Sept. 23, 1924. 1,509,101

A. S. DANA

PROCESS AND APPARATUS FOR COATING WIRE

Filed Jan. 26, 1920

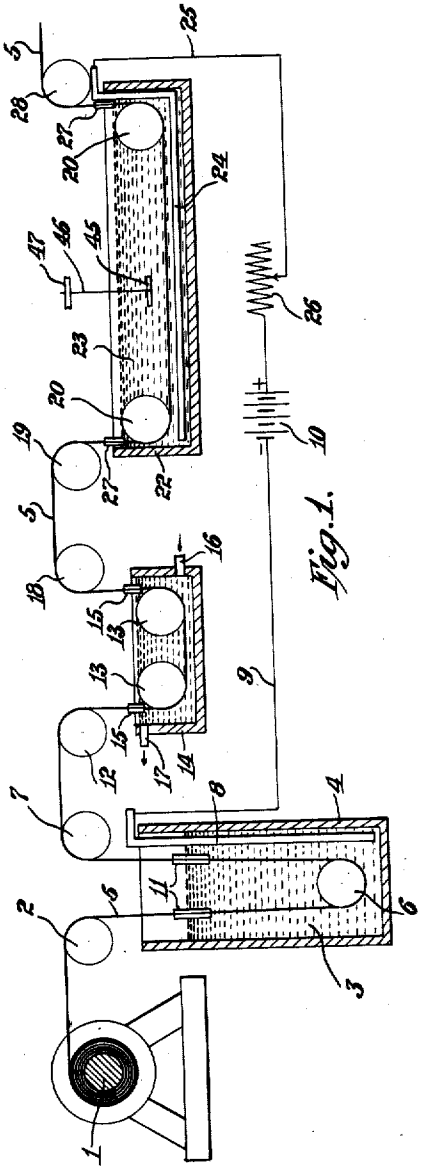

Fig. 1.

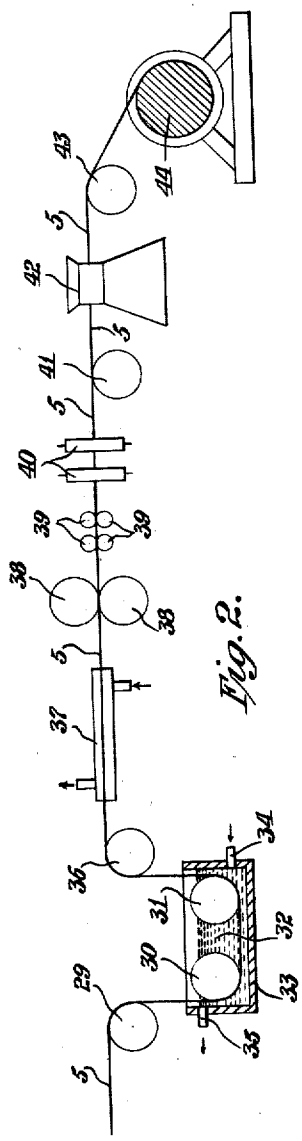

Fig. 2.

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Patented Sept. 23, 1924.

1,509,101

UNITED STATES PATENT OFFICE.

ALAN STANDISH DANA, OF SEYMOUR, CONNECTICUT, ASSIGNOR TO THE KERITE INSULATED WIRE AND CABLE COMPANY, A CORPORATION OF CONNECTICUT.

PROCESS AND APPARATUS FOR COATING WIRE.

Application filed January 26, 1920. Serial No. 354,088.

To all whom it may concern:

Be it known that I, ALAN STANDISH DANA, citizen of the United States, and resident of Seymour, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Processes and Apparatus for Coating Wire, of which the following is a specification.

My invention relates to improvements in process and apparatus for coating wire and more particularly electric conducting wires. My invention is especially adapted for the coating of copper conducting wire with a protecting covering, especially a coherent and adherent coating of lead over which an insulation covering may or may not be applied.

For many years it has been understood that copper and the usual rubber insulation should not be placed in intimate contact, and it has been common to first cover the copper wire with tin. Tin has the advantage that it requires only a moderate heat to melt it so that it is fairly easily applied by dipping copper wire into a molten bath of the tin. Tin also readily alloys with copper so that at the temperature of molten tin a firmly adherent coating is obtained. It has been suggested that wire be coated with lead by dipping the wire in molten lead, but tests indicate that in such case a lead tube is formed which flakes or pulls off the wire very readily. For many years, therefore, the tin coating has been substantially the only covering commercially employed for the purposes in question.

Conductors of this kind are likely to be subjected to hard uses and to all sorts of atmospheric and climatic conditions. In some cases acid or other chemicals are present either in liquid or gaseous form. While the tin coating has heretofore been commonly employed, it is found that under some conditions, after a greater or less lapse of time, the tin coating is destroyed, the inner surface of the insulation is deteriorated, the adhesion of the insulation to the conductor is lost and the surface of the copper is sometimes pitted. The immediate causes of this do not seem to be easily understood and therefore, no method of overcoming these difficulties have been patent. It may be that the tin under certain conditions gradually becomes wholly alloyed with the copper causing a disappearance of the tin layer and subjecting the insulation to the deteriorating action of the alloy. Probably in some cases electrolysis between the tin, copper and their alloys plays an important part. In some cases alternate wet and dry conditions with or without the presence of acid seem to have something to do with it. The wide variation in the thickness of tin coating as well as in the thickness of the alloy may possibly accelerate action by electrolysis.

According to my invention in its preferred form, I pass the wire continuously through an electrolytic bath depositing thereon a metal coating which is coherent and adherent to the copper whereby the wire is coated in a much more efficient and satisfactory manner and by using lead as the metal electro-deposited on the wire I form coating which does not alloy with the copper and is extremely resistant to acids. Also according to my invention the coated conductor may be produced at relatively low cost. Furthermore according to my invention in its preferred form I am able to clean and coat the wire successively in one continuous operation and also if desired apply to the lead coated wire suitable insulation material. I have provided an improved form of apparatus for this purpose whereby the wire may be continuously passed through various parts thereof and from one part to another continuously so that an insulated electrical conductor provided with the electro-deposited lead coating may be prepared in a most simple and economical manner.

Further objects, features and advantages will more clearly appear from the detail description given below taken in connection with the accompanying sheet of drawings which form a part of this specification. In the drawings Fig. 1 is a diagram illustrating part of an apparatus for carrying out my improvements, the same being shown largely in section. Fig. 2 is a similar figure showing the rest of the apparatus through which the wire passes.

Referring to the drawings 1 represents

a reel of copper wire to be treated. The wire 5 from the reel passes over a roller 2 and down into an electrolytic bath 3 in a tank 4. The wire 5 passes around a pulley 6 at the bottom of the tank and then upwardly out of the tank and around a pulley or roller 7. The electrolytic bath 3 comprises a solution of caustic potash. This solution I make by dissolving 300 grams of dry stick caustic in a similar amount of water and diluting the same in one liter. Preferably several gallons of such a solution are used. 8 represents an iron or other metal electrode which is connected as by wire 9 to the negative side of the battery or other suitable source 10 of electric current. The wire 5 in a bath 3 is made the anode in a manner more fully hereinafter described so that current passes from the wire 5 in the bath 3 to the cathode 8. Where the wire 5 passes into and out of the bath 3 at the surface thereof it is surrounded by small glass tubes 11 so that dirt and the like on the surface of the bath will not be drawn to the wire by reason of the surface tension as the wire passes from the surface, particularly on its exit from the bath. By passing the wire through this electrolytic bath the wire is cleaned thoroughly. If necessary the bath 3 may be heated and agitated in any suitable manner. However, according to the broader aspects of the invention any other suitable means may be used for cleaning the wire as for example, by pickling or sand blast and in some cases cleaning may not be necessary.

From the caustic cleaning bath the wire 5 after passing around the roller 7 passes around a roller 12 and down around the rollers 13 in a tank 14 filled with running water in order to remove any caustic or other matters adhering to the wire. Similar glass tubes 15 may be provided where the wire enters and leaves this water bath. The water is continuously run through the tank 14, the same being admitted through the inlet 16 and overflowing through the outlet 17.

After leaving the water bath, the wire 5 passes over rollers 18 and 19 and down around rollers 20 in a tank 22 containing electrolytic bath 23 for depositing upon the wire as it passes therethrough a coherent lead coating firmly adherent to the copper. While in the broader aspects of the invention any suitable electrolytic bath may be used according to the kind and nature of the metallic coating to be applied, I prefer to use a bath containing lead fluoborate. Such a bath may be prepared by taking 320 ounces of 50% hydrofluoric acid and putting the same into a lead lined tank and slowly adding 140 ounces of boric acid. After the solution has cooled, 190 ounces of basic lead carbonate are added with continuous stirring. The lead carbonate is added in the form of a cream, prepared by mixing it with a slight amount of water. The whole is then diluted to ten gallons and filtered through a filter to remove any lead sulphate formed by reason of any sulphuric acid in the hydrofluoric acid as impurity. Before the electrolysis is commenced 100 grams of glue or gelatin are added and stirred in.

In this electrolytic bath the wire is made the cathode and a lead plate or plates 24 are provided for an anode, these plates being connected by conductor 25 to the positive side of the source 10 through a suitable rheostat 26. It will be seen from the above that the current passes from the positive side of the source 10 through the variable resistance 26 to the lead plate anode 24, thence through the bath 23 to the wire 5 in the bath as cathode, thence along the wire 5 into the bath 3 and from the wire in the bath 3 as anode to the cathode 8 and back to the negative side of the source 10. The voltage I prefer to use will vary with the shape of the distance between electrodes and is generally below one volt in the electrodepositing bath. I may use a current density of from 65 to 260 amperes per square foot but over 100 is preferred. The wire 5 is continuously drawn through the baths 3, 14 and 23 as will more clearly appear hereinafter and as it moves continuously through the bath 23 I have found that not over 30 seconds is required between the entering of the wire and its exit from the bath in order to deposit thereon a satisfactory lead coating. This lead coating is dense, continuous, coherent and adherent to the copper and of substantially uniform thickness and is substantially pure and impervious and of substantially the density and homogenity of cast lead and different from lead coverings produced by various other methods wherein the lead is left more or less porous, flaky or non-adherent so that it would not remain impervious. However, many other electrolytes may be used to produce a more or less satisfactory coating such for example, as the acetate and silicate electrolytes and indeed the lead or other metal coating may be electro-deposited by any method which produces a substantially coherent coating adherent to the wire conductor. Glass tubes 27 may be provided where the wire 5 enters and leaves the bath 23. Also the bath may be provided with a small agitator 45 on a spindle 46 driven through a suitable pulley 47 so that the bath may be very gently agitated and the liquid kept in motion.

From the bath 23 the wire passes over rollers 28 and 29 and down around rollers 30 and 31 in a bath of running water 32 in tank 33, the water being admitted through

the pipe 34 and overflowing through pipe 35. In this bath the electrolyte which may remain on the wire when it leaves the bath 23 is washed from the wire and then the wire passes out of the bath 32 and around a roller 36 and through a cylinder 37 through which hot air is passed in order to dry off any water that may remain on the surface of the coated wire. Any other suitable means may be used for drying the wire and in some cases drying may not be necessary. If desired the wire 5 may then be drawn between suitable polishing means such as rolls 38 and then through sets of horizontal and vertical straightening rollers 39 and 40. Where there are no kinks or the wire does not need straightening, the straightening rollers 39 and 40 may be omitted. Also under some conditions the polishing rollers 38 may be omitted. After leaving the straightening rollers 39 and 40 the wire is shown as passing around a tractive drum 41, the wire being given a few turns around the drum 41 which, driven by any suitable means, may serve to continuously pull the wire through the various pieces of apparatus whereby the wire is treated consecutively and continuously by the various steps as above explained. From the tractive drum 41 the wire 5 may be passed through any suitable apparatus 42 for applying thereto a rubber compound insulation or other form of insulation or protective covering. After passing through the insulation applying means 42 the wire 5 passes over a guide 43 and is wound up upon a take-up reel 44 driven in any suitable manner. The wire may then be placed in iron cylinders and subjected to heat to vulcanize the rubber in a manner well understood by those skilled in the art. For some purposes other forms of insulation may be preferred and in some cases, none at all according to the use of which the conducting wire is to be put. While my improvements are particularly advantageous in connection with the making of insulated copper wire nevertheless, the lead coating has certain advantages as a protecting coating for wire conductors where no such insulation is used particularly in that it is resistant to sulphuric and other acids and for this and other reasons it will be found advantageous as a coating for bronze, iron and other electrical conducting wires, particularly where subjected to severe weather conditions, with or without the insulating covering.

I have pointed out that certain changes and omissions may be made. Other omissions and many other changes and modifications may be made without departing from the spirit and scope of the invention in its broader aspects. Thus while I have described my improvements in great detail and in connection with a preferred form of apparatus, I do not desire to be limited to the details of the method described nor to the particular apparatus shown, but desire to include all forms coming within the spirit of any one or more of the appended claims.

What I claim and desire to secure by Letters Patent is:

1. The process of coating wire which consists in drawing the wire continuously through a caustic alkali cleaning bath and thereafter without stopping, through an electrolytic bath depositing a lead coating on the wire.

2. The process of coating wire which consists in drawing the wire continuously through an electrolytic cleaning bath containing caustic alkali electrolyte and thereafter without stopping, through an electrolytic bath depositing a lead coating on the wire.

3. The process of coating wire which consists in drawing the wire continuously through an electrolytic cleaning bath containing caustic alkali electrolyte and in which the wire forms the anode, and thereafter without stopping, through an electrolytic bath depositing a lead coating on the wire.

4. The process of coating an electric conducting wire which consists in drawing the wire continuously through an electrolytic bath containing a lead salt electrolyte depositing on the wire as it passes through the bath a dense and coherent coating of lead of substantially uniform thickness the current density being over 100 amperes per square foot of cathode area.

5. The process of making insulated wire which includes drawing the wire continuously through an electrolytic bath depositing a lead coating on the wire and, thereafter without stopping, through insulating means applying a rubber compound insulating covering to the lead coated wire.

6. The process of coating copper conducting wire which includes drawing the wire continuously through a chemical cleaning bath, then without stopping, through a washing bath to wash the wire substantially free of chemicals from the wire cleaning bath, and then without stopping, through an electrolytic bath depositing a dense, coherent lead coating on the wire.

7. The process of coating copper electrical conducting wire which consists in drawing the wire continuously through an electrolytic bath of lead fluoborate depositing on the wire as it passes through the bath a coherent and substantially impervious coating of lead the current density being over 100 amperes per square foot of cathode area.

8. Apparatus for coating wire having in combination a cleaning bath, a washing bath, and a lead salt electrolytic bath for depositing a lead coating on the wire and means

for simultaneously and continuously drawing the wire through the cleaning bath, the washing bath and the electrolytic bath.

9. The process of coating wire which consists in drawing the wire continuously first through an electrolytic cleaning bath, thereafter without stopping the wire through an electrolytic bath depositing a coating of metal on the wire, and thereafter without stopping the wire through means applying an insulating covering to the wire.

10. Apparatus for coating wire having in combination a cleaning bath, a washing bath, a lead salt electrolytic bath depositing a lead coating on the wire, means for applying an insulating covering to the wire, and means for simultaneously drawing the wire through the cleaning bath, the washing bath, the electrolytic bath and the insulating means.

11. Apparatus for coating wire having in combination an electrolytic cleaning bath for the wire, an electrolytic bath for depositing a lead coating on the wire, means for straightening the wire, means for applying an insulating covering to the wire, and means for drawing the wire continuously and simultaneously through the cleaning bath, lead depositing bath, straightening means and insulating means.

12. Apparatus for coating wire having in combination means for cleaning the wire, a lead salt electrolytic bath for depositing a lead coating on the wire, means for straightening the wire, means for applying an insulating coating to the lead coated wire, and means for simultaneously drawing the wire through the insulating means, straightening means, electrolytic bath and cleaning means.

13. Apparatus for coating wire having in combination a lead salt electrolytic bath for depositing a lead coating on the wire, means for straightening the wire, means for applying an insulating coating to the lead coated wire, and means for simultaneously drawing the wire through the insulating means, straightening means and electrolytic bath.

14. Apparatus for coating wire having in combination an electrolytic bath for cleaning the wire, an electrolytic bath for depositing a metal coating on the wire, a source of current, and connections whereby the current from said source passes serially through said cleaning bath and electrolytic bath.

15. The process of treating wire which consists in drawing the wire continuously through an alkaline electrolytic bath to clean the wire in which the wire forms the anode.

16. The method of cleaning copper conducting wire which consists in drawing the wire gradually through an electrolytic bath of caustic alkali to clean the wire, in which the wire forms the anode.

Signed at New York, in the county of New York and State of New York, this 23rd day of January, A. D. 1920.

ALAN STANDISH DANA.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,509,101, granted September 23, 1924, upon the application of Alan Standish Dana, of Seymour, Connecticut, for an improvement in "Processes and Apparatus for Coating Wire," an error appears in the printed specification requiring correction as follows: Page 2, line 74, before the word "glue" insert the word *liquid;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of November, A. D. 1924.

[SEAL.]

KARL FENNING,
Acting Commissioner of Patents.