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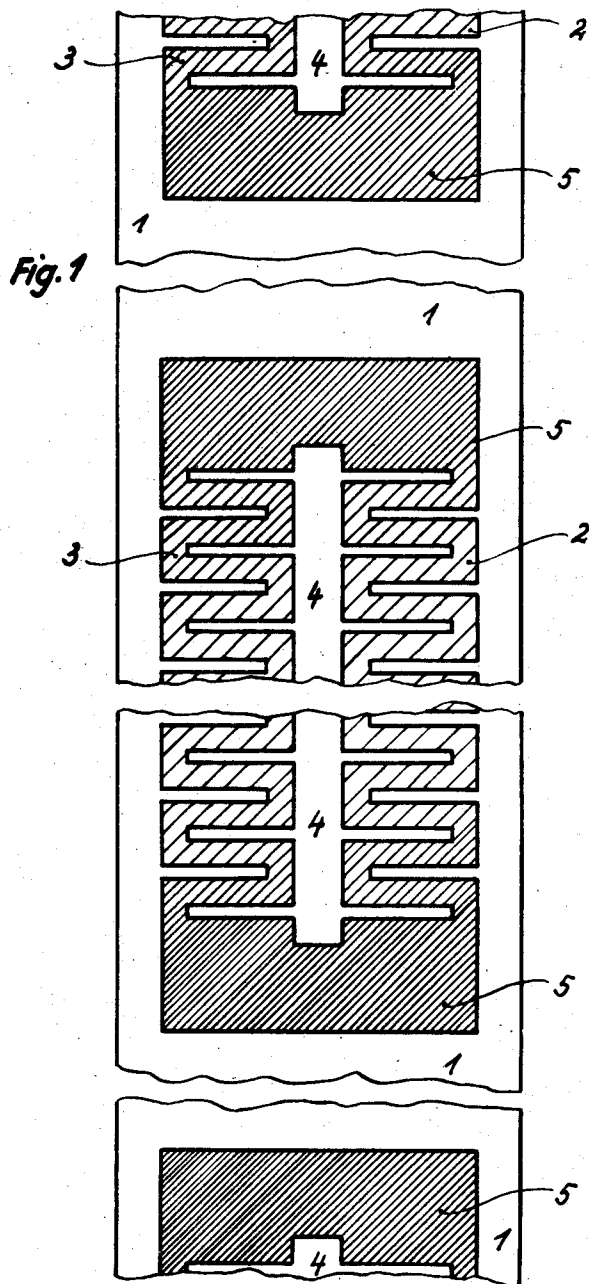
W. DORN

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PROCESS FOR THE PRODUCTION OF RESISTANCES

Filed July 26, 1938

2 Sheets-Sheet 1



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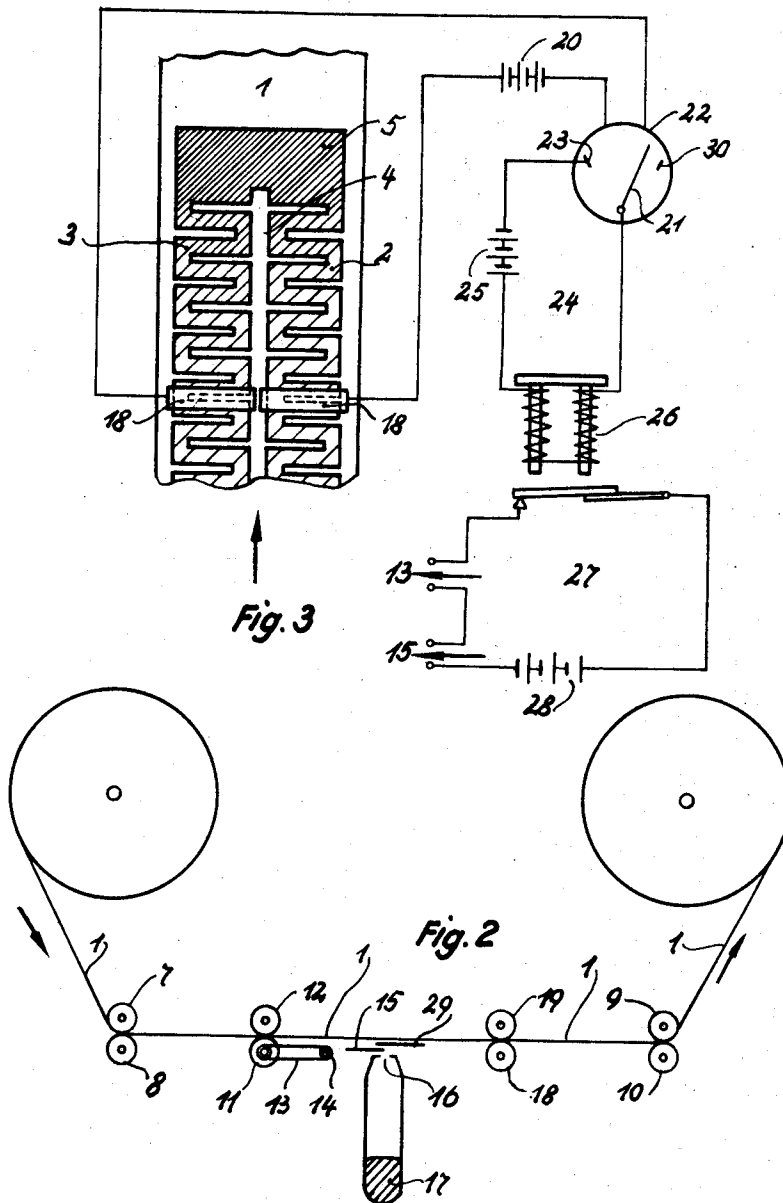
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UNITED STATES PATENT OFFICE

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PROCESS FOR THE PRODUCTION OF RESISTANCES

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8 Claims. (Cl. 201—69)

The present invention relates to processes for the production of metal-paper resistances with predetermined resistance values.

It has already been proposed to make electric resistances from metallised bands of insulating material, the metal coating being applied on the paper preferably in the form of a meander. According to a particularly advantageous process, the meander is produced by printing the paper with substances which give off vapour in a vacuum, and thereafter vapourising on a metal, i. e. applying metal in vapour form, the printed portions remaining free from metal. When using such metal-coated or metallised paper for resistances, it is desirable to have the resistances available in prescribed lengths or cuttings of definite resistance values, the limits of which cuttings are denoted by special marks or the like, which may for example be done by omitting the meandering in the metal layer vaporised-on. It is also possible to separate the several resistance cuttings from each other by runs of non-metallised paper. These non-metallised parts of the paper band can, given suitable length, also be used in place of the protecting cover which is otherwise specially wound on.

It is furthermore of importance, when using such resistances of metallised paper, to provide a faultless metal connection with the current supply, which entails certain difficulties in the case of metal layers of small thickness (in the resistances used metal layers of less than 1μ thickness are chiefly in question). When making resistances from metallised bands of insulating material it is furthermore important to increase the thickness of the metal layer at the points taking up the current, which feature may suitably be automatically combined with the making of the several resistance cuttings.

According to the present invention the resistance of the metal layers produced by vapouring a metal on to a band of insulating material is measured continuously, and on attainment of the required value allowing for the different constants of the manufacturing apparatus, a mark or a distinctive sign is produced on the resistance strip which may be done for example by cessation of the meander impression and/or by shutting off the metal vapour jet. It is also an essential feature of the invention that, say by enlarging or widening the metal vapour jet in the direction of movement of the band of insulating material, a thicker metal layer is applied on the paper support at the beginning and at the end of the resistance cutting, the meander, on discon-

tinuance of the impression at the ends of the single resistance cutting, passing finally into a connected metal layer.

The invention is more particularly described with reference to the accompanying drawings which show by way of example one form of construction of resistance band, in which runs of non-metallised paper are left between the single resistance cuttings, and in which

Figure 1 shows a part of the support band with resistance of prescribed amount applied thereon.

Figure 2 is a side view in diagram of the apparatus used for production of the resistances, and

Figure 3 is a diagram of the wiring arrangement.

In order to carry out the process, in place of the known form of meander, two meanders 2 and 3, having the width of the resistance strip, are applied on the paper support 1, which may be coated on both sides or likewise only on the side receiving the metal coating with a varnish or varnish-like insulating material, said meanders lying side by side and consisting of one metallisation. The dividing line 4 between the two meanders is, just like the meanders themselves produced by printing with a substance which in a vacuum and/or at high temperature gives off vapour, for example a fat (grease). If the printing roller is lifted off from the paper during the vaporising, the meander stops, and at the same time the dividing line 4 between the two meanders disappears. There is then formed a metal layer 5, which is unbroken and corresponds in its width to the lateral boundaries of the jet of vapour, and the length of which is limited by switching off the jet of vapour.

In the manufacturing apparatus working in a vacuum (see Figure 2) the paper support 1 is drawn from a storage roll and is fed through the driving rollers 7 and 8 or 9 and 10 respectively lying opposite each other to the printing arrangement 11/12 and the vaporising plant. Behind the rollers 7 and 8 the printing roller 11 with the back roller opposite to it 12 is fitted. The printing roller can, in a manner known in itself be constantly provided with the required quantity of the printing agent by a storage roller not shown and which transmits the printing agent. The printing roller 11 is suspended on the lever 13 which can pivot about the axis 14.

During the printing the printing roller 11 is, by means of an electromagnet, not shown, or another auxiliary device preferably of electric operation, pressed with the required pressure against the paper support 1 running over the

back roller 12. On discontinuance of the pressure the printing roller 11 automatically leaves the paper. For normal vaporisation the slide 15 is moved to the front of the aperture 16 of the metal vaporising furnace 17 by an electromagnetic device, so that it (the aperture) is reduced to a suitable narrow slit. On cessation of the force acting on the slide 15 the aperture of the metal vaporising furnace is correspondingly widened in the lengthwise direction of the paper to be metallised, and the thickness of the metal layer vaporised-on correspondingly increased.

After the band support 1 has, in its progressive movement in the direction of the arrow, left the nozzle 16 of the metal vaporizing furnace 17, it reaches the contact rollers 18, which press the band 1 against the back roller 19 and make contact with it at the places of the meanders 2 and 3. The width of the contact rollers 18 is so apportioned that they about correspond to the width of the meanders 2 and 3 (see Figure 3); over the two rollers 18 current from the battery 20 is fed to the meandering resistance passing by them, the amount of which current is continuously measured by the deflection of the needle 21 of the measuring instrument 22. At the beginning of the measurement the resistance is relatively small, and the needle 21 of the measuring instrument 22 undergoes a relatively large deflection through the correspondingly large amount of current. At that point of the scale which corresponds to the current corresponding to the desired amount of the resistance an adjustable contact 23 is fitted, which is in connection with a circuit 24 with the battery 25 and the relay 26. The circuit 24 can be closed by the needle 21 as soon as the latter makes contact with the contact 23, in which case, by actuation of the relay 26 the circuit 27 with the battery 28 is opened. In the circuit 27 there lies the electro-magnet for pressing down the printing roller 11 and also the electromagnet which holds the slide 15 in the position which produces a "normal" narrow outlet slit in the vapour furnace 17.

If when the paper strip 1 runs by, the desired resistance value is attained, or if the resistance meander is interrupted by any derangement or by a defect of material, the needle 21 owing to the falling off of current engages the contact 23 and in this way closes the circuit 24. The relay 26 thus supplied with current opens the circuit 27. Owing to de-energizing of the electromagnets lying in this circuit the printing roller 11 is lifted off and the slide 15 is opened.

In consequence of the widening which then takes place of the outlet nozzle of the metal vapour furnace 17 the thickness of the metal deposits is increased, and the meander thus increased finally, as soon as the parts of the paper which is no longer printed comes in front of the metal vapour nozzle is changed into a connected relatively thick metal deposit.

As soon as this massive and thick metal coating comes between the rollers 18, the resistance between these rollers becomes very small, as the current now takes the direct path through the thick metal deposit. The measuring instrument 22 therefore indicates a high current value, so that the needle reaches the contact 30 lying on the right hand side of the scale. By this a further circuit, not shown, is closed which, with the interposition if necessary of suitable relays or the like, serves for completely shutting of the aperture 16 of the vapour furnace 17 by means

of a second slide 29. The consequence of this is that the paper from that point onwards remains without metal coating.

By any suitable mechanism which may for example be actuated by the driving rollers after running over a predetermined piece of non-metallised paper, the slide 29 is again pushed back at the beginning of the making of the next resistance cutting, so that out of the widened aperture of the vapour furnace 17 a thick metal vapour jet is directed against the paper strip, and here again there is formed a connected metal deposit which constitutes the beginning of the new resistance cutting. By means of the needle 21 of the metering instrument 22 which during the time of non-vaporising, lies against the contact 23, the circuit 24 is interrupted through the relay 26. The printing roller 11 during that time does not lie against the paper band 1 and the slide 15 releases a wide outlet aperture 16 of the metal vapour furnace 17. Therefore as soon as the slide 29 at the end of a non-vapouring period, releases the outlet of the metal vapour jet on to the paper strip 1, a relatively thick connected metal deposit is in the first place formed on the latter. As soon as this continuous metal deposit with relatively little resistance reaches the contact rollers 18, a relatively large amount of current flows over it through the metering instrument 22. The consequence is that the needle 21 leaves the contact 23, and by de-energizing of the relay 26 the circuit 27 is again closed. By a means which need not be specified here (for example a retarding relay or the like) provision is made to ensure that, by the temporary impact of the needle 21 against the contact 30 the slide 29 is not at once pushed again in front of the vapour nozzle of the metal vapour furnace 17.

By closing the circuit 27 the printing roller 11 is again pressed against the paper band 1 and produces the impression with grease or the like required for the production of the meander form. Likewise, by the circuit 27, the slide 15 is pushed in front of the aperture 16 of the metal vapour furnace 17, so that now only a slit of normal width, such as is required for production of the normal meander, remains free. By retarding measures of a kind known in themselves provision may be made in order that the narrowing of the outlet nozzle of the metal vapour furnace by the slide 15 shall only take place after the first again printed parts of the paper band have reached the metal vapour jet, so that the originally greater thickness of the meandered parts of the metallising is gradually reduced to the normal thickness.

A normal meander with normal thickness of the metal coating is now produced. The resistance of the part of the resistance meander produced from time to time is measured by the current of the battery 20 fed to it through the contact rollers 18, until, after the required resistance value has been attained, the needle 21 makes contact with the contact 23, and in this way the operations are repeated in the manner described above.

The position of the contacts 23 and 30, the inertia of the relay 26 and also that of the electromagnets which provide for the actuation of the printing roller lever 13 and the slide 15 can be so influenced by means known in themselves, that the desired operation(s) take place at the moments indicated from time to time. Needless to say, the two meanders running side by side can be used as one unit. In that case a resistance

value is obtained which, with equal metal thickness and like form of meander amounts to one-fourth of the measured resistance. If therefore, it is desired to produce resistances with the highest possible value per unit of length, it will be better to make the resistance band with the two meanders of the two-fold desired width and to cut them apart along the separating line for the purpose of use.

It is no deviation from the essence of the invention if the disposition of the several structural elements is modified as compared with the constructional example illustrated and described, if the arrangement which serves for measuring the resistance cutting produced each time is a different one or likewise if the mechanical auxiliaries for that purpose, and also the mutual dependence and control is different from that which is the case in the constructional example described, provided only that the inventive idea is the same as regards its principle.

With like meandering and like thickness of the metal deposit an alteration of the resistance value can be effected by cutting apart a double meander strip along the dividing line 4. Moreover with like length and like width a quadruplication of the resistance value can be obtained by removing the metal deposit which connects them, at one end only of the double meander, and having a current supply to each meander end which thus arises.

I declare that what I claim is:

1. A process for the continuous production of resistances comprising coating a band of insulating material with metal to form continuously thereon two adjacent spaced uniform strips of metal of gradually increasing length, said strips being conductively connected at the beginning end of each, constantly measuring the resistance of said strips during the production thereof by passing an electric current through the whole length existing at any time on said band of both strips connected in series, and interrupting the production of said metal strips after a predetermined resistance value has been attained.

2. A process for the continuous production of resistance layers on bands of insulation material having such a length that a large number of resistances of the desired value can be produced thereon comprising producing two spaced adjacent uniform metal layers in the form of meanders of continuously increasing length on said band, said meanders being conductively connected at the beginning end of each, constantly measuring the resistance of said meanders during the production thereof by means of an electric current conducted through the whole length existing at any time on said band of both meanders connected in series, and interrupting the production of the metallic meanders after attaining a predetermined resistance value.

3. A process for the continuous production of resistance layers on bands of insulation material having such a length that a large number of resistances of the desired value can be produced thereon comprising producing two spaced adjacent uniform metal layers in the form of meanders of continuously increasing length on said band, said meanders being conductively connected at the beginning end of each, constantly measuring the resistance of said meanders during the production thereof by means of an electric current conducted through the whole length existing at any time on said band of both meanders connected in series, and producing a mark

on said band when a predetermined resistance value has been attained.

4. A process for the continuous production of resistances comprising applying metal to a band of insulating material, moving said band past the metal-applying means to provide a substantially uniform conductive coating of metal on said band, preventing application of metal at certain points after an initial uniform application to provide two spaced adjacent metal strips conductively connected at their beginning ends, constantly measuring the resistance of said strips during the production thereof by means of an electric current conducted through the whole length existing at any time on said band of both strips connected in series, and interrupting the application of metal to said band after a predetermined resistance value has been reached.

5. A process for the continuous production of resistances comprising applying metal to a band of insulating material, moving said band past the metal-applying means to provide a substantially uniform conductive coating of metal on said band, increasing the amount of metal applied at certain periods without changing the rate of movement of said band to provide thicker coatings of metal at certain points which merge with the thinner coatings at other points, preventing application of metal at certain points after an initial uniform application to provide two spaced adjacent metal strips conductively connected at their beginning ends, constantly measuring the resistance of said strips during the production thereof by means of an electric current conducted through the whole length existing at any time on said band of both strips connected in series, and interrupting the application of metal to said band after a predetermined resistance value has been reached.

6. A process for the continuous production of resistances comprising applying a vaporizable precipitation-preventing substance at spaced points along a band of insulating material and then metallising the uncoated portions of the material by thermal vaporization of metal in vacuo while moving the band past the vaporizer to form two adjacent spaced metal layers in the form of meanders on said band conductively connected at their beginning ends, constantly measuring the resistance of said meanders during the production thereof by means of an electric current conducted through the whole length existing at any time on said band of both meanders connected in series, and interrupting the application of metal to said band after a predetermined resistance value has been attained.

7. A process for the continuous production of resistances comprising applying a vaporizable precipitation-preventing substance at spaced points along a band of insulating material and then metallising the uncoated portions of the material by thermal vaporization of metal in vacuo while moving the band past the vaporizer to form two adjacent spaced metal layers in the form of meanders on said band conductively connected at their beginning ends, constantly measuring the resistance of said meanders during the production thereof by means of an electric current conducted through the whole length existing at any time on said band of both meanders connected in series, and interrupting the application of the precipitation-preventing substance and of said metal to said band after a predetermined resistance value has been attained.

8. A process for the continuous production of resistances comprising applying a vaporisable precipitation-preventing substance at spaced points along a band of insulating material and then metallising the uncoated portions of the material by thermal vaporization of metal in vacuo while moving the band past the vaporizer to form two adjacent spaced metal layers in the form of meanders on said band conductively connected at their beginning ends, increasing the amount of metal applied at certain periods without changing the rate of movement of said band

5 to provide thicker coatings of metal at the beginning and ending of said meanders, constantly measuring the resistance of said meanders during the production thereof by means of an electric current conducted through the whole length existing at any time on said band of both meanders connected in series, and interrupting the application of the precipitation-preventing substance and of said metal to said band after a pre-determined resistance value has been attained.

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