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

(11) Publication number: **0 645 780 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **94114976.7**

(51) Int. Cl.[6]: **H01B 7/08**

(22) Date of filing: **22.09.94**

(30) Priority: **24.09.93 JP 261657/93**

(43) Date of publication of application:
29.03.95 Bulletin 95/13

(84) Designated Contracting States:
DE FR GB

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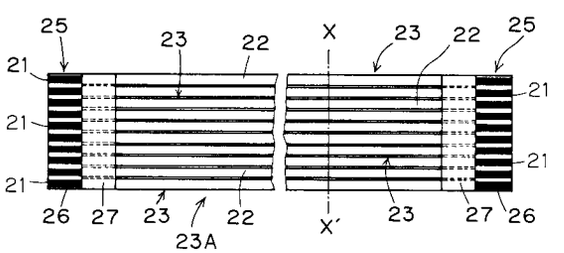
(54) Flat multi-conductor wire.

(57) There is disclosed a flat multi-conductor wire which includes a plurality of flat wires (23) arranged in planar, predetermined spaced relation and each having a rectangular conductor (21), and conductor coupling tapes (26) and coating coupling tapes (27) for coupling together the flat wires (23) in contact portions (25) at their opposed ends, whereby the flat multi-conductor wire is thin and flexible, requires no high temperature treatment on the contact portions at the ends, and is permitted for use in small-space wiring and two-dimensional flexural wiring.

FIG. 1



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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to flat multi-conductor wires for use in wiring of office automation equipments, vehicle-mounted electronics and the like.

Description of the Prior Art

Conventionally, this type of flat multi-conductor wire includes those shown in Figs. 6A, 6B, 7A, 7B, for example. Figs. 6A and 6B illustrate a flat multi-conductor wire known generally as a FPC (flexible printed wiring board) and a FFC (flat flexible wiring board), which comprises a plurality of elongated rectangular conductors 1 in the form of a thin plate or a foil arranged in predetermined spaced relation, and tapes 2a, 2b bonded to top and bottom surfaces of the rectangular conductors 1 in a sandwiched manner throughout the length thereof. The tape 2a on the top surface is removed at opposite ends to expose the rectangular conductors 1. The exposed portions of the rectangular conductors 1 are forced into a connector not shown to contact an internal terminal of the connector for electrical connection thereto.

The flat multi-conductor wire shown in Figs. 7A, 7B is disclosed in Japanese Patent Application Laid-Open No. 3-236112 (1991) proposed by the applicant of the present invention which comprises a plurality of round wires 7 juxtaposed in planar, predetermined spaced relation and each including a round conductor 5 and an insulative coating 6 thereon. The coatings 6 are peeled off at opposite ends of the round wires 7 to expose the round conductors 5 to form contact portions 8. A fixing tape 9 provided on the back of the contact portions 8 adheres to the exposed round conductors 5 and the coatings 6 adjacent the contact portions 8. A coupling tape 10 provided on the front of the coatings 6 adjacent the contact portions 8 adheres to the coatings 6.

In the structure of Figs. 7A and 7B, only an adhesive does not provide sufficient adherence between the conductors 5 and the fixing tape 9 because of the round shape of the conductors 5. It is, hence, a common practice to coat the entire round conductors 5 with tin which is in turn melted at a high temperature of about 350 °C to bond the fixing tape 9 to the round conductors 5 in the contact portions 8 by penetration of tin into the fixing tape 9.

In the flat multi-conductor wire such as the FPC, FFC shown in Figs. 6A and 6B, however, since the rectangular configuration of the conductors themselves provides a high flexural rigidity in the lateral directions, the conductors 1 are difficult to bend when the exposed portions of the conductors 1 at their one end are inserted into the connector. On the other hand, since all of the rectangular conductors 1 are sandwiched between the tapes 2a and 2b, the flat multi-conductor wire of Fig. 6 is less flexible in the lateral directions, resulting in difficulty in two-dimensional flexural wiring.

In the flat multi-conductor wire of Figs. 7A and 7B, the use of the round conductors 5 causes an increased thickness of the whole wire and difficulty in wiring in a small space, as compared with the flat multi-conductor wire of Figs. 6A and 6B employing the rectangular conductors 1. The flat multi-conductor wire of Figs. 7A and 7B is less flexible because of its round shape if the conductors have the same cross sectional area.

Further, in the wire of Figs. 7A and 7B, to achieve a sufficient adherence between the round conductors 5 in the contact portions 8 and the fixing tape 9, the whole round conductors 5 are coated with tin in consideration for time and labor to coat only the exposed portions of the round conductors 5 with tin, and the tin is melted by high temperature treatment. The tin coating process of the conductors 5 takes time and labor, and the subsequent high temperature treatment results in oxidation of fabrication jigs.

SUMMARY OF THE INVENTION

According to the present invention, a flat multi-conductor wire comprises: a flat wire group including a plurality of flat wires arranged in planar juxtaposition and each having a rectangular conductor and a coating portion made of an insulative material for covering an outer peripheral surface of the rectangular conductor; a contact portion formed such that the coating portions of the flat wires are removed at an end of the flat wire group to expose the rectangular conductors; a conductor coupling tape bonded to the rectangular conductors in the contact portion and the coating portions adjacent the contact portion on the back of the flat wire group; and a coating coupling tape bonded to the coating portions adjacent the contact portion on the front of the flat wire group.

The flat multi-conductor wire of the present invention which includes the plurality of juxtaposed flat wires each having the coated rectangular conductor is thinner and more flexible than the prior art flat multi-conductor wire including the round conductors, thereby permitting small-space wiring. The flat multi-conductor wire of the present invention in which only an adhesive is required to bond the conductor coupling tape to the rectangular conductors in the contact portion because of the rectangular shape of the conductors, requires no high tem-

perature treatment of the contact portion at the end.

As compared with the FPC and FFC employing the rectangular conductors similarly, the flat multi-conductor wire of the present invention is adapted such that the rectangular conductors are loose in portions other than the contact portion at the end, thereby to allow two-dimensional flexural wiring.

The flat multi-conductor wire according to the present invention is permitted for use in small-space wiring and two-dimensional flexural wiring and is very effective in wiring of office automation equipments and vehicle-mounted electronics.

It is an object of the present invention to provide a thin and flexible flat multi-conductor wire which requires no high temperature treatment of contact portions at ends thereof and which is permitted for use in small-space wiring and two-dimensional flexural wiring.

These and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of a preferred embodiment according to the present invention;

Fig. 2 is a side view in cross section taken along the line X-X' of Fig. 1;

Fig. 3 is a fragmentary enlarged view of Fig. 2;

Fig. 4 is a fragmentary enlarged side view of the preferred embodiment of Fig. 1;

Fig. 5 is a perspective view of portions of Fig. 4;

Figs. 6A and 6B illustrate a prior art flat multi-conductor wire; and

Figs. 7A and 7B illustrate another prior art flat multi-conductor wire.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 is a plan view of a preferred embodiment according to the present invention. Fig. 2 is a side view in cross section taken along the line X-X' of Fig. 1. Fig. 3 is a fragmentary enlarged view of Fig. 2. Fig. 4 is a fragmentary enlarged side view of the preferred embodiment of Fig. 1. Fig. 5 is a perspective view of portions of Fig. 4.

Referring to Figs. 1 to 5, a plurality of flat wires 23 are juxtaposed in planar, predetermined spaced relation to form a flat wire group 23A. Each of the flat wires 23 comprises a rectangular conductor 21 of a copper foil or a tinned copper foil, and a coating portion 22 made of an insulative material such as polyvinyl chloride (PVC) or polyethylene (PE) by extrusion and formed on the rectangular conductor 21.

Preferably, the thickness ta of the rectangular conductors 21 is 0.035 to 0.1 mm, and the width w thereof is 0.3 to 1.0 mm. The thickness tb of the coating portions 22 is preferably 0.1 to 0.3 mm.

The wire-to-wire pitch that is the center-to-center distance of the rectangular conductors 21 of the adjacent flat wires 23 in the flat wire group 23A is preferably set to 0.5 mm, 0.8 mm, 1.0 mm, or 1.25 mm.

As shown in Figs. 1, 4 and 5, the coating portions 22 at right and left ends of the flat wires 23 in the flat wire group 23A are peeled off to expose the rectangular conductors 21 to form contact portions 25. Conductor coupling tapes 26 made of an insulative material such as polyethylene terephthalate (PET), PVC, polyimide (PI) are provided on the back (bottom surface) of the right and left contact portions 25, respectively, and are bonded to the exposed rectangular conductors 21 and the coating portions 22 adjacent the contact portions 25 with an adhesive to hold the rectangular conductors 21 coupled together.

The adhesives used herein may be well-known thermoplastic adhesives and preferably those melted at a relatively low temperature of about 200 °C.

Coating coupling tapes 27 made of an insulative material such as PET, PVC PI are provided on the front (top surface) adjacent both the contact portions 25 in the same manner as the conductor coupling tapes 26. The coating coupling tapes 27 are bonded to the coating portions 22 adjacent the contact portions 25 with the above-mentioned thermoplastic adhesive. The ends of the flat wires 23 are held between the coupling tapes 26 and 27, and the flat wires 23 are coupled together at opposite ends thereof by the adhesive force of the adhesive, with the spacing between the flat wires 23 held at a predetermined value. Intermediate portions of the flat wires 23 are held in an uncoupled, loose condition.

Arranging the plurality of flat wires 23 having the rectangular conductors 21 in planar, predetermined spaced relation to form the flat wire group 23A and coupling the flat wires 23 together in the contact portions 25 at opposite ends thereof with the coupling tapes 26, 27, provides the flat multi-conductor wire which is thinner and more flexible than the prior art flat multi-conductor wire of Fig. 7 having the round conductors (Japanese Patent Application Laid-Open No. 3-236112) and which is permitted for use in small-space wiring. In addition, the rectangular shape of the conductors 21 provides a sufficient adherence between the conductor coupling tapes 26 and the rectangular conductors 21 in the contact portions 25 with the adhesive, thereby eliminating the need for tin coating and high temperature treatment which are executed on

the round conductors. The treatment of the contact portions 25 is significantly facilitated.

Compared with the FPC and FFC of Figs. 6A and 6B, the flat multi-conductor wire of this preferred embodiment includes the flat wires 23 which are loose between the contact portions 25 although similarly employing the rectangular conductors, thereby allowing two-dimensional flexural wiring. Since the flat multi-conductor wire of this preferred embodiment is substantially similar in schematic construction of the contact portions 25 to the FPC and FFC, the existing connector used for the FPC and FFC may be applied to the contact portions 25. There is no need to separately develop and fabricate a connector of special construction.

Comparison is made between the connector used for the FPC and FFC and the connector for the flat multi-conductor wire having the round conductors. The latter employing the round conductors is necessarily thicker than the former for the FPC and FFC having the rectangular conductors. Therefore, a thinner connector is applied to the flat multi-conductor wire of this preferred embodiment, permitting small-space wiring more effectively.

While the invention has been shown and described in detail, the foregoing description is in all aspects illustrative and not restrictive. It is therefore understood that numerous modifications and variations can be devised without departing from the scope of the invention.

Claims

1. A flat multi-conductor wire comprising:

a flat wire group including a plurality of flat wires arranged in planar juxtaposition and each having a rectangular conductor and a coating portion made of an insulative material for covering an outer peripheral surface of said rectangular conductor;

a contact portion formed such that said coating portions of said flat wires are removed at an end of said flat wire group to expose said rectangular conductors;

a conductor coupling tape bonded to said rectangular conductors in said contact portion and said coating portions adjacent said contact portion on the back of said flat wire group; and

a coating coupling tape bonded to said coating portions adjacent said contact portion on the front of said flat wire group.

2. The flat multi-conductor wire of claim 1, wherein

said rectangular conductors have a thickness ranging from 0.035 mm to 0.1 mm and a width ranging from 0.3 mm to 1.0 mm.

3. The flat multi-conductor wire of claim 1, wherein

said coating portions have a thickness ranging from 0.1 mm to 0. 3 mm.

4. The flat multi-conductor wire of claim 2, wherein

said coating portions have a thickness ranging from 0.1 mm to 0. 3 mm.

5. The flat multi-conductor wire of claim 1, wherein

a wire-to-wire pitch of said flat wires adjacent to each other is 0.5 mm, 0.8 mm, 1.0 mm, or 1.25 mm.

6. The flat multi-conductor wire of claim 1, wherein

said conductor coupling tape and said coating coupling tape are made of an insulative material.

7. The flat multi-conductor wire of claim 6, wherein

said insulative material of said conductor coupling tape and said coating coupling tape includes polyethylene terephthalate, polyvinyl chloride, and polyimide.

FIG. 1

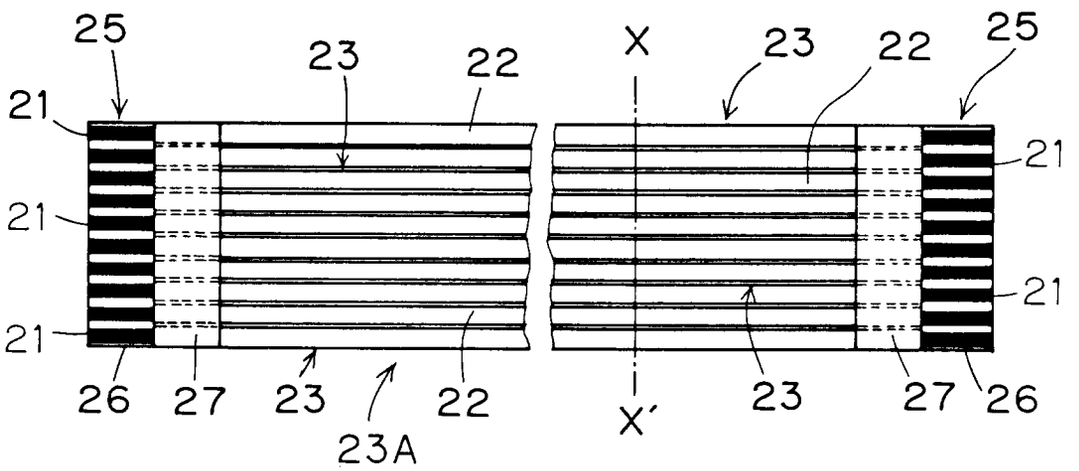

FIG. 2

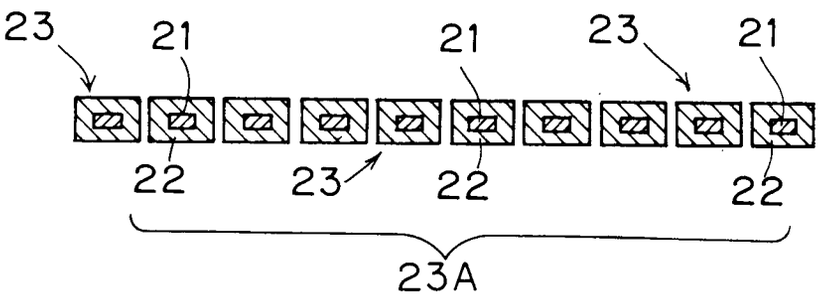

FIG. 3

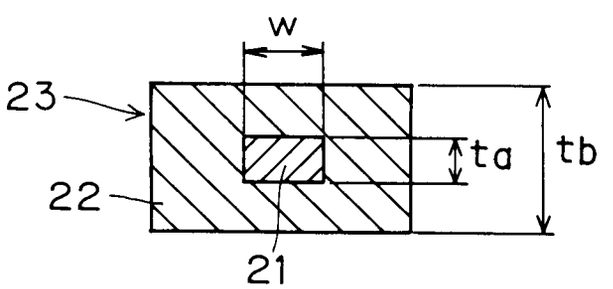

FIG. 4

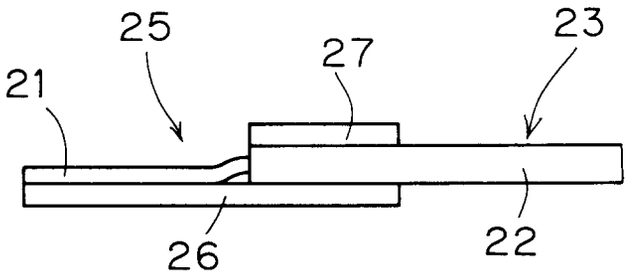

FIG. 5

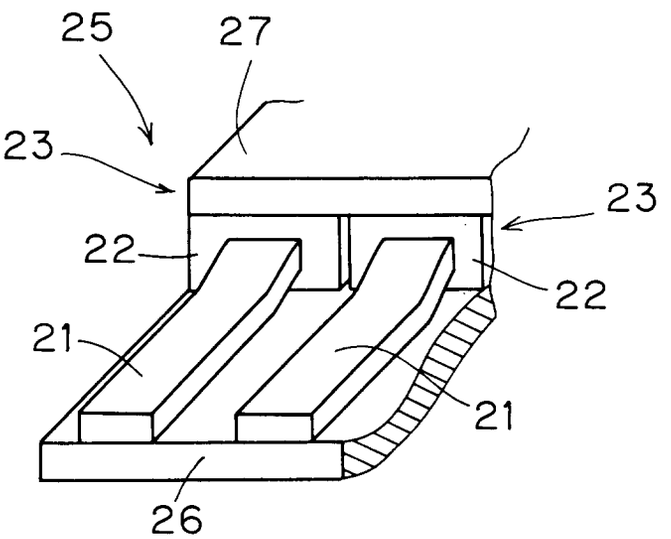

FIG. 6A

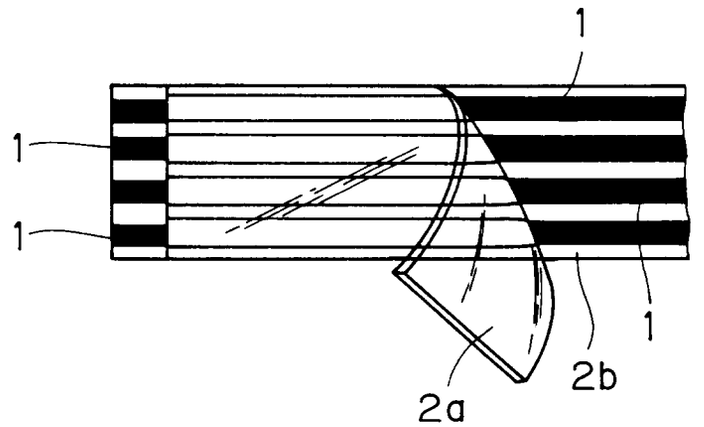

FIG. 6B

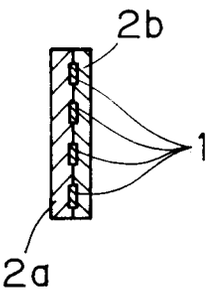

FIG. 7A

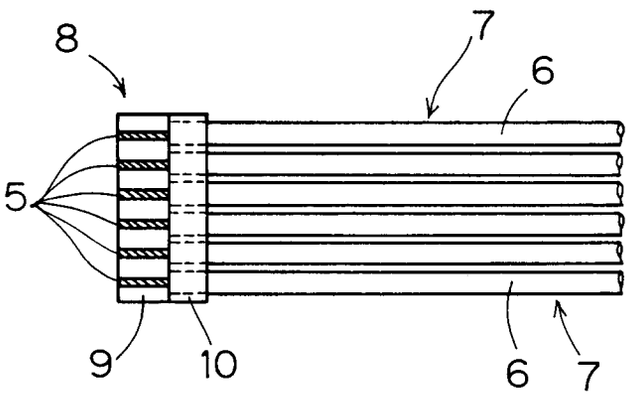

FIG. 7B