(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 346 012 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
03.04.2024 Bulletin 2024/14

(21) Application number: **22306457.7**

(22) Date of filing: **30.09.2022**

(51) International Patent Classification (IPC):
H01R 4/26 *(2006.01)* ***H05K 3/32*** *(2006.01)*
H01R 43/28 *(2006.01)* *H01R 12/68* *(2011.01)*

(52) Cooperative Patent Classification (CPC):
H01R 4/26; H01R 43/28; H05K 3/326; H01R 12/68

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Nexans**
92400 Courbevoie (FR)

(72) Inventor: **SCHRÖER, Frank**
92637 WEIDEN (DE)

(74) Representative: **Ipsilon**
Le Centralis
63, avenue du Général Leclerc
92340 Bourg-la-Reine (FR)

(54) **FLAT BAND CABLE SET AND METHOD FOR MANUFACTURING A FLAT BAND CABLE SET**

(57) A flat band cable set (300) comprising a flat band cable (100) and a connector (201) is suggested. The flat band cable comprises at least one conductor (101) embedded between two insulating layers (102-106). The connector (201) comprises a terminal (202) and a contact portion (203) with at least one piercing contact (204a,b) penetrating through the at least one conductor. A tip (205a,b) of the piercing contact is swaged. A swaged portion of the piercing contact enhances a mechanical and/or electrical connection between the flat band cable and the connector. One insulating layer (102-106) adjacent to the at least one conductor is removed over a predefined distance (d) for offering an enlarged contact area on the at least one conductor for the swaged tip portion of the piercing contact.

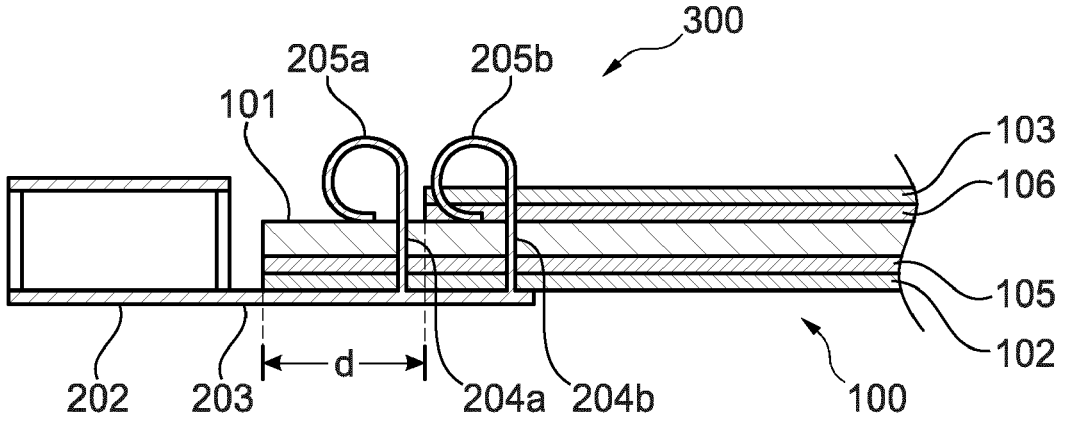


Fig. 3

EP 4 346 012 A1

Description

Field

[0001] The present disclosure relates to a flat band cable set and a method for manufacturing a flat band cable set.

Background

[0002] Flat band cables such as flexible flat band cables (FFC) and flexible printed circuit boards (FPC) are frequently used to provide for a flexible and reliable connection between printed circuit boards. One area of application is in the automotive industry. Flat band cables are cost efficient and require only a limited installation space. All flat band cables have in common that they contain a multitude of conductors which are arranged in parallel in a flat configuration. The number of conductors may range from a few to above 20 conductors. The conductors are typically realized as a copper foil with a thickness ranging for instance from 35 to 100 μm. The conductors are embedded between two insulating layers.

[0003] Figure 1A shows a schematic top view on a flat band cable 100 that contains two conductors 101. The number of conductors is limited to two only for the purpose to simplify the illustration. In reality, a flat band cable normally contains more than two conductors.

[0004] Figure 1B displays a cross-section through the flat band cable 100 along the line A-A' shown in Figure 1A. as illustrated in Figure 1B the conductor 101 is embedded between a lower and an upper insulating foil 102, 103. The lower and upper insulating foil 102, 103 are bonded onto the conductor 101 and to each other by a lower glue layer 105 and an upper glue layer 106, respectively. The combination of a glue layer and a foil will be named in the following as insulating layer. In practical embodiments the thickness of an insulating layer ranges from 0,03 to 1 mm.

[0005] The small thickness of the conductors in flat band cable requires a special contact technology for connecting a terminal or connector to the flat band cable and its conductors, respectively.

[0006] According to a common approach the conductors of the flat band cable are contacted by a piercing contact that penetrates the conductor in the flat band cable. A single conductor may be penetrated by several piercing contacts to increase the stability of the mechanical connection between the flat band cable and the connector. In practice, the piercing contact penetrates through all layers shown in Figure 1B. When penetrating through the lower foil 102 and the lower glue layer 105 the piercing contact may drag along particles of the lower foil and the lower glue layer that may have a negative impact on the electric properties of the contact between the conductor and the connector. In the worst case, there is no electrical contact between the connector and the conductor. In some types of crimp terminals for flat band cables, a portion of the piercing contact is swaged on the flat band cable and scratches the upper foil 103 and the upper glue layer 106 and provides in this way for an additional contact area. However, for some applications it is preferred to have a bigger contact area between the connector and the conductor of the flat band cable, for instance to increase reliability of the contact or its current carrying capability.

[0007] In view of the limitations of existing contact technologies for flat band cables there remains a desire for a modified contact technology to overcome or at least improve one or more of the problems mentioned at the outset.

Summary

[0008] According to a first aspect the present disclosure suggests a flat band cable set comprising a flat band cable and a connector. The flat band cable comprises at least one conductor embedded between two insulating layers. The connector comprises a terminal and a contact portion with at least one piercing contact penetrating through the at least one conductor. A tip of the piercing contact is swaged. A swaged portion of the piercing contact enhances a mechanical and/or electrical connection between the flat band cable and the connector. One insulating layer adjacent to the at least one conductor is removed for offering an enlarged contact area on the at least one conductor for the swaged tip portion of the piercing contact.

[0009] The suggested flat band cable set offers enhanced electrical properties over flat band cable sets with conventional crimp contacts without compromising mechanical stability of the contacts because the conductor of the flat band cable remains essentially intact.

[0010] In an advantageous embodiment both insulating layers are removed from the flat band cable such the swaged portion of the piercing contact contacts one side of the conductor, and the contact portion of the connector contacts the other side of the conductor. By virtue of stripping off both insulating layers, the contact area between the conductor and the connector is further increased.

[0011] It has been found useful in some embodiments to provide the connector with a plurality of piercing contacts. The number of piercing contacts can be adapted according to the required mechanical stability or electric properties of the contact.

[0012] Advantageously, the insulating layer(s) is/are removed only below one swaged portion of one piercing contact. In this way, the mechanical stability of the connection between the connector and the flat band cable is impacted only to a very small extent by the removal of the insulating layer(s).

[0013] According to a second aspect, the present disclosure suggests a method for manufacturing a flat band cable set. The method comprises

- exposing at least one conductor of a flat band cable;

- pressing a connector 1 or several piercing contacts penetrate through the at least one conductor of the flat band cable;
- swaging the piercing contacts such that at least one piercing contact is in direct contact with an exposed surface of the conductor.

[0014] In one advantageous implementation of the method the step of exposing the at least one conductor is implemented as stripping off one or both insulation layers of the flat band cable.

[0015] In an alternative implementation of the method the step of exposing the at least one conductor is implemented as providing windows in one or both insulation layers of the flat band cable during the manufacturing process of the flat band cable. This alternative implementation may have advantages in the manufacturing process in terms of costs.

Brief description of the drawings

[0016] Exemplary embodiments of the present disclosure are illustrated in the drawings and are explained in more detail in the following description. In the figures, the same or similar elements are referenced with the same or similar reference signs. It shows:

Fig. 1A a top view of a flat band cable;

Fig. 1B a cross-section of the flat band cable shown in Fig. 1A;

Fig. 2A a conventional flat band cable set;

Fig. 2B a connector of the flat band cable set shown in figure 2A;

Fig. 3 a first embodiment of a flat band cable set according to the present disclosure;

Fig. 4 a second embodiment of the flat band cable set according to the present disclosure; and

Fig. 5 a flow diagram of a method for manufacturing a flat band cable set.

[0017] In the figures the same or similar components are labelled with the same or similar reference signs. It is also noted that the dimensions, in particular the thickness of layers are exaggerated for the sake of clarity.

Detailed description

[0018] Figure 2A illustrates a cross-section of a flat band cable set 200 comprising the flat band cable 100 and a connector 201. The connector 201 is a female single connector that is shown as an example. However, in other embodiments of the present disclosure other types of connectors are used. Integral parts of the connector 201 are a terminal 202 and a contact portion 203 that extends in Figure 2A below the flat band cable 100. From the contact portion 203 two piercing contacts 204a, 204b protrude and penetrate the flat band cable 100. A tip portion 205a, 205b of each piercing contact 204a, 204b is swaged onto the upper foil 103 such that a front end 206 of the tip portion 205 scratches away the upper foil 103.

[0019] Figure 2B displays a perspective view of the connector 201. In Figure 2B the terminal 202, the contact portion 203 and the piercing contacts 204a, 204b are shown in greater detail. The shown connector 201 is only an example. Other embodiments of the connector 201 have different forms of terminals 202 and only one or more than two piercing contacts. The piercing contacts can be arranged in a parallel or staggered manner or in any other way on the contact portion 203 of the connector 201. These possible variants of the connector are not essential for the implementation of the present disclosure.

[0020] Figure 3 illustrates a flat band cable set 300 according to the present disclosure. The main difference of the cable set 300 shown in Figure 3 and the cable set 200 shown in Figure 2A is that on a free end of the flat band cable 100 the upper foil 102 and the upper glue layer 106 are stripped away along a distance d. The so exposed surface of the conductor 101 is in direct contact of the swaged tip portion 205a, 205b of the piercing contact 204a. Thus, the contact area between the swaged tip portion 205a and the conductor 101 is larger than the contact area between the piercing contact 204a and the conductor 101 in the flat band cable set 200 shown in Figure 2A. Consequently, the electrical properties of the electric contact between the terminal 201 and the conductor 101 in the flat band cable set 300 are improved compared to the flat band cable set 200 shown in Figure 2A.

[0021] In an alternative embodiment of the flat band cable set 300 the tip portion 205b of the piercing contact 204b makes a U-turn and repenetrates both insulation layers and the conductor 101 of the flat band cable 100. This alternative embodiment is not shown in the drawing.

[0022] In Figure 4 a flat band cable set 400 according to the present disclosure is shown as an alternative embodiment. In the flat band cable set 400 both insulating layers are stripped off along a distance d. A consequence of this difference is that when the piercing contact 204a is swaged, then the conductor 101 is bent down and comes in contact with the contact portion 203. Therefore, the contact area between the conductor 101 and the connector 201, specifically the contact area between the conductor and the piercing contact 204a, in flat band cable set 400 is even larger than in flat band cable set 300.

[0023] In the Figures 3 and 4 only one piercing contact, namely piercing contact 204a, is in contact with the surface(s) of conductor 101. However, in other embodiments more than one piercing contact may be in touch with the exposed surface(s) of conductor 101.

[0024] The method for manufacturing a flat band cable set 300 or 400 includes as a first step S1 exposing at least one conductor 101 of the flat band cable 100. The step S1 of exposing the conductor 101 is realized in practice by stripping off one or both insulating layers of the flat band cable or by providing windows in one or both insulation layers of the flat band cable during the manufacturing process of the flat band cable, for instance. The selection of one of the alternatives may depend on properties of the flat band cable or requirements of the final product. In a next step S2, the terminal 201 is pressed on the flat band cable 100 such that one or several piercing contacts 204a, 204b penetrate the conductor 101 of the flat band cable 100. Then, piercing contacts 204a, 204b are swaged such that at least one piercing contact 204a is in direct contact with an exposed surface of the conductor 101.

[0025] In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" does not exclude a plurality.

[0026] A single unit or device may perform the functions of multiple elements recited in the claims. The fact that individual functions and elements are recited in different dependent claims does not mean that a combination of those functions and elements could not advantageously be used.

List of reference signs

[0027]

100	flat band cable
101	conductor
102	lower foil
103	upper foil
105	lower glue layer
106	upper glue layer
200	flat band cable set
201	connector
202	terminal
203	contact portion
204a,b	piercing contacts
205a,b	tip portion of piercing contact
206	front end of tip portion
300	flat band cable set
301	front end
400	flat band cable set

Claims

1. Flat band cable set (300,400) comprising a flat band cable (100) and a connector (201), wherein the flat band cable (100) comprises at least one conductor (101) embedded between two insulating layers(102-106), wherein the connector (201) comprises a terminal (202) and a contact portion (203) with at least one piercing contact (204a,b) penetrating through the at least one conductor (101), wherein a tip (205a,b) of the piercing contact is swaged, wherein a swaged portion of the piercing contact enhances a mechanical and/or electrical connection between the flat band cable (300,400) and the connector **characterized in that** one insulating layer (102-106) adjacent to the at least one conductor (101) is removed for offering an enlarged contact area on the at least one conductor for the swaged tip portion of the piercing contact.

2. Flat band cable set according to claim 1, wherein both insulating layers (102-106) are removed such the swaged portion (205a,205b) of the piercing contact (204a,204b) contacts one side of the conductor (101) and the contact portion (203) of the connector contacts the other side of the conductor.

3. Flat band cable set according to claim 1, wherein the connector comprises a plurality of piercing contacts (204a,b).

4. Flat band cable set according to one of the preceding claims, wherein the insulating layer (120-106) is removed only below one swaged portion (205a,205b) of one piercing contact.

5. Method for manufacturing a flat band cable set, wherein the method comprises

   - exposing (S1) at least one conductor (101) of a flat band cable (100);
   - pressing (S2) a connector (201) onto the flat band cable (100) such that one or several piercing contacts (204a,b) penetrate through the at least one conductor (101) of the flat band cable;
   - swaging the piercing contacts (204a,b) such that at least one piercing contact is in direct contact with an exposed surface of the conductor (101).

6. Method for manufacturing a flat band cable set according to claim 5, wherein exposing (S1) the at least one conductor is implemented as stripping off one or both insulation layers of the flat band cable.

7. Method for manufacturing a flat band cable set according to claim 5, wherein exposing (S1) the at least one conductor is implemented as providing windows in one or both insulation layers of the flat band cable during the manufacturing process of the flat band cable.

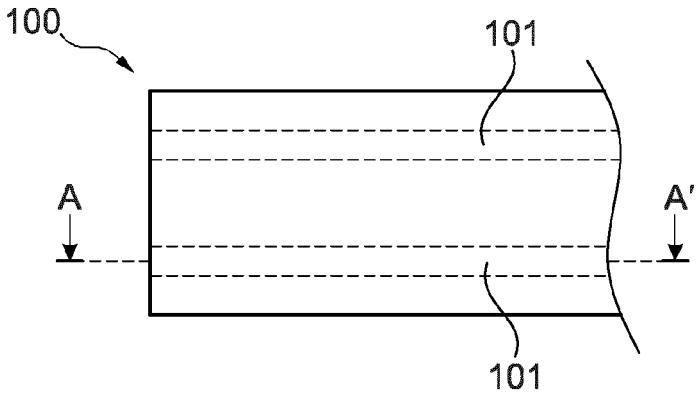


Fig. 1A

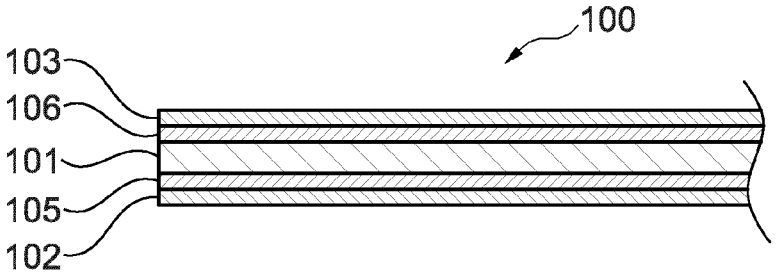
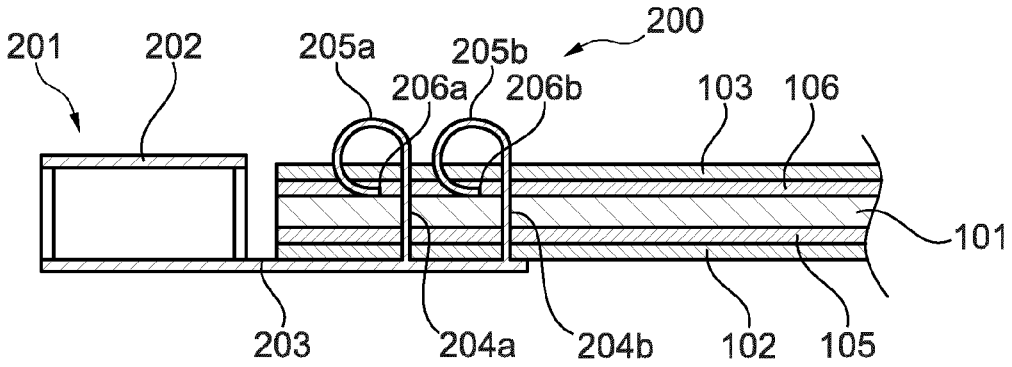


Fig. 1B



Prior art

Fig. 2A

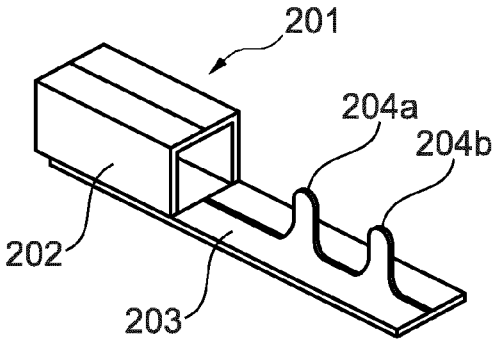


Fig. 2B

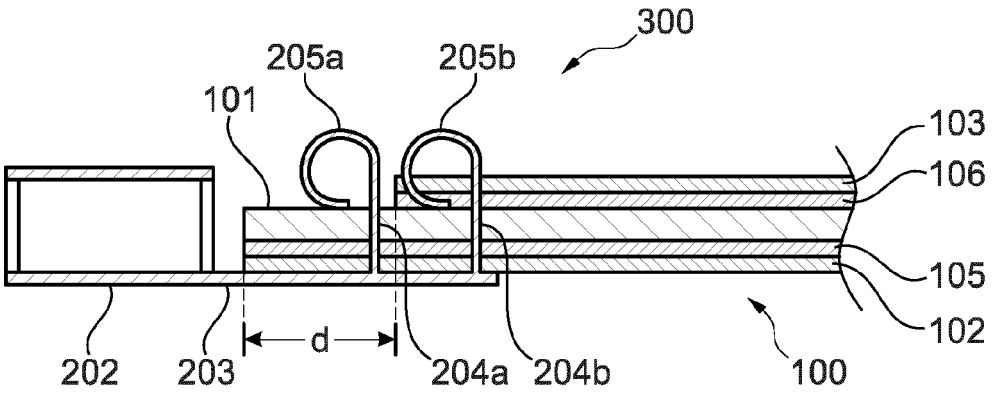


Fig. 3

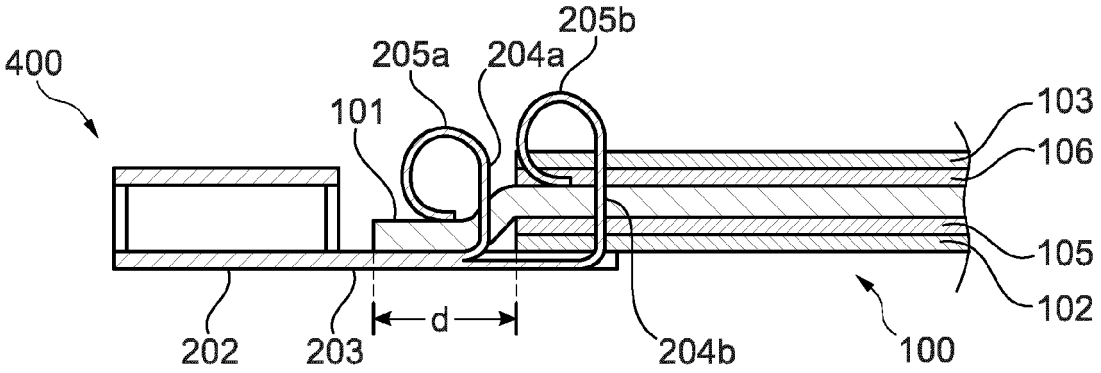


Fig. 4

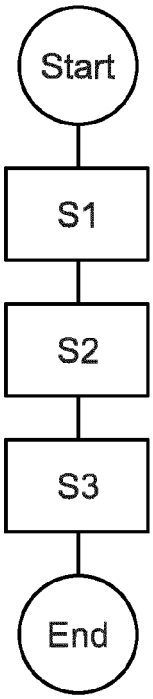


Fig. 5

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 30 6457

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2006 222057 A (FURUKAWA ELECTRIC CO LTD) 24 August 2006 (2006-08-24) * paragraphs [0040], [0041]; figures 3(c),5 *	1,3-5	INV. H01R4/26 H05K3/32 H01R43/28
X	JP 2003 203703 A (AUTO NETWORK GIJUTSU KENKYUSHO; SUMITOMO WIRING SYSTEMS ET AL.) 18 July 2003 (2003-07-18) * paragraphs [0026], [0027], [0031]; figure 3 *	1-7	ADD. H01R12/68
A	JP 2005 190719 A (FUJIKURA LTD) 14 July 2005 (2005-07-14) * paragraphs [0020], [0021]; figures 1,3 *	1-7	
A	EP 1 691 452 A2 (YAZAKI CORP [JP]) 16 August 2006 (2006-08-16) * paragraph [0004]; figures 3A-4B,20 *	1-7	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01R H05K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	9 March 2023	Vautrin, Florent

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 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 30 6457

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-03-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2006222057 A	24-08-2006	NONE	
JP 2003203703 A	18-07-2003	NONE	
JP 2005190719 A	14-07-2005	NONE	
EP 1691452 A2	16-08-2006	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82