

Dec. 21, 1937.

T. AKAHIRA

2,103,134

APPARATUS FOR MANUFACTURING A COATED INSULATED WIRE

Filed July 10, 1935

3 Sheets-Sheet 1

FIG. 1

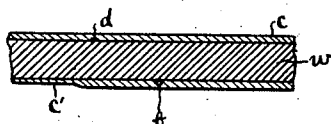


FIG. 2

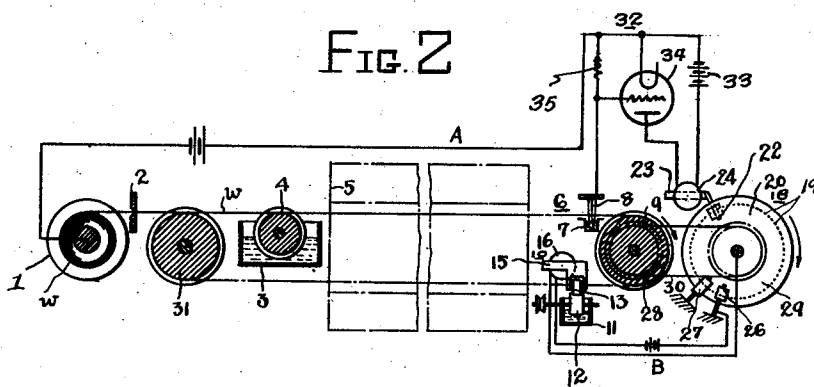
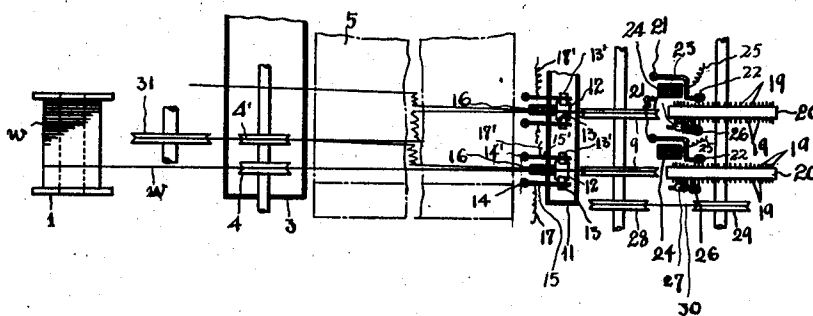


FIG. 3



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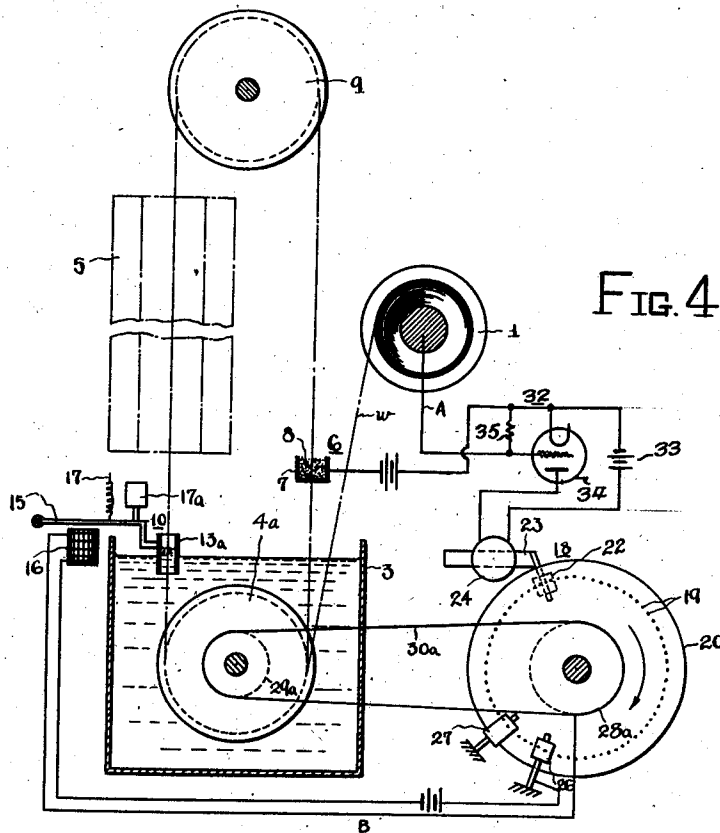
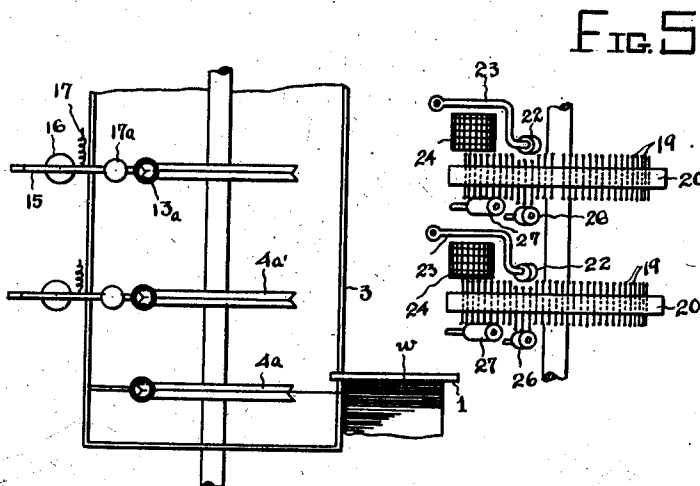
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3 Sheets-Sheet 2



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APPARATUS FOR MANUFACTURING A COATED INSULATED WIRE

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FIG. 6

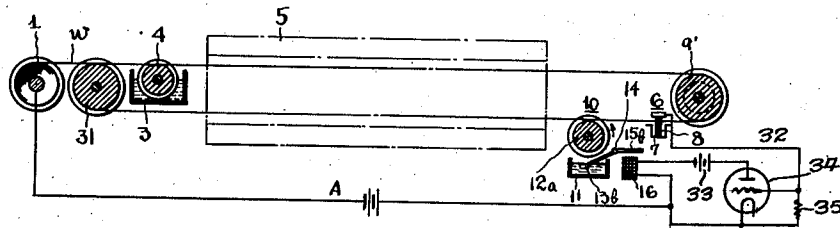


FIG. 7

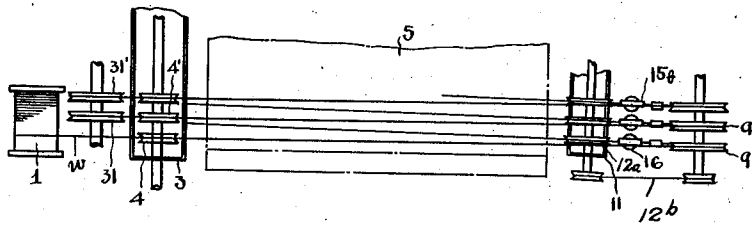


FIG. 9

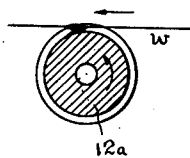


FIG. 8

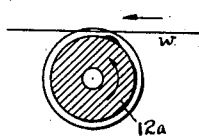


FIG. 10



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2,103,134

APPARATUS FOR MANUFACTURING A
COATED INSULATED WIRETakeo Akahira, Takinogawa-ku, Tokyo, Japan,
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Tokyo, JapanApplication July 10, 1935, Serial No. 30,749
In Japan July 19, 1934

7 Claims. (Cl. 91-48)

This invention relates to the manufacture of a coated insulated wire, and consists in successively applying one or more layers of an insulating coating material on the wire, drying the same, then passing said coated wire through the device for detecting bad insulation spots, and then passing through the spot coating device. This spot coating device is placed at a predetermined distance from said detecting device and is adapted to be automatically controlled and actuated by said detecting device, whereby a spot coating operation on the bad insulation spot in the wire is automatically effected when said bad insulation spot passes through the spot coating device. Finally the product is dried. The object of the invention is to manufacture in a simple manner a superior, coated insulated wire which has no defective, insulated spots throughout the whole length thereof.

In the accompanying drawings:—

Figure 1 is an enlarged fragmentary sectional view of an enamel coated insulated wire;

Figure 2 is a diagrammatic side view partly in section of one embodiment of an apparatus for carrying out the method according to this invention;

Figure 3 is a plan view of Fig. 2;

Figure 4 is a diagrammatic view showing in elevation and part section another form of apparatus for carrying out this invention;

Figure 5 is a plan view of Fig. 4;

Figures 6 to 9 show still another form of the apparatus for carrying out this invention, Figure 6 being a side view partly in section, Figure 7 a plan view of Fig. 6, Figures 8 and 9 sections of the wire showing the manner of spot coating, and Figure 10 showing in an enlarged scale a fragment of a coated wire with a spot coating applied thereon;

Similar reference numerals refer to similar or equivalent parts throughout the several views.

In coated insulated wire, manufactured by usual methods, metal or other electrically conductive dusts frequently remain as at *d* Figure 1 between the outer surface of the wire *w* and the layer of the coating material. When the coating is applied on such wire with adhering dust, or air bubbles *b* under the coating *c*, the insulating quality will be considerably decreased, so that the wire can not be recognized as possessing the necessary insulating value throughout the whole length thereof.

The present invention aims to produce a coated insulated wire which has no such spots of defective insulation. The invention will now be

described by way of example with reference to the accompanying drawings.

Referring to Figures 2 and 3, numeral 1 designates a drum or reel of a bare wire *w*, 2 a die or grinder, 3 an enamel bath, 4 a roller rotatably mounted in said bath 3, and 5 a drying oven. 6 designates generally a device for detecting incompletely insulated spots and consists of a pot 7, and a wet band 8 of cotton or fabric which is adapted to be normally maintained in wet state by absorbing water in said pot 7 by capillary action. 9 is a grooved pulley. 10 designates generally a spot coating device and consists of a coating material bath 11, a roller 12 normally rotating in said bath, a pair of levers 15 and 15' pivoted at 14 and 14' and carrying at the free ends rollers 13 and 13' respectively, said rollers 13 and 13' engaging with said roller 12. An electromagnet 16, and springs 17 and 17' maintain the levers 15 and 15' in their normal position apart from each other. 18 designates generally a time limit relay, through which the device 6 for detecting inferiorly insulated spots is associated with the spot coating device 10. This relay consists of a uniformly rotating metallic disc 20 carrying thereon a plurality of metallic pins 19 which are mounted to slide in axial direction. An arm 23 pivoted at 21 carries at its free end a roller 22, and an electromagnet 24 when energized is adapted to attract the arm 23 in order that the roller 22 may push in one or more of the pins 19. A spring 25 normally maintains said arm 23 in an inoperative position away from the disc 20. A metallic roller 26 is mounted in such position that it comes in contact with the pins 19 when pushed in by the arm 23, and a similar roller 27 is positioned nearer to the disc 20. The pulley 9 and the disc 20 are operatively connected by means of pulleys 28 and 29 and a belt 30. Preferably two units of the above mentioned device for detecting defectively insulated spots, the spot coating device and the time limit relay being employed and arranged side by side as shown in Figure 3.

By forming an electric circuit A including the wet band 8 of the device 6 for detecting bad spots, the coated conductor wire *w*, and a source of electricity as shown for applying a suitable test voltage to the layer of enamel coating, when any bad spot passes through the wet band 8 an excess current flows through said circuit A. A current amplifier shown generally at 32 is provided for amplifying said current to actuate the electromagnet 24. The amplifier comprises a plate circuit battery 33, a three-element ampli-

lying tube 34 and a grid leak 35, all of which is adapted to function in a well known manner to amplify the current flowing in the circuit A to more positively operate the electromagnet 24.

5 The electromagnet 16 in the spot coating device 10, the disc 20 and the roller 26 are connected in series by another electric circuit B.

The mode of operation of said apparatus is as follows:—

10 The bare wire *w*, released from the reel 1, passes through the die or grinder 2 cleaning the wire surface and, passing through the coating material bath 3, is there coated with the coating material over the whole circumference thereof by means of the roller 4. It then passes immediately through the drying oven 5, and is dried therein. The wire coming out from the drying oven passes through the wet band 8 of the detecting device, then passing round the pulley 9 enters between the rollers 13, 13' of the spot coating device 10, and again passes through the drying oven 5. The wire is then wound up as the final product. Or it is passed round the pulley 31 and is again coated with next layer of coating material by means of another coating roller 4' and, after being treated by the next unit of similar devices, is finally taken up and wound around a take-up drum (not shown).

If the coated wire coming from the drying oven 5 has a bad spot due to the presence of a dust particle *d* or an air bubble *b* as shown in Figure 1, an excess current flows in the circuit A supplied with the test voltage at the instance when such bad spot passes the wet band 8, so that said current being sufficiently amplified by the amplifier 32 will energize the electromagnet 24 of the time limit relay 18. Thus, the roller 22 will push one or more of the pins 19 in the rotating disc 20, projecting same further on the opposite side. When the projected pin engages with the roller 26 upon the rotation of the disc 20, the circuit B will be completed, including said roller 26, the disc 20 and the magnet 16, so that the magnet 16 is energized and the rollers 13 and 13' are moved toward each other. By such movement, the wire is partially coated by said pair of rollers 13 and 13', so that the thickness of the coating in the bad spot is increased to improve the insulation thereon. The time limit relay 18 is so adjusted that the time interval during which a bad spot in the wire passes from the wet band 8 to the rollers 13, 13' is equal to the time interval during which the pin 19 pushed by the roller 22 comes in contact with the roller 26, so that the spot coating rollers 13 and 13' operate just at the instant when the bad spot, detected by the device 6, comes between them.

In the modified form of the apparatus for carrying out the method according to this invention as shown in Figures 4 and 5, 1 designates, as before, a drum or reel of a bare wire *w*. Said wire *w* travels downwardly into the enamel bath 3, and changes its direction travelling upwardly after passing round the roller 4a, and is coated with the enamel in bath 3. After passing through the drying oven 5, the coated wire changes its direction and travels downwardly after passing round the upper roller 9, and re-entering the enamel bath 3 again changes its direction upwardly after passing round another roller 4a', whereby the coated wire is once more coated with the enamel, and is then dried. Similar coating operation is repeated for a desired

number of times and finally the finished wire is wound upon a take-up drum.

Numeral 6 designates in general the device for detecting bad spots and consists of a pot 7 provided at the downwardly running side of the wire *w*, viz., the feeding side of the wire between said upper and lower rollers 9 and 4a, a wet fabric or cotton 8 dipped in a pot 7 and being arranged to receive the coated wire passing there-through. 13a is a comparatively long cylinder receiving the wire *w* at a position adjacent the level of the enamel bath 3 on the upwardly running side of the wire. Said cylinder 13a is carried by one end of a lever 15, the latter being adapted to be attracted downwardly by an electromagnet 16, but normally held in the upper position by a spring 17. A dash-pot 17a is provided for retarding the upward movement of the lever 15. Thus said cylinder 13a, together with the associated parts, forms a spot coating device 10. The numeral 18 designates generally a time limit relay. A metallic disc 20 rotating uniformly forming a part of said relay carries a plurality of metallic pins 19 arranged in a circle. A lever 23 is provided at one side of the disc 20, and this is actuated by the electromagnet coil 24. A roller 22 carried by the free end of said lever is adapted to push one or more of said pins 19. At the other side of the disc 20 is provided a metallic roller 26 adapted to engage with the projected pins 19. Provided in the position nearer to the roller 26 is another roller 27 for returning the projected pins 19 to the retracted normal position. The electromagnet coil 24 is energized by the current flowing in the circuit A including the wire *w*, the wet fabric 8, and the amplifier 32. The electromagnet coil 16 is energized by the current flowing in the circuit B including said disc 20, pins 19 and the roller 26. 28a, 29a and 30a are pulleys and belt, respectively, for driving the disc 20 and the roller 4a' with the predetermined speed ratio.

In the operation of the apparatus shown in Figures 4 and 5, the wire *w* enters the enamel bath 3 from the reel 1 and is coated with the enamel, and then after passing through the cylinder 13a enters the drying oven 5, and is dried therein. If there is a bad spot, current flows in the circuit A when such bad spot passes through the wet fabric 8, so that the electromagnet coil 24 is energized, thereby actuating the roller 22 to push one or more of the pins 19. When the projected pins come into contact with the roller 26, the circuit B is closed, energizing the coil 16, so that the lever 15 and consequently the cylinder 13a trips in downward direction. The parts are so arranged and adjusted that when the cylinder 13a trips in downward direction the bad spot in the wire simultaneously reaches the space within the cylinder. Thus, due to the quick downward movement of the cylinder 13a along the wire *w* moving upward in uniform speed, a thicker layer of enamel is formed in the portion of the wire having the bad spot. The cylinder 13a is returned upwardly by means of a spring 17, but such returning movement is limited by a suitable retardation means such as a dash-pot 17a, so that no spot coating is performed during such slow return motion.

Thus, in this form of apparatus, the wire is 70 moving upwards with uniform speed, and the spot coating operation is effected by quick lowering of the level of the coating material around the wire just before the bad spot leaves the level of the coating material, making it possible to re-

move knots formed by the spot coating or so called shoulders at the ends of the spot coating.

Figures 6 to 10 show still another form of the apparatus for carrying out the method of this invention. Therein numeral 1 is the drum or reel for the bare wire *w*; 3 is the enamel bath; 4 is the grooved coating roller rotatably mounted within said bath, and 5 is the drying oven. The bare wire *w* is coated with the enamel in the bath 3, when passing the roller 4 dipped in the bath and is dried while passing through the drying oven 5. The coated wire then changes its direction when passing around the roller 9' and passing the wet band in the detector pot 7, thereupon passes through the bath 3, and is coated again with the enamel by means of another coating roller 4'. After having passed the drying oven 5, the wire passes round the rollers 9' and 31, and the above mentioned coating operation is repeated for a desired number of times. Finally the finished wire is wound upon a take-up drum. Numeral 6 designates in general the device for detecting bad spots and consists of a pot 7 and a wet fabric 8 therein. The reference character 10 designates in general the spot coating device and consists of an enamel bath 11 placed adjacent to said wet fabric 8 in the direction of the movement of the wire, and includes a grooved roller 12a which is preferably driven from the shaft of said roller 9' by means of pulleys and belt 12b. Pivoted at 14 adjacent the enamel bath 11, is an iron lever 15b carrying at its lower end a dipper 13b normally dipped in the enamel bath, and the other end the lever 15b constitutes an armature for an electromagnet coil 16 which is connected to an amplifier 32 in the circuit A including the wire *w* and the wet fabric 8. When a bad spot passes the wet fabric 8, current flows through the circuit A, so that the electromagnet coil 16 is energized and attracts the upper end of the lever 15b, raising the dipper 13b, whereby the latter transfers a small quantity of enamel to the groove in the roller 12a. Thus, just as the bad spot in the wire comes in contact with said roller 12a, it is coated with said transferred quantity of enamel in the manner as shown in Figures 8 and 9. Inasmuch as the spot coating is conducted by means of the grooved transferring roller 12a which picks up a small quantity of enamel from the dipper 13b at the instant when the bad spot passes the detecting device 6 and transfers said enamel to the wire while rotating in the direction of the movement of the wire, it is possible to avoid the formation of considerably swelled coating as shown in dotted lines in Figure 10, but the spot coating portion tends to extend in the direction of the wire as shown in full lines in the same figure.

In the manufacture of coated insulated wire, it has been found that the formation of bad insulation spots generally originates in the presence of dusts and powders of electric conductive material adhering to the surface of the wire. In carrying out the method according to this invention, therefore, special means is preferably provided for cleaning as completely as possible the surface of the wire before it is introduced into the coating material bath for the purpose of eliminating the formation of the bad spots.

What I claim is:—

1. An apparatus for manufacturing coated insulated wire comprising means for feeding the wire over a coating bath and through a drying device, a wet band provided in the path of the coated wire, an electric circuit including said wet

band, the coated wire and a source of electricity for applying a test voltage, a time limit relay actuated by the current flowing in said circuit, a second electric circuit controlled by said time limit relay, an electromagnet coil and a spot coating device in said second circuit, a coating member in said coating device adapted to come momentarily into contact with the wire when actuated into its operative position by said electromagnet coil.

2. In an apparatus according to claim 1, means for feeding the wire downward into said bath, said wet band being situated in the path of the wire on the feeding side, said coating member consisting of a lever carrying a vertical cylinder at its feeding end and adapted to be dipped downward when actuated by said electromagnet coil, said cylinder surrounding said wire passing there-through, a spring tending to return said cylinder to normal position, and a dash pot for retarding the return motion of said cylinder.

3. In an apparatus according to claim 1, in which said band consists of a wet fabric in contact with the coated wire in the path of said wire, a grooved roller provided at a distance from said wet fabric in the direction of movement of the wire and adapted to receive the wire in the groove thereof, a lever adjacent said grooved roller and adapted to be actuated by said electromagnet coil, a dipper carried by one end of said lever and normally positioned in the coating bath and adapted only when oscillated to transfer a quantity of the coating material to a portion of the groove of said roller actuated by said electromagnet.

4. An apparatus for manufacturing coated insulated wire comprising means for feeding the wire over a coating bath and through a drying device, a wet band provided in the path of the coated wire, an electric circuit including said wet band, the coated wire and a source of electricity for applying a test voltage, an amplifier of the circuit, an electromagnet coil operating in the amplified circuit, and a spot coating device, a coating member in said coating device being adapted to let a coating material come momentarily into contact with the wire actuated into its operative position by said electromagnet coil.

5. An apparatus for manufacturing coated insulated wire comprising means for feeding the wire over a coating bath and through a drying device, a wet band provided in the path of the coated wire, an electric circuit including said wet band, the coated wire and a source of electricity for applying a test voltage, a time limit relay actuated by the current flowing in said circuit, a second electric circuit controlled by said time limit relay, an electromagnet coil, and a spot coating device in said second circuit, a coating member in said coating device being adapted to come momentarily into contact with the wire actuated into its operative position by a magnetic device operated by said electromagnet coil.

6. In an apparatus according to claim 5, means for feeding the wire downward into said bath, said wet band being situated in the path of the wire on the feeding side, said coating member consisting of a lever carrying a vertical cylinder at its feeding end and adapted to be dipped downward when actuated by said electromagnet coil, said cylinder surrounding said wire passing therethrough, a spring tending to return said cylinder to normal position, and a dash pot for retarding the return motion of said cylinder.

7. In an apparatus according to claim 5, in which said band consists of a wet fabric in contact with the coated wire in the path of said wire, a grooved roller provided at a distance from said wet fabric in the direction of movement of the wire and adapted to receive the wire in the groove thereof, a lever adjacent said grooved roller and adapted to be actuated by said electro- magnet coil, a dipper carried by one end of said lever and normally positioned in the coating bath and adapted only when oscillated to transfer a quantity of the coating material to a portion of the groove of said roller actuated by said electro- magnet.

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