

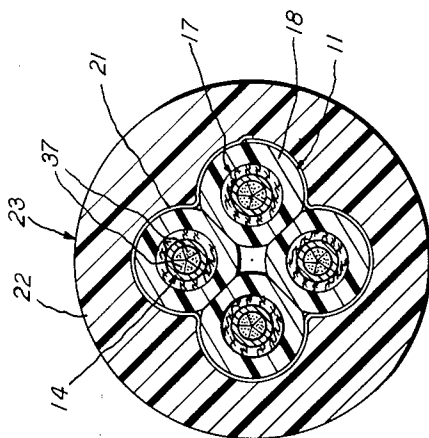
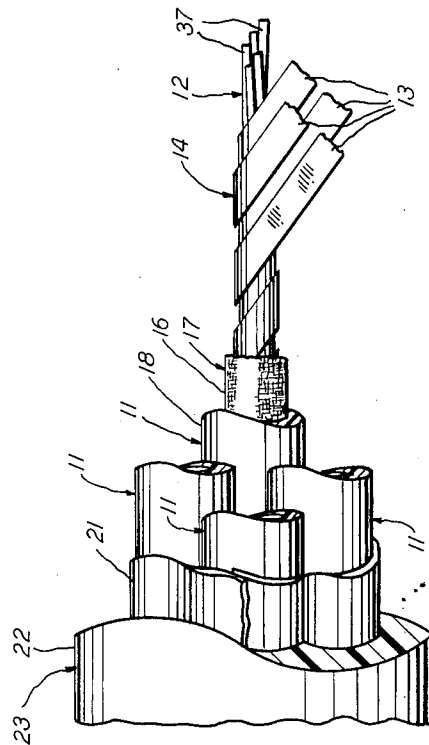
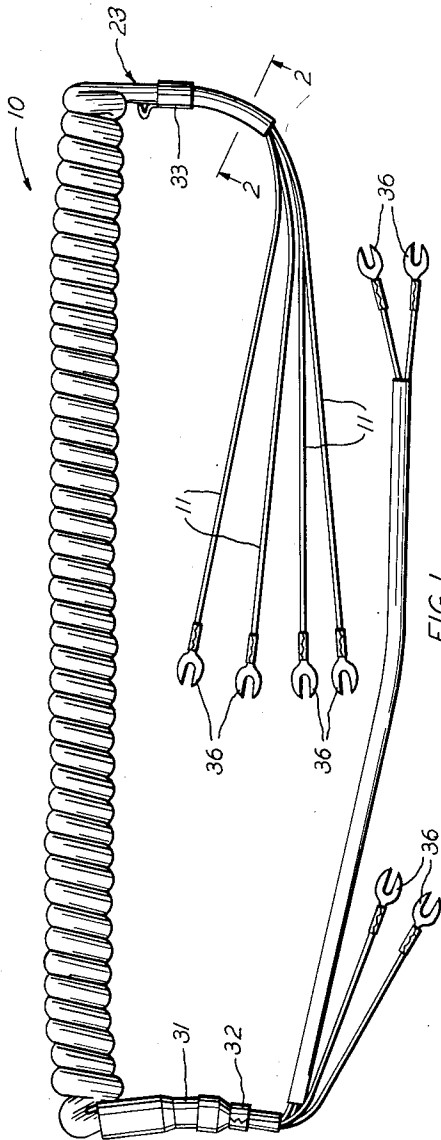
May 29, 1962

H. L. WESSEL

3,037,068

RETRACTILE TINSEL CORDAGE

Filed May 4, 1959



INVENTOR
H. L. WESSEL
BY
H. J. Winegar
ATTORNEY

1

3,037,068

RETRACTILE TINSEL CORDAGE

Hubert L. Wessel, Parkville, Md., assignor to Western Electric Company, Incorporated, New York, N.Y., a corporation of New York

Filed May 4, 1959, Ser. No. 810,686

2 Claims. (Cl. 174-69)

This invention relates to retractile tinsel cordage and, more particularly although not exclusively, to spring cords of the type used to conduct electrical current in the communications industry.

In this advanced technical age, one expects continuing improvements in the quality of transmission and in the appearance of communications equipment. Manifestly, it is highly desirable that such improvements be accomplished without increases in the cost of such equipment and, preferably, with attendant cost reductions.

In the communications industry, as in many industries, there is an ever existing demand for lower cost, miniaturized equipment, which is pleasing in appearance, more efficient in operation, having more desirable psychological effects on the customers and possessing a longer effective service life. For example, spring cords of the type used on telephone instruments are generally constructed of highly flexible cordage having a plurality of individually insulated, mandrelated tinsel conductors therein. Each of these tinsel conductors is made by wrapping a plurality of thin tinsel ribbons spirally around a textile core. This construction is designed to permit the repetitive flexure of the cordage for a relatively large number of times as encountered during normal usage and also to permit the cordage to be formed in a spiral configuration during the formation of the spring cords.

Spring cords used on telephone instruments must have sufficient retractility to insure that they will return promptly to their normal retracted form after having been extended and then released. However, such cords must not be so strongly retractile that they require an excessive amount of force to extend them. If a spring cord is too unyielding, instead of the cord extending when a pull is exerted thereon, the instrument to which it is attached may be moved on or pulled off of its support. Readily extensible spring cords are desirable particularly when the spring cords are connected to lightweight desk-type or bedroom-type telephone handsets. Further, it is economically desirable to obtain a desired extended length with as short a length of cordage as possible and, from an appearance standpoint, it is desirable that the retracted length of the spring cord be as short as possible.

It has been the practice in the industry to utilize cotton textiles for cores or mandrels about which the tinsel ribbons are wound to form tinsel conductors. However, it has been found that tinsel conductors made with cotton textiles are relatively large, relatively expensive, will not withstand the desired number of flexings and do not possess other desirable physical and electrical characteristics. Also, cotton textiles will absorb moisture which vaporizes during subsequent heat-treating processes and frequently causes blisters and bubbles in the insulation and jacket of the cordage. It is also a fact that certain cotton textiles have metallic salts therein which have adverse effects on the metal tinsel ribbons commonly used in tinsel conductors.

An object of the invention is to provide new and improved spring cords possessing superior physical and electrical properties and visual characteristics.

A cord embodying certain features of the invention may include a plurality of insulated tinsel conductors, each comprising a stranded nylon core around which a plurality of flexible, electrically conductive, tinsel ribbons are

2

wrapped spirally. A barrier of nylon threads is knitted over the spirally wrapped conductors, and a covering of plastic insulating material may be extruded over the knitted nylon barrier to provide an insulated tinsel conductor.

The spring cord may be constructed by stranding a plurality of the above-described insulated tinsel conductors together, wrapping a strip of heat-insulating paper longitudinally around the stranded, insulated tinsel conductors and providing an extruded jacket of plastic insulating material around the paper-wrapped, stranded, insulated tinsel conductors. The cordage may be formed into a spring cord in a conventional manner.

Other objects and features of the present invention will be more readily understood from the following detailed description of specific embodiments thereof, when read in conjunction with the accompanying drawings, in which:

FIG. 1 is a view of a spring cord embodying certain principles of the present invention;

FIG. 2 is an enlarged sectional view of the spring cord of FIG. 1, taken along line 2-2 thereof, and

FIG. 3 is an enlarged, fragmentary view of a section of flexible cordage prior to having been formed into the spring cord of FIG. 1, with portions thereof broken away for purposes of clarity.

Referring now to the drawings, there is shown a spring cord, designated generally by the numeral 10. The spring cord 10 is the type used on telephone instruments which includes a plurality of insulated tinsel conductors, designated generally by the numerals 11-11. Each of the insulated tinsel conductors 11-11 includes a nylon core, designated generally by the numeral 12, about which a plurality of tinsel ribbons 13-13 are wrapped spirally to form a tinsel conductor, designated generally by the numeral 14. The tinsel conductor 14 is enclosed in a barrier 16 composed of a plurality of knitted nylon threads to form a unit, containing the center core 12, the mandrelated tinsel ribbons 13-13 and the knitted nylon barrier 16, and designated generally by the numeral 17. An insulating covering 18 of a suitable plastic material, such as polyvinyl chloride, encloses the unit 17 to form one of the insulated tinsel conductors 11-11.

A plurality of the insulated tinsel conductors 11-11 are stranded in parallel, nontwisted, contiguous relationship with respect to each other so that the stranded, insulated conductors 11-11 are symmetrical with respect to a common longitudinal axis therebetween. The stranded, insulated tinsel conductors 11-11 are enclosed in a strip of cable insulating paper 21 wrapped longitudinally to form a cylindrical tube. A plastic insulating jacket 22 of a suitable plastic material, such as polyvinyl chloride, is extruded over the paper-enclosed, insulated tinsel conductors 11-11 to form a jacketed cordage, designated generally by the numeral 23.

The jacketed cordage 23 may be made into straight cords of various lengths by cutting indefinite lengths of the cordage to a desired length. The sections of the jacket 22 and paper 21 adjacent to each end of the lengths of cordage 23 are stripped therefrom. A grommet 31, a band 32 and a stay hook 33 are placed around the cordage 23 adjacent to the ends of the jacket 22, and bayonet-type tips 36-36 are placed on the ends of the insulated tinsel conductors 11-11.

The jacketed cordage 23 may also be formed into spring cords 10-10 of various lengths having different numbers of insulated conductors 11-11 therein. For example, the number of insulated conductors 11-11 are commonly three to eight, and the nominal extended lengths of the cords are commonly 4 feet, 5½ feet, 9 feet and 13 feet. The spring cords 10-10 are formed preferably by methods and apparatus disclosed and claimed

in copending applications Serial Nos. 738,439 and 681,035 filed jointly in the names of E. C. Hardesty and D. L. Myers on May 29, 1958, and August 29, 1957, respectively. Application Serial No. 681,035 is now Patent No. 2,920,351.

Example

In a specific type of cordage made in accordance with certain principles of the present invention, the nylon core 12 is approximately 0.017 inch in diameter, weighing approximately 0.0382 pound per thousand feet and consisting of five ends 37—37 of 34-filament, type 300 nylon, obtainable from E. I. du Pont de Nemours & Company, Wilmington, Delaware. The nylon core 12 has a left-hand lay of approximately twenty-four turns per foot. Each end 37 of the nylon core 12 includes thirty-four filaments twisted with a right-hand lay of the order of six turns per foot.

During the construction of each of the insulated tinsel conductors 11—11, the core 12 is advanced longitudinally and rotated direction right. Four bronze, tinsel ribbons 13—13, approximately 0.017 inch wide and 0.001 inch thick made of 0.75 percent tin and the remaining amount copper, are pulled from supplies thereof and are applied helically and concentrically in two layers around the rotating core 12, direction right at approximately twenty turns per inch, to form the tinsel conductor 14. The tinsel conductor 14 has an outer diameter of approximately 0.021 inch. The weight of the four bronze, tinsel ribbons 13—13 is approximately 0.335 pound per thousand feet of the tinsel conductor 14.

During the construction of the tinsel conductor 14, the magnitude of the angular velocity of the nylon core 12 is relatively high, in order to obtain maximum production of the tinsel conductors 14—14. The tinsel conductor 14 thus formed has the tinsel ribbons 13—13 wrapped around the core 12 so tightly that the tinsel conductor does not possess the desired degree of flexibility. In order to increase the flexibility of the tinsel conductor 14, the tinsel ribbons 13—13 are loosened on the core 12 by twisting the tinsel conductor 14 direction left approximately twenty-four turns per foot by methods and with apparatus disclosed and claimed in my Patent No. 2,805,538, granted September 10, 1957. The loosening of the tinsel ribbons 13—13 on the core 12 results in the core being twisted an additional twenty-four turns per foot so that the core 12 has forty-eight turns per foot direction left in the finished product.

The unit 17, approximately 0.031 inch in diameter, is formed by knitting the barrier 16 with eight needles using three threads of 100-denier, 34-filament, type 300 nylon to give approximately 480 stitches per foot and a lay of direction left. The weight of the knitted nylon barrier 16 is approximately 0.1295 pound per thousand feet. The insulating covering 18 is provided by extruding a plastic insulating compound, such as polyvinyl chloride, insulating compound, designated Geon 8818 and obtainable from B. F. Goodrich Chemical Company, Cleveland, Ohio, of an appropriate color on the unit 17. The insulating compound is similar to that disclosed in a copending application, Serial No. 529,641, filed August 22, 1955, in the name of V. T. Wallder (now abandoned). The weight of the polyvinyl chloride, insulating compound is approximately 0.700 pound per thousand feet of the insulated conductor 11 depending on the color used. The thus-formed insulated tinsel conductors 11—11 are covered with an antisticking compound.

Two white, one red and one black insulated tinsel conductors 11—11 are stranded in parallel, nontwisted, contiguous relationship with respect to each other. The stranded insulated conductors 11—11 are symmetrical with respect to a longitudinal axis therebetween and are covered with mica dust during the stranding operation. The mica dust is fine enough to pass through a 325 mesh screen, and is consumed at a rate of approximately

0.289 pound per thousand feet of stranded insulated tinsel conductors 11—11.

The mica-dust covered, insulated tinsel conductors 11—11 are covered with the 1/2 inch wide, 0.001 inch thick strip of formula F-101, natural colored, long fibered, resilient, cable insulating paper 21. The paper 21 consists of 100% rope pulp made from old manila hemp rope. The strip of paper 21 weighs approximately 0.194 pound per thousand feet and is applied longitudinally of the conductors 11—11 with a 3/32 inch maximum overlap. The strip of paper is used to prevent the conductors from sticking together and to the insulating jacket 22 extruded thereover to form a four-conductor, jacketed cordage 23. The paper 21 is also used to facilitate stripping of the jacket 22 from the cordage 23 to facilitate tipping and banding thereof.

The diameter of the jacketed cordage 23 is approximately 0.186 ± 0.003 inch when used for spring cords 10—10. The jacket 22 is formed of polyvinyl chloride jacketing compound designated PVC-6-5D, PVC-7-5D and PVC-8-5D by B. F. Goodrich Chemical Company; Monsanto Chemical Company, Plastics Division, Springfield, Massachusetts, and Gering Products, Inc., Kenilworth, New Jersey, respectively. The jacketing compound is similar to that disclosed in the above-mentioned abandoned V. T. Wallder application and weighs approximately 7.390 and 9.560 pounds per thousand feet of cordage 23 when the cordage 23 is to be used for straight cords and spring cords, respectively.

To form the finished spring cord 10, portions of the jacket 22 are removed from adjacent to each end of a section of cordage 23. The grommet 31, the band 32, the stay hook 33 and tips 36—36 are applied to the cordage 23 and conductors 11—11 in a conventional manner to permit the resulting spring cord 10 to be attached to a suitable telephone instrument (not shown) in a manner well known in the art. The section of tipped and banded, jacketed cordage 23, which is approximately 68 inches long between the stay hook 33 and the grommet 31, is wound spirally on a 1/4 inch mandrel (not shown) with adjacent convolutions in juxtaposition without intentionally introducing an axial twist to the cordage 23.

The mandrel with the cordage 23 wrapped therearound in helical form is placed in an oven (not shown) to heat treat the spirally wrapped cordage and thus impart a set thereto. The heat-treated cordage 23, which shrinks approximately 3%, in length, is then removed from the mandrel and twisted to reverse the direction of lay or pitch of the helix of the cordage 23 and to introduce increased retractile properties in the cordage 23. During the reverse twisting of the cordage 23, the cordage is given an overtwist of approximately 15 to 20% to introduce additional retractile properties therein. The coiled section of the spring cord 10 thus produced is approximately 10 inches long.

As described previously, it has been the practice in the past to use cotton textiles in tinsel conductors and cords, however, it should be noted that cotton absorbs moisture which vaporizes during the heat-treating process and causes blisters and bubbles in the insulating covering and jacket of the cords. Further, metallic salts exist in ordinary cotton yarn which will react with the bronze tinsel ribbons if placed in contact therewith. Therefore, when cotton is used in the core 12 and the knitted barrier 16, the cotton must be purified to remove the metallic salts therein prior to being used in the construction of units 17—17. Since nylon does not contain materials which will have an adverse effect on the bronze tinsel ribbons 13—13, this extra purifying process is not necessary.

Since the nylon core 12 is smaller in diameter than a cotton core would be, a longer length of the nylon core 12 than cotton core can be placed on the same size reel. Accordingly, by utilizing the same existing manufacturing equipment the frequency of splices for the tinsel con-

ductors 14 employing the nylon core 12 is approximately one-half that of tinsel conductors employing the cotton core.

The insulated tinsel conductors 11—11 must be substantially symmetrical with respect to the center line of the cordage 23, in order to permit stripping of the jacket 22 on existing machines without damaging the insulating covering 18 on any of the insulated conductors 11—11. Also, if the insulated conductors 11—11 were not symmetrical with respect to the center of the cordage 23, thick and thin wall sections in the jacket 22 would exist resulting in wrinkles therein on the finished, coiled spring cord 10. In four-conductor cordage constructed by utilizing cotton textiles, it has been found necessary to utilize a filler in the interstitial space between the insulated tinsel conductors in order to hold the conductors symmetrical with respect to the center of the cordage. Further, separate cutting operations are necessary to remove the ends of the filler which are exposed during the tipping and banding operation.

Cords made with nylon textiles therein will withstand greater tensile shock stresses when jerked as compared to the cords made with cotton textiles. However, the nylon core 12 is not used as a strength member like most cotton cores, since the nylon core 12 will withstand only approximately four pounds pull. Instead, the knitted nylon barrier 16 is used as the strength member and is made to withstand approximately twenty pounds pull. This represents a radical departure from previous conventions.

For obvious reasons, the tips 36—36 placed on the ends of each insulated conductor 11 must not slip off the ends of the insulated conductors when certain minimum tensile forces are applied thereto. It has been found that the tips 36—36 on the insulated conductors 11—11 constructed with the nylon textiles will withstand 50 to 100 percent more pulling forces before pulling loose than tips on insulated conductors made with cotton textiles. This may be attributed to the fact that cotton will elongate very little as compared to nylon and therefore cotton will break if high compressive forces are applied during the tipping process; whereas, nylon will stretch and will not break when relatively high compressive forces are applied thereto during the tipping process.

The average conductor, direct-current resistance at room temperature for the insulated tinsel conductors 11—11 having the nylon cores 12—12 therein is approximately 0.385 ohm per linear foot as compared to approximately 0.499 ohm per linear foot of comparable tinsel conductors having the cotton cores therein. Also, to obtain the same nominal extended length of four feet in the finished spring cords, only a 66-inch length of the jacketed cordage 23 having the nylon textiles therein is necessary as compared to 72 inches of comparable jacketed cordage having the cotton textiles therein. The cords produced by using nylon textiles as compared to cords made with cotton textiles have smaller diameter insulated conductors without decreased conductivity, and thus smaller diameter cordage. The average outside diameter of the spiral of the spring cords 10—10 made with nylon textiles is approximately 0.650 inch, as compared to 0.765 inch for comparable spring cords made by using cotton textiles. The spring cord 10 made with nylon textiles has a better appearance, requires less force to extend the spring cord 10 and costs of the order of 31.2% less than a comparable spring cord constructed with cotton textiles, because less bronze, less paper, less mica dust, less textile materials, and less polyvinyl chloride insulating and jacketing compounds are required. The insulated tinsel conductors 11—11 cost approximately 38.6% less than comparable tinsel conductors constructed with cotton textiles. This is attributed largely to the fact that approximately 25% less tinsel ribbon 13 is required, the cost of the core 12 is approximately 77% less, the cost of the knitted barrier 16 is approximately 10.5%

less and the cost of the insulating compound for the covering 18 is approximately 35.7% less.

The handling characteristics throughout a reasonable range of extended length of the spring cord 10 illustrated in FIG. 1 are completely different than cords made with cotton textiles, as is demonstrated by tabulations outlined hereinbelow. The tabulations set forth are comparable average results of laboratory tests of two different lengths of the cordage illustrated in FIG. 1 as compared with the results on tests of one length of cordage having cotton textiles therein which is being produced presently at a rate of billions of conductor feet per year.

Type of Cord	Length of Straight Cordage Between Stay Hook and Grommet Prior to Formation of Spring Cord, inches	Ounces Pull Required for Horizontal Extension of Spring Cord in Feet			
		2 ft.	3 ft.	4 ft.	5 ft.
Cords similar to that illustrated in Fig. 1	72	2.3	4.0	7.9	16.2
Cords similar to that of Fig. 1 but shorter	66	2.8	5.2	11.5	30.4
Four conductor cords similar to that of Fig. 1 utilizing cotton textiles	72	3.5	5.8	13.0	27.0

It should be noted that a 72-inch basic length of the cordage described in the example and illustrated in FIG. 1 yields a finished, spring cord which may be extended to distances up to five feet with only approximately 60% of the forces required for comparable cords constructed with cotton textiles. A basic length of sixty-six inches of the cordage yields a spring cord which may be extended to lengths up to four feet, which is a normal extended length of comparable cords constructed with cotton textiles, with forces 90% or less than that required for the same extended length of four feet for a comparable cord constructed with cotton textiles.

Further, laboratory tests conducted with straight, handset cords constructed with cotton textiles withstood an average of 185,000 (180°) bends with one pound of tension applied thereto before electrical failure resulted, as determined by a contact resistance variation of 0.06 ohm; as compared to straight handset cords similar to those illustrated on FIG. 3, which withstood an average of 543,000 (180°) bends with an applied tension of one pound. Further 12% of the cords tested, which were similar to those illustrated on FIG. 3, where in satisfactory condition after 1,000,000 (180°) bends, with an applied tension of one pound, had been applied thereto. As determined by laboratory flexing tests, the cordage illustrated in FIG. 1 has an increased life of approximately 30% as compared to similar spring cords constructed with cotton textiles.

It will be understood that the term nylon as used in the specification and appended claims is meant to include, any long-chain synthetic polymeric amide which has recurring amide groups as an integral part of the main polymer chain, and which is capable of being formed into a filament in which the structural elements are oriented in the direction of the axis. Type 300 nylon is a bright luster and high tenacity form filament yarn of nylon textile fibers produced by E. I. du Pont de Nemours & Company, Wilmington, Delaware, from a polymer based on hexamethylene diamine and adipic acid. It should be understood also that the term polyvinyl chloride as used herein and in the appended claims is intended to include copolymers of vinyl chloride with vinyl acetate and other similar materials.

It is to be understood that the above-described arrangements are simply illustrative of the principles of the invention. Other arrangements may be devised by those

skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. A spring cord for telephone handsets, which comprises a predetermined length of cordage including a plurality of individually insulated tinsel conductors covered with a common jacket; said cordage being coiled in a compact helix and set in such helical form; each of said individually insulated tinsel conductors comprising a small diameter core including a plurality of twisted filaments of bright lustre and high tenacity nylon and having a diameter of approximately 0.017 inch, four electrically conductive, flexible, tinsel ribbons of the order of 0.017 inch wide and 0.001 inch thick wrapped spirally about the nylon core, a knitted strength member and barrier including a plurality of knitted nylon threads encompassing the spirally wrapped tinsel ribbons and having a diameter of approximately 0.031 inch, and an extruded plastic insulating covering encompassing the individual knitted strength member and barrier; the strength member and barrier being relatively strong in tensile strength as compared to said core.

2. A spring cord for telephone handsets, which comprises a predetermined length of cordage including a plurality of individually insulated tinsel conductors covered with a common polyvinyl chloride jacket; said cordage being coiled in a compact helix and set in such helical form; each of said individually insulated tinsel

conductors comprising a small diameter core including five twisted ends of 100-denier, 34-filament, bright lustre and high tenacity nylon, four electrically conductive, flexible, bronze, tinsel ribbons of the order of 0.017 inch wide and 0.001 inch thick wrapped spirally about the nylon core of the order of twenty turns per foot, a knitted strength member and barrier including three knitted nylon threads of 100-denier, 34-filament nylon encompassing the spirally wrapped tinsel ribbons, and an extruded polyvinyl chloride insulating covering encompassing the individual knitted strength member and barrier; the strength member and barrier being of the order of five times as strong in tensile strength as said core and having of the order of 480 stitches per foot.

References Cited in the file of this patent

UNITED STATES PATENTS

2,573,439	Henning	Oct. 30, 1951
2,609,417	Cox et al.	Sept. 2, 1952
2,718,544	Shepp	Sept. 20, 1955
2,883,314	Martin	Apr. 21, 1959

FOREIGN PATENTS

452,413	Canada	Nov. 2, 1948
771,656	Great Britain	Apr. 3, 1957
800,128	Great Britain	Aug. 20, 1958