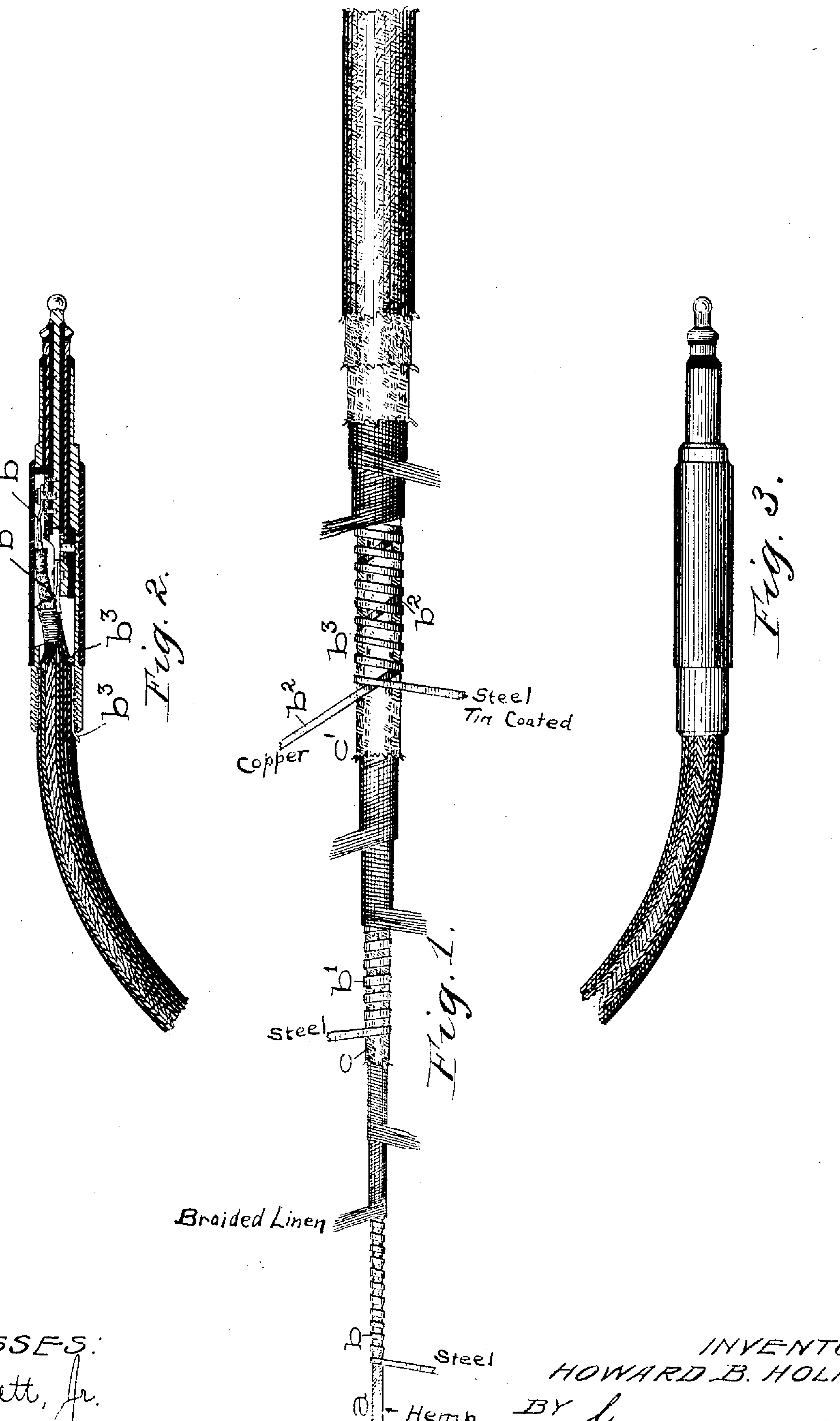
No. 752,840. PATENTED FEB. 23, 1904.

H. B. HOLMES.

FLEXIBLE CONDUCTING CORD.

APPLICATION FILED JAN. 27, 1902.

NO MODEL.



WITNESSES:

E. H. Ellett, Jr.

Matt S. Thornton

INVENTOR.

HOWARD B. HOLMES,

BY George P. Barton

ATTORNEY.

No. 752,840. Patented February 23, 1904.

UNITED STATES PATENT OFFICE.

HOWARD B. HOLMES, OF EVANSTON, ILLINOIS, ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

FLEXIBLE CONDUCTING-CORD.

SPECIFICATION forming part of Letters Patent No. 752,840, dated February 23, 1904.

Application filed January 27, 1902. Serial No. 91 335. (No model.)

To all whom it may concern:

Be it known that I, HOWARD B. HOLMES, a citizen of the United States, residing at Evanston, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Flexible Conducting-Cords, (Case No. 1,) of which the following is a full, clear, concise, and exact description.

My invention relates to a flexible conducting-cord; and my object has been primarily to produce a cord suitable for use in the plug-circuits of telephone-switchboards. The flexible conducting-cords heretofore provided in switchboards of telephone-exchanges have been constructed of strands of copper tinsel surrounded by braided insulating-coverings. The end of the cord is screwed tightly into the base of the terminal plug as a means of securing it thereto. Such tinsel cords by reason of their structure and the mode of attachment with the plug have developed a number of defects, which it is the aim of my present invention to obviate. Tinsel stranded cords when used in central-battery switchboards, wherein the strands of the cord constantly convey current to the substation-transmitters of united lines, permit a few strands when ruptured to open and close shunts about portions of the remaining continuous conductors, thereby producing annoying clicks and scraping sounds in the telephones and seriously interfering with the conversation.

The tinsel cords break most frequently at the base of the plug, since at that point the cord is bent sharply over the edge of the base when the plug is in position in the switchboard, while in alternately placing it in position in the switchboard or in its seat in the cord-shelf the same portion of the cord is subjected to constant bending back and forth through nearly a right angle. The cord becomes flattened at the point where it emerges from the plug-base, after which the bending back and forth takes place across the flattened portion, breaking some or all of the tinsel strands. The rupture of the tinsel conductors is hastened by the practice of withdrawing the plug from the spring-jack by pulling on the cord, whereby a tension is thrown upon the tinsel conductors, there being no other portion of the structure adapted to take the strain.

In my improved cord I have aimed first to produce a cord which cannot be flattened or caused to collapse under any ordinary stresses, even when bent over the sharp edge of the base of the plug. Such cord retains its circular cross-section, so that the bend at the base of the plug takes place across different diameters and does not occur always across one diameter, while the extensibility of the convolutions is not destroyed by flattening. Further, I have aimed to produce a cord having a single strand only for the telephonic circuits, so that the breaking of the strand would be at once definitely indicated by the rupture of the circuit and will not be attended by persistent and annoying disturbances in the telephones.

To these ends I have combined several new features in a cord, as follows: I provide a central strand of some material of considerable tensile strength adapted to take the longitudinal strains upon the conductors. About this central core I wind in a close helix a flat ribbon or wire of metal of great stiffness, preferably of steel. Over this I place a suitable insulating-covering, preferably of braided linen. Over this covering another similar helix is wound, covered by another braiding, and, finally, in constructing a three-conductor cord a third strand with the final outer braided covering. The convolutions of the concentric helices have different linear pitches to give them the same angular pitch in the cord, whereby the bending strain is distributed equally between the different conductors of the cord, and the successive helices are preferably wound in reverse directions in order that the complete cord may have no tendency to twist or coil. The cord is screwed into the base of the plug as heretofore, the parts being tightly compressed together within the plug-base. Each of the windings is caused to lie as closely upon the core within it as possible, whereby a very hard cord is produced. The rigidity of the convolutions, due to the stiffness of the material used, is reinforced by the solid core within each helix, so that collapse is practically impossible. Thus while the cord is sufficiently flexible to make a short bend across the edge of the plug-base the bend takes place without any collapse of the cord, while the strain of pulling the plug out of the spring-jack falls largely upon the central longitudinal core. If during the use of the cord one of the steel ribbons breaks, the severed parts are retracted and permanently open the circuit.

A further feature of my invention consists in winding a conductor of low resistance, such as copper, in contact with the spring-metal wire and preferably in an opposite direction to reduce the resistance between the terminals of the latter. I consider such a conducting-ribbon more desirable in connection with the strands of the cord which are contained in the local circuits than with conductors which are to be brought into the telephone-circuits. The low-resistance conductor may be broken in a number of places without materially affecting the resistance between the terminals of the spring-metal wire which is in contact therewith.

I will describe my invention by reference to the accompanying drawings, in which—

Figure 1 illustrates a three-stranded cord such as required for telephone-switchboards, the scale being somewhat enlarged. Fig. 2 is a sectional view of a switch-plug, showing how the conductors of the cord are connected to the different contact-pieces thereof; and Fig. 3 shows the cord provided with the plug-terminal as is used in practice.

Similar letters of reference are used to designate the same parts wherever they are shown.

In the cord illustrated the central core is of hemp twine *a*, and the first conductor *b* is a flat wire wound helically around this twine—say twenty-two turns to the inch. I prefer to employ flat steel wire about .008 of an inch thick and .025 of an inch wide, coated with tin to prevent corrosion. Two layers of tussah floss are wound over the conductor *b*, and these in turn are surrounded by a braided linen covering *c*, upon which the second conductor b' is wound. This second conductor may be wire similar to that used for conductor *b*, and is wound, say, eighteen turns to the inch, so that the angular pitch of the turns will be the same as the angular pitch of the turns of conductor *b*. Two layers of tussah floss and a braided linen covering c' envelop the second conductor. A flat copper wire b^2 is wound over the linen covering c' in a helix of, say, four turns to the inch. Over this copper wire and in contact therewith, but preferably wound in an opposite direction thereto, is a third flat steel wire b^3 similar to conductors *b* and b', but wound, say, fourteen turns to the inch, so that the angular pitch of the convolutions of conductor b^3 shall be the same as the pitch of the convolutions of the other two conductors. The three helical conductors b b' b^3 of spring metal are preferably wound alternately in opposite directions to resist kinking or twisting of the cord, which might occur if they were all wound in the same direction, as a result of the tendency of the helices to unwind. The cord is finished by covering it with two layers of floss, a double braiding of linen, and an external braid of three-ply black glazed cotton. The end of the cord upon which the plug is to be secured may be dipped in a solution of rubber, which is allowed to permeate the cord, so as to keep out moisture, and the entire cord except the ends should be dipped in hot beeswax for five minutes.

In Fig. 2 I have shown the end of one of my improved cords equipped with a switch-plug terminal, the tip, ring, and sleeve-contacts of the plug being connected, respectively, to the ends of the helical conductors b, b', and b^3.

Many advantages result from the use of flat wire instead of round for the helical conductors. There is much less strain on the outer fibers of the conductor for a given bending action, the flexibility of the cord in increased, and a large surface is provided to resist and distribute the force of blows acting to hammer or cut the cord. The diameter of the finished cord is also less than it would be if round wires were used. The helices and insulating-coverings should be wound as close and hard as possible, so that the turns will retain their circular outline under blows and forces tending to cause their collapse, since if the turns become loose or flattened they are more liable to break. It will be noticed that the helices b b' b^3 are wound at a different linear pitch, so that the angular pitch of all the turns will be the same, thus bringing the strain equally upon the three conductors when the cord is used.

It might at first be thought that the resistance of the conductors in a cord such as I have described would be so great as to be objectionable; but I have found that this in general is not the case. In a seven-foot cord made as above described the resistance of the inner conductor *b* would be about nine ohms, the resistance of the next conductor b' would be about eleven ohms, and the resistance of the third conductor b^3 would be about two and one-half ohms, the resistance in this case being reduced by the presence of the copper helix b^2 in contact with the steel helix. The copper helix is wound oppositely to the steel helix b^3 and is bound firmly in contact with it by the tension of the steel helix, so that a break in the copper helix has no appreciable effect upon the resistance of the total circuit. If the copper helix were omitted, the resistance of the third conducting-strand b^3 would be about sixteen ohms.

As to the prior art, reference is made to Letters Patent, No. 61,325, January 22, 1867, to De Morat, and No. 476,464, June 7, 1892, to Jackson. These references both relate to heavy and comparatively inflexible electric cables designed to be placed in permanent position either overhead or underground. My invention, on the other hand, is adapted for use in the conducting-cords of telephone-switchboards where the cord is subjected to continually-repeated sharp bending or flection.

It will be apparent that my invention is capable of modification, and I do not desire to be understood as limiting myself to the precise embodiment illustrated; but,

Having described my invention, I claim—

1. A flexible conducting-cord comprising a core *a* and a flat spring-metal wire of great tensile strength and toughness wound helically upon said core, and forming a conducting-strand for the cord, and a protective insulating-covering surrounding the helical conductor.

2. A flexible conducting-cord having flat spring-metal wires wound helically in different concentric layers insulated from one another, forming the conducting-strands of the cord, and an outer insulating-covering surrounding the conducting-strands.

3. A flexible conducting-cord having flat steel wires wound helically in different concentric layers insulated from one another, forming the conducting-strands of the cord, the inner layer having the greater number of turns, in combination with a switch-plug having terminal contact-pieces connected respectively to the helically-wound conductors of the cord.

4. A flexible conducting-cord having a core *a*, a flat spring-wire wound helically about the same, and a conducting-strand b^2 of low resistance in contact with the convolutions of said first-mentioned wire, whereby the resistance between the terminals of said first-mentioned wire is reduced, and a suitable covering for the cord.

5. A flexible conducting-cord comprising a core *a*, a flat steel wire *b* forming a conducting-strand of the cord, wound helically upon said core, insulating material covering said conductor, a second conductor b' similar to the first, wound over the insulating-covering, an insulating covering for the second conductor, a conductor b^2 of low resistance wound helically over the last-mentioned insulating-covering, a flat steel wire b^3 similar to conductors *b* and b' wound helically over the conductor b^2 and in contact therewith, and a suitable covering for the cord, the linear pitch of the outer convolutions being less than that of the inner, so that the angular pitch of said convolutions is substantially the same.

6. In a conducting-cord for telephone-switchboards, the combination with a flexible core, of a non-collapsible helical conductor wound closely thereon, consisting of a flat wire of metal, as steel, having great rigidity and tensile strength, as described.

7. The combination with a switchboard-plug, of a conducting-cord therefor secured within the body of the plug, said cord being constructed with a conductor in non-collapsible open helical convolutions formed of flat spring-metal wire of great tensile strength and rigidity, whereby the breaking of the cord at the base of the plug is prevented.

In witness whereof I hereunto subscribe my name this 20th day of January, A. D. 1902.

HOWARD B. HOLMES

Witnesses:

FREDERICK A. WATKINS,
EDWIN H. SMYTHE.