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(54) **HIGH-FIDELITY AUDIO TRANSMISSION CONNECTOR USING CONDUCTOR FROM CABLE**

(57) The present disclosure concerns an improved system for plug (100) and socket (200) connectors for transmission of electrical signals representing sound data, where the sound deterioration is reduced compared to prior art. The mechanical requirements of the plug (100) and socket (200) connectors are fulfilled by a

mechanically robust frame (101, 201), while the high-fidelity electrical connection is enabled by using the conductor (303) of a cable (300) with which the connector (100, 200) is connected wrapped around the mechanically robust frame (101, 201).

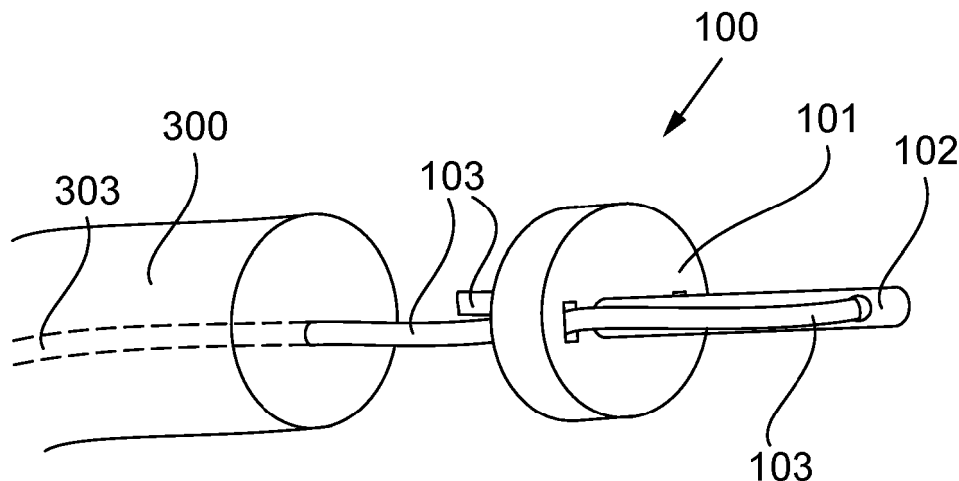


Fig. 1A

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Description

Technical field

[0001] The subject of the present disclosure is plugs and sockets for transmitting electrical signals representing sound data, in particular for extremely high fidelity audio transmission.

Background

[0002] High fidelity audio transmission relies on lossless and defect free conduction of electrical signals through cables and connections. In order to obtain as high a signal purity as possible, many high-end music equipment manufacturers use high-conductivity metals in their cables, such as copper and silver. Particularly, annealed noble metals, where the metal is heated and slowly cooled in a controlled manner in order to obtain a very high purity and defect-free crystal structure, have shown favorable conductivity properties that translate to high fidelity audio transmission. Such annealed metals are used in high-end cables but not for plugs and sockets due to their very high malleability making them difficult and infeasible to machine and process.

[0003] It is therefore common to produce plugs and sockets, where the conductor in the cable is connected to a contact element in the plug or socket by means of welding, soldering, or mechanical fastening, such as screwing. The conductor in the plug or socket is then typically a harder metal (such as hardened copper or alloys thereof) able to withstand the forces and wear associated with numerous mating cycles consisting of plugging and unplugging the connectors.

[0004] Extensive listening tests reveal that most plugs, including many expensive audiophile varieties, disturb the signal-carrying current and add coloration to the music signal. This leads many audio enthusiasts to bypass connections by "hard wiring" cables that connect audio equipment, thereby eliminating the deficiencies associated with the use of plug and socket connectors.

Summary

[0005] It is one objective of the present disclosure to provide a plug and socket that at least partially overcomes some of the challenges mentioned above.

[0006] In a first aspect of the present disclosure, a plug for transmitting electrical signals representing sound data is disclosed, configured to be connected in one end to a socket and at the other end to a cable. The plug comprises a mechanically robust frame, comprising in the end of the plug configured to be connected to the socket one or more pins configured to be received by and fit into one or more receptacles in the socket. Each pin is configured to support one or more electrical contact elements, wherein one or more of the electrical contact elements are integral parts of one or more electrical

conductors of the cable.

[0007] In a second aspect of the present disclosure, a socket for transmitting electrical signals representing sound data is disclosed, which is configured to be connected in one end to a plug, such as a plug described above, and at the other end to a cable. The socket comprises a mechanically robust frame, comprising in the end of the socket configured to be connected to the plug one or more receptacles each of which is configured to receive and hold a pin of the plug. Each receptacle is configured to support one or more electrical contact elements, wherein one or more of the electrical contact elements are integral parts of one or more electrical conductors of the cable.

[0008] In a third aspect of the present disclosure, a cable for transmitting electrical signals representing sound data is disclosed, comprising at one or both ends a connector configured to connect the cable to a further device, such as another cable, a sound collecting device, or a sound output device. The connector is a plug, such as a plug described above, or alternatively a socket, such as a socket described above, wherein one or more electrical conductors of the cable are arranged in the connector so as to provide electrical connection when the connector is mated with a complementary connector.

[0009] In a fourth aspect of the present disclosure, the use of a plug, such as a plug described above, and/or a socket, such as a socket described above, for providing a connection for transmitting electrical signals representing sound data between a cable and a further device is disclosed. The further device may be another cable, a sound collecting device, or a sound output device. One or more electrical contact elements of the plug and/or one or more electrical contact elements of the socket are integral parts of one or more electrical conductors of the cable.

[0010] In one or more embodiments of the present disclosure, the one or more electrical contact elements of the plug or the socket comprise a noble metal, such as copper, silver, or an alloy thereof.

[0011] In one or more embodiments of the present disclosure, the purity of the metal of the electrical contact elements of the plug or the socket is higher than 95%, such as higher than 99%, such as higher than 99.9%, such as higher than 99.99%.

[0012] In one or more embodiments of the present disclosure, the metal of the electrical contact elements of the plug or the socket has been annealed.

[0013] In one or more embodiments of the present disclosure, the one or more electrical contact elements of the plug or the socket each has a cross sectional area of less than 2 mm², such as less than 1 mm², such as less than 0.5 mm².

[0014] In one or more embodiments of the present disclosure, the mechanically robust frame of the plug or the socket is composed of an electrically insulating polymer, such as polyether ether ketone (PEEK).

[0015] In one or more embodiments of the present

disclosure, the mechanically robust frame of the plug or the socket is manufactured by means of molding, such as by means of injection molding.

[0016] In one or more embodiments of the present disclosure, the plug or the socket is designed to be compatible with standard connector designs, such as RCA standards, Banana plug standards, such as 4 mm Banana plug standards, or XLR standards, such as XLR3 standards.

[0017] In one or more embodiments of the present disclosure, one or more of the one or more electrical contact elements of the plug or the socket are integral parts of one or more electrical conductors of the cable.

[0018] In one or more embodiments of the present disclosure, each of the pins of the plug additionally comprise one or more elastic elements that cause the one or more electrical contact elements to reversibly bulge outwards, such that the diameter of each pin is larger when the plug is not inserted in the socket.

[0019] In one or more embodiments of the present disclosure, each of the one or more receptacles of the socket additionally comprises one or more elastic elements, which cause the one or more electrical contact elements to reversibly bulge outwards, such that the internal diameter of each receptacle is smaller when a plug is not inserted in the socket than it is when a plug is inserted in the socket.

Description of Drawings

[0020]

Fig. 1A: Schematic drawing of a general plug, where the electrical conductor from the cable is threaded through a mechanically stabilizing frame in the form of a pin, in one or more embodiments of the present disclosure.

Fig. 1B: Schematic drawing of a general socket, where the electrical conductor from the cable is threaded through a mechanically stabilizing frame in the form of an receptacle, in one or more embodiments of the present disclosure.

Fig. 2A: Exploded view of a Banana-type plug showing the mechanically stabilizing frame consisting of a base and a pin as well as two electrical conductor bands, in one or more embodiments of the present disclosure.

Fig. 2B: Schematic drawing of an assembled pin in the Banana-type plug, in one or more embodiments of the present disclosure.

Fig. 3A: Exploded view of an XLR3-type plug showing the mechanically stabilizing frame consisting of a base and three pins as well as three electrical conductor bands, in one or more embodiments of the

present disclosure.

Fig. 3B: Schematic drawing of an assembled pin in the XLR3-type plug, in one or more embodiments of the present disclosure.

Fig. 4A: Exploded view of an XLR3-type socket showing the mechanically stabilizing frame consisting of a base and three receptacles as well as three electrical conductor bands, in one or more embodiments of the present disclosure.

Fig. 4B: Schematic drawing of an assembled pin in the XLR3-type socket, in one or more embodiments of the present disclosure.

Detailed description

[0021] The present disclosure concerns an improved system for plug 100 and socket 200 connectors for transmission of electrical signals representing sound data, where the sound deterioration is reduced compared to prior art. In order to overcome the disturbances of the audio signal introduced by connections between one conductor (such as conductor 303 in a cable 300) and another conductor (such as a conductor 103 or 203 in a plug 100 or socket 200), the plug 100 and socket 200 connector in the present disclosure makes use of the conductor 303 of the cables 300 themselves to create contact across the connector. Thus, at least one conductor-to-conductor connection is avoided in both the plug 100 and the socket 200, compared to other solutions.

[0022] In one or more embodiments of the present disclosure, the electrical contact elements 103, 203, which are integral parts of the electrical conductor 303 of the cable 300 comprise a noble metal such as copper, silver, or alloys thereof. The advantage of using these metals is their high electrical conductivity. In one or more embodiments, the purity of the metal of the electrical contact elements 103, 203, 303 is higher than 95%, such as higher than 99%, such as higher than 99.9%, such as higher than 99.99%. The absence of impurities enhances the electrical conductivity and reduces disturbances of the electrical signal, which may deteriorate the listening experience. In one or more embodiments, the metal of the electrical contact elements 103, 203, 303 has been annealed. This is a process in which the metal is heated to an elevated temperature and subsequently cooled in order to enhance its ductility and decrease its hardness. During the heating, atoms migrate around the crystal structure to annihilate defects such as dislocations, making the metal softer even after cooling. Additionally, annealing metals, such as noble metals, increases their electrical conductivity. In one or more embodiments, the electrical contact elements 103, 203, 303 each has a cross sectional area of less than 2 mm², such as less than 1 mm², such as less than 0.5 mm². Using a very thin wire

or band of metal - particularly when the metal is very soft - is challenging in terms of mechanical stability, however when using expensive metals, it is preferable to keep the amount of material as low as possible. Additionally, a thin and bendable electrical conductor may be easier for a professional music technician to assemble in the connector without the need for special tools.

[0023] All the material properties mentioned in the embodiments above cause the electrical contact elements 103, 203, 303 to be very soft. In one or more embodiments, the metal of the electrical contact elements 103, 203, 303 has a hardness value (HV) of less than 75, such as less than 60, such as less than 45, such as less than or equal to 30, as measured using the Vickers hardness test (ISO 6507 / ASTM E384).

[0024] In order to be able to use soft metals in the electrical contact elements 103 or 203, the connector 100 or 200 comprises a mechanically robust frame 101 or 201, respectively. In one or more embodiments, the mechanically robust frame 101 or 201 comprises an electrically insulating polymer, such as polyether ether ketone (PEEK). It is advantageous that the mechanically robust frame 101 or 201 be electrically insulating as this avoids issues with short-circuiting connections inside the connector 100 or 200. PEEK is a wear-resistant material with excellent mechanical and chemical stability well suited for providing the structural integrity of the connector and thereby supporting the soft electrical contact elements 103, 203. In one or more embodiments, the mechanically robust frame 101, 201 may be fabricated by molding, such as injection molding. This method of manufacturing is relatively inexpensive, highly industrially scalable, and lends itself well to thermoplastics such as PEEK.

[0025] Furthermore, in one or more embodiments, the mechanically robust frame 101, 201 may be elastic or include elastic elements so as to improve the physical contact between electrical contact elements 103, 203 across the intermating connection. In this regard, many polymers, including PEEK, are ideal, since they exhibit favorable elastic properties that enable the connector to protect the soft electrical contact elements 103, 203 by flexing and absorbing any impacts in the mechanically robust frame 101, 201 whilst at the same time providing a suitable pressure of electrical contact elements 103, 203 against their counterparts during intermating.

[0026] Fig. 1 shows a schematic overview of such as plug 100 (Fig. 1A) and socket 200 (Fig. 1B). Here, a cable 300 is connected to a mechanically robust frame 101, 201. The mechanically robust frame 101 of the plug 100 comprises in the end configured to be connected to the socket 200 one or more pins 102. The pins 102 are configured to support one or more electrical contact elements 103. Similarly, the mechanically robust frame 201 of the socket 200 comprises in the end configured to be connected to the plug 100 one or more receptacles 202 configured to support one or more electrical contact elements 203. The electrical conductors 303 of the cable

300 are integral parts of the electrical contact elements 103, 203 of the plug 100 or socket 200. Electrical contact upon mating of the two is achieved by means of each of the pins 102 on the plug 100 side interconnecting with a receptacle 202 on the socket 200 side. The electrical contact element 103, 203 is supported on the outside of the pin 102 and on the inside of the receptacle 202.

[0027] The conductor of the cable may be made from a very malleable metal, such as annealed copper or annealed silver. In order to overcome the challenges associated with such soft metals for connections, where a certain level of wear and tear must be expected during numerous mating cycles, the plug 100 and socket 200 of the present invention each comprises a different elastic frame 101 and 201, respectively, composed of a strong and wear-resistant material, such as polyether ether ketone (PEEK) around which the high-conductivity metal 103 and 203, respectively, is wrapped in order to form the connection. Thus, the mechanical requirements of the plug 100 and socket 200 connectors are fulfilled by the frame 101 and 201, while the high-fidelity electrical connection is enabled by the use of the high-conductivity metal 103 and 203 from the cable 303.

[0028] This enables the connector 100 or 200 itself to be manufactured relatively inexpensively, since the noble metal used to obtain the high-quality connection stems from the cable 300 itself. Furthermore, a professional music technician can easily assemble each of the plug 100 and socket 200 connectors from an existing cable 300 without any specialized equipment or complicated procedure. This could for example be done on-site at a musical scene or performance location.

[0029] In one or more embodiments of the present disclosure (such as the embodiment illustrated in Fig. 2), the plug 120 is compliant with Banana plug standard dimensions, such as 4 mm Banana plug standards. Here, each pin 122 comprises one or more elastic elements 126, such as flutes or incisions 126 extending longitudinally along the length of the pin 122, which cause the electrical contact elements 123 to reversibly bulge outwards such that the diameter of the pin 122 is larger when the plug 120 is not mated with a complementary socket 200 than when it is mated. This elastic deformation causes the electrical contact elements to press outwards when intermating with a complementary connector, thereby ensuring a good electrical contact. Since the main mechanical structure is provided by the mechanically robust frame 121, even very malleable electrical contact element material can be utilized.

[0030] In one or more embodiments of the present disclosure (such as the embodiment illustrated in Fig. 3), the plug 130 is compliant with XLR standard dimensions, such as XLR3 standard dimensions. In either case, the plug 130 comprises a number of pins 132 (in the case of XLR3, this number is three). In one or more embodiments, each pin 132 has a hole 134 towards the distal end 132a through which the electrical contact element 133 is threaded. In one or more embodiments, each pin 132

additionally comprises, along the outer surface, a longitudinal groove in which the electrical contact element 133 is arranged along the length of the pin 132.

[0031] In one or more embodiments of the present disclosure (such as the embodiment illustrated in Fig. 4), the socket 230 is compliant with XLR standard dimensions, such as XLR3 standard dimensions. In either case, the socket 230 comprises a number of receptacles 232 (in the case of XLR3, this number is three). In one or more embodiments, each receptacle 232 has a recess 234 in the distal rim 232a configured to hold the electrical contact element 233 when it is bent about the rim 232a of the receptacle 232. Importantly, the electrical contact element 233 extends longitudinally along the inside of the receptacle 232, where it may form electrical contact when the socket 230 is mated with a complimentary plug 130.

[0032] In one or more embodiments, the cable 300 with which the connector 100, 200 is connected is coaxial.

Items

[0033]

1. A plug (100) for transmitting electrical signals representing sound data, configured to be connected in one end to a socket (200) and at the other end to a cable (300), wherein the plug (100) comprises a mechanically robust frame (101), comprising in the end of the plug (100) configured to be connected to the socket (200) one or more pins (102) configured to be received by and fit into one or more receptacles (202) in the socket (200), the pins (102) additionally configured to support one or more electrical contact elements (103), wherein one or more of the electrical contact elements (103) are integral parts of one or more electrical conductors (303) of the cable (300).
2. The plug (100) according to item 1, wherein the mechanically robust frame (101) is composed of an electrically insulating polymer, such as polyether ether ketone (PEEK).
3. The plug (100) according to any of the preceding items, wherein the mechanically robust frame (101) is manufactured by means of molding, such as by means of injection molding.
4. The plug (100) according to any of the preceding items designed to be compatible with standard connector designs, such as RCA standards, Banana plug standards, such as 4 mm Banana plug standards, or XLR standards, such as XLR3 standards.
5. The plug (120) according to any of the preceding items, wherein each of the pins (122) additionally comprise one or more elastic elements (126) configured to cause the one or more electrical contact

elements (123) to reversibly bulge outwards, such that the diameter of each pin (122) is larger when the plug (120) is not inserted in the socket (200) than it is when the plug (120) is inserted in the socket (200).

6. A socket (200) for transmitting electrical signals representing sound data, configured to be connected in one end to a plug (100), such as a plug (100) according to any of items 1-5, and at the other end to a cable (300), wherein the socket (200) comprises a mechanically robust frame (201), comprising in the end of the socket (200) configured to be connected to the plug (100) one or more receptacles (202) configured to receive and hold one or more pins (102) of the plug (100), the receptacles (202) additionally configured to support one or more electrical contact elements (203), wherein one or more of the electrical contact elements (203) are integral parts of one or more electrical conductors (303) of the cable (300).

7. The socket (200) according to item 6, wherein each of the one or more receptacles (202) additionally comprises one or more elastic elements (206) configured to cause the one or more electrical contact elements (203) to reversibly bulge outwards, such that the diameter of each receptacle (202) is smaller when a plug (100) is not inserted in the socket (200) than it is when a plug (100) is inserted in the socket (200).

8. The socket (200) according to any of items 6-7, wherein the mechanically robust frame (201) is composed of an electrically insulating polymer, such as polyether ether ketone (PEEK).

9. The socket (200) according to any of items 6-8, wherein the mechanically robust frame (201) is manufactured by means of molding, such as by means of injection molding.

10. The socket (200) according to any of items 6-9 designed to be compatible with standard connector designs, such as RCA standards, Banana plug standards, such as 4 mm Banana plug standards, or XLR standards, such as XLR3 standards.

11. Use of a plug (100), such as a plug according to any of items 1-5, and/or a socket (200), such as a socket according to any of items 6-10, for providing a connection for transmitting electrical signals representing sound data between a cable (300) and a further device, such as another cable (300), a sound collecting device, or a sound output device, wherein one or more electrical contact elements (103) of the plug (100) and/or one or more electrical contact elements (203) of the socket (200) are integral parts of one or more electrical conductors (303) of the

cable (300).

12. The use according to item 11, wherein the one or more electrical contact elements (103, 203, 303) are composed of a noble metal, such as copper, silver, or an alloy thereof. 5

13. The use according to any of items 11-12, wherein the purity of the metal of the electrical contact elements (103, 203, 303) is higher than 95%, such as higher than 99%, such as higher than 99.9%, such as higher than 99.99% 10

14. The use according to any of items 11-13, wherein the metal of the electrical contact elements (103, 203, 303) has been annealed. 15

15. The use according to any of items 11-14, wherein the one or more electrical contact elements (103, 203, 303) have a hardness value (HV) of less than or equal to 75, such as less than or equal to 60, such as less than or equal to 45, such as less than or equal to 30, as measured using the Vickers hardness test (ISO 6507 / ASTM E384). 20

16. The use according to any of items 11-15, wherein the one or more electrical contact elements (103, 203, 303) each has a cross sectional area of less than 2 mm², such as less than 1 mm², such as less than 0.5 mm². 25

17. A cable (300) for transmitting electrical signals representing sound data, comprising at one or both ends a connector configured to connect the cable to a further device, such as another cable, a sound collecting device, or a sound output device, wherein the connector is a plug (100), such as a plug (100) according to any of items 1-5, or alternatively a socket (200), such as a socket (200) according to any of items 6-10, wherein one or more metal electrical conductors (303) of the cable (300) are arranged in the connector so as to provide electrical connection when the connector is mated with a complementary connector. 30

18. The cable (300) according to item 17, wherein the one or more electrical conductors (303) comprise a noble metal, such as copper, silver, or an alloy thereof. 35

19. The cable (300) according to any of items 17-18, wherein the purity of the metal of the one or more electrical conductors (303) is higher than 95%, such as higher than 99%, such as higher than 99.9%, such as higher than 99.99% 40

20. The cable (300) according to any of items 17-19, wherein the metal of the electrical conductors (303) 45

has been annealed.

21. The cable (300) according to any of items 17-20, wherein the one or more electrical conductors (303) have a hardness value (HV) of less than or equal to 75, such as less than or equal to 60, such as less than or equal to 45, such as less than or equal to 30, as measured using the Vickers hardness test (ISO 6507 / ASTM E384).

22. The cable (300) according to any of items 17-21, wherein the one or more electrical conductors (303) each has a cross sectional area of less than 2 mm², such as less than 1 mm², such as less than 0.5 mm².

23. The cable (300) according to any of items 17-22, wherein the connector is a plug (100), and wherein each of the one or more electrical conductors (303) extends along the outside surface of one of the one or more pins (102) so as to form the electrical contact element (103) of said pin (102).

24. The cable (300) according to any of items 17-23, wherein the connector is a socket (200), and wherein each of the one or more electrical conductors (303) extends along the inside surface of one of the one or more receptacles (202) so as to form the electrical contact element (203) of said receptacle (202).

25. The cable (300) according to any of items 17-24 characterized as being coaxial.

Claims

1. A plug (100) for transmitting electrical signals representing sound data, configured to be connected in one end to a socket (200) and at the other end to a cable (300), wherein the plug (100) comprises a mechanically robust frame (101), comprising in the end of the plug (100) configured to be connected to the socket (200) one or more pins (102) configured to be received by and fit into one or more receptacles (202) in the socket (200), the pins (102) additionally configured to support one or more electrical contact elements (103), wherein one or more of the electrical contact elements (103) are integral parts of one or more electrical conductors (303) of the cable (300). 45
2. The plug (100) according to claim 1, wherein the mechanically robust frame (101) is composed of an electrically insulating polymer, such as polyether ether ketone (PEEK), and wherein the mechanically robust frame (101) is manufactured by means of molding, such as by means of injection molding. 50
3. The plug (100) according to any of the preceding claims designed to be compatible with standard 55

connector designs, such as RCA standards, Banana plug standards, or XLR standards, such as XLR3 standards.

4. The plug (120) according to any of the preceding claims, wherein each of the pins (122) additionally comprise one or more elastic elements (126) configured to cause the one or more electrical contact elements (123) to reversibly bulge outwards, such that the diameter of each pin (122) is larger when the plug (120) is not inserted in the socket (200) than it is when the plug (120) is inserted in the socket (200). 5
5. A socket (200) for transmitting electrical signals representing sound data, configured to be connected in one end to a plug (100), such as a plug (100) according to any of claims 1-4, and at the other end to a cable (300), wherein the socket (200) comprises a mechanically robust frame (201), comprising in the end of the socket (200) configured to be connected to the plug (100) one or more receptacles (202) configured to receive and hold one or more pins (102) of the plug (100), the receptacles (202) additionally configured to support one or more electrical contact elements (203), wherein one or more of the electrical contact elements (203) are integral parts of one or more electrical conductors (303) of the cable (300). 10
6. The socket (200) according to claim 5, wherein each of the one or more receptacles (202) additionally comprises one or more elastic elements (206) configured to cause the one or more electrical contact elements (203) to reversibly bulge outwards, such that the diameter of each receptacle (202) is smaller when a plug (100) is not inserted in the socket (200) than it is when a plug (100) is inserted in the socket (200). 15
7. The socket (200) according to any of claims 5-6, wherein the mechanically robust frame (201) is composed of an electrically insulating polymer, such as polyether ether ketone (PEEK), and wherein the mechanically robust frame (201) is manufactured by means of molding, such as by means of injection molding. 20
8. The socket (200) according to any of claims 5-7 designed to be compatible with standard connector designs, such as RCA standards, Banana plug standards, or XLR standards, such as XLR3 standards. 25
9. Use of a plug (100), such as a plug according to any of claims 1-4, and/or a socket (200), such as a socket according to any of claims 5-8, for providing a connection for transmitting electrical signals representing sound data between a cable (300) and a further device, such as another cable (300), a sound collecting device, or a sound output device, wherein one or 30
10. A cable (300) for transmitting electrical signals representing sound data, comprising at one or both ends a connector configured to connect the cable to a further device, such as another cable, a sound collecting device, or a sound output device, wherein the connector is a plug (100), such as a plug (100) according to any of claims 1-4, or alternatively a socket (200), such as a socket (200) according to any of claims 5-8, wherein one or more metal electrical conductors (303) of the cable (300) are arranged in the connector so as to provide electrical connection when the connector is mated with a complementary connector. 35
11. The cable (300) according to claim 10, wherein the one or more electrical conductors (303) comprise a noble metal, such as copper, silver, or an alloy thereof. 40
12. The cable (300) according to any of claims 10-11, wherein the purity of the metal of the one or more electrical conductors (303) is higher than 95%, such as higher than 99%, such as higher than 99.9%, such as higher than 99.99% 45
13. The cable (300) according to any of claims 10-12, wherein the metal of the electrical conductors (303) has been annealed. 50
14. The cable (300) according to any of claims 10-13, wherein the one or more electrical conductors (303) have a hardness value (HV) of less than or equal to 75, such as less than or equal to 60, such as less than or equal to 45, such as less than or equal to 30, as measured using the Vickers hardness test (ISO 6507 / ASTM E384). 55
15. The cable (300) according to any of claims 10-14, wherein the one or more electrical conductors (303) each has a cross sectional area of less than 2 mm², such as less than 1 mm², such as less than 0.5 mm².

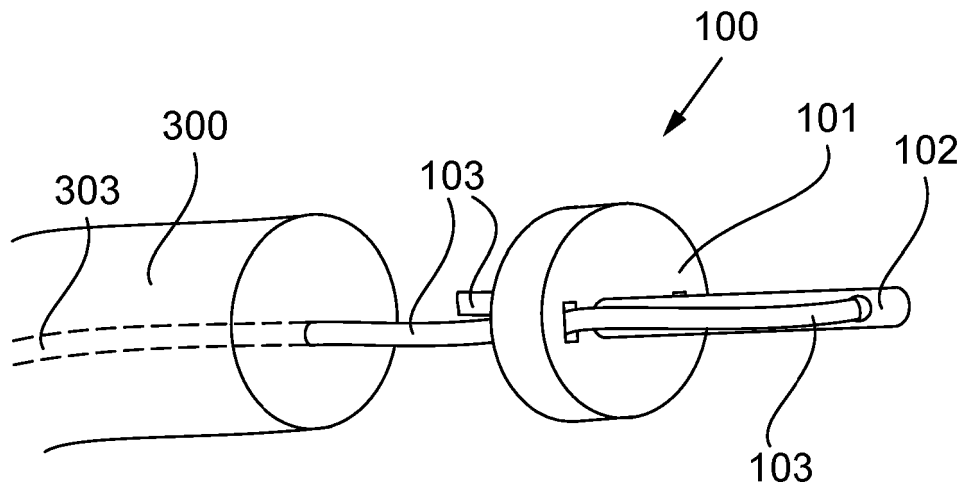


Fig. 1A

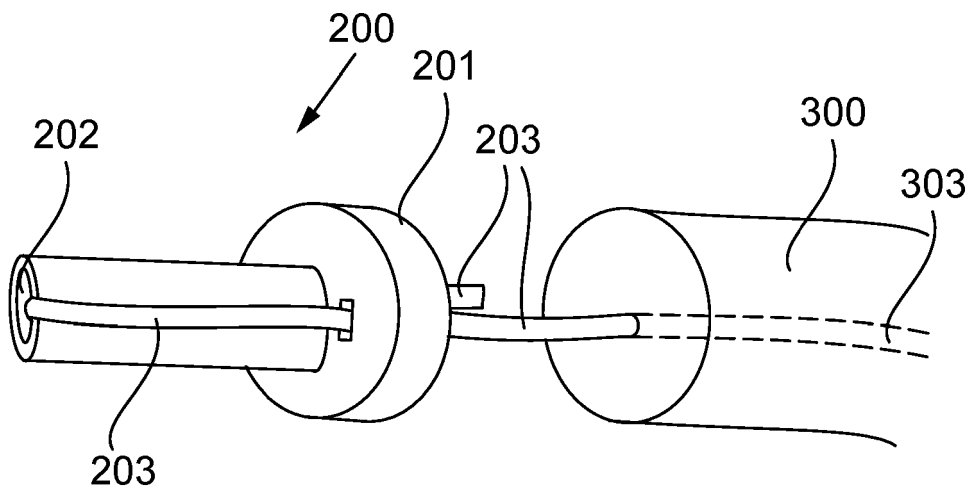


Fig. 1B

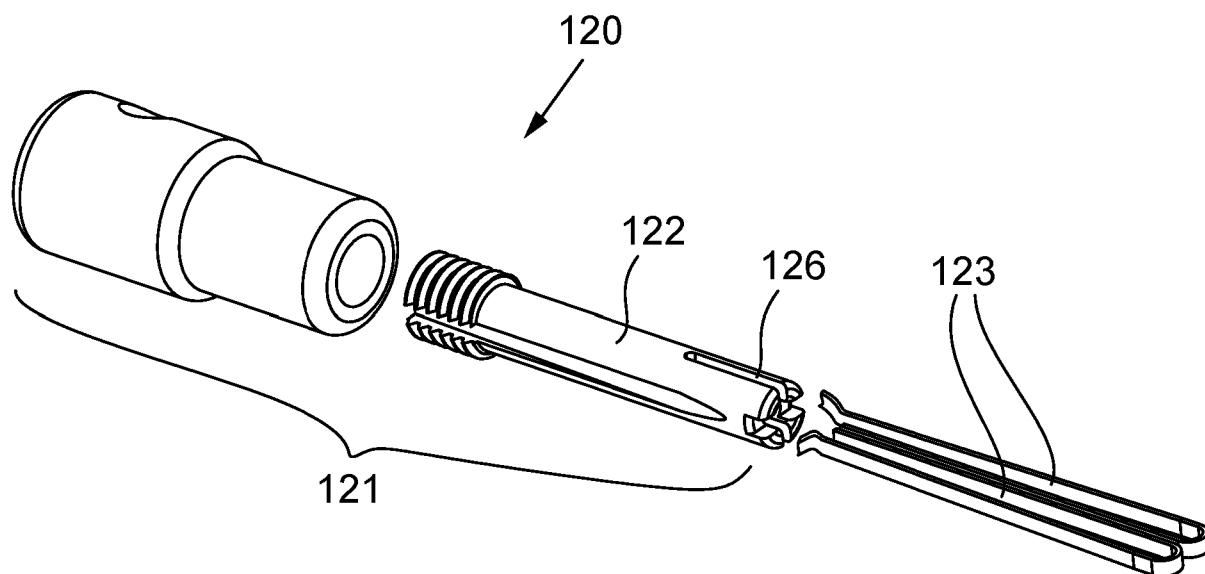


Fig. 2A

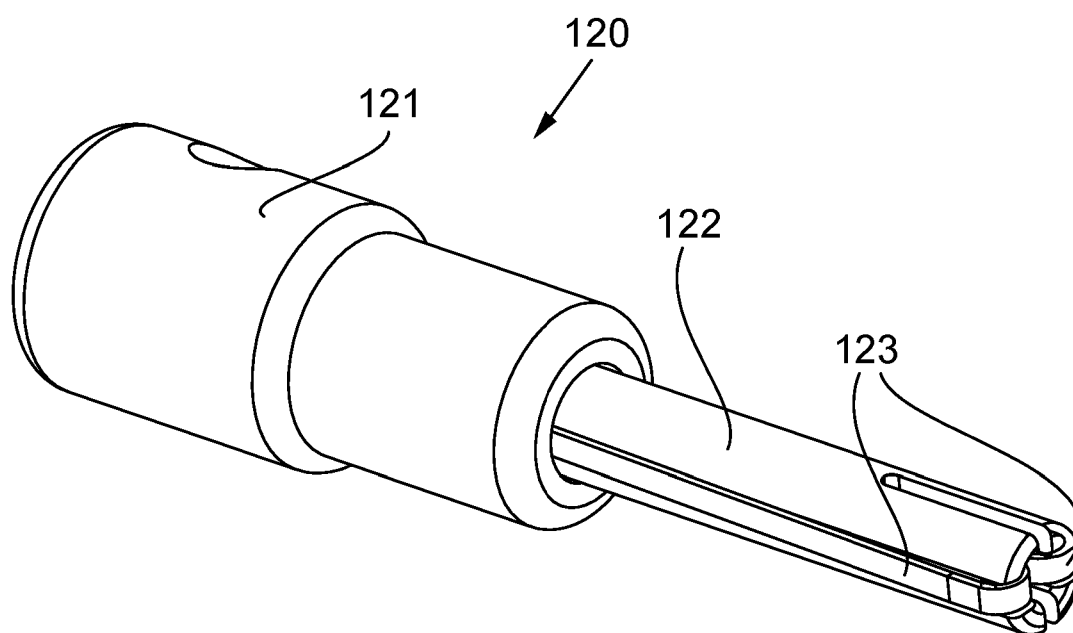


Fig. 2B

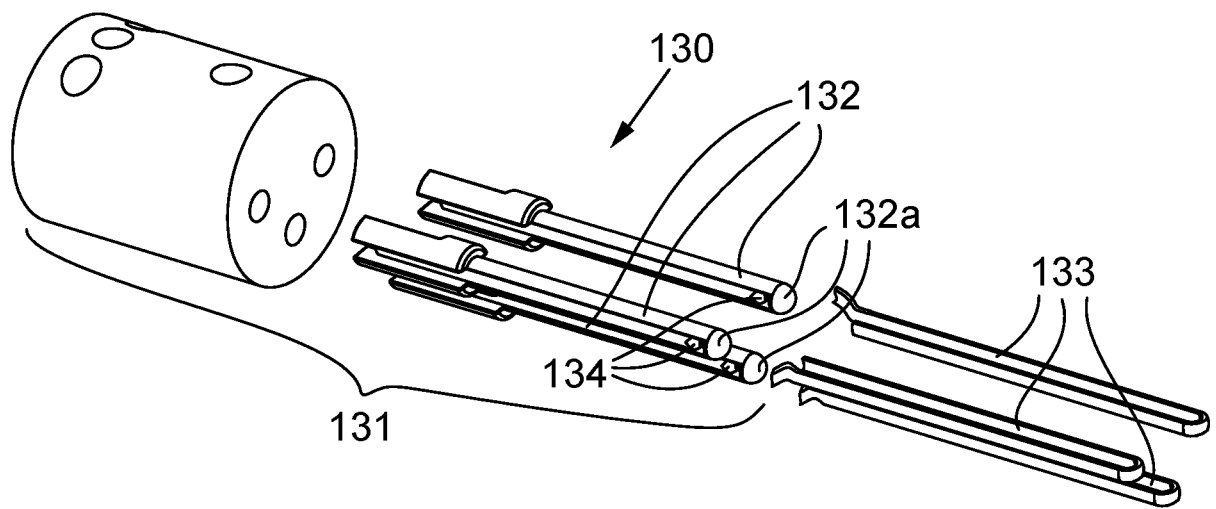


Fig. 3A

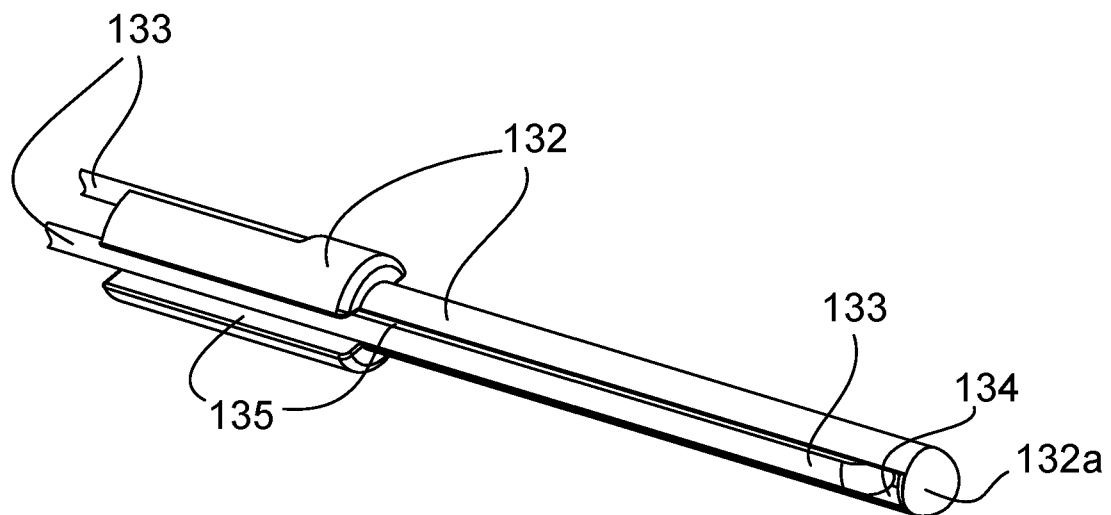


Fig. 3B

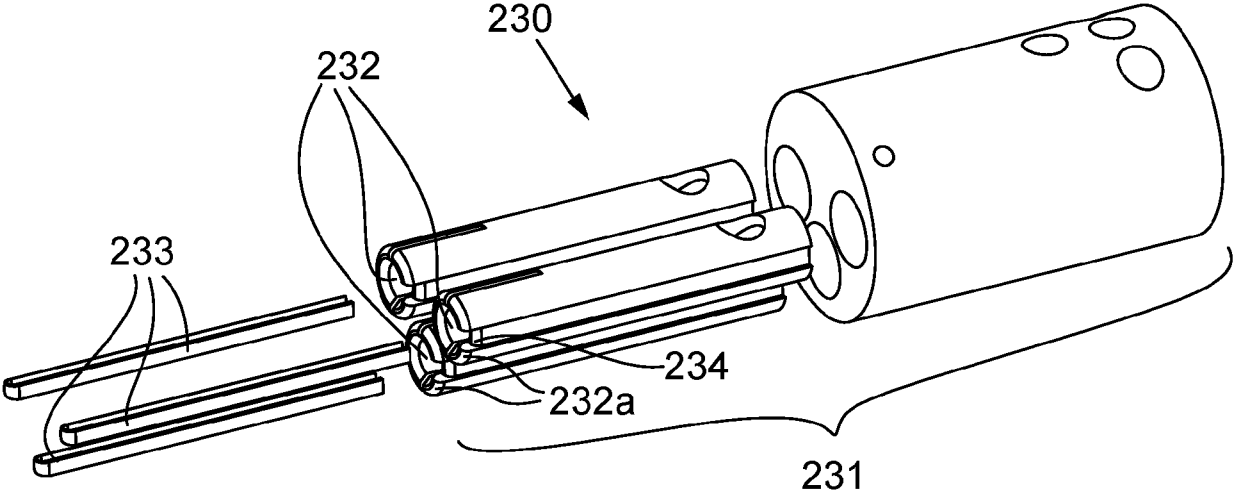


Fig. 4A

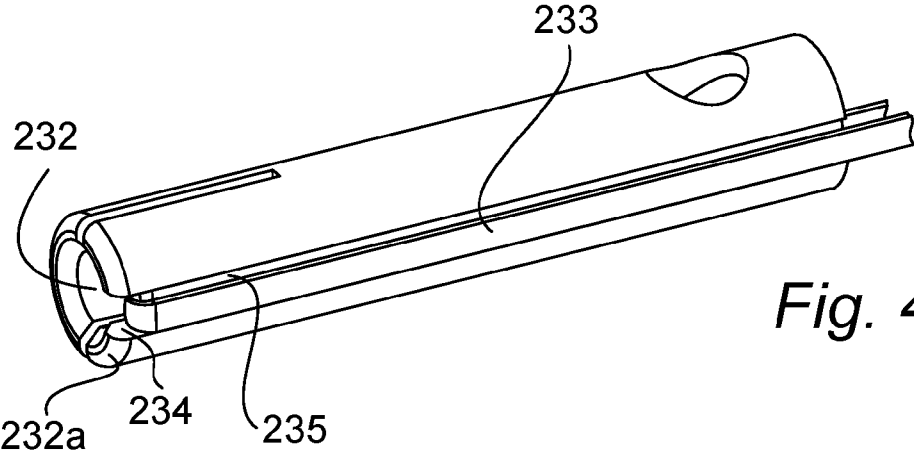


Fig. 4B



EUROPEAN SEARCH REPORT

Application Number

EP 25 16 7749

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	US 4 392 703 A (HALL JAMES R ET AL) 12 July 1983 (1983-07-12) * figure 5 *	1-3,5, 7-10,15 12-14 4,6	INV. H01R13/02
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A			
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