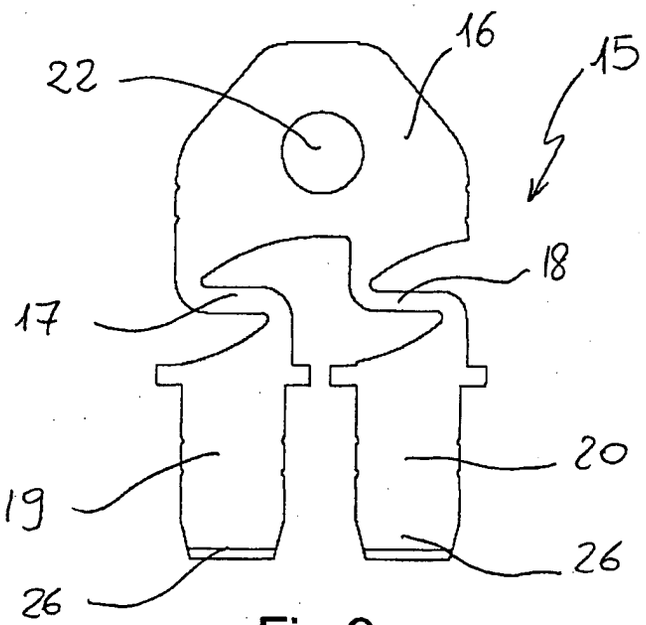

Fig.9

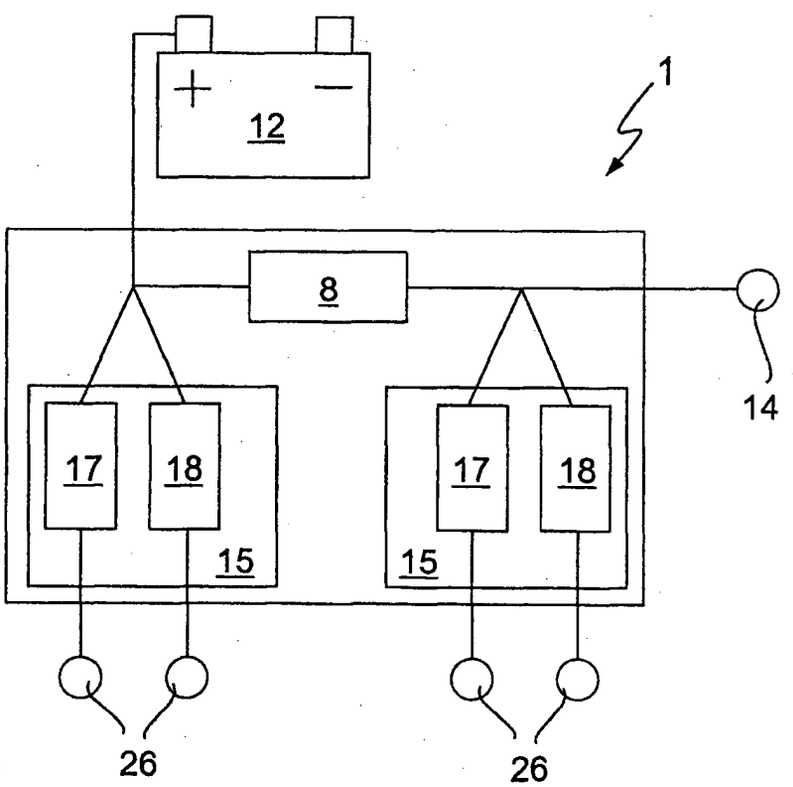

Fig.10

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EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5466

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 924 734 A (CODOGNESE MECCANOTEC) 23 June 1999 (1999-06-23) * abstract; figure 1 * ---	1-10	H01H85/044
A	EP 1 075 012 A (TOYOTA MOTOR CO LTD ;PACIFIC ENGINEERING CORP (JP)) 7 February 2001 (2001-02-07) * abstract; figure 2 * ---	1-10	
A	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 26, 1 July 2002 (2002-07-01) & JP 2001 256878 A (SUMITOMO WIRING SYST LTD), 21 September 2001 (2001-09-21) * abstract * -----	1-10	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	23 January 2004	Simonini, S

CATEGORY OF CITED DOCUMENTS

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23-01-2004

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