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(54) HIGH-SPEED FLAT CABLE WITH SHAPE MEMORY AND MANUFACTURING METHOD THEREOF

(57) The present invention discloses a high-speed flat cable with shape memory, which includes a plurality of signal unit groups that are substantially arranged in the same plane and are arranged with intervals or adjacently. The signal unit group is a differential signal unit group. The high-speed flat cable with shape memory further includes an adhesive agent layer and two bending composite layers. The two bending composite layers embrace the signal unit group. The adhesive agent layer is located between two bending composite layers and makes the bending composite layers surrounding the signal unit groups adhered to each other. The bending composite layer includes an internal insulation film layer, a bending metal foil layer, and an external insulation film layer that are adhered together in sequence. The high-speed flat cable of the present invention has a shape memory, does not bounce after bending, can be bent multiple times, and does not affect the high-speed transmission of the signal while bending. The difficulty during the assembly is effectively handled. The productivity is improved.

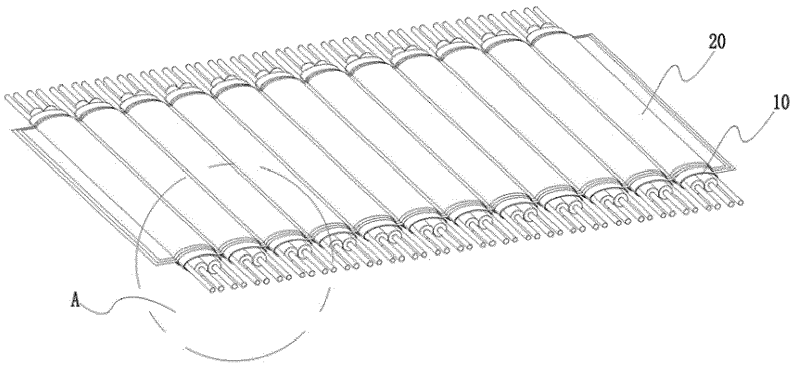

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of communication cables, particularly to a high-speed flat cable with shape memory and the manufacturing method of the same.

BACKGROUND

[0002] The high-speed flat cable usually includes a differential signal unit group, a ground wire, and a shield insulation film embracing the signal unit group and the ground wire. Currently, as the transmission rate and the data storage of electronic devices are growing continuously, while the inner layout space in the device is becoming smaller, the arrangement of components is getting more and more compact. There is a demand that the high-speed flat cable can be bent at will without resilience or affecting the data transmission.

[0003] The thickness of the high-speed flat cable in the prior art is large, usually more than 1mm. The high-speed flat cable in the prior art generally has the defects of having poor shape memory, being prone to bouncing, etc., causing great difficulty during installation. Meanwhile, the data transmission performance will degrade after multiple times of bending. Thus, the requirements of electronic devices like a server, a working station, an exchanger, a base station, etc. cannot be met. Moreover, the high-speed flat cable in the prior art also has the defect of poor recognition function, which will cause the operation and recognition of the entire system to slow, etc.

SUMMARY

[0004] In order to solve the above technical problems, one object of the present invention is to provide a high-speed flat cable with a shape memory, less thickness, and without bouncing.

[0005] Another object of the present invention is to provide a high-speed flat cable with a control signal which can improve the operation and recognition function of the system on the basis of the high-speed flat cable with shape memory function.

[0006] In order to achieve the above objectives, the present invention provides following technical solutions. A high-speed flat cable with shape memory includes a plurality of signal unit groups that are substantially arranged in the same plane and are arranged with intervals or adjacently. The signal unit group is a differential signal unit group. The high-speed flat cable with shape memory further includes an adhesive agent layer and two bending composite layers. Two bending composite layers embrace the signal unit group. The adhesive agent layer is located between two bending composite layers and makes the bending composite layers surrounding the signal unit groups adhered to each other. The bending composite layer includes an internal insulation film layer, a bending metal foil layer, and an external insulation film layer that are adhered together.

[0007] Further, the metal foil used in the metal foil layer may include aluminum foil, copper foil, silver foil, gold foil, and alloy foil thereof, etc. The metal foil layer is, preferably, an aluminum foil.

[0008] Further, the internal insulation film layer, the bending metal foil layer, and the external insulation film layer are adhered to each other using the adhesive agent. The adhesive agent may include polyester, polyimide, polyamide-imide, Teflon, polypropylene, polyethylene, polyphenylene sulfide, polyethylene naphthalate, polycarbonate, silicone rubber, ethylene propylene diene rubber, polyurethane, acrylic ester, organosilicon, natural rubber, epoxy resin, and synthetic rubber adhesive agent.

[0009] Further, the bending composite layers at the outermost signal unit group laterally extend for a short distance and are adhered to each other. The width of the external insulation film layer and the width of the internal insulation film layer are all slightly greater than the width of the bending metal foil layer, so as to prevent the aluminum foil layer from contacting anything outside. Alternatively, insulation paint or insulation glue is applied at a connection location where two sides of the two bending composite layers are adhered to each other, so as to prevent the bending metal foil layer from contacting anything outside.

[0010] Further, the differential signal unit group includes a first core wire, a first ground wire, and a first anti-interference insulation layer embracing the first core wire and the first ground wire. There may be two first core wires. Each first core wire includes a first conductor and a first longitudinal insulator embracing the first conductor. Alternatively, there may be a single first core wire. The first core wire includes two first conductors and a first longitudinal insulator. The first longitudinal insulator embraces and separates the two first conductors. Preferably, the first anti-interference insulation layer is an aluminum foil layer.

[0011] Further, there may be a single first ground wire. The first ground wire is arranged on one side of the second core wire. Alternatively, the number of the first ground wires may be two. The two first ground wires are symmetrically arranged on the upper and lower sides or the left and right sides of the first core wire.

[0012] Further, the external insulation film layer and the internal insulation film layer can be made of insulation material that can enhance the mechanical shape memory, like PET, PFA, FEP etc.

[0013] The present invention further provides a manufacturing method of the above high-speed flat cable, characterized in that the method includes the following steps:

Step 1: The first core wire is extruded. The first core wire and the first ground wire are surrounded by the

first anti-interference insulation layer, so as to make up the differential signal unit group.

Step 2: The differential signal unit group made in step 1 is arranged in parallel. An adhesive agent layer is applied on the internal insulation film layer. The side of the internal insulation film layer that is applied with the adhesive agent layer is next to the signal unit group. The internal insulation film layer is laminated on the signal unit group arranged in parallel.

Step 3: The bending metal foil layer is adhered and laminated to the internal insulation film layer using a glue.

Step 4: The external insulation film layer is adhered and laminated to the bending metal foil layer using a glue.

[0014] In order to improve the system operation and recognition function, the present invention further provides a high-speed flat cable with shape memory and control signal. Based on the above high-speed transmission cable, the signal unit group further includes at least one control signal unit group. The differential signal unit group and the control signal unit group can be arranged arbitrarily.

[0015] Further, the control signal unit group includes a second core wire. The second core wire includes a second conductor and a second longitudinal insulator embracing the second conductor. The second core wire is embraced by a second anti-interference insulation layer. Preferably, the second anti-interference insulation layer is an aluminum foil layer.

[0016] Further, the second anti-interference insulation layer further embraces at least one second ground wire.

[0017] Further, the control signal unit group includes at least five control signal unit groups. Every five control signal unit groups are arranged adjacently. At most five control signal unit groups are arranged adjacently.

[0018] The present invention further provides a manufacturing method of the above high-speed flat cable with a control signal, which includes the following steps:

Step 1: The first core wire is extruded. The first core wire and the first ground wire are embraced by a first anti-interference insulation layer, so as to make up a differential signal unit group.

Step 2: The second core wire is extruded. The second core wire and the second ground wire are embraced by a second anti-interference insulation layer, so as to make up a control signal unit group.

Step 3: The differential signal unit group made in step 1 and the control signal unit group made in step 2 are arranged in parallel arbitrarily to make up a signal unit group. An internal insulation film layer is provided on the upper and lower sides of the signal unit group. An adhesive agent layer is applied on the internal insulation film layer. The side of the internal insulation film layer that is applied with the adhesive agent layer, is next to the signal unit group. The internal insulation film layer is laminated on the signal unit group arranged in parallel.

Step 4: The bending metal foil layer is adhered and laminated to the internal insulation film layer using an adhesive agent.

Step 5: The external insulation film layer is adhered and laminated to bending metal foil layer using an adhesive agent.

[0019] Compared to the prior art, the high-speed flat cable with shape memory and the manufacturing method of the same of the present invention have following advantages:

1) With the arrangement of the bending composite layer, the mechanical bending resistant property of the cable is improved effectively, such that the high-speed flat cable can perform the bending of a variety of angles, i.e., 45°, 90°, 180° etc., or multiple times of bending. During bending, the high-speed transmission of the signal is not affected. The present invention has the advantages of shape memory, no bouncing after bending, etc. The difficulty in installation is effectively handled. The productivity is improved.

2) The lifetime is long. After tested by at least more than 500 times of bending, over and over again, the electrical property of the signal is not affected.

3) As a preferable method, a control signal unit group is provided in the cable. The system operation and recognition function are improved effectively. The transmission rate of the control signal can reach 24Gbps or higher.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Figure 1 is the schematic diagram of the high-speed flat cable of the present invention;

Figure 2 is the enlarged schematic diagram of A in Figure 1;

Figure 3 is the schematic diagram of the cross section of the high-speed flat cable with the interval-free structure of the present invention;

Figure 4 is the schematic diagram of the cross sec-

tion of a single signal unit group in Figure 3;

Figure 5 is the schematic diagram of the cross section of the high-speed flat cable with the interval structure of the present invention;

Figure 6 is the impedance test diagram of the high-speed flat cable of the present invention;

Figure 7 is the attenuation test diagram of the high-speed flat cable of the present invention;

Figure 8 is the near-end crosstalk diagram of the high-speed flat cable of the present invention;

Figure 9 is the far-end crosstalk test diagram of the high-speed flat cable of the present invention;

Figure 10 is the schematic diagram of Embodiment 1 of the differential signal unit group of the present invention;

Figure 11 is the schematic diagram of Embodiment 2 of the differential signal unit group of the present invention;

Figure 12 is the schematic diagram of Embodiment 3 of the differential signal unit group of the present invention;

Figure 13 is the schematic diagram of Embodiment 4 of the differential signal unit group of the present invention;

Figure 14 is the schematic diagram of Embodiment 5 of the differential signal unit group of the present invention;

Figure 15 is the schematic diagram of Embodiment 6 of the differential signal unit group of the present invention;

Figure 16 is the schematic diagram of Embodiment 7 of the differential signal unit group of the present invention;

Figure 17 is the schematic diagram of the high-speed flat cable which is bent at 45° of the present invention;

Figure 18 is the schematic diagram of the high-speed flat cable which is bent for multiple times of the present invention;

Figure 19 is the schematic diagram of the high-speed flat cable with control signal of the present invention;

Figure 20 is the schematic diagram of the high-speed flat cable with control signal of the present invention;

Figure 21 is the schematic diagram of the high-speed flat cable with control signal of the present invention;

Figure 22 is the schematic diagram of Embodiment 1 of the control signal unit group of the present invention;

Figure 23 is the schematic diagram of Embodiment 2 of the control signal unit group of the present invention;

Figure 24 is the schematic diagram of Embodiment 3 of the control signal unit group of the present invention.

DETAILED DESCRIPTION

[0021] Hereinafter, the present invention is further described with reference to the drawings and embodiments.

[0022] As the transmission rate and the data storage of electronic devices are growing continuously, while the inner layout space in the device is becoming smaller, the arrangement of components is getting more and more compact. The high-speed flat cable of the present invention can effectively improve the shape memory property of the high-speed flat cable. The cable does not bounce after bending. The high-speed transmission of signal is not affected when the cable is bent. The difficulty during assembling is effectively handled. The productivity is improved.

[0023] Specifically, as shown in Figure 1 and Figure 2, the high-speed flat cable of the present invention includes a plurality of differential signal unit groups 10 that are arranged at intervals and substantially in the same plane. The high-speed flat cable of the present invention further includes two bending composite layers 20 and an adhesive agent layer (not shown). Two bending composite layers 20 embrace the differential signal unit groups 10. The adhesive agent is located between two bending composite layers 20 and makes bending composite layers 20 surrounding signal unit groups 10 adhered to each other. The portions of two bending composite layers 20 at an interval between differential signal unit groups 10 are adhered to each other via the adhesive agent layer.

[0024] Further, as shown in Figure 1 and Figure 2, bending composite layer 20 includes internal insulation film layer 21, bending metal foil layer 22, and external insulation film layer 23 that are adhered together in sequence. External insulation film layer 23 and internal insulation film layer 21 can be made of PET, PFA, FEP, or any other insulation material that can improve the mechanical shape memorability, so that the shape memory effect of the high-speed flat cable can be improved. Bending metal foil layer 22 can be made of metal foil with good memorability, like aluminum foil, copper foil, silver foil, gold foil, and alloy foil thereof, etc. After verification, the aluminum foil as bending metal foil layer has the optimal shape memory effect.

[0025] Since the present invention adheres bending composite layer 20 on the upper and lower sides of signal unit group, bending composite layer 20 makes the best of the memory function of the metal foil layer to achieve the shape memory effect of the flat cable, such that the high-speed flat cable does not bounce after bending. Meanwhile, an external insulation film layer and an internal insulation film layer are provided on the upper and lower sides of the metal foil layer, such that the bending metal foil layer does not have electrical property but only has the enhanced mechanical shape memory property. Moreover, each of internal insulation film layer 21, external insulation film layer 23, and bending metal foil layer 22 has a relatively thin size. Intermediate adhesive agent also has an ultra-thin size. The thickness of the entire cable is less than 1mm. Furthermore, the arrangement of internal insulation film layer 21 and external insulation film layer 23 can effectively prevent the cracking of the metal foil layer, improve the toughness of the bending composite layer, make the entire bending composite layer easy to bend, and prolong the lifetime of the cable.

[0026] The high-speed flat data cable of the present invention can be bend up to more than 500 times. The high-speed flat cable of the present invention can be bend at a variety of angles, i.e., 45° (as shown in Figure 17), 90°, 180° etc., or multiple times of bending (as shown in Figure 18). During bending, the electrical transmission property of the high-speed flat cable is not affected. After 500 times of bending, the test results of the present high-speed flat cable are shown in Figures 6-8. Figure 6 is the impedance test diagram. Figure 7 is the attenuation test diagram. Figure 8 is the near-end crosstalk diagram. Figure 9 is the far-end crosstalk test diagram. The test results indicate that: after 500 times of bending, regarding the high-speed flat cable of the present invention, the variation of impedance is within 1ohm, and the variation of attenuation is within 0.8db. The performance is very stable and can meet the requirement of a transmission rate of 24Gbps.

[0027] The internal insulation film layer, the bending metal foil layer, and the external insulation film layer are adhered together via an adhesive agent. The adhesive agent includes (but not limited to) polyester, polyimide, polyamide-imide, Teflon, polypropylene, polyethylene, polyphenylene sulfide, polyethylene naphthalate, polycarbonate, silicone rubber, ethylene propylene diene rubber, polyurethane, acrylic ester, organosilicon, natural rubber, epoxy resin, and synthetic rubber adhesive agent, etc.

[0028] In order to prevent the surface and two sides of the aluminum foil from contacting the apparatus to lead to short circuit, as shown in Figure 3 and Figure 5, the bending composite layers at the outermost signal unit group laterally extend for a short distance and are adhered to each other, so as to play the role of insulator. Moreover, the width of the external insulation film layer and the width of the internal insulation film layer are all slightly greater than that of the bending metal foil layer, so as to prevent the aluminum foil layer from contacting anything outside. Also, insulation paint or insulation glue can be applied at the connection locations on the two sides where two bending composite layers are adhered to each other, so as to prevent the bending metal foil layer from contacting anything outside.

[0029] The differences between the Embodiment shown in Figure 5 and the Embodiment shown in Figure 3 are as below. Differential signal unit groups 10 are arranged adjacently. Two bending composite layers 20 embrace the plurality of differential signal unit groups. An adhesive agent layer is located between two bending composite layers 20 and makes bending composite layers 20 surrounding the signal unit groups adhered to each other.

[0030] Further, as shown in Figures 10-16, differential signal unit group 10 includes first core wire 11, first ground wire 12, and first anti-interference insulation layer 13 embracing first core wire 11 and first ground wire 12. There are two first core wires. Each first core wire includes a conductor and a longitudinal insulator embracing the conductor. The shielding and insulation are achieved by first anti-interference insulation layer 13. Preferably, first anti-interference insulation layer 13 is an aluminum foil layer. Alternatively, there is only one first core wire. The first core wire includes two conductors and a longitudinal insulator embracing the two conductors and separating the two conductors. Preferably, the first anti-interference insulation layer is an aluminum foil layer. Ground wire 12 is located aside of core wire 11. In case differential signal unit group has only one ground wire, the ground wire is arranged on one side of core wire 11. The ground wire can be arranged on the left side, the right side, the upper side, or the lower side of a single piece of core wire 11. The ground wire can be arranged on the left side, the right side, the upper side, or the lower side of the two core wires 11. In case differential signal unit group has two ground wires, the ground wires can be symmetrically arranged on the upper and lower sides or the left and right sides of core wires 11. First anti-interference insulation layer 13 embraces core wire 11 and ground wire 12. The seven kinds of differential signal unit groups can be used in the Embodiments shown in Figure 3 and Figure 5.

[0031] In order to improve the system operation and recognition function of the high-speed flat cable, the present invention further provides a technical solution of a high-speed flat cable with shape memory and control signal. As shown in Figures 16 and 17, based on the above high-speed flat cable, the signal unit group further includes at least one control signal unit group 30. Differential signal unit group 10 and control signal unit group 30 can be arranged arbitrarily. The number of control signal unit group 30 and the number of differential signal unit group 10 can be determined as required. The high-speed signal transmission is achieved by differential signal unit group 10, while the low-frequency signal is transmitted by control signal unit group 30. The system oper-

ation and recognition function of the high-speed flat cable can be achieved. For example, an LED light can be connected to the control signal. The LED light is lighted on, indicating that the signal communication is available. Preferably, control signal unit group 30 is provided with impedance control and can be used to transmit the control signal or single-ended impedance. With such arrangement, the transmission rate of the control signal can reach 24Gbps or higher.

[0032] In the present embodiment shown in Figures 20 and 21, there are one differential signal unit group and five control signal unit groups. Meanwhile, the control signal unit group includes at least five control signal unit groups. Every five control signal unit groups are arranged adjacently. At most five control signal unit groups can be arranged adjacently. Each of the five control signal unit groups can be configured to have single impedance. Two wires can make up a set of differential pair to transmit high-frequency signal. Also, low-frequency signal can be transmitted separately. Moreover, each core wire has a ground wire individually, such that the core wire can be connected to the ground, so as to achieve the interference-proof and anti-interference function.

[0033] The difference between the Embodiment shown in Figure 21 and the Embodiment shown in Figure 20 are as below. The signal unit groups are arranged with intervals. Two bending composite layers 20 embrace a plurality of signal unit groups. The adhesive agent is located between two bending composite layers 20 and makes bending composite layers 20 surrounding the signal unit groups adhered to each other. The portions of two bending composite layers 20 at the interval between the signal unit groups are adhered to each other via the adhesive agent layer.

[0034] Figure 22 shows Embodiment 1 of control signal unit group 10. Control signal unit group 10 includes a second core wire. The second core wire includes second conductor 31 and second longitudinal insulator 32 embracing second conductor 31.

[0035] Figure 23 shows Embodiment 2 of control signal unit group 10. Control signal unit group 10 includes a second core wire and second anti-interference insulation layer 33. The second core wire includes second conductor 31 and second longitudinal insulator 32 embracing second conductor 31. Second insulation shield layer 33 embraces the second core wire. Preferably, the second anti-interference insulation layer 33 is an aluminum foil layer.

[0036] Figure 24 shows Embodiment 3 of control signal unit group 30. Control signal unit group 30 includes a second core wire, second ground wire 34, and second anti-interference insulation layer 33. The second core wire includes second conductor 31 and second longitudinal insulator 32 embracing second conductor 31. Second ground wire 34 is provided on one side of the second core wire and is parallel to the second core wire. Second aluminum foil layer 33 embraces the second core wire and second ground wire 34. Preferably, second anti-interference insulation layer 33 is an aluminum foil layer.

[0037] As shown in Figures 12-24, control signal unit group 30 can be used in Embodiments shown in Figures 20 and 21.

[0038] The present invention further provides a manufacturing method of the above high-speed flat cable with shape memory and control signal, which includes the following steps:

Step 1: The first core wire is extruded. The first core wire and the first ground wire are surrounded by the first anti-interference insulation layer, so as to make up the differential signal unit group.

Step 2: The second core wire is extruded. The second core wire is surrounded by the second anti-interference insulation layer, so as to make up the control signal unit group.

Step 3: The differential signal unit group made in step 1 and the control signal unit group made in step 2 are arranged in parallel arbitrarily to make up a signal unit group. The internal insulation film layer is provided on the upper and lower sides of the signal unit group. The adhesive agent layer is applied on the internal insulation film layer. The side of the internal insulation film layer that is applied with the adhesive agent layer is next to the signal unit group. The internal insulation film layer is laminated on the signal unit groups that are arranged in parallel.

Step 4: The bending metal foil layer is adhered and laminated on the internal insulation film layer via the adhesive agent.

Step 5: The external insulation film layer is adhered and laminated on the bending metal foil layer via the adhesive agent.

[0039] The above descriptions are only preferred embodiments of the present invention, but not used to limit the present invention in any form. Under the teachings of the above disclosure, a person of ordinary skill in the art can derive equivalent embodiments with modifications, alternations, and equal variations. However, based on the technical spirit of the present invention without departing the content of the technical solution of the present invention, a simple modification, equivalent variation, and alternation of the above embodiment all fall within the scope of the technical solution of the present invention.

Claims

1. A high-speed flat cable with shape memory, comprising:

a plurality of signal unit groups, substantially arranged in a same plane; the plurality of signal unit groups being arranged with intervals or adjacently; each of the plurality of signal unit groups being a differential signal unit group; **characterized in that**, the high-speed flat cable with shape memory further includes:

an adhesive agent layer; and
two bending composite layers,
wherein
the two bending composite layers embrace the plurality of signal unit groups;
the adhesive agent layer is located between two bending composite layers and makes the bending composite layers surrounding the plurality of signal unit groups adhered to each other;
the bending composite layer includes an internal insulation film layer, a bending metal foil layer, and an external insulation film layer that are adhered together in sequence.

2. The high-speed flat cable with shape memory according to claim 1, **characterized in that**, a metal foil used in the metal foil layer is selected from the group consisting of aluminum foil, copper foil, silver foil, and gold foil.

3. The high-speed flat cable with shape memory according to claim 1, **characterized in that**, a metal foil used in the metal foil layer is aluminum foil.

4. The high-speed flat cable with shape memory according to claim 1, **characterized in that**, the bending composite layers at an outermost signal unit group laterally extend for a short distance and are adhered to each other.

5. The high-speed flat cable with shape memory according to claim 1, **characterized in that**,
the width of the external insulation film layer and the width of the internal insulation film layer are all slightly greater than the width of the bending metal foil layer, so as to prevent the aluminum foil layer from contacting anything outside; or
insulation paint or insulation glue is applied at a connection location where two sides of the two bending composite layers are adhered to each other, so as to prevent the bending metal foil layer from contacting anything outside.

6. The high-speed flat cable with shape memory according to claim 1, **characterized in that**, the differential signal unit group includes:

a first core wire;
a first ground wire; and
a first anti-interference insulation layer embracing the first core wire and the first ground wire;
wherein
the number of the first core wires is two, and each first core wire includes a first conductor and a first longitudinal insulator embracing the first conductor, or
the number of the first core wire is one, and the first core wire includes two first conductors and a first longitudinal insulator, and the first longitudinal insulator embraces and separates the two first conductors.

7. The high-speed flat cable with shape memory according to claim 6, **characterized in that**, the first anti-interference insulation layer is an aluminum foil layer.

8. The high-speed flat cable with shape memory according to claim 3, **characterized in that**,
the number of the first ground wire is one, and the first ground wire is arranged on one side of the second core wire; or
the number of the first ground wires is two, and the two first ground wires are symmetrically arranged on the upper and lower sides or the left and right sides of the first core wire.

9. The high-speed flat cable with shape memory according to claim 1, **characterized in that** the external insulation film layer and the internal insulation film layer are made of insulation material enhancing mechanical shape memory.

10. A manufacturing method of the high-speed flat cable with shape memory according to any of claims 1-9, **characterized in that**, the method comprises the following steps:

step 1: extruding the first core wire; embracing the first core wire and a first ground wire by the first anti-interference insulation layer, so as to make up the differential signal unit group;
step 2: arranging the differential signal unit group made in step 1 in parallel; applying the adhesive agent layer on the internal insulation film layer, wherein a side of the internal insulation film layer that is applied with the adhesive agent layer is next to the signal unit group; laminating the internal insulation film layer on the signal unit group arranged in parallel;
step 3: adhering and laminating the bending metal foil layer to the internal insulation film layer using a glue; and
step 4: adhering and laminating the external insulation film layer to the bending metal foil layer using a glue.

11. A high-speed flat cable with shape memory and control signal, **characterized in that**, the high-speed flat cable is the high-speed flat cable with shape memory according to any of claims 1-9;
the signal unit group further includes at least one control signal unit group; and
the differential signal unit group and the control signal unit group are arranged randomly.

12. The high-speed flat cable with shape memory and control signal according to claim 11, **characterized in that**,
the control signal unit group includes a second core wire;
the second core wire includes a second conductor and a second longitudinal insulator embracing the second conductor; and
the second core wire is embraced by a second anti-interference insulation layer.

13. The high-speed flat cable with shape memory and control signal according to claim 12, **characterized in that**, the second anti-interference insulation layer is an aluminum foil layer.

14. The high-speed flat cable with shape memory and control signal according to claim 12, **characterized in that**, the second anti-interference insulation layer further embraces at least one second ground wire.

15. The high-speed flat cable with shape memory and control signal according to claim 11, **characterized in that**,
the signal unit group includes at least five control signal unit groups;
every five control signal unit groups are arranged adjacently; and
at most five control signal unit groups are arranged adjacently.

16. A manufacturing method of a high-speed flat cable with shape memory and control signal, **characterized in that**, the method comprises the following steps:

step 1: extruding a first core wire; embracing the first core wire and a first ground wire with a first anti-interference insulation layer, so as to make up a differential signal unit group;
step 2: extruding a second core wire; embracing the second core wire and a second ground wire with a second anti-interference insulation layer, so as to make up a control signal unit group;
step 3: arranging the differential signal unit group made in step 1 and the control signal unit group made in step 2 in parallel randomly to make up a signal unit group; providing an internal insulation film layer on upper and lower sides of the signal unit group; applying an adhesive agent layer on the internal insulation film layer, wherein a side of the internal insulation film layer that is applied with the adhesive agent layer is next to the signal unit group; laminating the internal insulation film layer on the signal unit groups arranged in parallel;
step 4: adhering and laminating the bending metal foil layer to the internal insulation film layer using an adhesive agent; and
step 5: adhering and laminating the external insulation film layer to the bending metal foil layer using an adhesive agent.

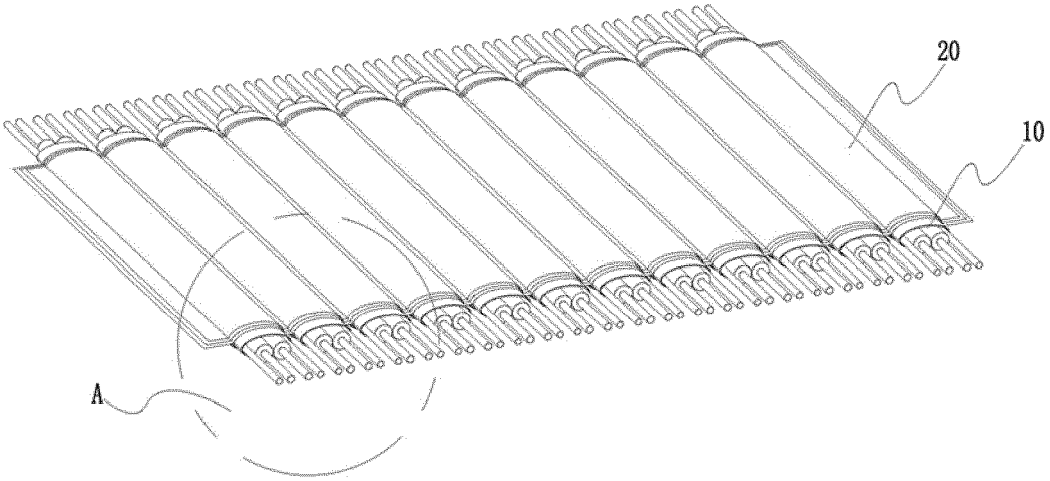


Fig. 1

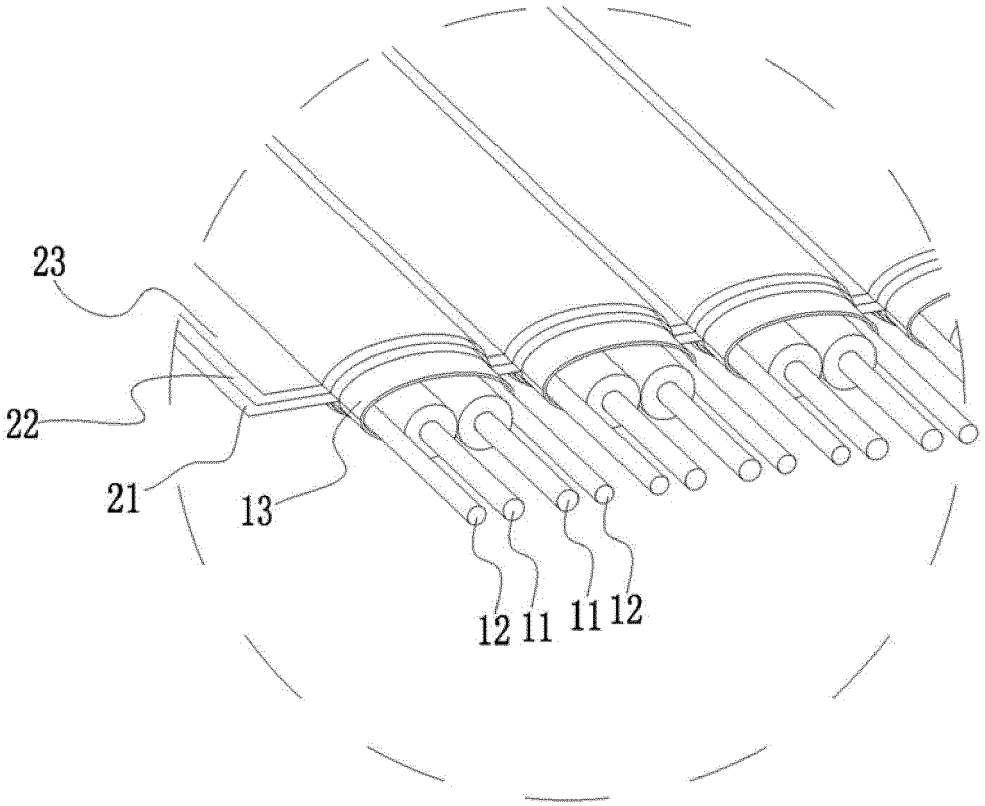


Fig. 2

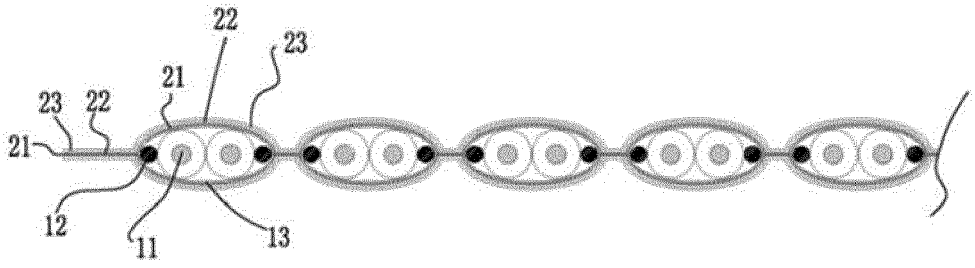


Fig. 3

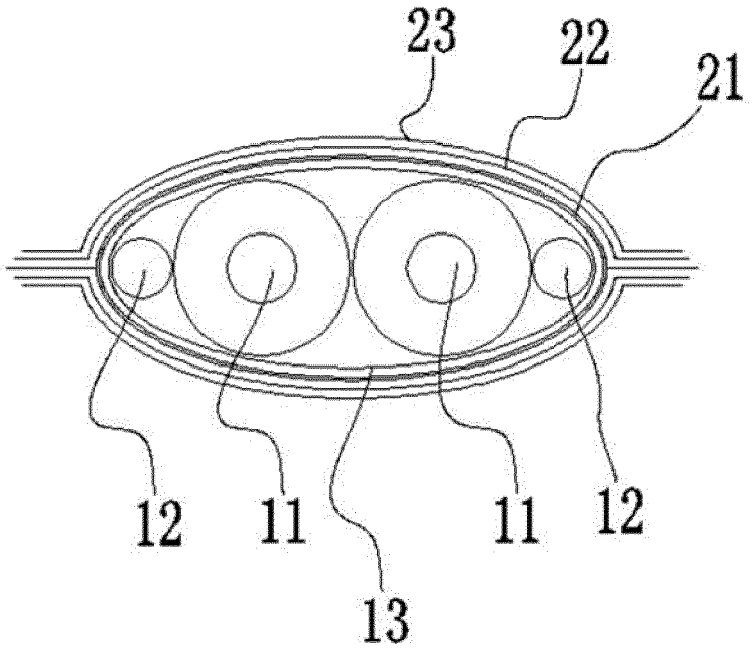
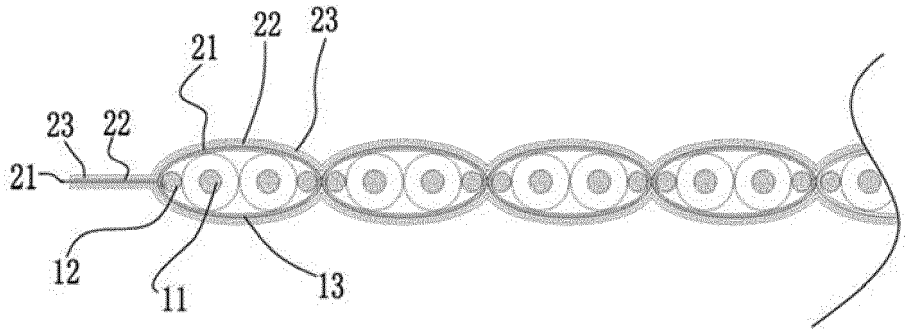


Fig. 4



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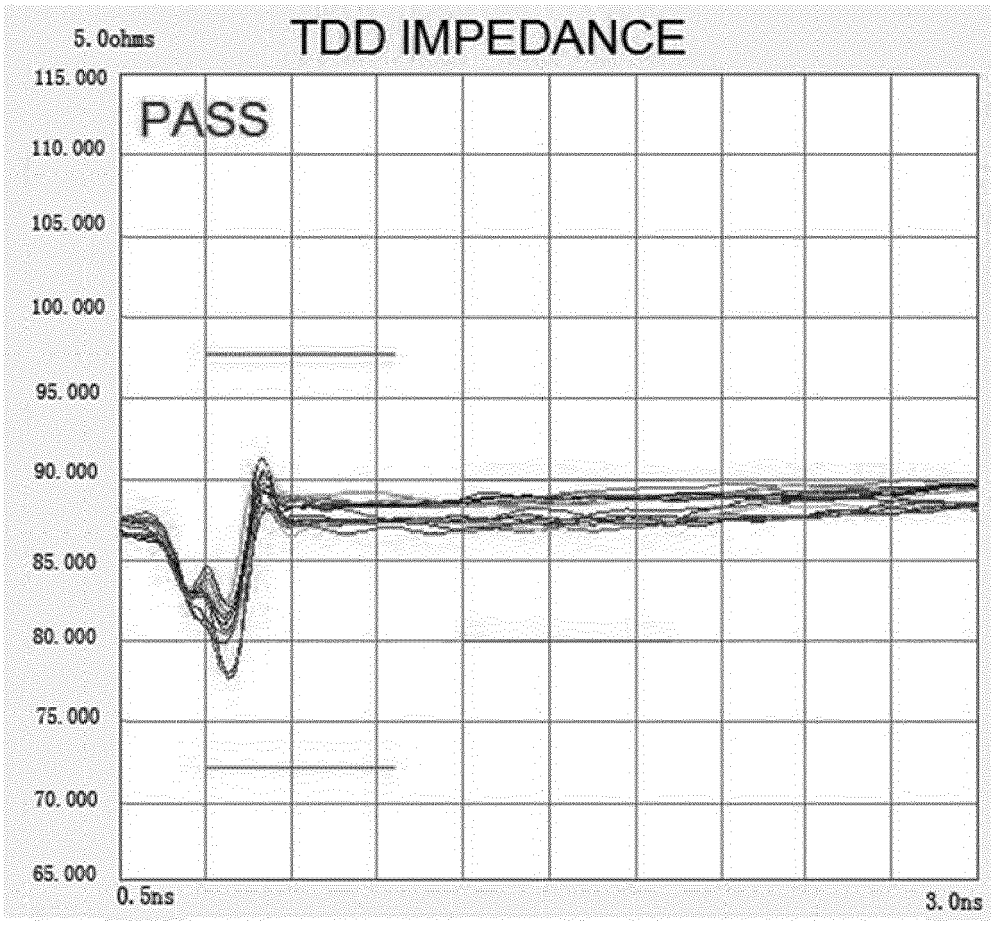
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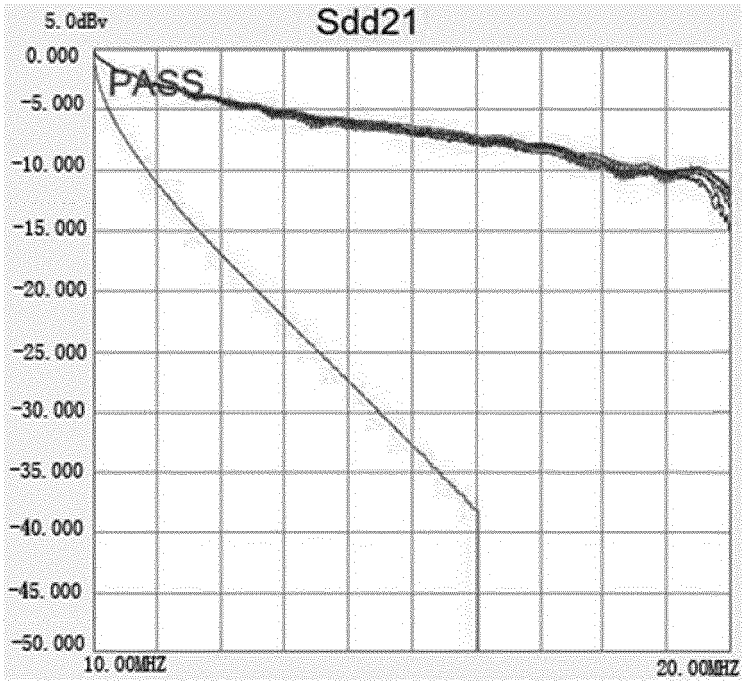
PASS
115.000
110.000
105.000
100.000
95.000
90.000
85.000
80.000
75.000
70.000
65.000
0.5ns
3.0ns

Fig. 6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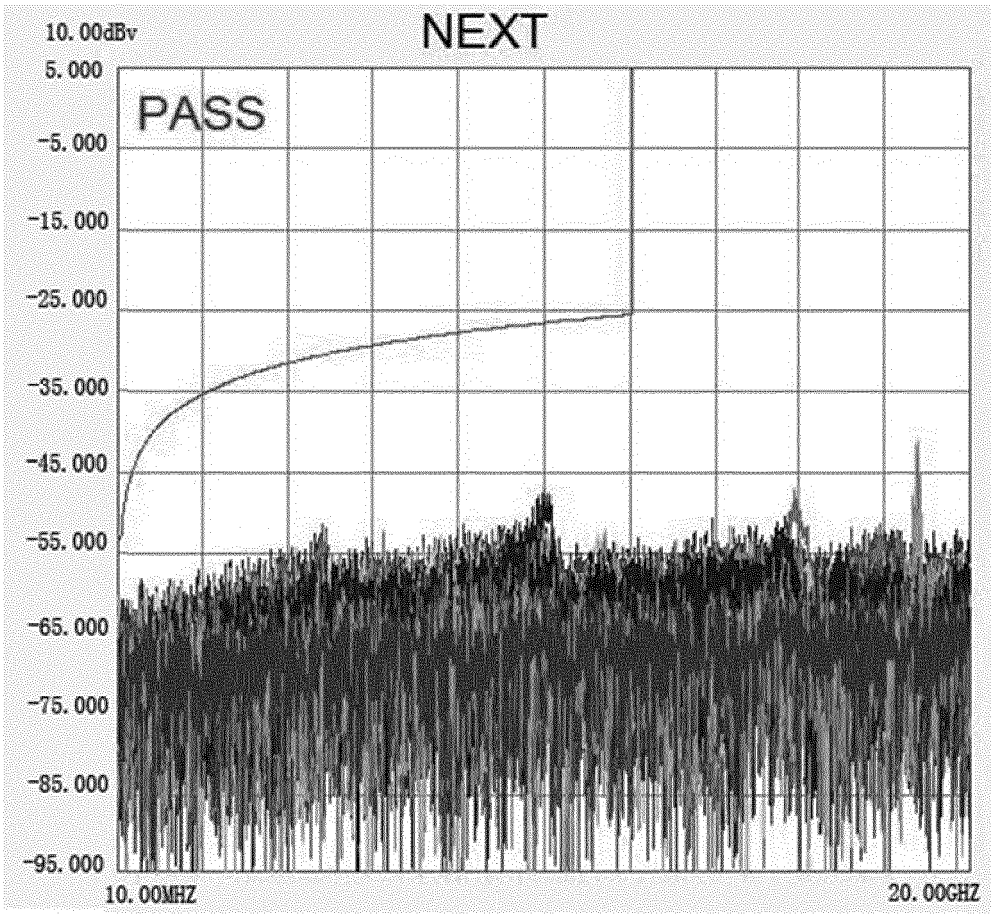
Sdd21
0.000
-5.000
-10.000
-15.000
-20.000
-25.000
-30.000
-35.000
-40.000
-45.000
-50.000
PASS
10.00MHZ
20.00MHZ

Fig. 7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5.000
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-15.000
-25.000
-35.000
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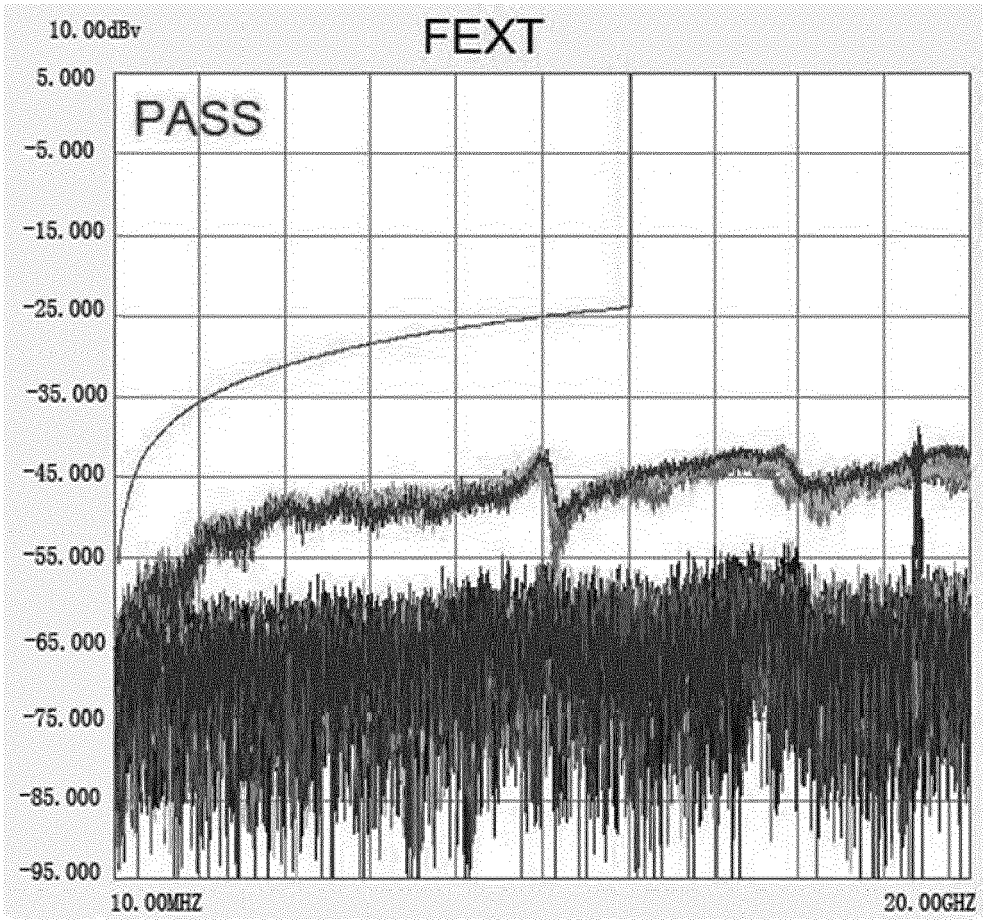
-75.000
-85.000
-95.000
10.00MHZ
20.00GHZ

Fig. 8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10.00MHZ
20.00GHZ

Fig. 9

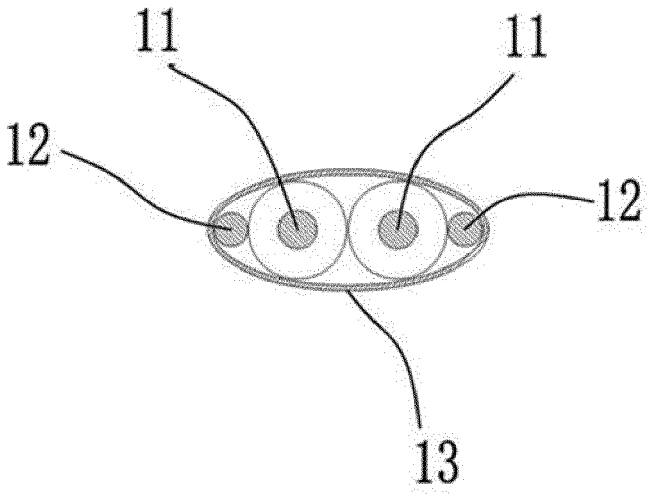

Fig. 10

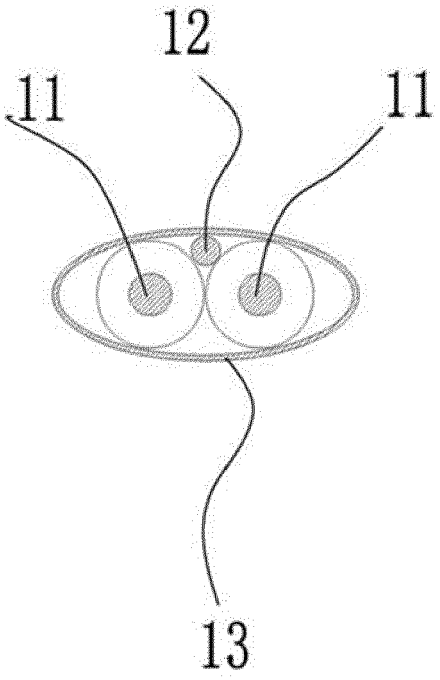

Fig. 11

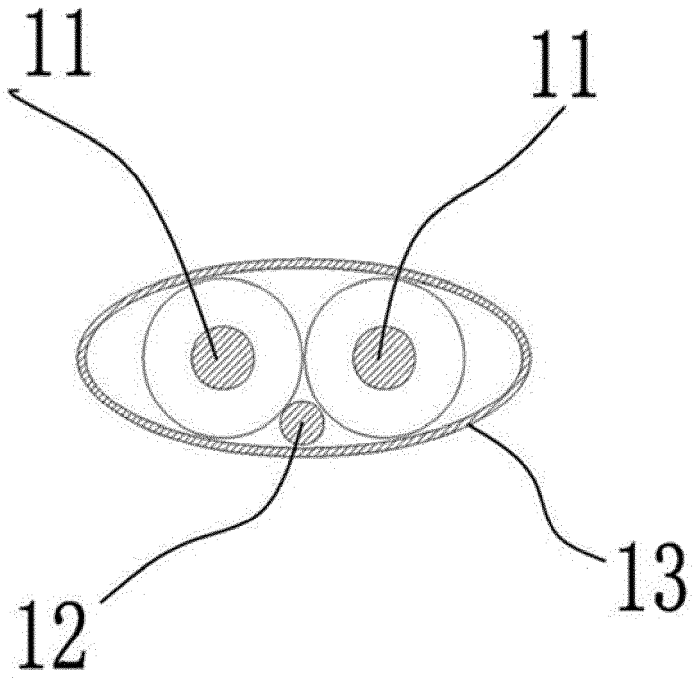

Fig. 12

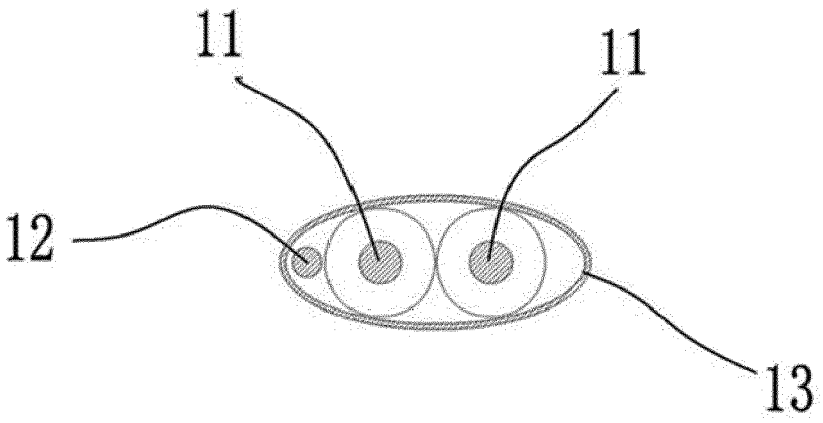

Fig. 13

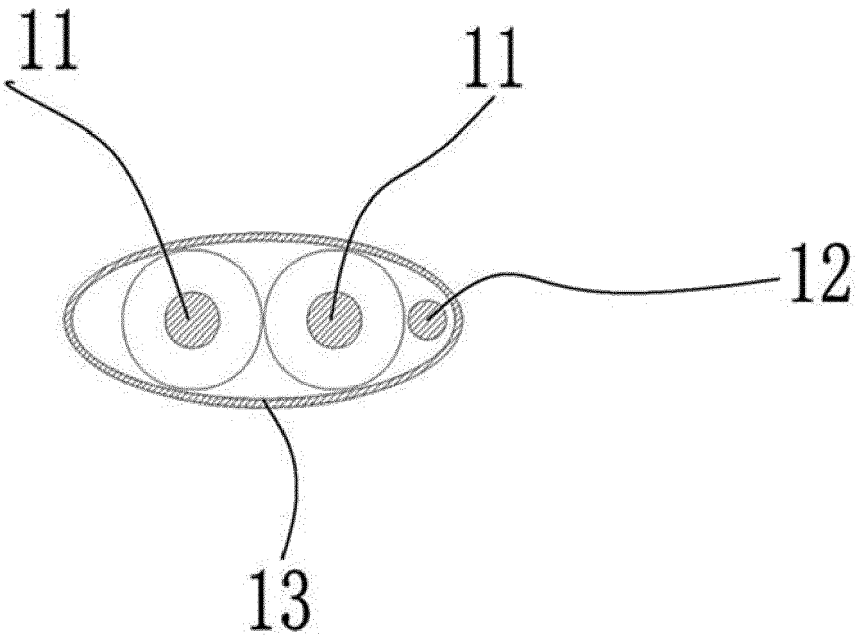

Fig. 14

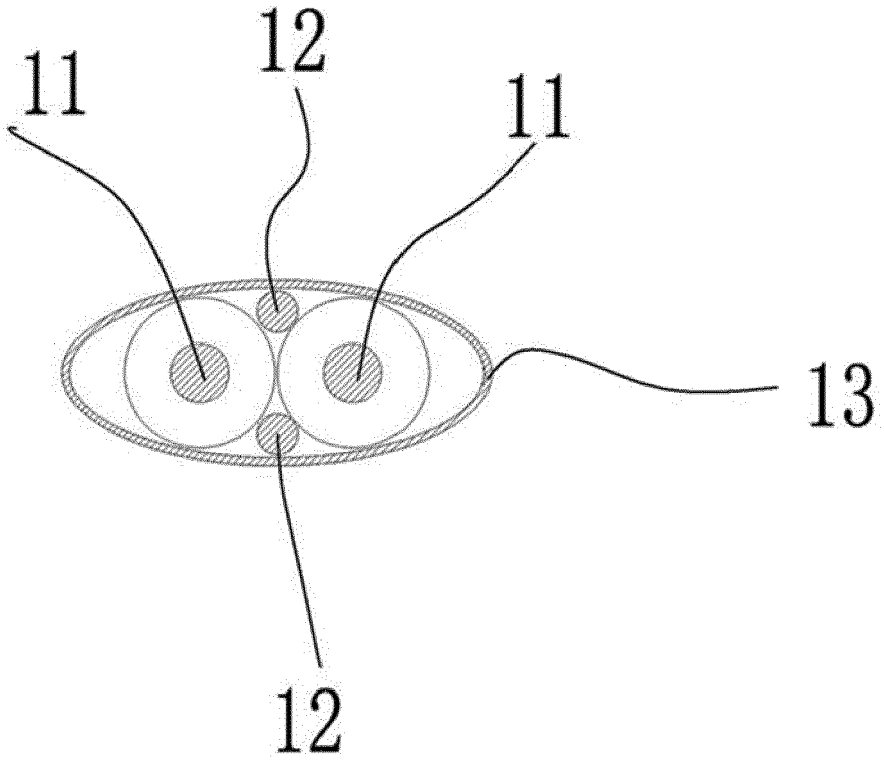

Fig. 15

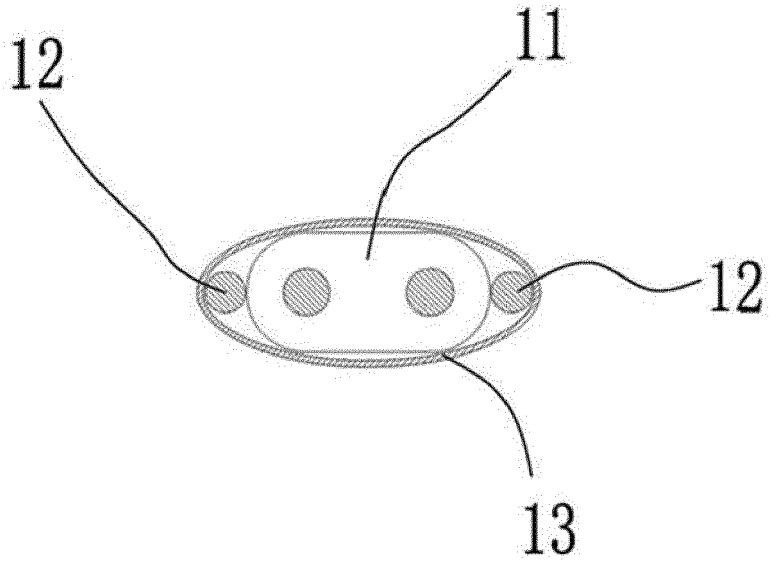

Fig. 16

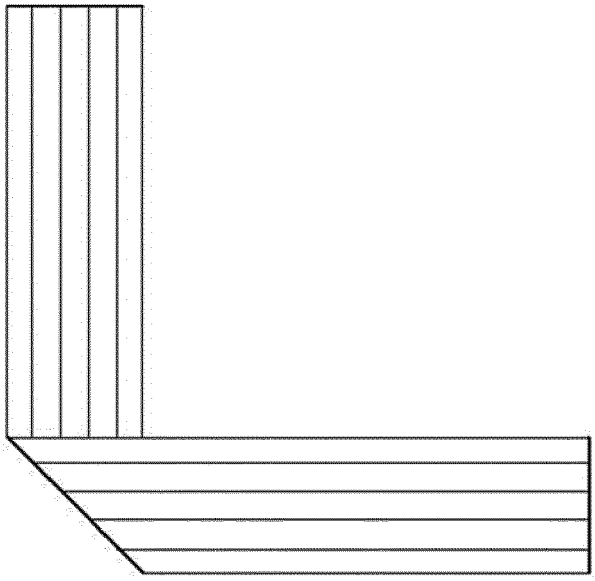

Fig. 17

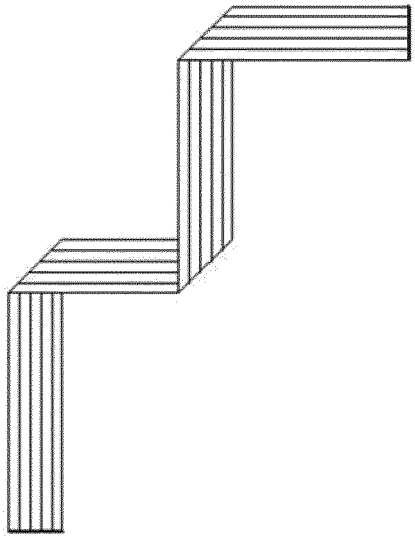

Fig. 18

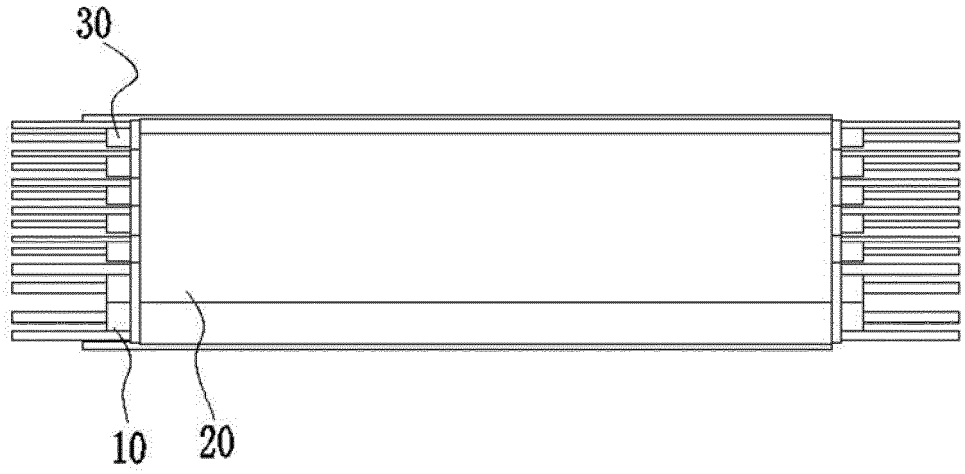

Fig. 19

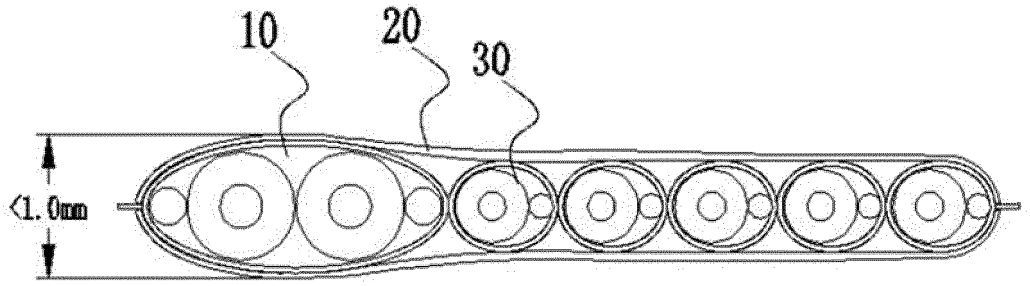

Fig. 20

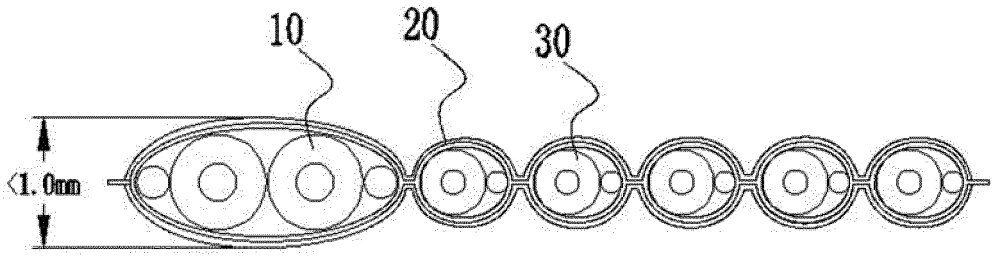

Fig. 21

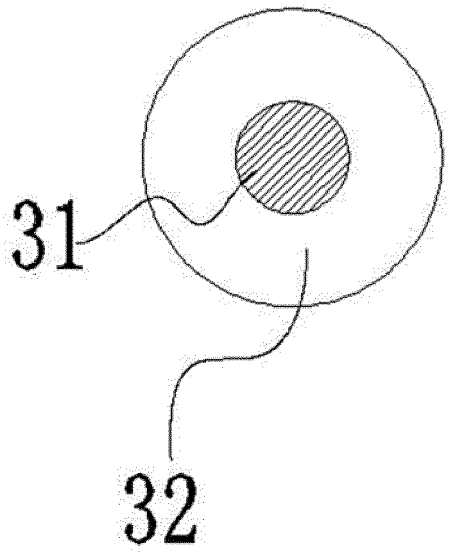

Fig. 22

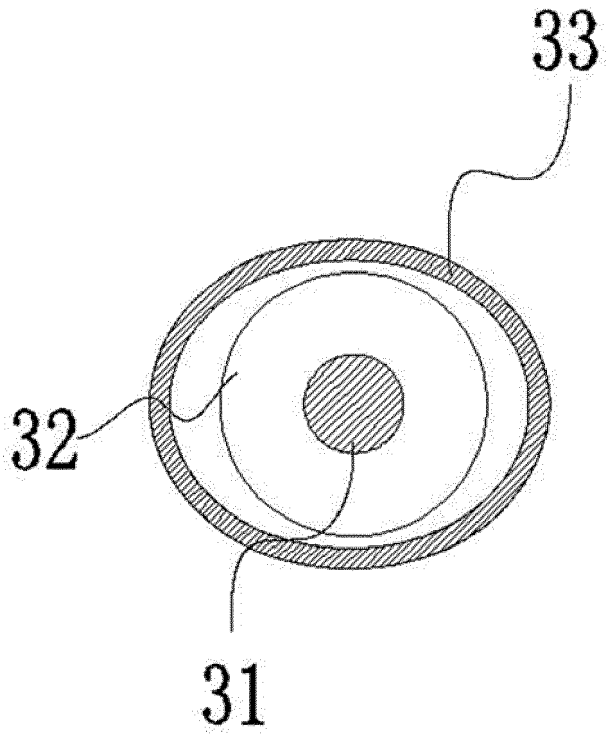

Fig. 23

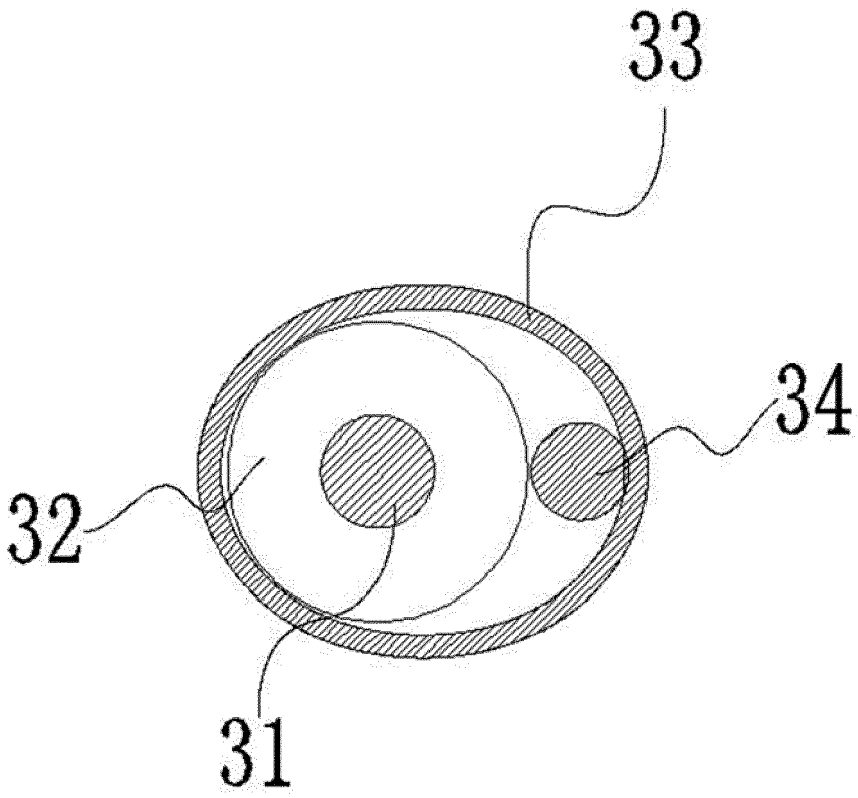

Fig. 24

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EUROPEAN SEARCH REPORT

Application Number
EP 17 18 4408

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 March 2018	Alberti, Michele

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