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(71) Applicant : **BITRON S.p.A.**
Via Ligiard, 5
I-10060 Cantalupa (TO) (IT)

(72) Inventor : **Guidi, Guido**
C. so Francia, 28
I-03100 Frosinone (IT)
Inventor : **Boezi, Giampaolo**
Via Murette, 9
I-03011 Alatri (FR) (IT)
Inventor : **Reibaldi, Luigi**
Via Della Sanità, s.n.c.
I-03011 Alatri (FR) (IT)

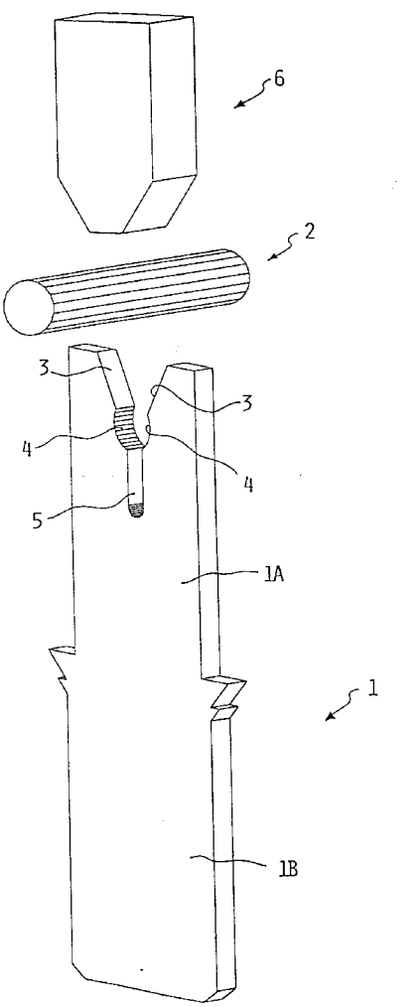
(74) Representative : **Dini, Roberto, Dr. Ing.**
Via Castagnole, 59
I-10060 None (Torino) (IT)

(54) Device and method for the connection, both mechanical and electrical, of a terminal.

(57) A device is described, for the permanent connection, both mechanical and electrical, of a terminal (2) of electric and/or electronic components.

According to the invention, a contact element is provided, being permanently elastic (1A), made of a foil of electrically conductive material, said contact element (1A) including an insertion zone for the terminal (2) defined by two opposite hemisurfaces (4), and a flexion slot (5) of the two hemisurfaces (4), contiguous to the contact zone, being able to consent the insertion of the terminal (2) in a stress condition of the hemisurfaces (4) within the elastic field of the material constituting the foil (1).

FIG. 1



EP 0 675 568 A1

The present invention refers to a device for the connection and the electric contact of terminals of electric and/or electronic components.

It is known that for realizing the permanent connection and the contact of terminals of electric and/or electronic components, such as for example resistors rheophores or connecting terminals of coils of relays, it has become common practice to utilize the welding, in its different available techniques (tin, laser, supersonic, etc).

For realizing permanent contacts are also known holding systems which provide a contact interface having shear-shaped elements, able to retain in a plastic way the cited terminals: such known devices are therefore characterized by a notable plasticity, inasmuch as the cited shear-shaped elements, apart from realizing the electric contact, have to be able to block in a permanent way the terminal (for the definitions of plasticity, elasticity, elastic field, plastic field of materials, and the relevant governing laws, any engineering text can be consulted).

Such known devices for holding and contacting are usually provided for working on the limit condition of the plastic field of the material which constitute them, whereupon they often suffer drawbacks in particular working conditions. For example, in the case of vibrations and/or thermal shock, the electric contact between terminal and interfaces is subject to temporary interruptions, caused by the imperfect electric union of the parts; said imperfect union is due to the fact that the interface-terminal junction happens in a stress condition that can overcome the limit of the plastic field of the materials: this involves therefore the possibility of failure of the system in which the device is used, especially if a functional constraint of permanent electric junction is required.

The cited problem is increased by the mechanical working tolerances, which can determine a dispersion of the pressure characteristics with which the junction between interface and terminal occurs.

In some known devices, the contact interface is subject to one or more superficial coinings, the condition of high plasticity of the interface being the same: such solutions, however, do not allow for the complete elimination of the cited drawbacks.

Another problem of the prior art is then represented by the fact that, due to the particular geometry being necessary for assuring the holding, the coupling phase between terminals and known holding devices requires notable attentions, which make the manufacturing process complicated.

From the above, it therefore results that the realization of the known holding and contact devices require geometry being almost complicated, materials being very ductile, or plastic, and manufacturing being somewhat complicated, without however a high reliability being assured.

From DE-U78 21 715 a contact spring is known, of complex geometry, which is inserted in a coating of insulated material and has a couple of shear-shaped elements, between which a pin connector is to be inserted. The details of the junction principle of this device are not described in the cited document; however it is clear that, being it a spring provided for retaining pin connectors which should be removable, the device is not suitable for assuring a functional constraint of permanent electric and mechanic junction; also said device therefore has the above mentioned problems.

From DE-A- 34 38 800 a device is also know, which allows for the quick union of an electric wire to a connector, wherein the device is expressively provided for coated wire having in the inside a plurality of annularly arranged compressed strands. The device comprises a contact portion having a slotted opening, the width of which is lower than the diameter of the insulated coating of the wire; for the connection, the wire is pressed in the slotted opening, so that the insulating coating of the wire is broken ad the sides of the slotted opening get in contact with the wire strands, which slightly expand without distorting their annularly arrangement. In this case, therefore, the contact portion requires strength rather than resilience, being the electric wire which adapts to the contact portion, and not the contrary. Said device, being specifically provided for coated wires with a plurality of compressed strands, is not suitable for the use with other type of electric wires and above all for the use with terminals or rheophores.

The aim of the present invention is that of eliminating the cited drawbacks of the known art and in particular to indicate a device for the connection of a terminal of electric and/or electronic components which, working within the full elastic field, allows the absorption of any eventual deformation, deriving for example from vibrations and/or thermal shocks.

Further aim of the present invention is that of indicating a device being of a simple and economic realization, which presents a characteristic of real and constant stay of the electric contact between the joined parts, and which allows therefore to increase the reliability of the contact in the very different conditions of use.

Said aims are attained according to the present invention through the device of the annexed claim 1 and the method of the annexed claim 11.

Said aims are equally attained by a method for the permanent connection, both electrical and mechanical, of a terminal to a contact device, having the characterizing feature of the annexed claim 11.

Further characteristics and advantages of the present invention will result in being clear from the detailed description which follows, carried out with reference to the annexed drawings, being supplied purely as an explanatory and non-limiting example, wherein:

- in figure 1 a contact interface of the device according to the present invention is represented in a perspective view;
- in figure 2 the contact device according to the present invention is represented in a schematic front view.

In the cited figures, reference number 1 indicates the holding and contact device according to the present invention, composed in the shown case by a small foil of normal brass, for example of the type 67 H10 or 67 H20, duly shaped; in the shown case, such a device 1 is practically constituted by a classic terminal of the "faston" type, for example of the type of those used in relays for motor vehicles: in particular, in the case of figure 1, with 1A is shown an interfacing zone, or contact interface, while with 1B is shown the more properly said "faston" portion, i.e. a portion for the connection of the device 1 to another interlocked device.

With reference number 2 a contact element is shown, which has to be coupled to the interface 1A, i.e. the terminal of an electric and/or electronic component: for example, the element 2 may be the rheophore of a resistor, or the terminal of a coil for relays; for exemplification purposes, the contact element 2 has been represented in the figures as having a round section, premising the possibility to adapt the device for other shapes.

With reference number 3 two opposite planes are indicated, being slant, in the illustrated case of 60° one to the other, that converge from the top of the interface 1A up to two contact hemisurfaces 4; said hemisurfaces 4, which in the illustrated specific case have a curved shaped, realize the "heart" of the interface 1A, or a contact zone for containing the element or terminal 2 in the permanent working position.

The shape of the hemisurfaces 4 depends upon the section of the contact element or terminal 2 to be used in conjunction with the interface 1A, so as also the diameter delimited by the hemisurfaces 4, that it is slightly lower than the diameter of the contact element or terminal 2.

The two slant planes 3 have the function of facilitating the positioning and the insertion of the contact element 2 within the hemisurfaces 4, and the function of facilitating the elastic deformation being necessary for the right positioning of the two parts in contact.

Reference number 5 indicates a flexion slot, obtained in the interface 1A under the area defined by the contact hemisurfaces 4. The slot 5, even if the device object of the invention is not of the type having a prevalent elastic holding, has the function of allowing the minimum elasticity that consents the insertion of the contact element 2 between the hemisurfaces 4 in a stress condition of the interface 1A.

Reference number 6 finally indicates a suitable tool, making up part of a machine suitably equipped, provided for carrying out the elastic deformation of the interface 1A, by means of the widening of the slant planes 4; in the illustrated case the tool 6 has in fact a trapezoidal profile with an attack angle of 75°, i.e. having a dimension being greater that the angle of 60° defined by the two slant planes 3.

From the above it can be understood that, in substance, the device object of the invention is realized through a foil in an electrically conductive material in which are present:

- a holding and contact zone defined by two hemisurfaces (4),
- a flexion slot (5) for the two contact hemisurfaces (4), contiguous to the holding and contact zone, that allows the insertion of the terminal (2) in a stress condition of the holding zone being comprised within the elastic field of the material that constitutes the foil;
- two slant planes (3) converging towards the hemisurfaces (4), having the aim of conveying the terminal (2) towards the holding and contact zone.

The operation of the device according to invention is the following.

The contact element or terminal 2 is inserted in the notch defined by the slant planes 3, so as to be guided downwardly for resting on the upper zone of the hemisurfaces 4 (as mentioned, the diameter A is lower than the diameter of 2); successively, such a notch is resiliently deformed due to the action of the tool 6, which pushes down with a predetermined force, for example in the order of 10 Newton, and for a determined stroke, for example under the control of a suitable force transducer; such a lowering of the tool 6 has the effect of slightly widening the hemisurfaces 4, allowing the element 2 to penetrate between the same hemisurfaces; the cited operation is carried out within the full elastic field of the material constituting the interface 1A: due to the presence of the flexion slot 5, expressly dimensioned for satisfying the scope, the positioning of the contact element 2 is obtained, in the permanent contact zone defined by the two hemisurfaces 4.

Once such a positioning is obtained, the tool 6 is raised and the contact element 2 remains rigidly coupled between the hemisurfaces 4, in a field of elastic stress.

It is clear that the right dimensioning and the reciprocal arrangement of the slot 5, the hemisurfaces 4 and the slant planes 3 are determined depending upon the cases, the concept at the basis of the invention remaining the same, i.e. that of consenting the insertion of the terminal 2 in a stress condition of the hemisurfaces being comprised within the elastic field of the material constituting the interface 1A; the parameters A-G of figure 2 are in other words duly calculated during the project phase, depending upon the use of the device and of the type of terminals to retain and connect.

An example of the constructive parameters of the device and of the coupling method being the objects of the present invention, in the case of a rheophore 2 of tinned annealed copper (or soft-copper) having a diameter of 0,8 mm, and with an interface 1A realized starting from a foil of brass of the type 67 H10 being thick 0,8 mm, is the following (with reference to the quotes of figure 2):

A = 0,75 mm
B = 1,175 mm
C = 3,75 mm
D = 1,575 mm
E = 0,40 mm
F = 0,60 mm
G = 60°

In the just exemplified case, the attack angle of the tool 6 shall be of 75° and the force being necessary for producing the desired flexion within the full elastic field of the device will be of 10 Newton.

In respect of the prior art, the main advantage of the described device is due to the fact that, according to invention, it is possible to obtain the coupling and the permanent electric contact by using materials having a high electric conductivity, even if not properly adapt to the "spring" function, such as for example of the common brass of the type 67 H10 or 67 H20; on the contrary, as mentioned in the opening of the present description, the known devices requires constructive materials being highly plastic, inasmuch as such known devices base their functioning just upon the plasticity of the material: as mentioned, however, this is a source of drawbacks.

Therefore, in respect of the prior art, in the case of the present invention a minimum elasticity is required, only for allowing the initial coupling between the interfaces 1A and the contact element 2; the rigid coupling is then realized by means of the hemisurfaces 4.

As mentioned, by means of an adequate dimensioning of the parameters of the parts of the interface 1A, it is possible to generate the desired condition of electric contact, so as to satisfy functional needs which up to now were limited to the welding systems.

Concerning the manufacturing process, as mentioned the device 1 can be obtained starting from a foil of electrically conductive material, advantageously punched for realizing the slant planes 3, the hemisurfaces 4 and the slot 5. In the case in which the slot 5 must have a reduced width E, which could make problematic or impossible the punching process, it is possible to proceed in one of the following ways:

A)
- to use a starting foil having reduced thickness, which allows the punching operation, for obtaining the slot 5 on the portion 1A;
- to fold up the opposite portion 1B of the starting foil, for obtaining the faston zone having the thickness adequate to the needs, or

B)
- to use a starting foil of adequate thickness for the connection to be realized through the portion 1B, and to subject a portion of said foil to a reduction of section, or coining (i.e. a squeezing), for bringing its thickness to a quote which allows to obtain for punching the slot 5 of wished width;
- to use the remaining portion 1B of the foil for the connection of the device 1 with another interlocked device.

It is then clear that the coupling between the contact element 2 and the interface 1A may be realized in an automatic way, but without the particular attentions characterizing the prior art.

From the given description the characteristics of the present invention are thus clear, so as clear are its advantages. In particular it should be underlined the possibility of realizing holding and permanent contact devices by means of common materials with high electric conductivity, the simplicity of realization, due to the elementary geometry, and the manufacturing simplicity, inasmuch as the terminal-device coupling phase does not requires particular attentions.

It is clear that several variant embodiments and applications are possible to the device being the object of the present invention.

For example the device object of the invention may be used with terminal 2 onto which tin is present, being used as protective galvanic coat; in such a case, after the execution of the coupling operation as described above, a remelting phase of said tin may be provided, being obtainable in a very simple way, for example by means of an heating element: in this way it is therefore possible to obtain the interaction between the electric conduction due to the remelting of the tin and the electric conduction obtained by the contact pressure between the parts as described above, with a further increasing of the functional reliability of the same device. Such an application is particularly indicated for heavy conditions of use, among which for example the connection of the ends of the coil of a relay, or other similar ones, where the connection is critic.

It is then evident that, as already mentioned, changing the section of the contact element or terminal 2, also the hemisurfaces 4 should have a shape being different in respect of the semicircular one, herein described as an example.

It is however clear that several other changes can be made to the device being the object of the present invention, without departing from the novelty principles inherent the inventive idea.

Claims

1. Device for the permanent connection, both mechanical and electrical, of a terminal (2) of electric and/or electronic components, characterized in that, for said connection, a contact element is provided, being permanently elastic (1A), made from a foil of an electrically conductive material, said contact element (1A) including an insertion zone for the terminal (2) defined by two opposite hemisurfaces (4), and a flexion slot (5) of the two hemisurfaces (4) contiguous to the contact zone, being able to consent the insertion of the terminal (2) in a stress condition of the hemisurfaces (4) within the elastic field of the material constituting the foil (1).

2. Device, according to claim 1, characterized in that it is composed by a foil (1) of an electrically conductive material presenting two opposite slant planes (3), said slant planes (3) converging from an end of the foil (1) up to two hemisurfaces (4), said hemisurfaces (4) defining a contact zone for containing the terminal (2) in a permanent working position, the dimension (A) of said zone being smaller than the section of the terminal (2), a flexion slot (5) being obtained in said foil (1), in a position being contiguous to the contact zone defined by said hemisurfaces (4).

3. Device, according to claim 1 or 2, characterized in that the material realizing said foil (1), for example brass, is not properly of the type adapt to the spring function.

4. Device, according to claim 2, characterized in that said slant planes (3) define a notch being apt at facilitating the insertion of the terminal (2) within the contact zone defined by said hemisurfaces (4) and/or at facilitating the elastic deformation being necessary for the adequate reciprocal positioning of the parts in contact (2,4).

5. Device, according to claim 2, characterized in that said slot (5) allows for a stress being completely comprised in the elastic field of said foil (1), and sufficient for allowing the insertion of said terminal (2) between said hemisurfaces (4).

6. Device, according to at least one of previous claims, characterized in that a suitable tool (6) is provided for realizing an elastic deformation of said foil (1), by means of the widening of said slant planes (3).

7. Device, according to at least one of previous claims, characterized in that said tool (6) has two slant surfaces having an attack angle being greater than the angle of said slant planes (3).

8. Device, according to at least one of previous claims, characterized in that its mechanical and/or electrical connection to said terminal (2) is increased by the remelting of the coating material being eventually present onto said terminal (2).

9. Method for the realization of the device according to one or more of the previous claims, wherein the device has two portions (1A,1B) having a different thickness and is obtained starting from a foil of an electrically conductive material, characterized in that the following steps are provided:
   - using a starting foil having a reduced thickness, such to allow the realization of the slot (5) on a portion (1A) of the foil by means of a punching operation;
   - folding up the opposite portion (1B) of the starting foil, for obtaining a zone for the connection with another interlocked device, having a thickness being adequate to the needs.

10. Method for the realization of the device according to one or more of the previous claims, wherein the device has two portions (1A,1B) having a different thickness and is obtained starting from a foil in an electrically conductive material, characterized in that the following steps are provided:
   - using a starting foil having a thickness being adequate for the connection of said device (1) to another interlocked device;
   - subjecting at least a portion (1A) of said foil to a thickness reduction, or coining, in order to allow to realize the slot (5) by punching with the desired width (E);
   - using the remaining portion (1B) of the foil, not being subject to the thickness reduction, as a zone for connecting the device to said other interlocked device.

11. Method for the permanent connection, both mechanical and electrical, of a terminal (2) to a contact device, wherein said contact device is obtained starting from a foil of an electrically conductive material, characterized in that the following steps are provided:
   - in the foil (1) there are obtained
     A) a contact zone defined by two opposite hemisurfaces (4), the section of the terminal being greater than the distance between the hemisurfaces (4);
     B) two slant planes (3), being opposite and converging from an end of the foil (1) towards the hemisurfaces (4);
     C) a flexion slot (5), being contiguous to the contact zone and dimensioned so as to

allow a stress of the foil (1) being comprised within the elastic field of the material constituting the foil;

- the terminal (2) is inserted in the notch defined by the slant planes (3), so as to be downwardly guided for resting on the upper zone of the hemisurfaces (4);
- the notch is stressed within the full elastic field of the material constituting the foil, by means of a suitable tool (6), which provides to slightly widen the hemisurfaces, so allowing the terminal (2) to enter in the holding and contact zone defined by the same hemisurfaces (4);
- the tool (6) is moved backward and the terminal (2) remains rigidly coupled between the hemisurfaces (4).

12. Method, according to the previous claim, characterized in that it is further provided a phase of remelting of the coating material being eventually present onto said terminal (2), in order to increase the holding and the electrical contact.

FIG. 1

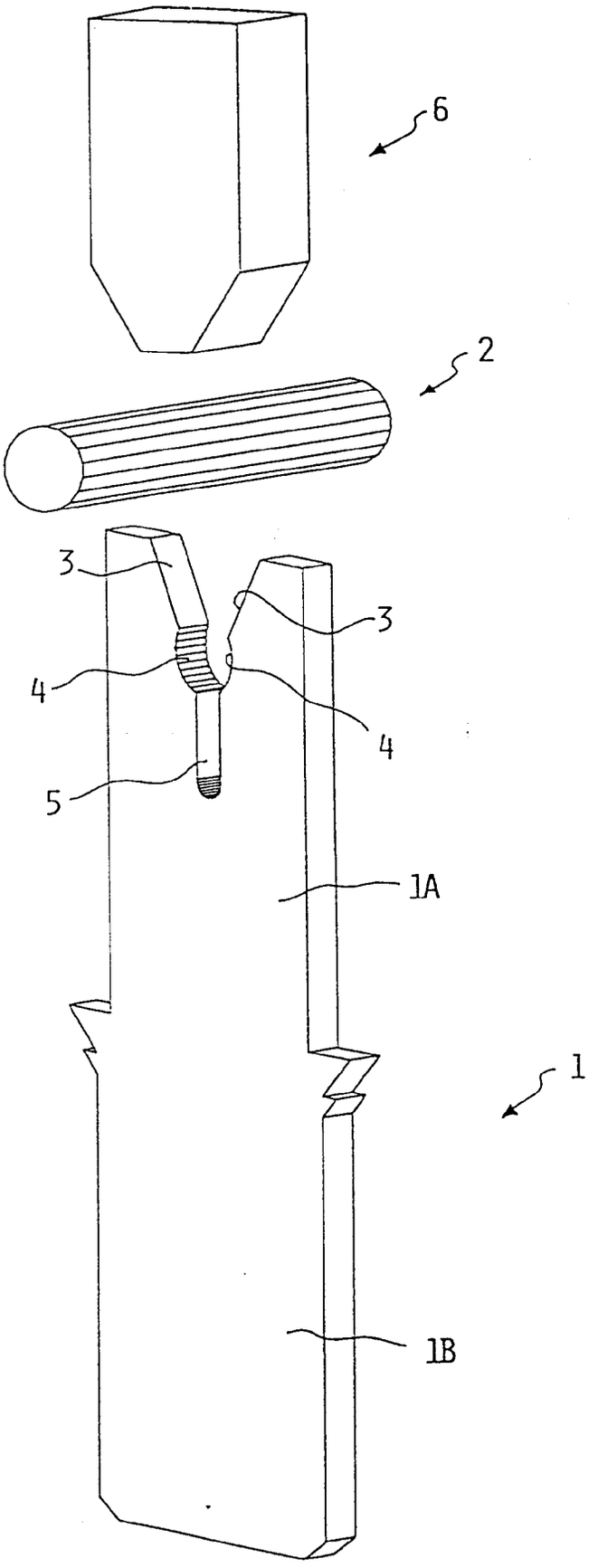
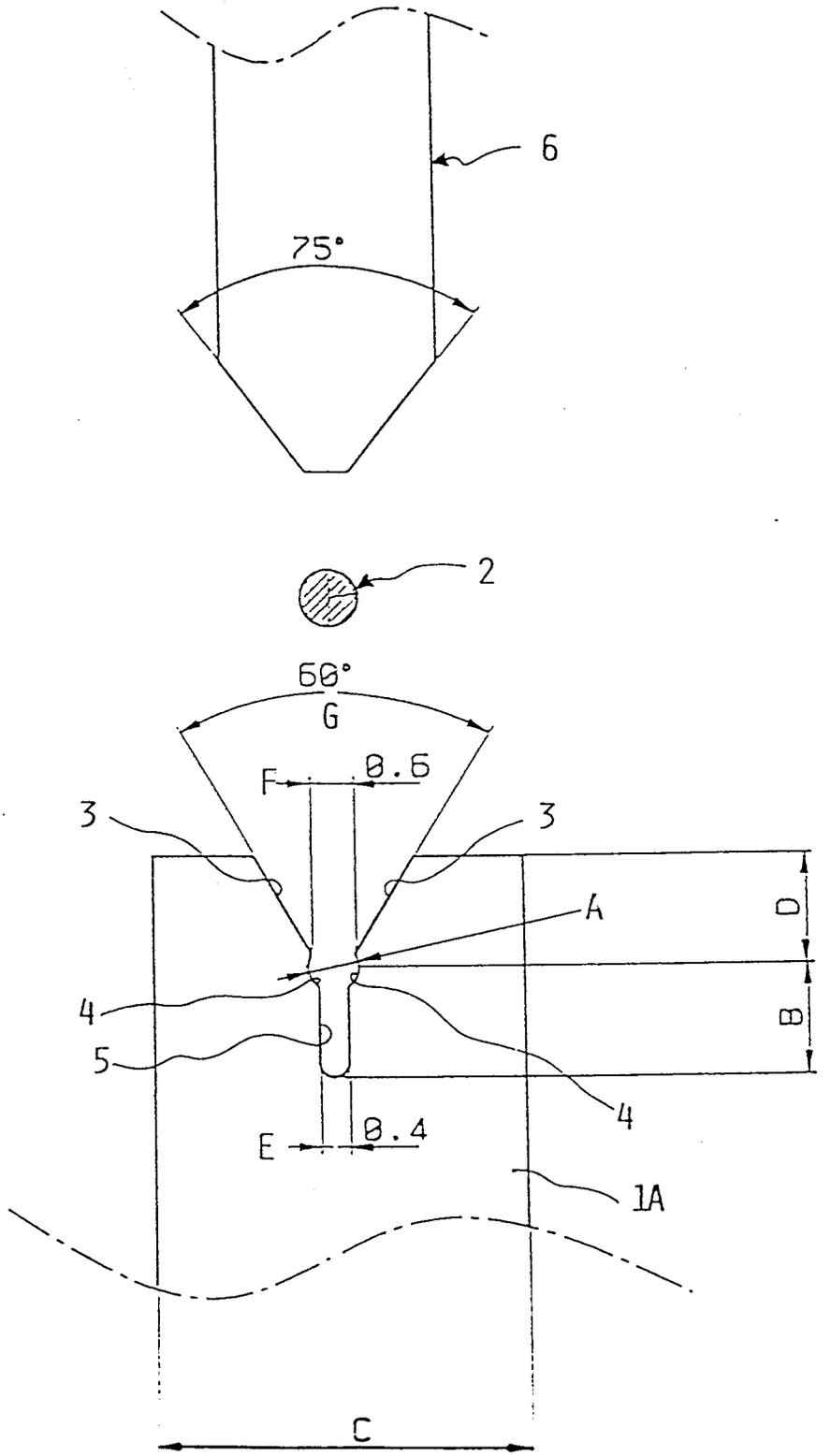


FIG. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 95 10 4772

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.6)
Y	DE-A-34 38 800 (YAZAKI CORP.) * page 11, line 21 - page 22; figures 1-10 * ---	1-5	H01R13/11 H01R13/193 H01R43/26 H01R43/16
Y	DE-U-78 21 715 (JAKOB PREH NACHF. GMBH & CO) * page 2 - page 3, paragraph 1; figure 1 * ---	1-5	
A	NEW ELECTRONICS.INCORPORATING ELECTRONICS TODAY, vol. 15, no. 2, January 1982 LONDON GB, pages 59-61, JIM MILNER, H & T COMPONENTS 'state of the art interconnection' ---	1-5	
A	US-A-2 316 555 (KENLY C. BUGG) * page 2, column 1, line 59 - column 1, line 73; figure 10 * * page 2, column 2, last paragraph * ---	1-5,8,12	
A	EP-A-0 501 392 (THE WHITAKER CORPORATION) * page 3, column 3, line 40 - page 6, column 9, line 47; figures 1-10 * ---	1,9-11	TECHNICAL FIELDS SEARCHED (Int.Cl.6) H01R
A	EP-A-0 320 323 (BONHOMME FRANCOIS ROBERT) * page 2, column 2, line 55 - page 3, column 3, line 47; figures 1-5 * ---	9-11	
A	US-A-3 546 663 (CENTRE WILLIAM HOLMBERG JR.) * column 3, line 63 - column 4, line 38; figures 1-8 * -----	6,7	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 July 1995	Tappeiner, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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