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COAXIAL-TYPE MULTIPLE CONDUCTOR CONTACT PLUG

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Fig. 2

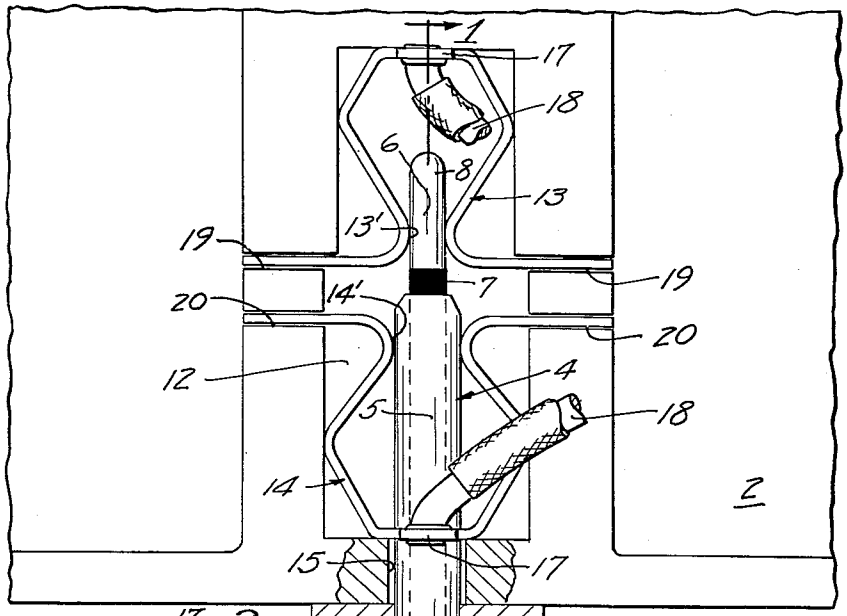
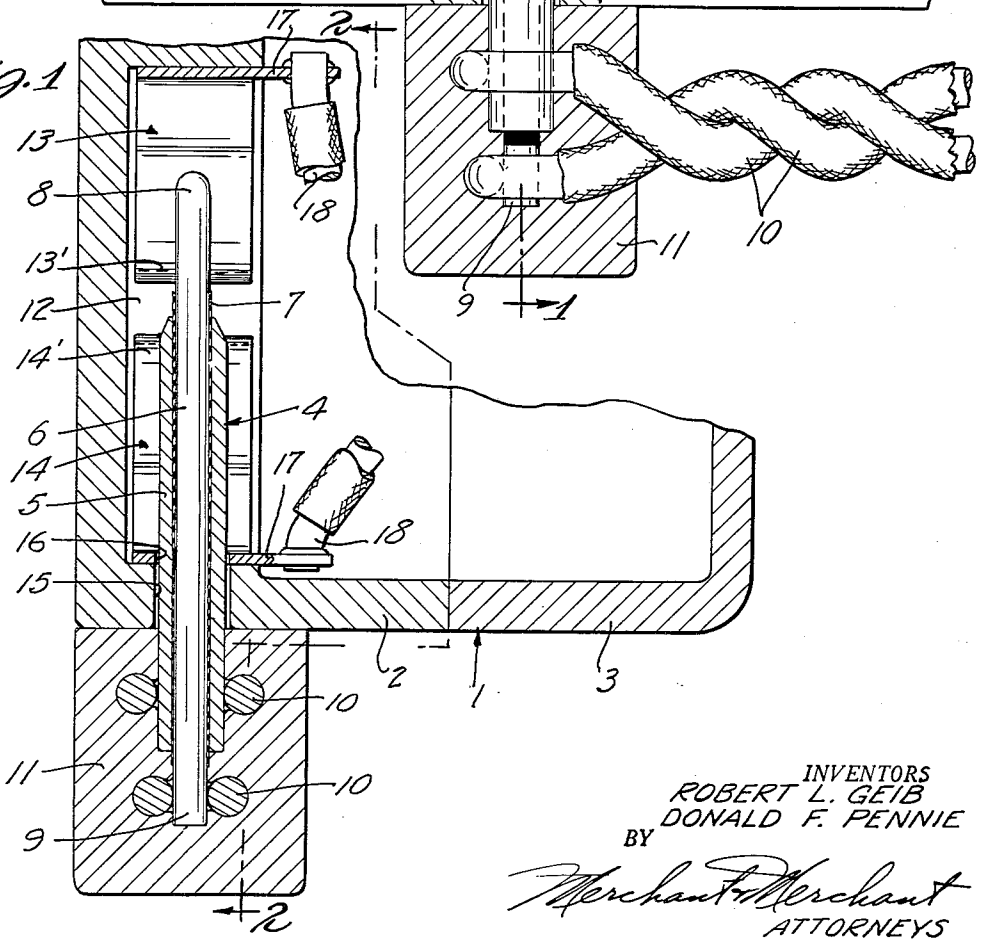


Fig. 1



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COAXIAL-TYPE MULTIPLE CONDUCTOR CONTACT PLUG

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Our present invention relates to improvements in coaxial conductor contact plugs of the general character used extensively in telephone, radio and audio reproducing apparatus, in conjunction with suitable contact-equipped receiving sockets, to detachably connect ear phones, loud speakers or other reproducing apparatus in a suitable circuit; there being, of course, numerous other uses for such coaxial multiple conductor contact plugs.

In a more specific sense, the instant invention relates to structure improvements in coaxial multiple conductor contact plugs of the kind broadly described above, whereby inexpensive and reliable devices of this character may be manufactured in miniature, or, in fact, sub-miniature sizes which are commercially practical and desirable for use in connection with miniature and sub-miniature electrical or electronic apparatus, such, for example, as even the smallest variety of present-day electronic hearing aids. In fact, the achievement of this result is a major objective of the instant invention.

Coaxial contact plugs have, of course, been extensively employed for many years in connection with full-sized or normal-sized electrical and electronic apparatus; one very common use for such coaxial conductor contact plugs being the detachable connection of head phones and other reproducing apparatus into suitable audio circuits, and because of which use such devices are often referred to in the trade as "phone plugs." However, the designs of such previously-employed coaxial contact plugs have not been practical or desirable in the manufacture of miniature or sub-miniature devices of this kind, of such minute dimensions as are required for practical use in connection with sub-miniature audio systems and apparatus, such as represented by present-day electronic hearing aids of the sub-miniature variety to connect a remotely-located earpiece or reproducer to the output of the audio system. In fact, to the best of our knowledge, there has hitherto been no practical solution to this problem.

Another object of the invention is, however, the provision of improvements of the character described whereby such may be produced at extremely low cost.

The above and other highly important objects and advantages of the invention will be made apparent from the following specification, claims and appended drawings.

In the accompanying drawings like characters indicate like parts throughout the views.

Referring to the drawings:

Fig. 1 is a fragmentary view, with some parts broken away and some parts shown in section, on a greatly enlarged scale, of a sub-miniature electronic hearing aid incorporating our invention, said view being taken on the section line 1—1 of Fig. 2; and

Fig. 2 is a fragmentary sectional view taken on the line 2—2 of Fig. 1.

In the drawings, a very small portion of the casing or housing of a miniature hearing aid is indicated as an entirety by 1 and may be assumed to be of the generally rectangular type comprising a back section 2 and a front section 3. As previously indicated, this casing is shown

on a greatly enlarged scale. To convey an idea of the degree of enlargement and the really minute dimensions of the present-day sub-miniature hearing aids; attention being called to the fact that some commercial hearing aids, to which this invention is applicable, have overall dimensions approximated as follows: 2½" x 1¾" x ⅞". It is expected that the use of printed circuits and new tube and battery developments will allow the casings or housings of these sub-miniature hearing aids to be still further reduced, which is, of course, very remarkable when it is considered that housings of such small dimensions contain a microphone, a multiple tube electronic amplifier and A and B batteries to power the amplifier. From this, it should be readily appreciated that all accessories and associated parts of hearing aids must be of very diminutive dimensions.

In the drawings hereof, a coaxial-type multiple conductor contact plug, built in accordance with our invention, is indicated as an entirety by 4. This plug 4 comprises coaxially-arranged outer and inner conductors 5 and 6, respectively. The outer conductor 5 is formed from a length of suitable metallic tubing, and the inner conductor 6 is formed of a somewhat longer length of standard commercially-available pre-enameled wire of the kind commonly used for winding the electromagnetic coils and the like. The enameled coating, which is indicated by 7, is, of course, non-conductive and, although extremely thin, provides a high degree of electrical insulation. While enamel is perhaps most commonly used for this purpose, it is appreciated that other coating materials, such as synthetic enamel, lacquer, plastics, and the like, may be employed. Hence, the term "enamel" is used herein in a generic sense to include enamel and its various substitutes and equivalents. By reference to the drawings, it will be seen that the inner conductor 6 is electrically isolated or insulated from the tubular outer conductor 5 by its enamel insulation coating 7. Also, it will be seen that the inner conductor 6 extends beyond opposite ends of the tubular outer conductor 5 and that the enamel insulation coating 7 has been removed from these outwardly-projected opposite end portions to provide inner and outer contact surface areas 8 and 9 respectively. Preferably and as shown, the bore of the tubular outer contact 5 is of such diameter that it will snugly receive the telescopically-applied enamel coated inner conductor 6.

A pair of lead wires 10, which may be assumed to extend from an audio reproducer or earpiece, not shown, of the miniature hearing aid, are connected one to the contact area 9 of the inner conductor 6 and the other to the corresponding end portion of the outer tubular contact 5. The leads 10 are of the highly flexible insulated variety and are anchored fast to their respective cooperating conductors, preferably by solder or the like. As shown, the bared ends of the lead wires 10 are twisted at least once around their respective conductors and soldered in this condition.

In the commercial embodiment of the invention illustrated, the corresponding outer end portions of the inner conductor 6, tubular outer conductor 5 and the anchored end portions of the lead wires 10 are snugly mounted in a plug head 11, which is preferably of suitable plastic material and is mounted under pressure forming a potted assembly about the enclosed portions of the conductors 5 and 6 and lead wires 10. The anchored ends of the lead wires 10 securely lock the conductors 5 and 6 against axial movements in the head 11 and against axial movements 1 in respect to the other. Preferably, the free inner ends of the plug conductors 5 and 6 are rounded or tapered to provide cam surfaces for cooperation with socket contacts to be hereinafter described.

In carrying out the invention, the inner conductor 6 is preferably formed of highly conductive metal, such as

copper, which has been pre-coated by the manufacturer with enamel or equivalent insulation coating. In some cases, this pre-enameled wire, which will usually be of copper, will be coated beneath the enamel with tin or other highly conductive and relatively non-corrosive metal.

To further emphasize the extremely diminutive dimensions to which coaxial contact plugs, of the kind described, may be built, in accordance with the invention, attention is called to the fact that the specimen of the invention from which the instant drawings were prepared, employed a center or inner conductor 6 of 21 gauge enameled copper wire, which has an outside diameter, exclusive of the enamel insulation, of .0285 in., and has an overall diameter, including the enamel insulation, of .030 in. In this same device, the tubular outer contact 5 is formed of commercially-available metallic tubing having an outside diameter of approximately .051 in. and a bore sized to snugly receive the enamel coated portion of the inner conductor 6.

For cooperation with my improved contact plug 4, the section 2 of the hearing aid casing 1, which is formed of plastic insulated material, is formed to provide a plug-receiving socket 12 containing a contact spring 13 for cooperation with the bared inner end of the inner conductor 6 and another similar contact spring 14 for cooperation with the inner end portion of the outer tubular contact 5. The casing section 2 in its ends shown is provided with a plug-receiving aperture 15 for reception of the plug 4, and in alignment with said aperture 15 the spring contact 14 is provided with a corresponding aperture 16. By reference to the drawings, it will be seen that the spring contacts 13 and 14 are provided with upstanding contact tabs 17 for connection to suitable circuit lead wires 18, which, in this case, are a part of the power output circuit of the hearing aid. The spring contacts 13 and 14 are under yielding tension to move toward one another at their contact areas 13′ and 14′, respectively, and are spread apart upon insertion of the plug by camming action of the cooperating plug conductors 6 and 5 thereon. In this respect, attention is directed to the fact that the outturned free ends of the spring contacts 13 and 14 are seated in mounting apertures 19 and 20 respectively, which lock the contacts against movements axially of the plug, but allow lateral movements so as to permit spreading of the contact areas of the spring contacts to receive the plug 4.

What we claim is:

1. A coaxial-type multiple conductor contact plug comprising a rigid elongated tubular outer conductor, an inner conductor extending axially through but insulated from the tubular outer conductor and having uninsulated contact portions beyond opposite ends of the tubular outer conductor, a pair of lead wires externally anchored each to a corresponding end portion of a different one of said conductors, the point of anchorage of the lead wire to the inner conductor being axially outwardly of the adjacent end of the tubular outer conductor, and a plug head having the said corresponding end portions of the coaxial outer and inner conductors and the said anchored end portions of the lead wires potted therein defining a potted assembly, said potted assembly locking the conductors against axial movement relative to each other and preventing movement of the lead wires relative to the conductors and to each other.

2. In a coaxial-type multiple conductor contact plug including coaxial inner and outer conductors, the outer conductor comprising a rigid metallic tube and the inner conductor comprising a section of pre-insulated wire extending axially through the tubular outer conductor and beyond the opposite ends thereof, the insulation of the wire inner conductor serving to electrically insulate the inner and outer conductors, the insulation being removed from portions of the wire inner conductor beyond the opposite ends of the tubular outer conductor to provide contact areas, a pair of lead wires externally anchored each to a corresponding end portion of a different one of said conductors, the point of anchorage of the lead wire to the inner conductor being axially outwardly of the adjacent end of the tubular outer conductor, and a plug head having the corresponding end portions of the coaxial outer and inner conductors and the said anchored ends of the lead wires potted therein defining a potted assembly, said potted assembly locking the conductors against axial movement relative to each other and preventing movement of the lead wires relative to the conductors and to each other.

3. In a coaxial-type multiple conductor contact plug including coaxial inner and outer conductors, the outer conductor comprising a rigid metallic tube, and the inner conductor comprising a section of pre-enameled wire extending axially through the tubular outer conductor and beyond the opposite ends thereof, the enamel of the wire inner conductor serving to electrically insulate the inner and outer conductors, the enamel insulation being removed from portions of the wire inner conductor beyond the opposite ends of the tubular outer conductor to provide contact areas, a pair of lead wires externally anchored each to a corresponding end portion of a different one of said conductors, the point of anchorage of the lead wire to the inner conductor being axially outwardly of the adjacent end of the tubular outer conductor, and a plug having the said corresponding end portions of the coaxial outer and inner conductors and the said anchored ends of the lead wires potted therein defining a potted assembly, said potted assembly locking the conductors against axial movement relative to each other and preventing movement of the lead wires relative to the conductors and to each other.

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