(No Model.)

H. F. CAMPBELL.

ELECTRICAL CONDUCTOR.

No. 290,853. Patented Dec. 25, 1883.

Fig. 1.

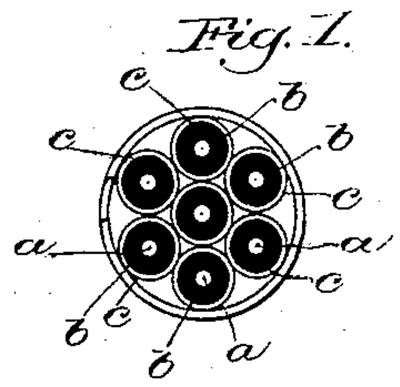
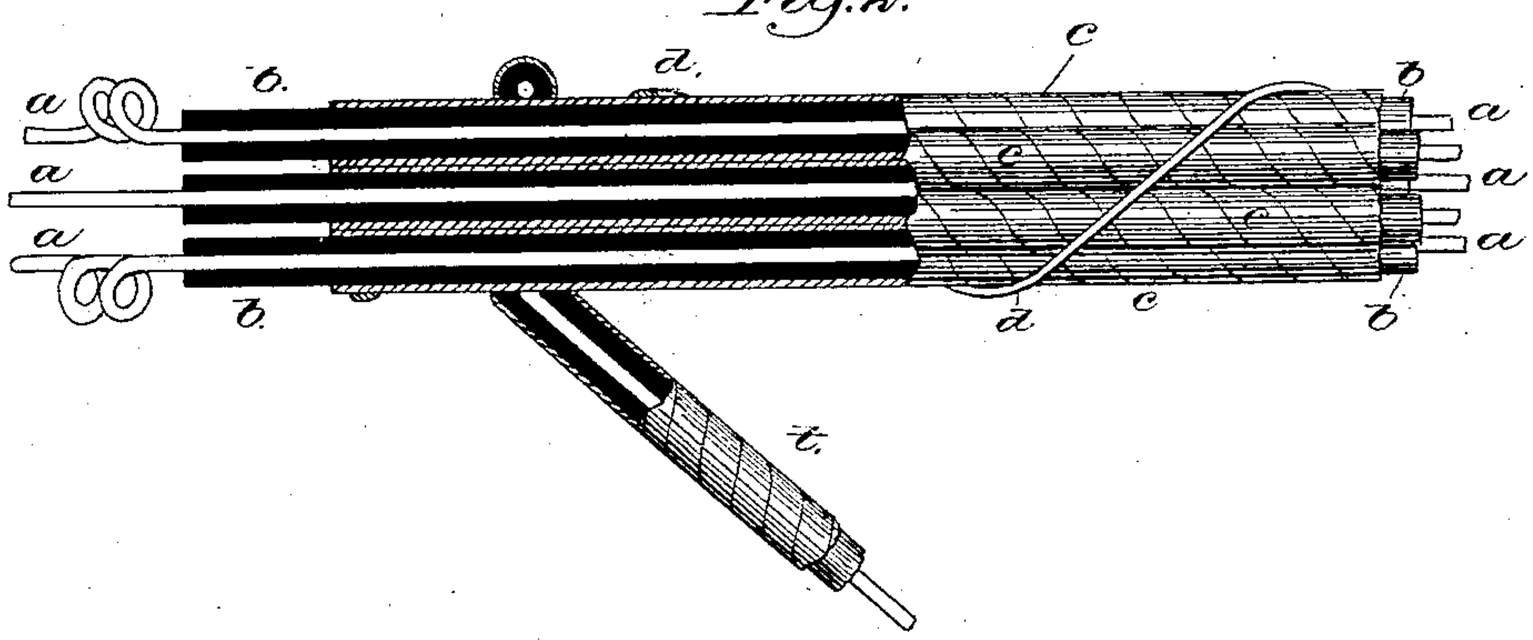


Fig. 2.



Witnesses.
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UNITED STATES PATENT OFFICE.

HENRY F. CAMPBELL, OF CONCORD, NEW HAMPSHIRE.

ELECTRICAL CONDUCTOR.

SPECIFICATION forming part of Letters Patent No. 290,853, dated December 25, 1883.

Application filed August 20, 1883. (No model.)

To all whom it may concern:

Be it known that I, HENRY F. CAMPBELL, of Concord, county of Merrimac, State of New Hampshire, have invented an Improvement in Electrical Conductors, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings respresenting like parts.

My invention, relating to electric conductors, has for its object to prevent disturbances arising from induction from neighboring wires or other disturbing influences. Electric cables have been made in which each independent conductor, covered with the usual insulating material, is provided with an outer metallic covering, usually composed of a lead or copper tube or of a covering of tin-foil, it having been supposed that such a covering would prevent the transmission of disturbing currents to the wire. Experiment, however, has shown that such coverings are ineffectual, at least for cutting off such currents as will produce disturbances in the telephonic instruments of the present day. I have discovered, after long investigation, that while an ordinary covering composed of the metals usually employed for this purpose—viz., copper, lead, or tin, all good conductors of electricity—is inefficient, there are certain substances which, when employed as a covering or shield for an insulated wire, will greatly diminish or entirely annul the disturbances referred to.

In another application for Letters Patent, No. 97,028, filed June 4, 1883, I have described and claimed a shield composed of paramagnetic and diamagnetic materials, it being many times more effectual than the coverings composed of diamagnetic material alone heretofore employed. While the shield therein described is the best known to me for this purpose, there are other materials besides such a combination of paramagnetic and diamagnetic substances which can be employed and will give far better results than the materials formerly used. All my investigations have shown that while the materials known and classed as "diamagnetic" materials, including copper, lead, and tin, which have been most commonly used on account of their abundance, their electrical conductivity, and the ease with which they may be manipulated, are ineffectual, all the paramagnetic elements are found to be effective in a very high degree; and the present invention consists, mainly, in the combination, with an insulated conductor, of a covering or shield composed of one or more paramagnetic materials, and with means to connect the said shield in an electric circuit, whereby the current generated in the said shield may be conducted away from it without passing to or effecting the conductors inclosed in the said shield and protected thereby.

Figure 1 shows in transverse section a cable composed of electric conductors embodying my invention, and Fig. 2 a longitudinal section thereof.

As herein shown, a series of independent conductors are united to form a cable, the said conductors *a*, of any usual kind, being each intended to form a portion of the circuit of telephonic or other electrical instruments, and each being provided with a covering, *b*, of any usual and suitable insulating material, to prevent the currents from escaping from it. Each insulated conductor *a b* is provided with an anti-inductive shield or covering, *c*, which in this instance is composed of paramagnetic material, either a single substance—such as iron, manganese, cobalt, or nickel—or a composition of two or more of the said substances. Iron is considered the best paramagnetic when used alone or as the chief element in quantity when two substances are used, as it stands at the head of the list of materials classed as "paramagnetics." The said covering *c* can be most conveniently made of a strip of iron annealed, or of a soft and flexible nature, wound spirally upon the outside of the insulating material *b*, care being taken that each successive turn of the strip is in close contact with or partially overlaps the edge of the one already applied, so as to form a complete uninterrupted covering. The shields *c* of the different wires *a* may be insulated from one another, or, if desired, may be in electrical contact with one another, as shown. In the former case each individual wire will be connected by a terminal, as described in my former application referred to, with the ground or other return-circuit for conveying the cur-

rents away from the said shields, and thus preventing them from passing upon or affecting the wires *a*, inclosed within them. When the shields are in contact with one another, as shown, they constitute, practically, a single conductor, and single terminals *t*, of a similar nature to those described in my former application, may be employed at each end of the cable to connect the said shields with the ground or with a metallic conductor forming the return-circuit for the said shields, as described in another application for Letters Patent filed.

I consider that the employment of an annealed strip or ribbon of steel or of homogeneous iron or steel without fiber, or, in fact, any annealed or soft ribbon composed of iron as the base, is within my invention. When two or more of the paramagnetic substances are employed, they may be combined or conjoined in any desired manner. In some instances independent strips of two different materials may be employed—one overlying the other; or one metal may be deposited or plated on the surface of the other; or an alloy of the different metals may be used. With some materials for some special purposes it might be desirable to apply the materials in a pulverized state, mixing two or more of them together, if necessary.

I do not in the present application broadly claim a covering of the paramagnetic material upon the outside of the insulating-covering of an electrical conductor, as such a claim will form the subject of another application for Letters Patent.

I claim—

1. The combination, with an insulated electrical conductor, of an anti-inductive shield composed of two or more paramagnetic substances compounded together, substantially as described.

2. An electrical conductor composed of an insulated wire covered with a flattened soft or annealed strip of paramagnetic material wrapped about it, with the edges of the strip in intimate contact to form a practically-continuous shield or a shield without gaps or spaces, substantially as described.

3. An electrical conductor composed of an insulated wire covered with a flattened strip of paramagnetic material, suitably annealed and wound spirally about the insulated wire, the edges of the strip coming intimately in contact or overlapping to avoid spaces between adjacent edges of the said strip, substantially as described.

4. An electric conductor having a covering of insulating material, combined with an anti-inductive shield composed of paramagnetic material, and forming a portion of a complete electric circuit independent of the inclosed conductor, substantially as described.

5. The combination, with an insulated electrical conductor, of an anti-inductive shield composed of two or more paramagnetic substances, compounded together as set forth, the said shield forming a portion of a complete electric circuit independent of the insulated conductor protected by the said shield, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HENRY F. CAMPBELL.

Witnesses:

JOS. P. LIVERMORE,

W. H. SIGSTON.