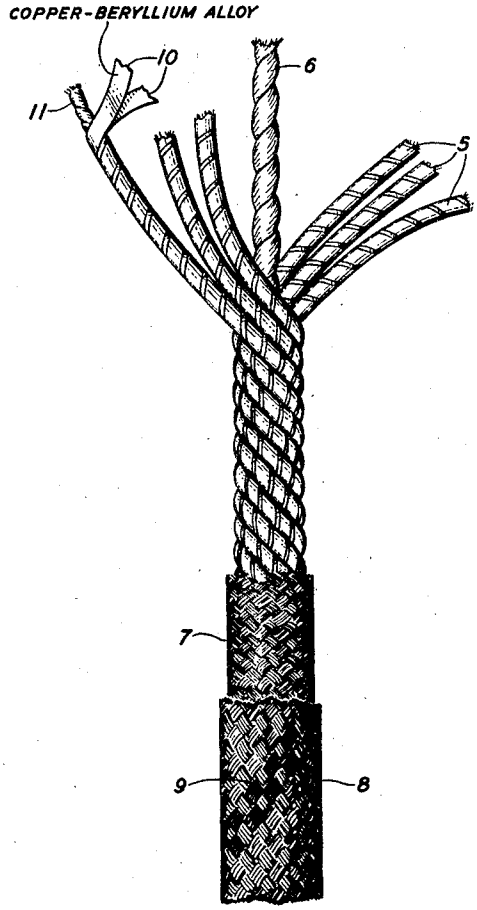
May 6, 1941. E. E. SCHUMACHER ET AL 2,240,579

FLEXIBLE CONDUCTOR

Filed Nov. 5, 1938



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Patented May 6, 1941 2,240,579

UNITED STATES PATENT OFFICE

2,240,579

FLEXIBLE CONDUCTOR

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Application November 5, 1938, Serial No. 238,978

3 Claims. (Cl. 174—131)

This invention relates to flexible conductors and more particularly to an improved tinsel thread for use in flexible conductors such as those employed in telephone cords.

In order to provide a satisfactory telephone cord it is not only essential that the individual conductors have the required flexibility and electrical conductivity but they must also be capable of retaining these characteristics even under severe service conditions for the entire period of their useful life. To replace a telephone cord a special trip to the subscriber's station is necessary and, accordingly, the cost of replacement is often quite large in comparison to the cost of the cord per se. It is therefore desirable that the construction of the conductors be such that a long life is assured.

It is therefore the principal object of this invention to produce a flexible conductor having the desired electrical and physical characteristics and one in which these characteristics will remain constant for a greater period of time than has been possible heretofore.

In accordance with one or more features of the present invention this object is attained by the use of a plurality of tinsel conductors twisted together and each composed of one or more metallic ribbons helically wrapped about a textile core. These metallic ribbons are composed of a copper-beryllium alloy containing from .5 to 2.5 per cent of beryllium and so treated as to have not only the desired physical and electrical characteristics but also to retain these characteristics over a long period of life when subjected to the repeated bending and twisting action that such conductors receive under certain service conditions.

In the single figure of the drawing there is disclosed one embodiment of the invention in which a plurality of tinsel threads are twisted together about a textile core to provide an electrical conductor in accordance with the invention.

Referring to this drawing, six conducting elements or tinsel threads 5—5 are stranded about a textile core member 6 to form a complete conductor. An inner cotton braid 7 is woven about this conductor and over this is woven an outer braid 8 which carries colored tracer threads 9 which are used to identify the various conductors of a complete cord. Each of the individual tinsel threads is shown as composed of two metallic ribbons 10—10 served in an open helix about the textile core 11. These ribbons, which are approximately .017 inch wide and .0009 inch thick, are rolled down from No. 37 AWG wire or drawn to these dimensions from larger size wire and are composed of a copper-beryllium alloy, the beryllium content of which is preferably about 1¼ per cent although conductors having improved characteristics are obtained when the beryllium content of the ribbon is not less than .5 per cent and not more than 2½ per cent.

It has been found that to obtain the maximum improvements in the characteristics of the conducting ribbons they should be subjected to both dispersion hardening and cold working. The preferred method of treating these alloys is as follows:

The alloy in the form of ¼ inch rods is first subjected to a softening treatment by maintaining it at a temperature of approximately 800° C. for a period of two hours, followed by quenching. The material then is cold drawn down to No. 33 AWG wire and during this reduction it is preferably softened after each reduction of four AWG numbers. When the wire has been drawn down to No. 33 gauge it is given a dispersion hardening treatment at approximately 375° C. for four hours in a purified hydrogen atmosphere and then water quenched. It is then cold drawn down to No. 37 gauge wire, after which it is cold rolled to ribbons approximately .0009 inch thick and .017 inch wide. Satisfactory results have been obtained using a softening temperature of from 800° C. to 1000° C., depending upon the particular alloy, and a dispersion hardening temperature of 250° C. to 500° C.

In the following table are given the results of tests on various copper-beryllium alloys in the form of No. 37 AWG wire treated as disclosed above and compared with similar samples of a copper-tin alloy in common use for tinsel conductors. This table also gives the results of tests showing the bending fatigue resistance of ribbons of these materials of the size specified when bent about a steel arbor having a radius of .02 inch.

Alloy	Electrical conductivity compared to IACS copper	Ultimate breaking strength of No. 37 AWG wire	Ultimate elongation	Comparative fatigue resistance in No. of bends of .0009" x .017" ribbon about a .02" radius
	Percent	*Grams*	*Percent*	
Std. copper-tin alloy	40	750	1.5	1660
Cu—Be (1.125% Be)	35	1320	1.5	2940
Cu—Be (1.250% Be)	35	1360	1.5	4160
Cu—Be (1.50% Be)	32	1650	1.5	3920
Cu—Be (2.50% Be)	23.5	1875	1.8	2870

The fatigue resistance test on metallic ribbons of the size used has been found to give results which simulate very closely the results obtained in subjecting the conductors to life tests under service conditions and in the present case it indicates a far greater life than would be expected from a knowledge of the physical characteristics of the material. The conductivity of the alloys containing from 1⅛ to 1½ per cent beryllium when treated as disclosed above is well above the accepted minimum value of 30 per cent of that of IACS copper and a minimum increase in tensile strength of 75 per cent is obtained over that of the standard copper-tin alloy. The alloy containing 2½ per cent beryllium is not only lower in conductivity but its resistance to fatigue when formed into ribbons is less than the other types tested. Furthermore, because of its increased hardness it is more difficult to work and is harder on the tools involved.

What is claimed is:

1. A tinsel thread for electrical conductors consisting of a textile core member and a metallic ribbon helically wound thereupon and composed of an alloy containing approximately 1¼ per cent beryllium and the balance copper, such alloy having the physical characteristics produced by being dispersion hardened followed by cold working.

2. A tinsel thread for electrical conductors consisting of a textile core member having a metallic ribbon helically wound thereupon composed of a copper-beryllium alloy consisting of from 1⅛ to 1½ per cent beryllium and the balance copper and having a conductivity not less than 30 per cent that of pure copper.

3. A tinsel thread for electrical conductors comprising a textile core member and a metallic ribbon approximately .0009 inch thick and .0 inch wide, said ribbon being composed of a dispersion hardened alloy consisting approximately of 1¼ per cent beryllium and the balance copper, and having a conductivity not less than 30 per cent that of pure copper.

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