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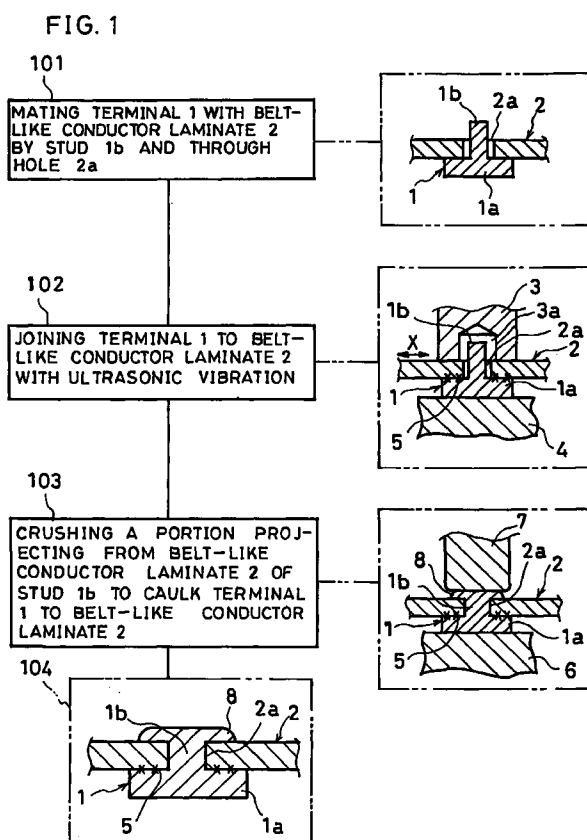
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(54) **A connected body comprising a terminal and a belt-like conductor laminate and a method for connecting a terminal to a belt-like conductor laminate**

(57) A connected body comprising a terminal (1) and a belt-like conductor laminate (2) and having improved mechanical and electrical reliabilities and a method for connecting a terminal (1) and a belt-like conductor laminate (2).

Mating portions of the belt-like conductor laminate (2) mated with a thin stud (1b) projecting from the base (1a) of the terminal (1) and the base are joined together with ultrasonic vibration, and a crushed portion (8) formed by caulking a portion projecting from the belt-like conductor laminate (2) of the stud (1b) supports the belt-like conductor laminate with the base.



Description

Background of the Invention

[Field of the Invention]

[0001] The present invention relates to a connected body comprising a terminal and a belt-like conductor laminate and to a method for connecting a terminal to a belt-like conductor laminate.

[Description of the Prior Art]

[0002] Fig. 5 shows a connected body comprising a terminal 1 for an electric part such as a capacitor or battery and a belt-like conductor laminate 2 formed by piling up a plurality of thin belt-like conductors as an example of a connected body comprising a terminal 1 and a belt-like conductor laminate 2 of the prior art. Before the terminal 1 is connected to the belt-like conductor laminate 2, the terminal 1 is integrated with the cap 9 of an electric part by insert molding. That is, the terminal 1 is made from a metal material having small electric resistance and has a thin stud 1b projecting from the surface of a base 1a and a thin external electrode 1c coaxial to the stud 1b and projecting from the rear surface of the base 1a. Insert molding is for obtaining a molded piece comprising the base 1a of the terminal 1 integrated with the molded cap 9 by placing the above terminal 1 in a cap mold as an insert member, charging a synthetic resin as a material for molding the cap 9 into a molding space formed in the inside of the cap mold containing the terminal 1 to mold a molded piece consisting of the terminal 1 and the cap 9 and releasing the molded piece from the cap mold. Before the terminal 1 is connected to the belt-like conductor laminate 2, the belt-like conductor laminate 2 has a through hole 2a into which the stud 1b can be inserted in a portion specified as a connection portion with the terminal 1. The connected body is formed by caulking the above terminal 1 to the belt-like conductor laminate 2. To this end, the stud 1b of the terminal 1 is first inserted into the through hole 2a of the belt-like conductor laminate 2 so that the terminal 1 is mated with the belt-like conductor laminate 2 by the stud 1b and the through hole 2a. Thereafter, a pressing member such as a washer is fitted onto a portion projecting from the belt-like conductor laminate 2 of the stud 1b. In this state, a portion projecting from the pressing member 10 of the stud 1b is crushed to caulk the terminal 1 to the belt-like conductor laminate 2.

Summary of the Invention

[0003] In the connected body comprising the terminal 1 and the belt-like conductor laminate 2 formed by caulking and the method for connecting the terminal 1 to the charted body 2 of the prior art, it is possible that

electric conductivity is insufficient though mechanical strength is relatively high. This is because the mating portions of the terminal 1 and the belt-like conductor laminate 2 are merely strongly contacted to each other by caulking by crushing the stud 1b. When the contact surfaces of the terminal 1 and the belt-like conductor laminate 2 are observed microscopically, there are a large number of extremely small spaces between the contact surfaces.

[0004] It is therefore an object of the present invention to provide a connected body comprising a terminal and a belt-like conductor laminate and having high mechanical and electric reliabilities and a method for connecting the terminal to the belt-like conductor laminate.

[0005] According to a first aspect of the present invention, there is provided a connected body in which mating portions of a belt-like conductor laminate mated with a thin stud projecting from the base of a terminal and the base are joined together with ultrasonic vibration, and a crushed portion formed by caulking a portion projecting from the belt-like conductor laminate of the stud supports the belt-like conductor laminate with the base.

[0006] According to a second aspect of the present invention, there is provided a connected body in which mating portions of a belt-like conductor laminate mated with a thin stud projecting from the base of a terminal and the base are supported by a crushed portion formed by caulking a portion projecting from the belt-like conductor laminate of the stud and the base, and part of the belt-like conductor laminate outside the crushed portion is folded down and joined to the top surface of the crushed portion with ultrasonic vibration.

[0007] According to a third aspect of the present invention, there is provided a connection method which comprises the steps of mating a thin stud projecting from the base of a terminal with a belt-like conductor laminate, giving ultrasonic vibration to the outside of at least one of the base of the terminal and the belt-like conductor laminate to join the mating portions of the base and the belt-like conductor laminate, and crushing a portion projecting from the belt-like conductor laminate of the stud to caulk the terminal to the belt-like conductor laminate.

[0008] According to a fourth aspect of the present invention, there is provided a connection method which comprises the steps of mating a thin stud projecting from the base of a terminal with a belt-like conductor laminate, crushing a portion projecting from the belt-like conductor laminate of the stud to caulk the terminal to the belt-like conductor laminate, folding down one side of the belt-like conductor laminate with the stud as a boundary between it and the other side, placing it upon the crushed portion of the stud, and giving ultrasonic vibration to the outside of at least one of the base of the terminal and the belt-like conductor laminate to join the mating portions of the crushed portion of the stud and the belt-like conductor laminate.

[0009] According to a fifth aspect of the present inven-

tion, there is provided a connection method in which ultrasonic vibration is given to the outside of the belt-like conductor laminate.

[0010] According to a seventh aspect of the present invention, there is provided a connection method in which a through hole for the stud is formed in the belt-like conductor laminate so that the stud is mated with the belt-like conductor laminate by the through hole.

[0011] According to a seventh aspect of the present invention, there is provided a connection method in which after joining with ultrasonic vibration, a pressing member is fitted onto the portion projecting from the belt-like conductor laminate of the stud and a portion projecting from the pressing member of the stud is crushed to caulk the terminal to the belt-like conductor laminate.

[0012] The above and other objects, features and advantages of the invention will become more apparent from the following description when taken in conjunction with the accompanying drawings.

Brief Description of the Accompanying Drawings

[0013]

Fig. 1 is a flow chart showing Embodiment 1 of the present invention;

Fig. 2 is a flow chart showing Embodiment 2 of the present invention;

Fig. 3 is a sectional view of Embodiment 3 of the present invention;

Fig. 4 is a sectional view of Embodiment 4 of the present invention; and

Fig. 5 is a sectional view of a connected body of the prior art.

Detailed Description of the Preferred Embodiments

Embodiment 1

[0014] With reference to Fig. 1, a connected body and a connection method according to Embodiment 1 of the present invention will be described hereinafter. Before a terminal 1 and a belt-like conductor laminate 2 are connected to each other, the terminal 1 is made from a metal material having small electric resistance and a stud 1b projects from the surface of a base 1a so that the base 1a exists around the thin stud 1b. Before the terminal 1 and the belt-like conductor laminate 2 are connected to each other, the belt-like conductor laminate 2 is a laminate consisting of a plurality of thin belt-like conductors having small electric resistance which are placed one upon another and joined together and has a through hole 2a into which the stud 1b can be inserted in a portion specified as a connection portion with the terminal 1.

[0015] To form the connected body comprising the above terminal 1 and belt-like conductor laminate 2, the

stud 1b is inserted into the through hole 2a in step 101 so that the terminal 1 and the belt-like conductor laminate 2 are mated with each other by the stud 1b and the through hole 2a. In the next step 102, the terminal 1 and the belt-like conductor laminate 2 mated with the terminal 1 are joined together with ultrasonic vibration. Thereafter, in step 103, a portion projecting from the belt-like conductor laminate 2 of the stud 1b is crushed to caulk the terminal 1 to the belt-like conductor laminate 2.

[0016] A method for connecting the terminal 1 to the belt-like conductor laminate 2 with ultrasonic vibration will be described with reference to a figure within a frame shown by a virtual line on the right side of step 102. This connection method uses an ultrasonic vibration connection device, for example. The terminal 1 mated with the belt-like conductor laminate 2 is placed on a workpiece mounting table 4 right below the connection tool 3 of the ultrasonic vibration connection device with a predetermined interval therebetween. This state is such that the rear surface on a side opposite to the stud 1b of the terminal 1 is in contact with the top surface of the workpiece mounting table 4 and that the stud 1b and the belt-like conductor laminate 2 face the connection tool 3. Thereafter, the connection tool 3 having a relief hole 3a in the end surface is moved down by the pressure drive unit of the ultrasonic vibration connection device, the relief hole 3a of the connection tool 3 thereby contains the portion projecting from the belt-like conductor laminate 2 of the stud 1b coaxially without contact, the annular end surface around the relief hole 3a of the connection tool 3 contacts the belt-like conductor laminate 3 around the stud 1d, and the connection tool 3 presses the base 1a and the belt-like conductor laminate 2 in a direction that they approach each other with a predetermined pressure together with the workpiece mounting table 4.

[0017] This pressure force is set to a predetermined value according to the materials and physical properties such as thickness of the belt-like conductor laminate 2 and the terminal 1 to be joined together with ultrasonic vibration and determined by the amount of the downward movement of the pressure drive unit which is set to achieve the above predetermined value. For instance, the distance between the top surface of the workpiece mounting table 4 and the top surface of the belt-like conductor laminate 2 (the surface that the connection tool 3 contacts) before the base 1a and the belt-like conductor laminate 2 are pressed by the connection tool 3 and the workpiece mounting table 4 is compared with the distance between the top surface of the workpiece mounting table 4 and the top surface of the belt-like conductor laminate 2 (the surface that the connection tool 3 contacts) after the base 1a and the belt-like conductor laminate 2 are pressed by the connection tool 3 and the workpiece mounting table 4, and the relationship between the pressure and the amount of downward movement is obtained from experiments on correlation

between the pressure and the amount of downward movement to find how much pressure is applied to the base 1a and the belt-like conductor laminate 2 when the distance after the application of pressure is reduced from the distance before the application of pressure by a certain value. By using the amount of downward movement, the base 1a and the belt-like conductor laminate 2 can be pressed with a predetermined pressure by the connection tool 3 and the workpiece mounting table 4. A pressure sensor may be provided to the pressure drive unit so that the pressure drive unit is controlled to stop downward movement and to maintain the stop position when the pressure sensor detects a predetermined pressure, thereby making it possible for the connection tool 3 and the workpiece mounting table 4 to press the base 1a and the belt-like conductor laminate 2 with a predetermined pressure.

[0018] While the base 1a and the belt-like conductor laminate 2 are sandwiched between the connection tool 3 and the workpiece mounting table 4 and pressed with a predetermined pressure, ultrasonic vibration is transmitted to the connection tool 3 from a transducer which is an electro-acoustic converter or electro-vibration converter composed of a piezoelectric element or magnetostrictive element for converting into mechanical energy electric energy for generating and outputting vibration of a vertical ultrasonic wave having a predetermined frequency with power supplied from the ultrasonic generator of the ultrasonic vibration connection device through a booster or an ultrasonic horn. Then, the connection tool 3 resonates with the transmitted ultrasonic vibration and the resonance (the direction of this vibration is a horizontal direction shown by an arrow X) is given to the outside of the belt-like conductor laminate 2 for a predetermined time. Thereby, the resonance of the connection tool 3 is transmitted through the inside of the belt-like conductor laminate 2 from the outside of the belt-like conductor laminate 2 and joins together the plurality of conductors forming the belt-like conductor laminate 2 and also the mating portions of the belt-like conductor laminate 2 and the base 1a. Thereafter, the pressure drive unit goes up and the connection tool 3 moves away from the terminal 1 and the belt-like conductor laminate 2 joined to the terminal 1 and stops with a predetermined interval between it and the workpiece mounting table 4. In this state, an intermediate product consisting of the terminal 1 and the belt-like conductor laminate 2 joined to the terminal 1 is removed from the workpiece mounting table 4.

[0019] With reference to a figure within a frame shown by a virtual line on the right side of step 103, a method for caulking the terminal 1 to the belt-like conductor laminate 2 by crushing a portion projecting from the belt-like conductor laminate 2 of the stud 1b of the intermediate product removed from the ultrasonic vibration connection device will be described hereinafter. This caulking can be carried out manually or by a press machine. In an either case, the intermediate product is placed on a

workpiece mounting table 6 for caulking. The intermediate product is placed on the workpiece mounting table 6 in such a manner that the rear surface on a side opposite to the stud 1b of the terminal 1 is in contact with the top surface of the workpiece mounting table 6 and that the stud 1b and the belt-like conductor laminate 2 face a caulking tool 7. In this state, the portion projecting from the belt-like conductor laminate 2 of the stud 1b is crushed by the caulking tool 7. This caulking tool 7 may be a hammer when caulking is carried out manually or may be stricken by a hammer. When the press machine is used, the caulking tool 7 is attached to the ram of the press machine and crushes the stud 1b by the downward movement of the ram. That is, while the intermediate product is placed on the workpiece mounting table 4, the end surface of the caulking tool 7 strikes the top surface of the portion projecting from the belt-like conductor laminate 2 of the stud 1b toward the base 1a with predetermined forging force, the portion projecting from the belt-like conductor laminate 2 of the stud 1b is thereby crushed by the caulking tool 7, the stud 1b is elastically deformed between the workpiece mounting table 6 and the caulking tool 7, part of the stud 1b spreads in the entire through hole 2a of the belt-like conductor laminate 2 and contacts the through hole 2a without a space therebetween, other part of the stud 1b spreads over a portion around the through hole 2a of the belt-like conductor laminate 2 and contacts and covers the top surface (surface on the caulking tool 7 side) of the belt-like conductor laminate 2 around the through hole 2a without a space therebetween, and the terminal 1 is thereby caulked to the belt-like conductor laminate 2. The portion of the stud 1b covering the top surface of the belt-like conductor laminate 2 is called "crushed portion" hereinafter. A connected body comprising the terminal 1 and the belt-like conductor laminate 2 shown in step 104 is obtained by the completion of this caulking.

[0020] According to Embodiment 1, since the plurality of conductors forming the belt-like conductor laminate 2 are joined together with ultrasonic vibration and the mating portions 5 are also joined together with ultrasonic vibration, the plurality of conductors forming the belt-like conductor laminate 2 are fused together and the mating portions 5 are also fused together by friction heat generated between adjacent elements when they receive ultrasonic vibration, thereby improving the electric conductivity of the connected body comprising the terminal 1 and the belt-like conductor laminate 2. Further, since the belt-like conductor laminate 2 is supported by the base 1a and the crushed portion 8 formed by caulking, the mechanical strength of the connected body comprising the terminal 1 and the belt-like conductor laminate 2 is improved. After joining with ultrasonic vibration, the mating portions 5 are supported by the base 1a and the crushed portion 8 and a portion having high electric conductivity is connected in a state that it has high mechanical strength by the above caulking method, whereby high mechanical and electric reliability

ties can be suitably exhibited for a long time. Since the belt-like conductor laminate 2 has the through hole 2 into which the stud 1b can be inserted in a portion specified as the connection portion with the terminal 1, the connection position of the terminal 1 and the belt-like conductor laminate 2 is accurately determined by mating between the stud 1a and the through hole 2a.

Embodiment 2

[0021] With reference to Fig. 2, a connected body and a connection method according to Embodiment 2 of the present invention will be described hereinafter. Embodiment 2 differs from Embodiment 1 in the shape of part of the terminal 1 and the shape of part of each of the workpiece mounting tables 4 and 6 and that a pressing member 10 such as a washer is used to caulk the terminal 1 to the belt-like conductor laminate 2. However, the belt-like conductor laminate 2 and the connection tool 3 are identical to those of Embodiment 1. Before the terminal 1 is connected to the belt-like conductor laminate 2, the terminal 1 whose thin external electrode 1c projects coaxial to the stud 1b from the rear surface of the base 1a is integrated with a synthetic resin cap 9 for an electric part such as a capacitor or battery by insert molding. The workpiece mounting tables 4 and 6 have relief holes 4a and 5b for containing the external electrode 1c coaxially without contact in the top surfaces, respectively.

[0022] To form a connected body comprising the terminal 1 and the belt-like conductor laminate 2, the terminal 1 and the belt-like conductor laminate 2 are first mated with each other by the stud 1b and the through hole 2a in step 201, and the terminal 1 and the belt-like conductor laminate 2 are joined together with ultrasonic vibration in step 102. For joining, the external electrode 1c is contained in the relief hole 4a of the workpiece mounting table 4, the stud 1b is contained in the relief hole 3a of the connection tool 3, and the base 1a and the belt-like conductor laminate 2 are sandwiched between the connection tool 3 and the workpiece mounting table 4 and pressed with a predetermined pressure. In this state, the resonance of the connection tool 3 which resonates with ultrasonic vibration generated by the transducer of the ultrasonic vibration connection device is transmitted through the inside of the belt-like conductor laminate 2 from the outside of the belt-like conductor laminate 2 and joins together the plurality of conductors forming the belt-like conductor laminate 2 and the mating portions 5. After the connection tool 3 is removed from the terminal 1 and the belt-like conductor laminate 2, the intermediate product consisting of the terminal 1 and the belt-like conductor laminate 2 is removed from the workpiece mounting table 4. In the subsequent step 203, the pressing member 10 is fitted onto a portion projecting from the belt-like conductor laminate 2 of the stud 1b, and the portion projecting from the belt-like conductor laminate 2 of the stud 1b is

crushed by the caulking tool 7 to caulk the terminal 1 to the belt-like conductor laminate 2 while the external electrode 1c is contained in the relief hole 6a of the workpiece mounting table 6 and the rear surface of the base 1a is in contact with the top surface of the workpiece mounting table 6. The connected body comprising the terminal 1 and the belt-like conductor laminate 2 shown in step 204 is obtained by the completion of this caulking.

[0023] According to Embodiment 2, since the pressing member 10 interposed between the crushed portion 8 and the belt-like conductor laminate 2 supports the belt-like conductor laminate 2 with the base 1a, the mechanical and electric reliabilities of the connected body comprising the terminal 1 and the belt-like conductor laminate 2 can be enhanced even if the outer diameter of the crushed portion 8 is small, in addition to the function and effect of the above Embodiment 1.

Embodiment 3

[0024] With reference to Fig. 3, a connected body and a connection method according to Embodiment 3 of the present invention will be described hereinafter. In Embodiment 1 and Embodiment 2, the mating portions 5 joined together with ultrasonic vibration are supported by the base 1a and the crushed portion 8 formed by caulking. In Embodiment 3, after the terminal 1 is caulked to the belt-like conductor laminate 2, part of the belt-like conductor laminate 2 is folded down and joined to the top surface of the crushed portion 8 with ultrasonic vibration. That is, while the terminal 1 caulked to the belt-like conductor laminate 2 through the pressing member 10 is placed upon the workpiece mounting table 4 and part of the belt-like conductor laminate 2 is placed upon the crushed portion 8, the connection tool 3 is press contacted to the belt-like conductor laminate 2 placed upon the crushed portion 8 with a predetermined pressure. The resonance of the connection tool 3 which resonates with ultrasonic vibration generated by the transducer of the ultrasonic vibration connection device is transmitted through the inside of the belt-like conductor laminate 2 from the outside of the belt-like conductor laminate 2 to the mating portions 11 of the belt-like conductor laminate 2 and the crushed portion 8. In this process, the plurality of conductors forming the belt-like conductor laminate 2 sandwiched between the connection tool 3 and the crushed portion 8 and the mating portions 11 are joined together with ultrasonic vibration.

[0025] According to Embodiment 3, connection having mechanical strength by caulking and high electric conductivity and high reliability by joining with ultrasonic vibration is effected without forming the relief hole 3a in the connection tool 3 as in Embodiment 1 and Embodiment 2.

Embodiment 4

[0026] With reference to Fig. 4, a connected body and a connection method according to Embodiment 4 of the present invention will be described hereinafter. In Embodiment 4, the order of joining and caulking in Embodiment 1 is reversed. The connection tool 3 has an relief hole 3b which can contain the crushed portion 8. After the completion of caulking so that the portion projecting from the belt-like conductor laminate 2 of the stud 1b is crushed and the belt-like conductor laminate 2 is supported by the crushed portion 8 and the base 1a, the crushed portion 8 is contained in the relief hole 3b without contact, and the annular end surface around the relief hole 3a of the connection tool 3 presses the belt-like conductor laminate 2 around the crushed portion 8 with a predetermined pressure. In this state, the resonance of the connection tool 3 is transmitted through the inside of the belt-like conductor laminate 2 from the outside of the belt-like conductor laminate 2 and joins the mating portions 5.

[0027] In Embodiment 1 and Embodiment 4, the pressing member 9 may be used as in Embodiment 2 and Embodiment 3. On the contrary, in Embodiment 2 and Embodiment 3, the pressing member 9 may be omitted as in Embodiment 1 and Embodiment 4.

[0028] In Embodiments 1 to 4, the base 1a of the terminal 1 may be rod-shaped or belt-shaped.

[0029] In Embodiments 1 to 4, the stub 1b may be mated with the belt-like conductor laminate 2 by omitting the through hole 2a from the belt-like conductor laminate 2 and sticking the portion specified as the connection portion with the terminal 1 of the belt-like conductor laminate 2 into the stud 1b.

[0030] In Embodiments 1, 2 and 4, after the terminal 1 and the belt-like conductor laminate 2 are connected to each other by joining with ultrasonic vibration and caulking by crushing, part of the belt-like conductor laminate may be folded down and joined to the top surface of the crushed portion 8 with ultrasonic vibration as in Embodiment 3. In this case, though two connection tools 3 having an relief hole 3a or 3b and no relief hole are required, the number of portions joined with ultrasonic vibration is increased and electric reliability can be further improved.

[0031] According to the connected body of the first and second aspects of the present invention, since the terminal and the belt-like conductor laminate have portions joined with ultrasonic vibration and portions joined by caulking, high mechanical and electric reliabilities can be suitably exhibited for a long time.

[0032] According to the connection method of the third and fourth aspects of the present invention, since the terminal and the belt-like conductor laminate are joined together with ultrasonic vibration and caulked to each other, a connected body having high mechanical and electric reliabilities and comprising the terminal and the belt-like conductor laminate can be easily and advantageously obtained.

geously obtained.

[0033] According to the connection method of the fifth aspect of the present invention, since ultrasonic vibration is suitably transmitted from the belt-like conductor laminate which is thinner than the terminal to the portion to be joined to the terminal, the terminal and the belt-like conductor laminate can be joined together firmly.

[0034] According to the sixth aspect of the present invention, since the stud and the through hole are mated with each other, the connection position of the terminal and the belt-like conductor laminate is accurately determined.

[0035] According to the seventh aspect of the present invention, connection having mechanical strength by caulking, electric conductivity by joining with ultrasonic vibration and high reliability is effected without forming a relief hole in the connection tool.

[0036] The features disclosed in the foregoing description, in the claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

Claims

1. A connected body comprising a terminal and a belt-like conductor laminate, wherein

mating portions of the belt-like conductor laminate mated with a thin stud projecting from the base of the terminal and the base are joined together with ultrasonic vibration, and a crushed portion formed by caulking a portion projecting from the belt-like conductor laminate of the stud supports the belt-like conductor laminate with the base.

2. A connected body comprising a terminal and a belt-like conductor laminate, wherein

mating portions of the belt-like conductor laminate mated with a thin stud projecting from the base of the terminal and the base are supported by a crushed portion formed by caulking a portion projecting from the belt-like conductor laminate of the stud and the base, and part of the belt-like conductor laminate outside the crushed portion is folded down and joined to the top surface of the crushed portion with ultrasonic vibration.

3. A method for connecting a terminal to a belt-like conductor laminate comprising the steps of:

mating a thin stud projecting from the base of the terminal with the belt-like conductor laminate;
giving ultrasonic vibration to the outside of at

least one of the base of the terminal and the belt-like conductor laminate to join the mating portions of the base and the belt-like conductor laminate; and

crushing a portion projecting from the belt-like conductor laminate of the stud to caulk the terminal to the belt-like conductor laminate. 5

4. A method for connecting a terminal to a belt-like conductor laminate comprising the steps of: 10

mating a thin stud projecting from the base of the terminal with the belt-like conductor laminate;

crushing a portion projecting from the belt-like conductor laminate of the stud to caulk the terminal to the belt-like conductor laminate; 15

folding down one side of the belt-like conductor laminate with the stud as a boundary between it and the other side and placing it upon the crushed portion of the stud; and 20

giving ultrasonic vibration to the outside of at least one of the base of the terminal and the belt-like conductor laminate to join the mating portions of the crushed portion of the stud and the belt-like conductor laminate. 25

5. The method for connecting a terminal to a belt-like conductor laminate according to claim 3, wherein ultrasonic vibration is given to the outside of the belt-like conductor laminate. 30

6. The method for connecting a terminal to a belt-like conductor laminate according to claim 3, wherein a through hole for the stud is formed in the belt-like conductor laminate so that the stud is mated with the belt-like conductor laminate by the through hole. 35

7. The method for connecting a terminal to a belt-like conductor laminate according to claim 3, wherein after joining with ultrasonic vibration, a pressing member is fitted onto the portion projecting from the belt-like conductor laminate of the stud and a portion projecting from the pressing member of the stud is crushed to caulk the terminal to the belt-like conductor laminate. 40 45

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FIG. 1

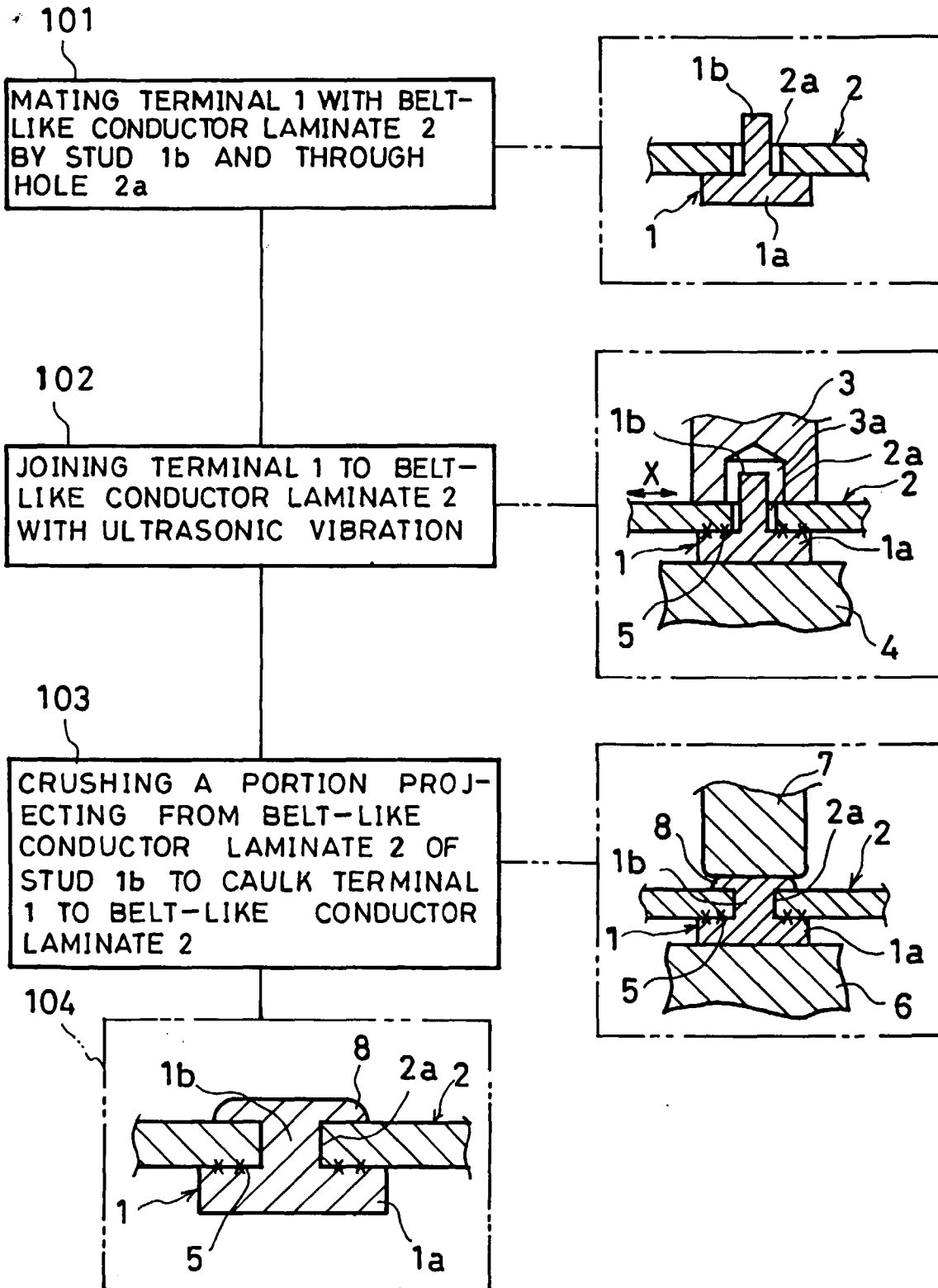


FIG. 2

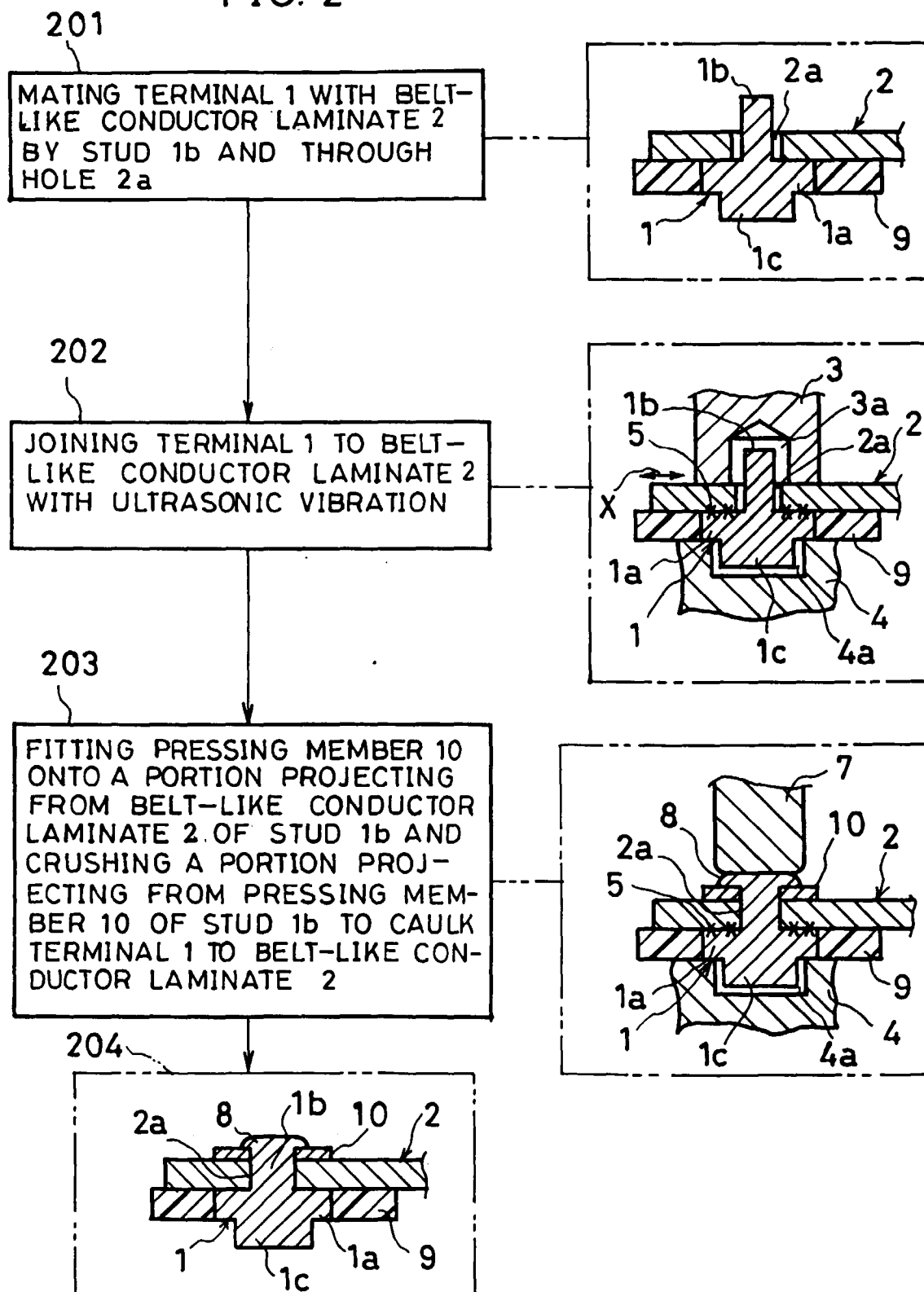


FIG. 3

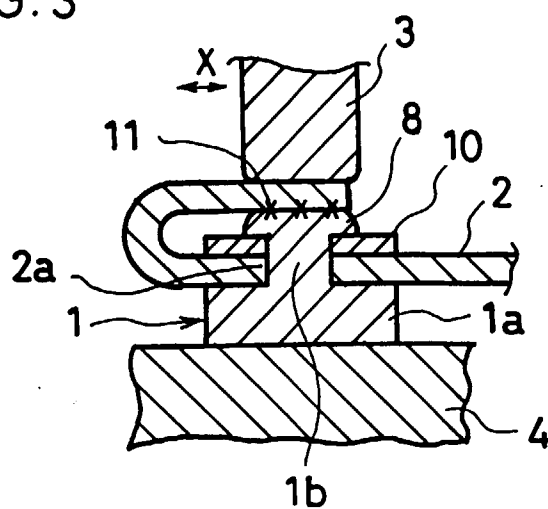


FIG. 4

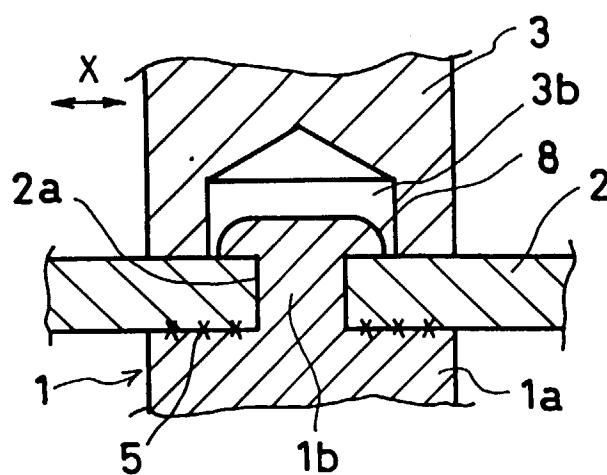
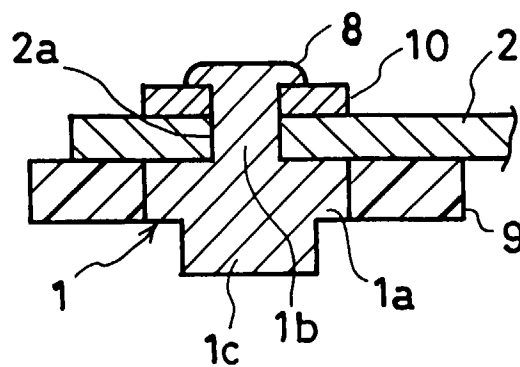


FIG. 5 PRIOR ART





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 11 0578

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)
A	US 5 046 971 A (ANDERSON GEORGE A ET AL) 10 September 1991 * column 3, line 11-63 * * column 6, line 22-43; figure 4 * ---	1-7	H01R43/02 H01R43/04 H01R4/06 H01R43/20
A	US 3 281 923 A (BEST ET AL) 1 November 1966 * column 2, line 16-70; figures 1-5 * ---	1-7	
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A	GB 1 333 936 A (GEN ELECTRIC) 17 October 1973 -----	1-7	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6) H01R
Place of search THE HAGUE		Date of completion of the search 1 July 1999	Examiner Waern, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P/4C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 99 11 0578

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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01-07-1999

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