Dec. 10, 1929. A. H. JACKSON 1,738,828

LOW RESISTANCE PERMANENT WIRE

Filed March 2, 1925

Fig. 1.

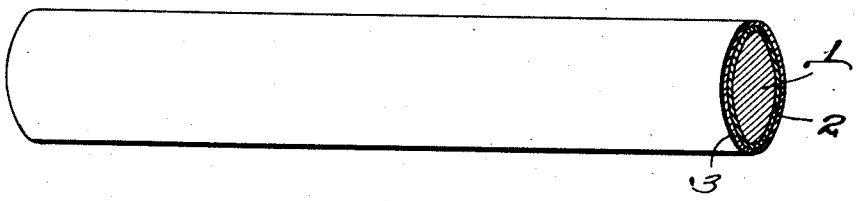


Fig. 2.

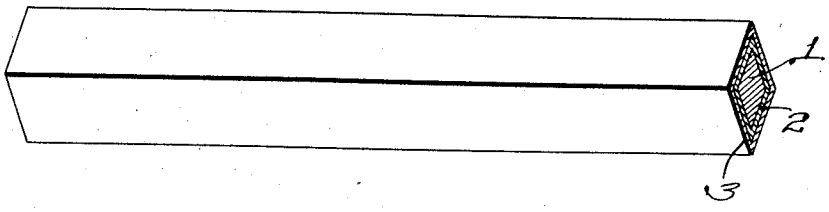
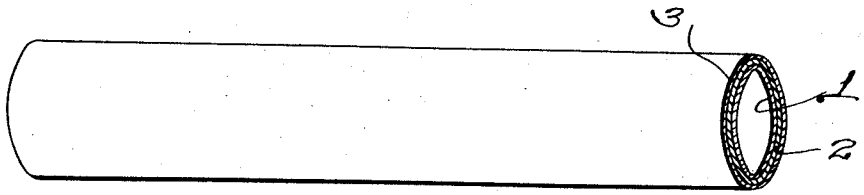


Fig. 3.



Inventor:

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UNITED STATES PATENT OFFICE

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LOW-RESISTANCE PERMANENT WIRE

Application filed March 2, 1925. Serial No. 12,728.

The object of my invention is to provide in particular an aerial or antenna wire, bus-wire for wiring radio wireless instruments and other types of wire used in the transmission and reception of radio wireless communication and broadcasting programs and for other electrical uses, having a low resistance to electrical currents used in wireless telegraphy and telephony, thus rendering same far superior electrically to all other types now in use, and by virtue of the application of a protective coating to cause same to retain their electrical efficiency for many years, practically permanently, when exposed to the air or elements.

Reference is hereby made to the drawings hereto annexed.

Figure (1) shows a section and cross section of round copper wire, same having been first silver plated and a plating of gold applied over the silver.

Figure (2) shows a section and cross section of square bus or hook-up wire plated the same as Figure (1).

Figure (3) shows a section and cross section of hollow copper wire or tubing plated the same as Figure (1).

Figure (1)—"1" shows the solid copper core or entire copper component; "2" shows a silver plating applied over "1"; "3" shows a gold plating applied over "2".

Figure (2)—"1, 2 and 3" same as in Figure (1).

Figure (3)—"1, 2 and 3" same as in Figures (1) and (2).

It is well known that copper wire tarnishes and corrodes when exposed to the air, and this action is rapid when it is subjected to the elements out-doors, thus increasing its resistance to high frequency electrical currents or waves used in wireless telegraphy and telephony, with a consequent impairment of its conductivity of such currents when used as an aerial or antenna in such wireless telegraphy communication or radio telephony transmission and reception, and likewise when used in wireless instruments, and apparatus. The efficient operation of such mentioned aerial, antenna, wireless instruments and apparatus requires conductors of low resistance to such high frequency currents, and any increase of resistance is a detriment.

The high frequency currents herein referred to, travel in the outer layers of wire and other conductors and penetrate but a minute distance, thus a hollow tube would offer practically the same resistance as a solid wire of the same diameter.

Silver is the best conductor of electrical currents, both direct and high frequency wireless alternating. While it has a lower resistance to direct currents than all other metals or combination of metals, this characteristic is very pronounced and of great value where high frequency wireless currents are used. Such currents are very minute or weak comparatively and any lowering of resistance in conductors used in connection therewith is of prime importance and means the more efficient and successful operation of radio wireless aerials, antennas, wireless instruments and apparatus.

The high cost of silver prohibits its use in solid state such as solid silver wires and conductors. The serious drawback to the use of silver as a conductor of high frequency currents where its surface is exposed to the air or elements is that it rapidly tarnishes and corrodes, thus increasing its surface resistance to such high frequency electrical currents. Such currents travel with the least loss on conductors having bright surfaces, so it is necessary for efficiency to protect the silver surface from such tarnishing and corrosion by a protecting coat of metal, preferably gold.

While the contact resistance of silver to direct electrical currents remains unaltered if the surface be tarnished or oxidized, a different situation is encountered when such tarnished, that is oxidized, silver surface is used as a conductor for high frequency electrical currents or waves, as an aerial or antenna for wireless electrical uses. Another point is that a comparatively thin silver plating when applied to copper wire or other metallic surfaces undergoes severe damage when tarnishing takes place; this tarnishing is oxidization of the silver surface, a chemical action, the oxygen of the air changing the

structure of the silver surface and plating and in a measure consuming it, so a silver plating if not protected from oxidization would soon deteriorate and break down, thus the plating would not be stable. The air outdoors in thickly settled communities is more or less mixed with various gases due for the most part to the burning of coal and petroleum, all of which cause injurious chemical action on silver surfaces and rendering such surfaces inefficient as conductors for said high frequency electrical currents.

Pure gold withstands the action of the elements and does not tarnish or corrode so as to impair its electrical conductivity after many years of exposure to them. It has a low resistance to direct and high frequency electrical currents. The high frequency resistance of any electrical conductor is several times its direct current value, thus the metal conductor having low direct current resistance is the best to use with high frequency currents.

Efforts to protect copper from tarnishing and corroding have been made, such as applying a thin coating of tin to the surface or covering with various enamels which are generally baked on. The cost of applying sufficient block tin to the copper surface to protect it as mentioned is prohibitive, and besides any protective coating of tin offers a high resistance to high frequency currents about ten times that of copper. It is well known that a thin coating of tin will deteriorate or permit surfaces directly beneath it to do so when exposed to the elements. High frequency currents traveling along the surface and penetrating slightly a conductor coated with tin encounter high resistance, thus tin coated bus-wire, aerials, antennas and other types of wire are inefficient when compared to such wires with silver plate applied followed by a plating of gold.

Any enamel, outside of porcelain which is entirely unsuitable for coating wire, which will withstand the action of the elements for a period of years without deteriorating is yet to be produced. When enameled wire is exposed to the elements the contraction and expansion of the metal forming such wire breaks down the enamel covering, causing minute fissures in it which permit air and moisture to enter with consequent tarnishing and corrosion of the surface of the wire, thus impairing its surface conductivity to high frequency currents. The elements alone will cause the enamel to deteriorate independent of the said contraction and expansion of the metal.

Rubber covered wire, which is not as suitable for aerials and antennas as bare, has a serious disadvantage for wireless telegraphy and telephony uses due to the fact that the sulphur remaining in the rubber causes the surface to corrode with the result heretofore mentioned.

In order to produce the most efficient aerial and antenna wire, also other wires, I have and propose to produce such manufactured as follows: By applying to a copper wire core 1 or surface an electro-plate of silver 2 and directly over the silver 2 and in contact with it an electro-plate of pure gold 3. The silver plating 2 offers a path of low resistance, the lowest of any metallic coating, to the high frequency currents mentioned, and the plating of gold 3 protects the silver plating 2 from tarnishing and corrosion practically permanently, thus such a plated wire preserves its electrical high frequency current efficiency throughout a long period of time. Actual exhaustive tests have proven that such a plated wire aerial, Figs. 1 and 3, antenna, Figs. 1 and 3, bus-wire, Fig. 2, is far superior to any others now in use by reason of its lower resistance to high frequency wireless currents and its protection from tarnishing and corrosion. Such a wire aerial or antenna is the most economical when long service is considered. The cost can not be raised as an objection to its use. Applicant is now marketing a #14 copper wire plated as described that costs but 1 cent per foot to plate, and this cost can be reduced to less than a cent by efficient quantity production in applicant's own plant. A thin plating of gold 3 is effectual in protecting the silver 2 as mentioned. Church spires in Europe have been coated with gold leaf that has endured for centuries.

While gold has a somewhat higher electrical resistance than copper, this only holds true as long as copper surface is bright, unoxidized and free from corrosion when used as a conductor for high frequency radio currents, for as copper starts to build up a high resistance to these currents as soon as it is left exposed to the air or elements, it will quickly develop a higher electrical high frequency resistance than a gold plating or covering. Bronze, or combinations of bronze and other metals or elements, while it resists oxidization, is inefficient as a conductor for high frequency electrical currents due to its high electrical resistance compared with silver, copper and gold. It is considered very important to avoid unnecessary angles and turns in aerials, antennas and lead in wires because of the increased electrical resistance to high frequency currents introduced, yet woven, twisted or braided combinations of enameled aerial and antenna wires have a great number of such angles and turns.

I am not confining myself to patent rights on a round copper wire Fig. 1 alone, for I believe it is within the scope of my invention to include other forms of wire such as square, Fig. 2, hollow, Fig. 3, twisted, braided and others. I have manufactured and marketed square bus-wire, Fig. 2, applying the plating to the copper 1 as herein described. I do not

claim rights on the electro-plating process which has been known and used for many years, neither on various types of wire. It might be considered that I am building on to wires new structures 2 and 3 that perform new and useful functions and incorporate with the wires so as to form a unit. I also include other forms of electrical conductors comprising a core over which is applied a lower electrcial resistance metallic coating with a protective covering applied over it as herein described, and I further contemplate the addition of layers of other materials between the important elements of said conductors.

I am electro-plating the said copper wire and propose to plate it by dipping and suspending coils of same in the various electro-plating solutions, but for quantity production I propose to run the wire through such solutions or use any other process or means of bringing the wire in contact with them. I am not confining myself solely to the electro-plating process for applying the coating of silver and gold but include other processes such as running the wire through molten metal. I also include the use of other metals, though not as efficient, as where a metal of low high frequency resistance is applied over a metal of higher resistance and a covering of weather resisting metal or material is applied over the metal of low resistance. The electro-plating process is too well known by those who are skilled in it to need any detailed description. I use and propose to use the electro-plating processes in general use. The silver plating applied should not be simply a wash but one sufficiently substantial that would stand burnishing, a heavy strike plate being sufficient for the gold plating. By using the electro-plating process referred to the metals are applied in soft form as distinguished from hard or hard drawn, similar to annealed metals which have a lower resistance to all electrical currents than the hard drawn.

I may use and therefore include the use of combinations of metals, among which is gold alloyed with silver or other metals.

Having disclosed my invention I claim:

1. A wire of the character described consisting of a round copper core, a layer of silver around the core and a layer of gold over the silver.

2. An electrical conductor consisting of a core, a coating of silver over the core and a coating of gold covering the silver coating.

ARTHUR HEWS JACKSON.