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## (54) SAFETY CONNECTING DEVICE AND APPARATUS INCLUDING SUCH A DEVICE

(57) The present invention concerns a Safety connecting device (1) for connecting an electrical component (4), provided with at least one electrical terminal (41), to a circuit (5), said connecting device (1) comprising a first element (2) that can be removably coupled to said electrical terminal (41) of said electrical component (4), a second element (3), electrically connected with said circuit (5), coupling means for coupling said first element (2) to said second element (3), said coupling means being electrically conductive and configured to reduce the mechanical coupling between said first element (2) and said second element (3) due to an increase over than a presettable threshold temperature, to which they are subjected to, and a safety member (34) configured to exert a separating force between said first element (2) and said second element (3), wherein, when said temperature to which said coupling means are subject to exceeds said presettable threshold, said safety member (34) interrupts the electrical coupling between said first element (2) and said second element (3).

The present invention concerns also an apparatus (A) including such a safety connecting device (1).

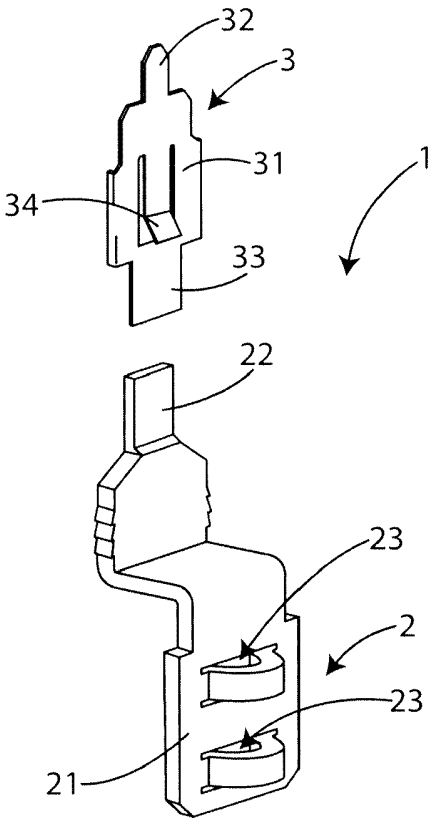


Fig. 1

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## Description

**[0001]** The present invention relates to a safety connecting device and apparatus including such a device.

**[0002]** More specifically, the invention concerns a connection device for terminal of electrical circuits, which allows opening the electrical circuit, i.e. to interrupt the power supply, in case of increase of the surrounding temperature or in case of increase of the supply electric current over a predefined level or threshold.

**[0003]** In the following, the description will be directed to the use in power circuits of cars cooling fans, but it is clear that the same should not be considered limited to this specific use.

**[0004]** As it is well known, currently the fans for cooling vehicle engines are generally powered by means of circuits which have a first line of direct power supply, which connects the alternator or the battery of the vehicle directly to the fan, thus achieving a connection that feeds the fan at maximum speed, and a second supply line, selectable by means of suitable selector devices, such as relays and the like, in which there are, in general, resistors, which provides several safety connections, suitable to interrupt the power supply of the fan, in case of the temperature or the supply current are above a respective preset threshold.

**[0005]** It is known the use an elastic plate, consisting of a metal alloy, connected to the supply circuit, which is folded and subsequently welded, usually by means of tin, on the terminal of a passive component of the circuit to be protected, such as a resistor and the like. In this "preloaded" position a possible melting of the tin due to anomalous conditions, such as an excessive increase of the temperature, implies the separation of the lamina from the electrode due to its elasticity.

**[0006]** This solution implies a welding under the printed circuit board, which is generally very difficult to carry out. This difficulty in the welding operation implies that such a connection is generally not very uniform, which means that the weldings carried out can also be very different among them, so that, in case of anomalies, the melting parameters of the welding, and then of the terminal detachment, i.e. threshold temperature and current, may be subject to considerable variations.

**[0007]** Moreover, following the restore of the anomaly, the recovery system is usually very complex.

**[0008]** It appears obvious that this procedure is costly in industrial and large scale production terms, as well as in safety terms.

**[0009]** In light of the above, it is, therefore, object of the present invention to propose a security connection device that overcome the technical problems of the mentioned prior art.

**[0010]** These and other results are obtained according to the invention by means of a device for connecting an electrical component to a circuit, comprising two elements coupled by welding, and a safety member capable to exert a removal force between said first element and said second element.

**[0011]** It is therefore specific object of the present invention a safety connecting device for connecting an electrical component, provided with at least one electrical terminal, to a circuit, said connecting device comprising a first element that can be removably coupled to said electrical terminal of said electrical component, a second element, electrically connected with said circuit, coupling means for coupling said first element to said second element, said coupling means being electrically conductive and configured to reduce the mechanical coupling between said first element and said second element due to an increase over than a presettable threshold temperature, to which they are subjected to, and a safety member configured to exert a separating force between said first element and said second element, wherein, when said temperature to which said coupling means are subject to exceeds said presettable threshold, said safety member interrupts the electrical coupling between said first element and said second element.

**[0012]** Always according to the invention, said safety member could comprise an elastic tongue, capable to assume a rest position and an operating position, in which it exercises the separating force between said first element and said second element.

**[0013]** Still according to the invention, said elastic tongue could be obtained on said second element.

**[0014]** Advantageously according to the invention, said second element could comprise a body, said elastic tongue being formed on said body, preferably said elastic tongue could be formed by carving on said body.

**[0015]** Always according to the invention, said coupling means between said first element and said second element could comprise a welding by tin, conductive resin or the like.

**[0016]** Still according to the invention, said coupling means between said first element and said second element could comprise a reflow welding or "reflow".

**[0017]** Advantageously according to the invention, said first element could comprise a first coupling plate and said second element comprises a second coupling plate removably coupled to said first coupling plate of said first element by means of said coupling means.

**[0018]** Further according to the invention, said second element could comprise a connection terminal for the fixing and the electrical connection to said circuit.

**[0019]** Always according to the invention, said first element could comprise a base, on which a pair of through projecting slots are formed, in which said terminal of said electrical component is insertable.

**[0020]** Still according to the invention, said first element and said second element could be made of metal, metal alloy or conductive material.

**[0021]** It is further object of the present invention an apparatus comprising a printed circuit board, an electrical component, such as a resistor and the like, provided with at least one electrical terminal, and a safety connecting device, as defined above, coupled to said printed circuit

board by means of said connection terminal, said electrical terminal of said electrical component being coupled to said first element.

**[0022]** Always according to the invention, said apparatus could comprise a containment enclosure, having internally at least one wall, and said safety connecting device is arranged approached to said wall of said containment enclosure, so that said elastic tongue is in said operating position or preloaded, such that, if the temperature at which said safety connecting device exceeds a respective presettable threshold, or the supply current of said electrical component passing through said safety connecting device exceeds a respective further presettable threshold, then the coupling of coupling means between said first element and said second element would tend to reduce the mechanical coupling, until the force exerted by said elastic tongue separates said first element from said second element, interrupting the supply of said electrical component.

**[0023]** The present invention will be now described, for illustrative but not limitative purposes, according to its preferred embodiments, with particular reference to the figures of the enclosed drawings, wherein:

figure 1 shows a safety connecting device according to the present invention in coupling position;
figure 2 shows a connecting device according to figure 1 in a decoupling position;
figure 3 shows a front view of a first element of connecting device according to figure 1;
figure 4 shows a side view of the first element of the connecting device according to figure 3;
figure 5 shows a front view of a second element of the connecting device according to figure 1;
figure 6 shows a side view of the second element of the connecting device according to figure 5;
figure 7 shows a front view of the connecting device according to figure 1;
figure 8 shows a side view of the connecting device according to figure 1;
figure 9 shows a side view of the connecting device applied to a printed circuit and to a resistor;
figure 10 shows a front view of the connecting device according to figure 9;
figure 11 shows an electronic apparatus for controlling the speed of a fan, which is applied to the connecting safety device according to the present invention;
figure 12 shows a sectional view along F-F section line;
figure 13 shows a detail of figure 12;
figure 14 shows the installation of a safety connecting device according to the present invention, in an apparatus for controlling the supply of a cooling fan for vehicles; and
figure 15 shows a detail of figure 14.

**[0024]** In the various figures, similar parts will be indicated by the same reference numbers.

**[0025]** Referring to figures 1-8, it is possible to see a safety connecting device 1. Said the connecting device 1 comprises a first element 2 and a second element 3.

**[0026]** Said first element 2 is made of metal, metal alloy or conductive material, and comprises a base 21, on which a pair of protruding through slots 23 are obtained, in which a terminal of a device to be protected is inserted, and a first coupling plate 22.

**[0027]** Said second element 3 is also made of metal or conductive material, and comprises a body 31, which has a connection terminal 32 arranged at the top, by which said second element 3 is fixable to a chassis or to an integrated circuit, and a second coupling plate 33, arranged below, coupled by welding, e.g. tin welding, or in general by means of coupling by adhesion, such as resin and the like, to said first coupling plate 22 of said first element 2. On the body 31 also an elastic tongue 34 is formed by carving, as a safety member. Said elastic tongue 34 is such as to assume a rest position, in which it is protruding with respect to said body 31, and an operating position, or preloaded, in which it is substantially coplanar with said body 31. The operation of said elastic tongue 34 will be better defined in the following.

**[0028]** In a preferred embodiment, the coupling between said first element 2 and said second element 3 is performed by reflow welding or "reflow", which is a process in which a welding paste is used, typically a mixture of tin in powder and fluxing, in which preliminary and temporarily said first 2 and second element 3 are fixed by said paste, and subsequently, controlled heat is applied, by suitable means, such as ovens, infrared lamps or hot air welders, which melts the alloy and welds permanently said elements 2 and 3.

**[0029]** Figures 9 and 10 show said safety connection device 1 that connects a resistor 4 to a printed circuit board 5. In particular, said connection device 1 presents the second coupling plate 33 of said second element 3 and the first coupling plate 22 of said first element 2 fixed by tin welding.

**[0030]** Furthermore, the connection terminal 32 is fixed to a printed circuit board 5, while said first element 2 is electrically connected to a terminal 41 of a resistor 4. In particular, said terminal 41 is inserted through said projecting slots 23, so as to achieve an electrical contact.

**[0031]** The electrical connection between said terminal 41 and said base 21 of said first element 2 can be possibly also secured by a weld.

**[0032]** The operation of the safety connecting device 1 described above is as follows.

**[0033]** Referring to figures 11-13, it is observed a control apparatus A for controlling the supply of a cooling fan for vehicles, arranged in a containment enclosure I, which has a printed circuit board 5, to which a resistor 4 is connected. On a least one of the terminals 41 of said resistor 4 a connecting device safety 1 is arranged.

**[0034]** Said safety connection device 1 is arranged close to the wall P inside the containment enclosure I,

so that said elastic tongue 34 is in the operating position or preloaded, thus exerting a constant away force on the second element 3 from said first element 2, which thus tends to urge the welding between said second coupling plate 33 of said second element 3 and said first coupling plate 22 of said first element 2.

**[0035]** Furthermore, the second element 3, connection terminal 32 can also be fixed to a fulcrum C.

**[0036]** In this configuration, the supply current of the resistor 4 passes through the connection device 1.

**[0037]** Therefore, in case of the temperature at which the security connection device 1 would increase over a respective preset threshold, or the supply current of the resistor 4, which then passes through said connection device 1, exceeds a respective further preset threshold, then the welding between said second coupling plate 33 of said second element 3 and said first coupling plate 22 of said first element 2 would tend to melt, up to the point that (see figures 14 and 15) the force exerted by elastic tongue 34, indicated with the arrow S, exceeds that of the weld that keep the plates, so that said second element 3 separates from said first element 2, rotating according to the arrows indicated with M.

**[0038]** To restore the operation of the connection device 1 is necessary to proceed again to weld said first element 2 and said second element 3.

**[0039]** An advantage of the present invention is that the safety device is assembled "off-line", in self standing production process phases that allow the control of the parameters relating to the welding process. This allows increasing the degree of repeatability of the weld between the first element and the second element.

**[0040]** The present invention has been described for illustrative but not limitative purposes, according to its preferred embodiments, but it is to be understood that modifications and/or changes can be introduced by those skilled in the art without departing from the relevant scope as defined in the enclosed claims.

## Claims

1. Safety connecting device (1) for connecting an electrical component (4), provided with at least one electrical terminal (41), to a circuit (5), said connecting device (1) comprising
   a first element (2) that can be removably coupled to said electrical terminal (41) of said electrical component (4),
   a second element (3), electrically connected with said circuit (5), coupling means for coupling said first element (2) to said second element (3), said coupling means being electrically conductive and configured to reduce the mechanical coupling between said first element (2) and said second element (3) due to an increase over than a presettable threshold temperature, to which they are subjected to, and
   a safety member (34) configured to exert a separating force between said first element (2) and said second element (3),
   wherein, when said temperature to which said coupling means are subject to exceeds said presettable threshold, said safety member (34) interrupts the electrical coupling between said first element (2) and said second element (3).

2. Connecting device (1) according to claim 1, **characterized in that** said safety member comprises an elastic tongue (34), capable to assume a rest position and an operating position, in which it exercises the separating force between said first element (2) and said second element (3).

3. Connecting device (1) according to claim 2, **characterized in that** said elastic tongue (34) is obtained on said second element (3).

4. Connecting device (1) according to claim 3, **characterized in that** said second element (3) comprises a body (31), said elastic tongue (34) being formed on said body (31), preferably said elastic tongue (34) is formed by carving on said body (31).

5. Connecting device (1) according to anyone of the preceding claims, **characterized in that** said coupling means between said first element (2) and said second element (3) comprise a welding by tin, conductive resin or the like.

6. Connecting device (1) according to anyone of the preceding claims, **characterized in that** said coupling means between said first element (2) and said second element (3) comprise a reflow welding or "reflow".

7. Connecting device (1) according to anyone of the preceding claims, **characterized in that** said first element (2) comprises a first coupling plate (22) and said second element comprises a second coupling plate (33) removably coupled to said first coupling plate (22) of said first element (2) by means of said coupling means.

8. Connecting device (1) according to anyone of the preceding claims, **characterized in that** said second element (3) comprises a connection terminal (32) for the fixing and the electrical connection to said circuit (5).

9. Connecting device (1) according to anyone of the preceding claims, **characterized in that** said first element (2) comprises a base (21), on which a pair of through projecting slots (23) are formed, in which said terminal (41) of said electrical component (4) is insertable.

**10.** Connecting device (1) according to anyone of the preceding claims, **characterized in that** said first element (2) and said second element (3) are made of metal, metal alloy or conductive material.

**11.** Apparatus (A) comprising
a printed circuit board (5),
an electrical component (4), such as a resistor and the like, provided with at least one electrical terminal (41), and
a safety connecting device (1), according to anyone of claims 1-8, coupled to said printed circuit board (5) by means of said connection terminal (32), said electrical terminal (41) of said electrical component (4) being coupled to said first element (2).

**12.** Apparatus (A) according to claim 11, **characterized in that** it comprises a containment enclosure (I), having internally at least one wall (P), and
**in that** said safety connecting device (1) is arranged approached to said wall (P) of said containment enclosure (I), so that said elastic tongue (34) is in said operating position or preloaded, such that, if the temperature at which said safety connecting device (1) exceeds a respective presettable threshold, or the supply current of said electrical component (4) passing through said safety connecting device (1) exceeds a respective further presettable threshold, then the coupling of coupling means between said first element (2) and said second element (3) would tend to reduce the mechanical coupling, until the force exerted by said elastic tongue (34) separates said first element (2) from said second element (3), interrupting the supply of said electrical component (4).

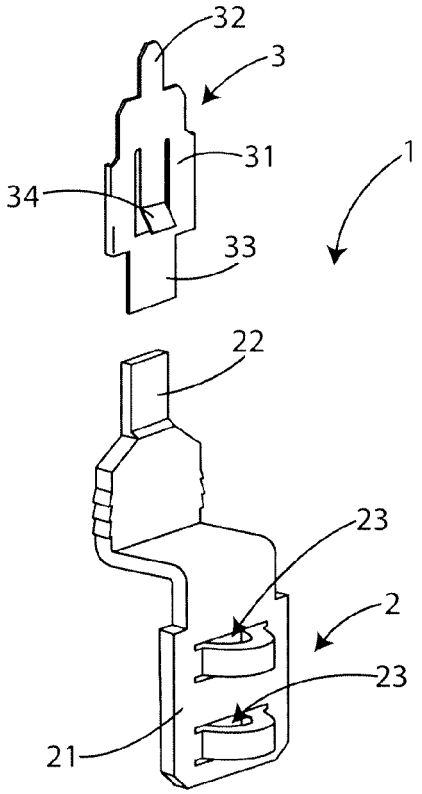


Fig. 1

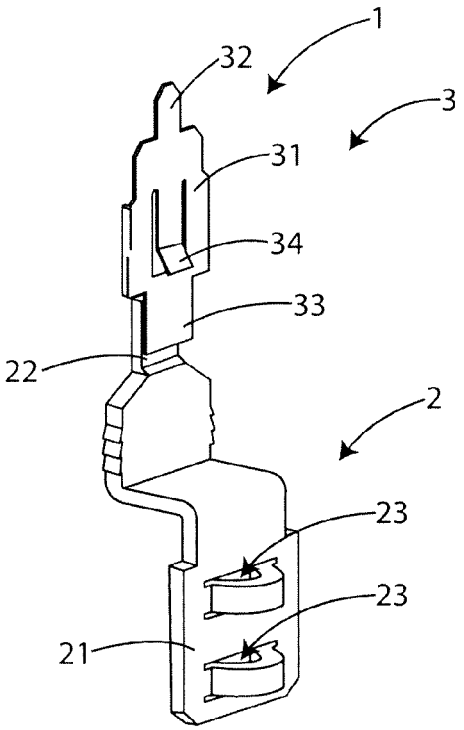


Fig. 2

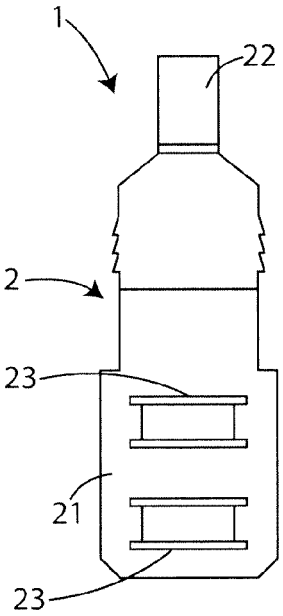


Fig. 3

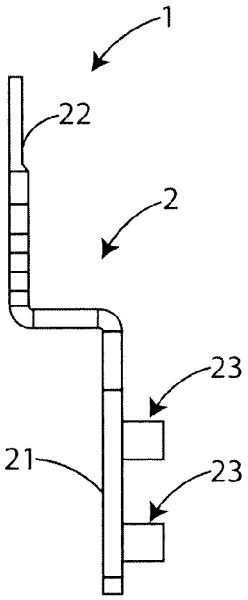


Fig. 4

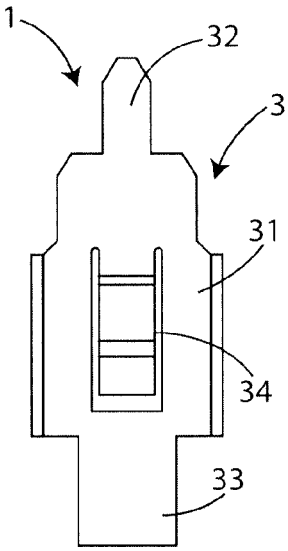


Fig. 5

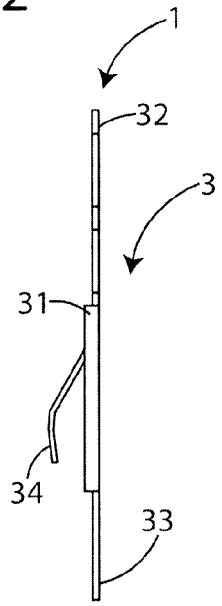


Fig. 6

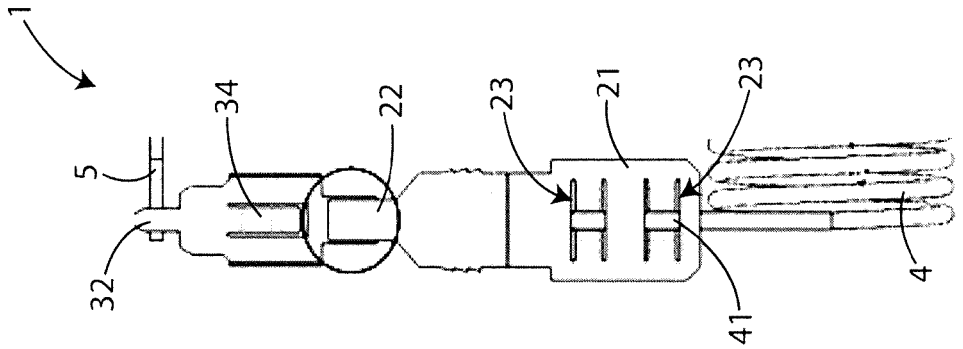


Fig. 10

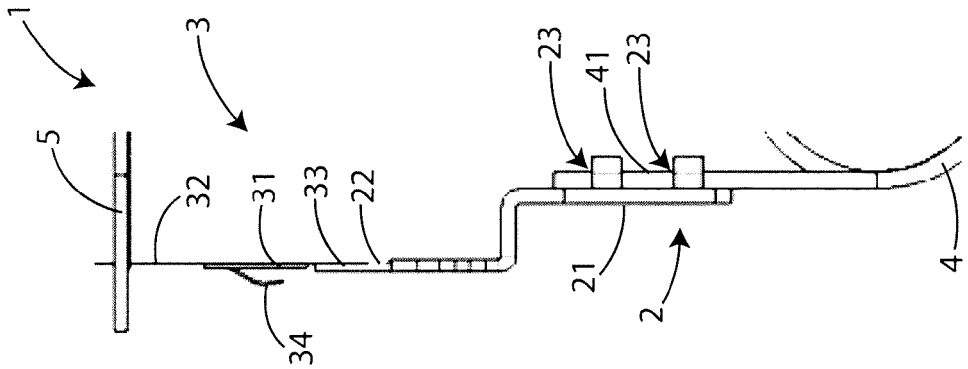


Fig. 9

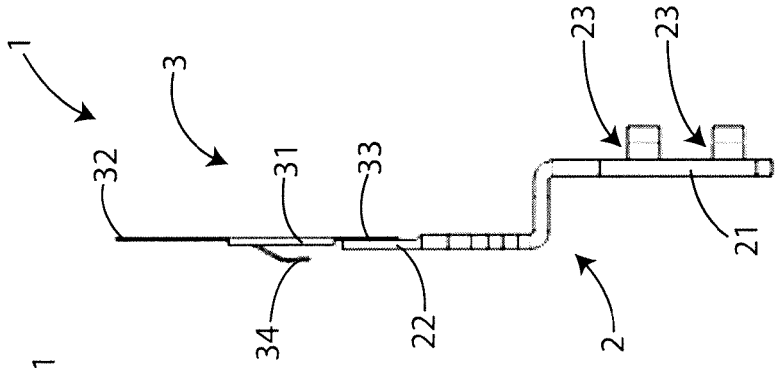


Fig. 8

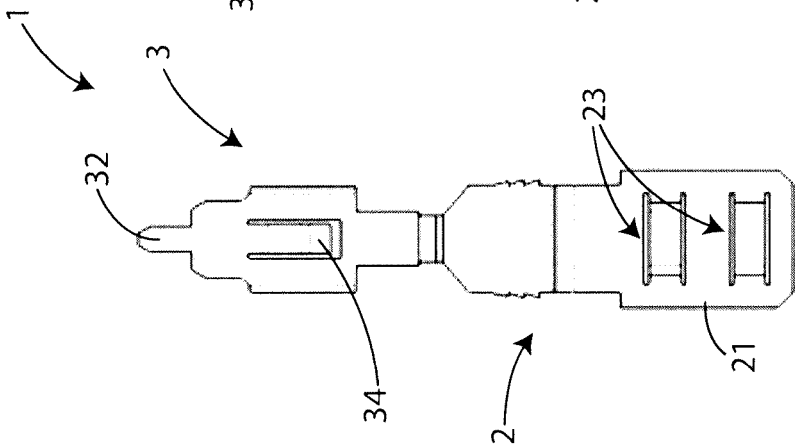


Fig. 7

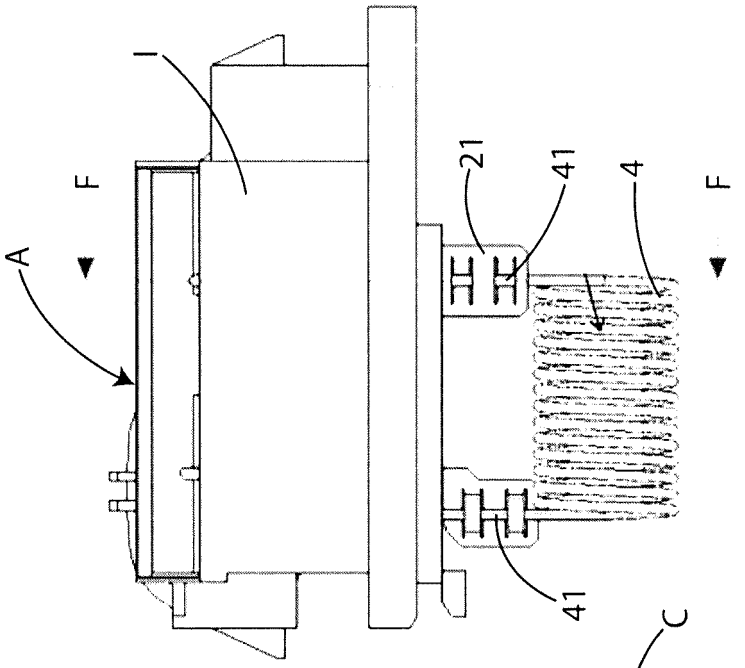


Fig. 11

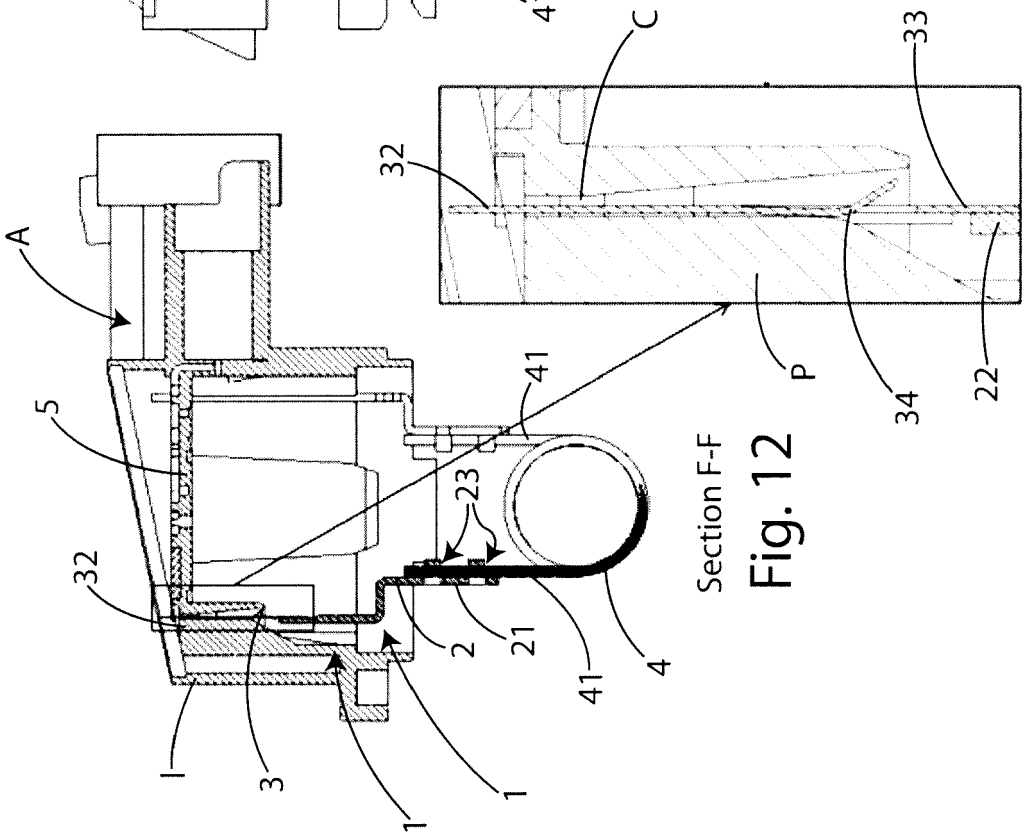


Fig. 12

Fig. 13

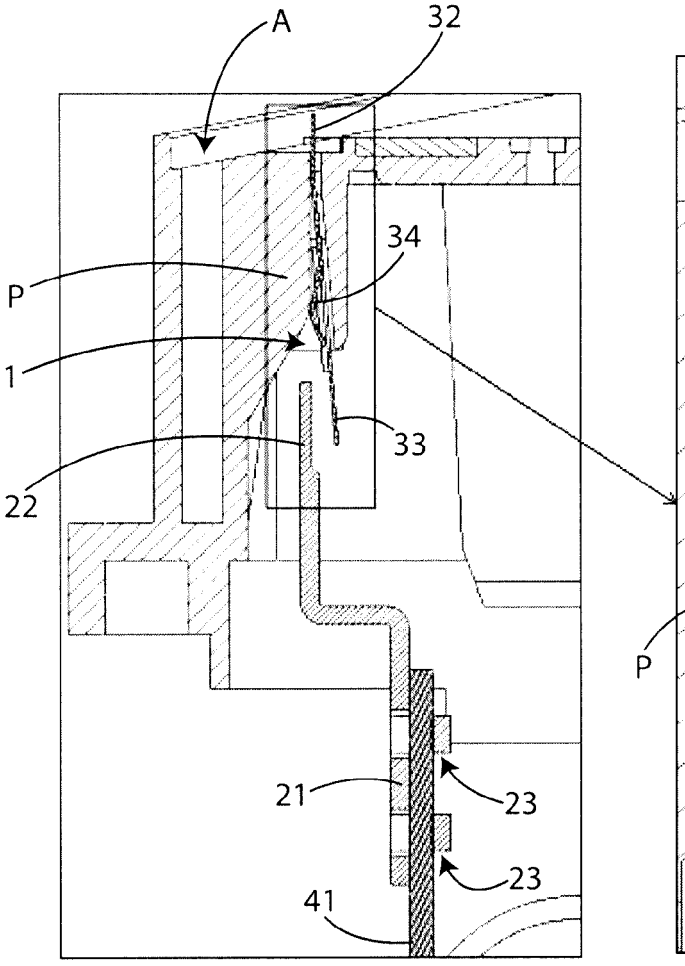


Fig. 14

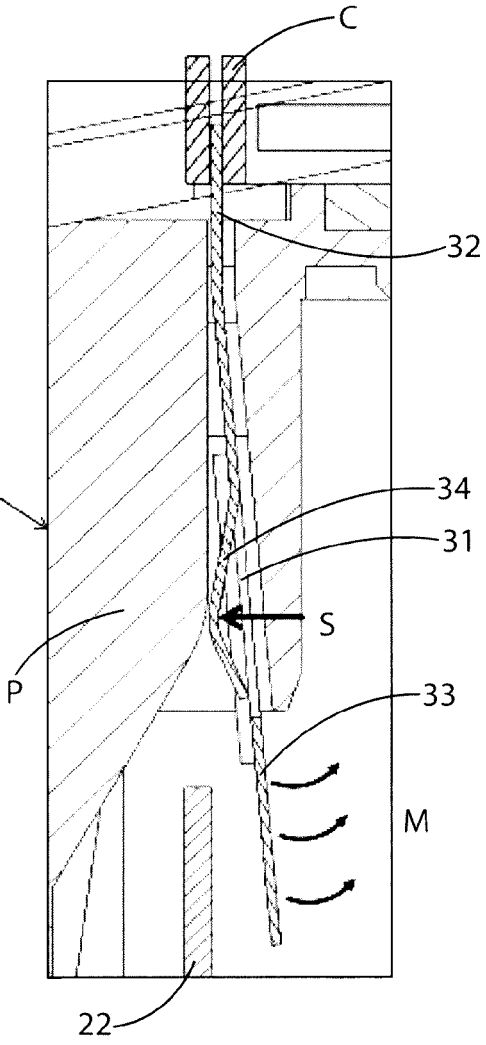


Fig. 15

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# EUROPEAN SEARCH REPORT

Application Number
EP 15 42 5018

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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 22 July 2015 | Ramírez Fueyo, M |

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 42 5018

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