(No Model.) 2 Sheets—Sheet 1.

S. Z. DE FERRANTI.

CONDUCTOR FOR CONVEYING ELECTRICITY.

No. 409,181. Patented Aug. 20, 1889.

Fig. 1.

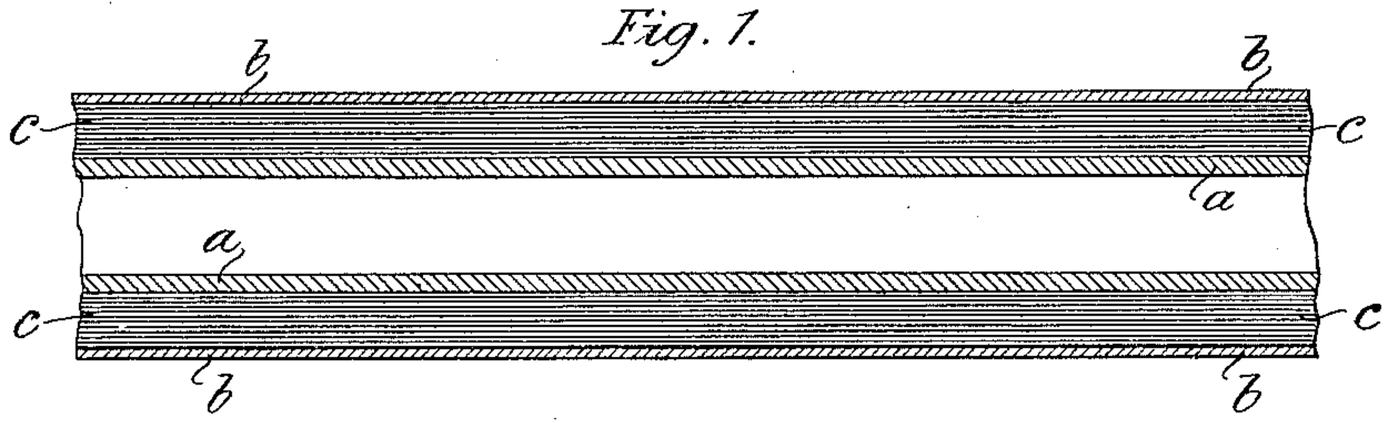


Fig. 2.

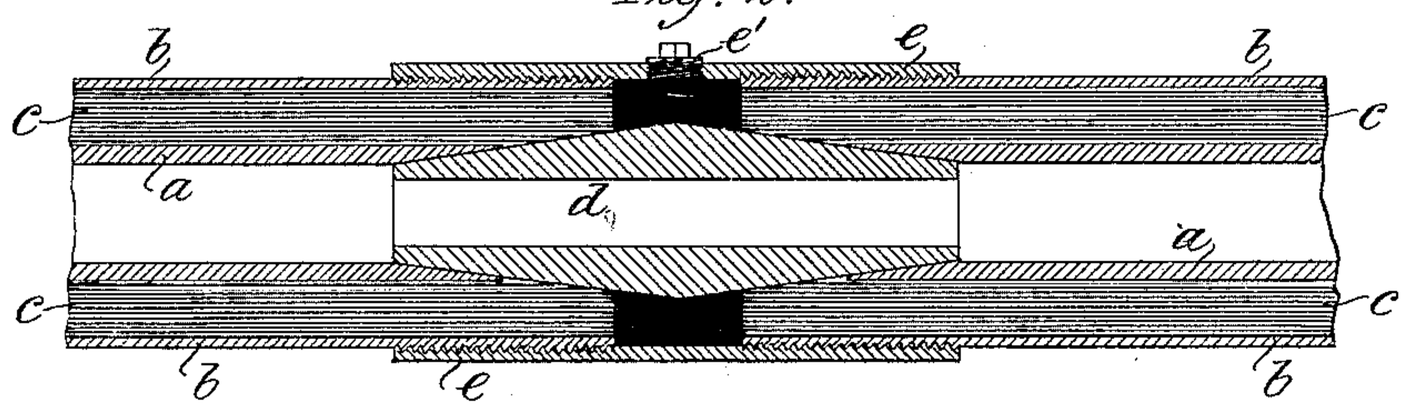
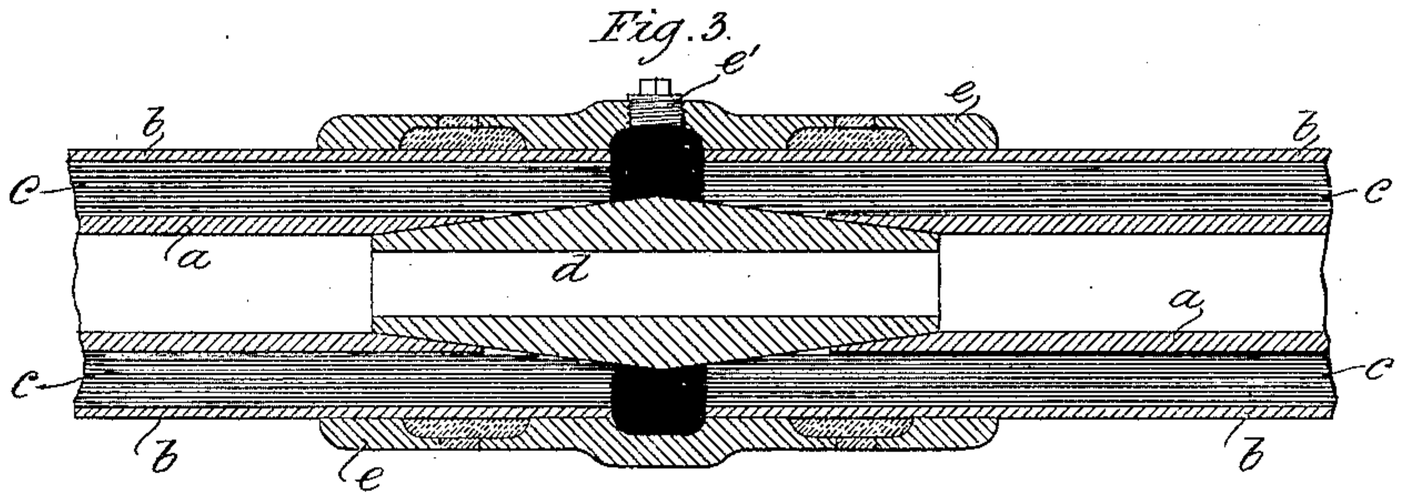


Fig. 3.



Witnesses
Lloyd B Wright
Baltus De Long.

Inventor
Sebastian Ziani de Ferranti,
By his attys.
Baldwin Wanderson & Wright.

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.) 2 Sheets—Sheet 2.

S. Z. DE FERRANTI.

CONDUCTOR FOR CONVEYING ELECTRICITY.

No. 409,181. Patented Aug. 20, 1889.

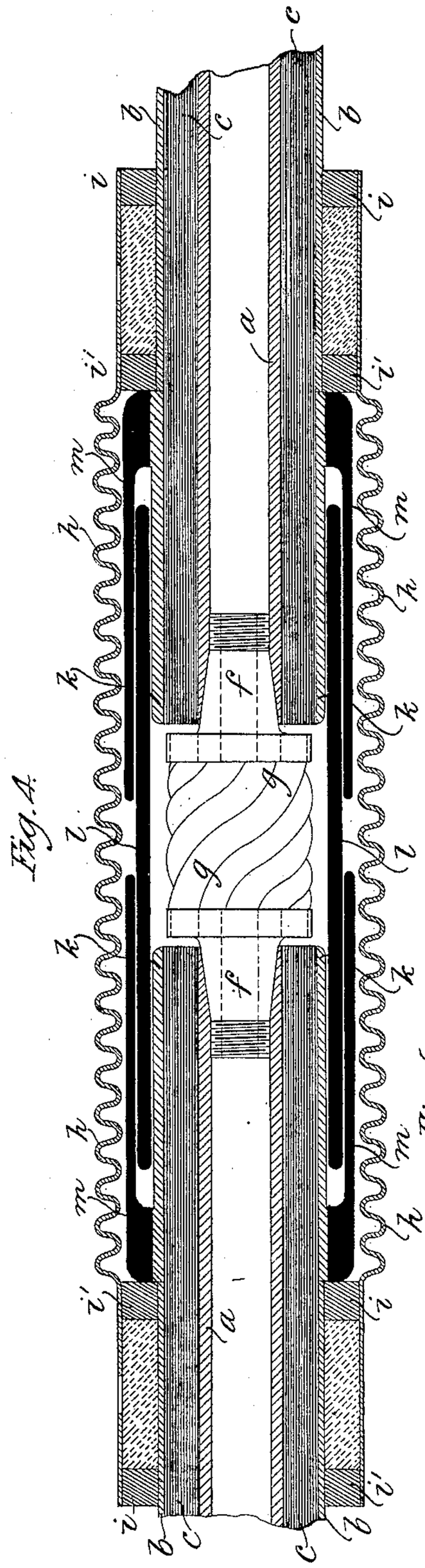


Fig. 4.

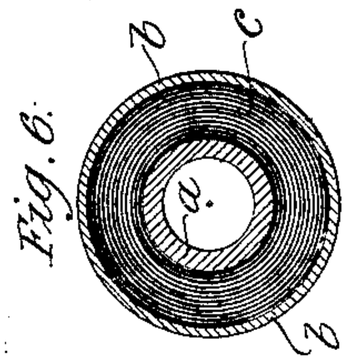


Fig. 6.

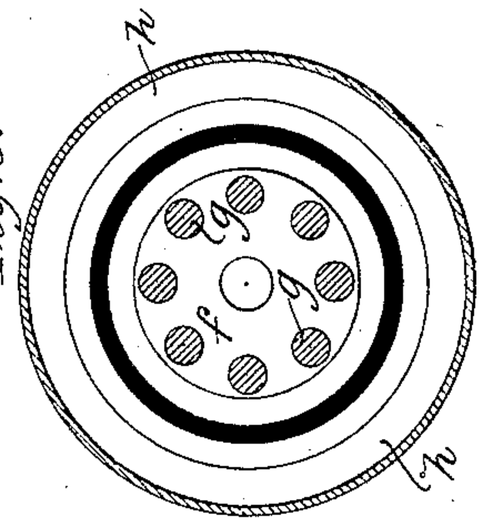


Fig. 5.

Witnesses
Lloyd B Wright
Baltus De Lany.

Inventor
Sebastian Ziani de Ferranti.
By his attys.
Baldwin Wanderen & Wright

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

SEBASTIAN ZIANI DE FERRANTI, OF HAMPSTEAD, COUNTY OF MIDDLESEX, ENGLAND.

CONDUCTOR FOR CONVEYING ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 409,181, dated August 20, 1889.

Application filed September 24, 1888. Serial No. 286,208. (No model.) Patented in England December 11, 1885, No. 15,251; in France December 9, 1886, No. 180,176; in Belgium January 8, 1887, No. 75,875, and in Italy January 19, 1887, No. 21,119.

To all whom it may concern:

Be it known that I, SEBASTIAN ZIANI DE FERRANTI, electriciaan, subject of the Queen of Great Britain, residing at 120 Fellows Roads, Hampstead, in the county of Middlesex, England, have invented certain new and useful Improvements in Conductors for Conveying Electric Energy, (for which I have obtained Letters Patent in Great Britain dated December 11, 1885, No. 15,251; in France dated December 9, 1886, No. 180,176; in Italy dated January 19, 1887, No. 21,119, and in Belgium dated January 8, 1887, No. 75,875,) of which the following is a specification.

This invention has for its object improvements in conductors for conveying electric energy and is applicable more especially for conveying powerful alternating currents from dynamos of high potential. I employ concentric conductors consisting of metal tubes separated by insulating material. The insulator I employ is paper saturated with ozokerit or other solid paraffine.

The tube serving as the inner conductor should be of copper. It is made in convenient lengths, each, say, twenty feet, and on each length paraffined paper is wound to a suitable thickness. The length thus prepared is then inserted into a corresponding length of the tube intended to form the outer conductor, which also should be copper, and the whole together is then drawn through a conedie, by which the outer tube is slightly reduced in size until it nips tightly upon the paraffined paper lapped around the inner tube. The lengths so prepared are coupled together so that the electrical resistance at the joint may be no more than at any other point in the length of the conductor. This is done as follows: The ends of the inner conductors are reamed out to a conical form and a copper cone is inserted between them. The outer conductors have right and left screw-threads formed upon them. They are screwed into a corresponding ferrule and so drawn together. The interior of the ferrule is then filled with paraffine and the joint is complete; or, in place of using a screw-ferrule, the ends of the conductors are drawn together by clamps within a ferrule or socket-piece made with cavities, into which white metal in a melted state is then poured. The metal when it solidifies solders the socket-piece to the outer conductors and completes the joint.

Where an expansion-joint is required, I make it in the following manner: I insert into the ends of the inner conductors copper cones, which are connected by flexible strands, and I connect the outer conductors by a socket-piece, as above described. The socket-piece in this case, however, is made of great length and is corrugated, so that it can elongate sufficiently to allow the expansion and contraction required.

To prevent an arc being formed from the inner to the outer conductor, screens of vulcanite are inserted between the conductors or within the socket-piece. The outer tube of each conductor is cut away for some distance from the end and is replaced by a tube of vulcanite. This is loosely surrounded by another tube of vulcanite extending over the two ends, and outside this again are two other vulcanite tubes, and these are attached to the inner tubes of vulcanite beyond the extremities of the intermediate tube. Thus the free path from conductor to conductor is made sufficiently long to avoid all risk of an arc being formed.

Among the advantages which these arrangements present are the following: First, the tubular or hollow conductors convey alternating currents with more efficiency than solid conductors of the same area of section; second, however high the tension such conductors are absolutely safe, for the inner conductor is entirely incased by the outer, and the outer conductor, being everywhere uninsulated, is approximately of the same potential as the earth; third, as no insulation is required, the conductors can be laid anywhere, and no special precautions are required.

In the annexed drawings, Figure 1 is a longitudinal section of the concentric conductors. Fig. 2 is a longitudinal section taken at a joint. Fig. 3 is a modification of this joint. Fig. 4 is a longitudinal section, and Fig. 5 is a transverse section of an expansion-joint. Fig. 6 shows full size a transverse section of a large electric main.

a is the inner tubular conductor, of copper. *b* is the outer concentric conductor, preferably of the same metal. *c* is the insulating material between the two. This insulating material consists of paper. That on which newspapers are printed is suitable. The paper is dipped into hot paraffine, so as both to saturate it completely and to leave a thin film on the surface. The coated paper is cut to lengths equal to the length of the conductor *a*, and it is then rolled tightly around the conductor to the proper thickness. The outer conductor *b* is passed on to the covered inner conductor with a loose fit, and is then drawn down on to it, as already stated.

In Fig. 2, *d* shows the copper cone inserted between the reamed-out ends of the inner conductor when making a joint. *e* shows the socket into which the outer conductors *b b* are screwed, preferably with right and left screw-threads, but in any case so as to bring the ends of the conductors *a a* into contact with the cone *d*. *e'* is a hole in the socket closed by a screw-plug. After screwing up the socket it is filled up with paraffine, and a plug is then screwed into the hole *e'*.

In the modification shown by Fig. 3 the socket-piece is not screwed on, but it is provided with cavities to receive melted metal. The tubes *b b* enter the socket-piece freely. The ends of the conductor *a* are drawn up to the cone *d* by cramps, and then hot white-metal is poured into the socket-piece by holes in the side. The socket-piece and the tubes *b* where the white-metal comes into contact with it should be tinned, so that the whole may become securely soldered together.

In Figs. 4 and 5, *f f* are hollow cones or plugs of copper screwed into the conductors *a a*, and these are connected by flexible wire strands *g g*, soldered to them. The socket-piece consists of a copper tube *h h*, corrugated, as shown, and the rings *i i'*, fitting its plain ends. These rings inclose between them a cavity for white-metal, and when this is poured in the tubes *b* and *h* and the rings *i i'* become soldered together. *k k* are vulcanite tubes, which are applied around the end of each conductor *a* over the paper insulation after the tube *b* has been shortened. The tubes *k* fit closely upon the paraffined paper. *l* is a loose intermediate tube of vulcanite. *m m* are outer vulcanite tubes. They are thickened at one end and fit upon the tubes *k* where these also are slightly thickened.

The joint between the tubes *k* and *m* is made good with india-rubber varnish.

I am aware that British Patent No. 3,374 of 1875 suggests the use of a tubular conductor surrounded by insulating material wrapped spirally with a copper strip.

I am also aware that it is common to cover insulated wires with a sheath of lead, and that it has been proposed to lay such a cable in the earth or water and to use the exterior metal sheath as the return-conductor.

I claim as my invention—

1. The combination of two concentric conductors consisting of the interior metallic tube *a*, the exterior solid metallic tube *b*, and insulating material filling the space between them.

2. The combination of two concentric conductors consisting, respectively, of the interior metal tube *a* and the exterior solid metal tube *b* and the intervening solid insulating material *c*, consisting of paper saturated with paraffine.

3. An electric cable or conductor composed of an uninsulated exterior solid metallic tube *b*, an interior metallic tube *a*, and insulating material filling the space between them.

4. The joint consisting of two pairs of concentric conductors *a* and *b*, the metallic cone between the ends of the interior conductors *a*, and the socket-piece coupling the outer tubes or conductors *b*.

5. The joint consisting of two pairs of concentric conductors *a* and *b*, the metallic cone *d* between the inner conductors, and the socket-piece *e*, soldered to the outer tubes or conductors *b*.

SEBASTIAN ZIANI DE FERRANTI.

Witnesses:
JNO. H. WHITEHEAD,
34 *Southampton Buildings, London.*
WALTER J. SKERTEN,
17 *Gracechurch Street, London, E. C.*