

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN AND RELATING TO THE CONTINUOUS APPLICATION OF COATINGS BY ELECTROLYSIS

(71) We, GALENTAN AG, a Swiss Company of Gartenstrasse 2, Zug, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a method and device for the continuous electrolytic application of a complete or partial strip, ribbon or patch-shaped coating, for example, of a noble metal such as gold to an electrically conductive tape, which is directed by an electrically insulating roller across a solution of an electrolyte containing a coating metal with an electrolysis current being directed between the electrolyte and the conductive tape.

Electrical parts such as contacts, holders of semiconductor elements and integrated circuits are often punched from endless tapes. The selective application of, for example, gold layers to separate elements, that is to say the application to the areas where the layers have an operative function, is costly in labour and it is, therefore, important to provide the tapes prior to or after punching, when the products are still interconnected by means of auxiliary strips, with the required selective layer, for example, the gold layer.

In addition, the required metal layer, usually a precious metal such as gold, is expensive so that a satisfactory, selective deposition and a sharp limitation of the required pattern may provide material saving of costs.

The invention provides a method and a device which satisfy these requirements in a very simple manner. The invention enables a great variety of patterns of noble metal to be applied by electrolysis with great accuracy and at a high rate by means of expedients of low cost.

According to the present invention, there is provided a method of electrolytically continuously applying a complete or partial strip, ribbon or patch-shaped coating for example of a precious metal such as gold to an electrically conductive tape or strip, which is transported by an electrically insulating roller across a solution of an electrolyte containing the coating material, the electrically conductive tape or strip being fed in fluid-tight contact with the surface of the roller through a bath of the electrolyte wherein said roller is partly immersed, and electrolyte being sprayed in said bath on said part of the tape or strip which is in contact with the roller by spray means, while a positive electrical potential is present on anode means located in said bath separately from said spray means. Advantageously the coating may be delimited by at least one masking or supporting tape which moves together with the first mentioned tape or strip and which is made of electrically insulating material and which partially covers the first tape or strip.

The edges of the masking or second tape may extend parallel to those of the first tape, in which case the pattern on the first tape is rectilinear, or the second tape may be provided with apertures of suitably chosen shape, which provides relatively separated patterns. In both cases the coated tape or strip, if necessary after further treatment, can be divided into smaller portions for obtaining the desired shape and size of the objects.

If one side of the conductive tape has to be completely coated with a gold layer, the second tape need, if desired, only be employed for rotating the roller or propelling the guide member or the second tape is not used at all. As a matter of course, in the case of complete gliding of one side of the metal tape this second tape must not

cover said conductive tape.

It is furthermore possible to coat the electrically conductive tape partially on both sides with a layer or a pattern.

- 5 The invention will be described more fully with reference to the following drawings, which show various examples of the invention.

In the drawings:

- 10 Figs. 1 to 9 illustrate various examples of the method of coating the first tape using the second tape so that various patterns of coating material can be obtained.

- 15 Fig. 10 shows a first embodiment of a device in accordance with the invention.

Fig. 11 illustrates another relative disposition of the two tapes.

Fig. 12 illustrates a patch-shaped distribution of deposits.

- 20 Fig. 13 illustrates a perforation of the second tape.

Fig. 14 shows a second embodiment of the device in accordance with the invention.

- 25 Referring to Figs. 1 to 9, reference numeral 3 designates the roller or guide member for the tape or strip 1. The roller 3 is provided with a weak, elastic coating 4 which provides a fluid-tight seal of the inner side of the tape 1. Reference numeral 30 13 designates the spray pipes for the solution with the desired electrolyte: 14 is the anode connected to the positive terminal of a direct-current source, the negative terminal of which is connected to the cathode.

- Fig. 1 illustrates an example in which one side of the tape 1 is completely coated, for example, with a gold layer so that a second tape or further tapes 8 shown in Figs. 2 to 9 are not employed.

- Fig. 2 shows two masking tapes 8 which partially cover in a fluid-tight manner the tape or strip 1 and thus the tape 1 may be gilded with a layer of the desired width 15. As a matter of course, such a strip layer may be applied to any area of the tape 1.

- Fig. 3 illustrates how partially on two sides of the tape or strip layers or patterns 15 may be applied, in the first place because the tape or strip 1 is located partially beyond the righthand side of the elastic cover 4 and secondly because the tape 8 covers only partially the tape 1. The layers 15 on both sides of the tape need not have the same width as is indicated in Fig. 3. The tape can also be coated on its inner side by providing grooves in the surface of the roller.

- Fig. 4 illustrates an example of a divided roller 3', 3" leaving a central slot or aperture and adapted to rotate about a hollow shaft 23 so that a spray pipe 13 for the supply of the electrolyte can be passed through the shaft 23. Fig. 4 shows that to

the inner side of the tape 1 a layer or pattern 15 can be applied, whilst for example on the other side two layers or patterns 15 can be simultaneously applied.

Figs. 5, 6 and 7 show some further examples for the application of layers.

Figs. 8A, 8B and 8C show (Fig. 8A) the conventional composition of the roller 3 with the elastic coating 4, the tape 1 and the masking tape 8 and (Fig. 8B) the tape 8 separately, the patches 15 representing the desired metal deposits, which correspond to the apertures 16 of the tape 8 as shown in Fig. 8C. Fig. 8B shows furthermore recesses 21.

Fig. 9 illustrates that simultaneously a plurality of tapes 1, for example of the type shown in Fig. 8B, can be treated by the process of continuously applying strip-, ribbon- or patch-shaped coatings to a metal tape.

When a device as shown in Fig. 10 is employed, the operation is as follows.

The tape 1 is passed via a guide roller 2 along the circumference of the wheel or roller 3. The circumference is provided with a weak, elastic coating 4 (Fig. 11) so that a fluid-tight seal on the inner side of the tape 1 is obtained. The tape leaves the roller 3 via a guide roller 5, on which, if desired, an after-treatment of the tape can be carried out. An endless belt 8 is passed along the rollers 6 and 7. A plurality of such belts 8 may be provided for example as shown in Figure 11. These belts are formed by a core of weak, elastic material coated on the side engaging the tape 1 with a soft layer. The belts 8 are guided along the rollers 9 and a stretching member 10, which may be combined with a cleaning device for removing adhering electrolyte from the belt 8. The roller 3 is journaled in a container 11 for the electrolyte 12. The container 11 contains a solution of a compound of the metal (e.g. gold) to be deposited. One or more nozzles 13 are provided for spraying the liquid against the surface of the tape 1 to be coated. This may be carried out by means of a pumping device (not shown). The container 11 comprises furthermore an anode 14, which is connected to the positive terminal of a direct-current source, the negative terminal of which is connected to the tape 1.

In this manner the passage of current produces a metal deposit on the areas 15 of the tape 1, which is, for example, provided with a line-shaped coating and which leaves the roller 3 via the roller 5.

By an axial displacement of the rollers 2 and 5 the position of the deposit 15 can be adjusted at will.

In this manner by means of a single device a line pattern can be applied to tapes

having different widths and at arbitrary positions.

In Figs. 1 to 9 the direction of flow of the electrolyte is indicated by arrows. In Fig. 1 a surface is coated throughout its width, whereas Fig. 2 shows a coating of only the central part. Fig. 3 shows a coating of the two sides of a tape and Fig. 4 shows the coating of the two edges and on the other side a coating of the tape 1. Fig. 5 shows the simultaneous coating of two lines or strips on a tape, whereas Fig. 6 shows two edge deposits on two sides like Fig. 7, the widths on the two sides being, however, different. In the latter two cases, as in Fig. 3, the rear side of the tape has to be partially free. Figs. 8 and 9 show the possibility of applying separate coatings: Fig. 9 shows the simultaneous treatment of two tapes. Fig. 12 illustrates the application of a patch-shaped pattern with the aid of a perforation of the kind shown in Fig. 13.

In the embodiment shown in Fig. 14 the tape 1 is supplied along the guide roller after the required preliminary treatment (not shown). A combination 2-22 of two rollers is used, which are coupled in synchronism by means of a gear wheel drive. The roller 22 is provided with pick-up pins 17, which co-operate with the recesses 21 of the tape 1. To the roller 2 is simultaneously fed the supporting belt 8 along the guide roller 9 and the stretching member 10. The supporting belt 8 has a larger width than the first tape 1. The supporting belt 8 has recesses 16 (Fig. 13) which correspond to the desired gold patches 15 on the tape 1. By means of projections 18 on the roller 2 the supporting belt 8 is so arranged opposite the tape 1 that the recesses 16 are located accurately at the desired positions.

The pitch 20 of the recesses 16 in the supporting belt 8 is chosen to be smaller than the pitch 19 of the patches in the tape 1. Owing to the elasticity of the supporting belt 8 and with the aid of the stretching member 10 the feed of the belt 8 can be regulated so that a very uniform synchronous movement of the belt 8 is ensured. The difference between the pitches 20 and 19 of the recesses 16 and 21 (See Figs. 12 and 13) is preferably more than 0.1% and less than 20%. With smaller differences the pressing force of the belt 8 on the tape 1 is slight during the passage across the electrolyte, which gives rise to unsharp patterns 15. An excessive difference has to be compensated for by an excess tension of the belt so that deformations of the recesses 16 may be involved.

It will be obvious that by driving the wheel 3 or the supporting belt 8 the feed and withdrawal of the tape 1 can be per-

formed substantially without stress so that it is possible to treat extremely fine punching patterns in the tape 1 without deformations. It is possible to arrange simultaneously two or more tapes 1 and belts 8 along the wheel 3.

The pre- and after-treatments such as degreasing, washing and deoxidation may be carried out in known manner.

By using an automatic unwinding and winding-up apparatus for the tape 1 a device can be obtained, in which during a single passage 1 or simultaneously a plurality of tapes 1 can be provided with a line or patch pattern at a high rate and at low costs.

WHAT WE CLAIM IS:—

1. A method of electrolytically continuously applying a complete or partial strip-, ribbon- or patch-shaped coating for example of a precious metal such as gold to an electrically conductive tape or strip, which is transported by an electrically insulating roller across a solution of an electrolyte containing the coating material, the electrically conductive tape or strip being fed in fluid-tight contact with the surface of the roller through a bath of the electrolyte wherein said roller is partly immersed, and electrolyte being sprayed in said bath on said part of the tape or strip which is in contact with the roller by spray means, while a positive electrical potential is present on anode means located in said bath separately from said spray means.

2. A method as claimed in Claim 1, in which the tape or strip on the outer side is in fluid-tight contact with a second tape serving as a masking or supporting tape which moves together with the first mentioned tape or strip and which is made of electrically insulating material and which partially covers the first tape.

3. A method as claimed in Claim 2, in which the edges of the second tape extend parallel to those of the first tape, and delimit the coated area on the conductive tape or strip.

4. A method as claimed in Claim 2, in which the second tape is a masking tape provided with equally spaced apertures in the form of a desired pattern.

5. A method as claimed in any one of Claims 2 to 4, in which a number of masking tapes of electrically insulating material are provided for providing one or more electrically conductive tapes simultaneously with a pattern.

6. A method as claimed in any one of Claims 2 to 5, in which the conductive tape or tapes project(s) beyond the roller or over grooves formed in the roller so that also on the inner side of the tape a partial coating is obtained.

7. A method as claimed in any one of



having different widths and at arbitrary positions.

In Figs. 1 to 9 the direction of flow of the electrolyte is indicated by arrows. In Fig. 1 a surface is coated throughout its width, whereas Fig. 2 shows a coating of only the central part. Fig. 3 shows a coating of the two sides of a tape and Fig. 4 shows the coating of the two edges and on the other side a coating of the tape 1. Fig. 5 shows the simultaneous coating of two lines or strips on a tape, whereas Fig. 6 shows two edge deposits on two sides like Fig. 7, the widths on the two sides being, however, different. In the latter two cases, as in Fig. 3, the rear side of the tape has to be partially free. Figs. 8 and 9 show the possibility of applying separate coatings: Fig. 9 shows the simultaneous treatment of two tapes. Fig. 12 illustrates the application of a patch-shaped pattern with the aid of a perforation of the kind shown in Fig. 13.

In the embodiment shown in Fig. 14 the tape 1 is supplied along the guide roller after the required preliminary treatment (not shown). A combination 2-22 of two rollers is used, which are coupled in synchronism by means of a gear wheel drive. The roller 22 is provided with pick-up pins 17, which co-operate with the recesses 21 of the tape 1. To the roller 2 is simultaneously fed the supporting belt 8 along the guide roller 9 and the stretching member 10. The supporting belt 8 has a larger width than the first tape 1. The supporting belt 8 has recesses 16 (Fig. 13) which correspond to the desired gold patches 15 on the tape 1. By means of projections 18 on the roller 2 the supporting belt 8 is so arranged opposite the tape 1 that the recesses 16 are located accurately at the desired positions.

The pitch 20 of the recesses 16 in the supporting belt 8 is chosen to be smaller than the pitch 19 of the patches in the tape 1. Owing to the elasticity of the supporting belt 8 and with the aid of the stretching member 10 the feed of the belt 8 can be regulated so that a very uniform synchronous movement of the belt 8 is ensured. The difference between the pitches 20 and 19 of the recesses 16 and 21 (See Figs. 12 and 13) is preferably more than 0.1% and less than 20%. With smaller differences the pressing force of the belt 8 on the tape 1 is slight during the passage across the electrolyte, which gives rise to unsharp patterns 15. An excessive difference has to be compensated for by an excess tension of the belt so that deformations of the recesses 16 may be involved.

It will be obvious that by driving the wheel 3 or the supporting belt 8 the feed and withdrawal of the tape 1 can be per-

formed substantially without stress so that it is possible to treat extremely fine punching patterns in the tape 1 without deformations. It is possible to arrange simultaneously two or more tapes 1 and belts 8 along the wheel 3.

The pre- and after-treatments such as degreasing, washing and deoxidation may be carried out in known manner.

By using an automatic unwinding and winding-up apparatus for the tape 1 a device can be obtained, in which during a single passage 1 or simultaneously a plurality of tapes 1 can be provided with a line or patch pattern at a high rate and at low costs.

WHAT WE CLAIM IS:—

1. A method of electrolytically continuously applying a complete or partial strip-, ribbon- or patch-shaped coating for example of a precious metal such as gold to an electrically conductive tape or strip, which is transported by an electrically insulating roller across a solution of an electrolyte containing the coating material, the electrically conductive tape or strip being fed in fluid-tight contact with the surface of the roller through a bath of the electrolyte wherein said roller is partly immersed, and electrolyte being sprayed in said bath on said part of the tape or strip which is in contact with the roller by spray means, while a positive electrical potential is present on anode means located in said bath separately from said spray means.

2. A method as claimed in Claim 1, in which the tape or strip on the outer side is in fluid-tight contact with a second tape serving as a masking or supporting tape which moves together with the first mentioned tape or strip and which is made of electrically insulating material and which partially covers the first tape.

3. A method as claimed in Claim 2, in which the edges of the second tape extend parallel to those of the first tape, and delimit the coated area on the conductive tape or strip.

4. A method as claimed in Claim 2, in which the second tape is a masking tape provided with equally spaced apertures in the form of a desired pattern.

5. A method as claimed in any one of Claims 2 to 4, in which a number of masking tapes of electrically insulating material are provided for providing one or more electrically conductive tapes simultaneously with a pattern.

6. A method as claimed in any one of Claims 2 to 5, in which the conductive tape or tapes project(s) beyond the roller or over grooves formed in the roller so that also on the inner side of the tape a partial coating is obtained.

7. A method as claimed in any one of

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the preceding claims in which on the side facing the rotatable roller the tape is simultaneously provided with a desired pattern by providing the roller with one or more slots or apertures, through which the electrolyte containing the coating material is brought into contact with the side facing the roller.

8. A device for carrying out the method claimed in any one of the preceding claims comprising a trough, an electrically insulating roller mounted so as in use partially to dip into a bath of electrolyte contained in said trough, anode means mounted in said trough, spray means for spraying electrolyte mounted in said trough separate from said anode means for spraying electrolyte onto an electrically conductive tape or strip passing through the bath while in contact with the surface of the roller, and means for guiding the tape or strip into the trough, round said roller and then away from the trough.

9. A device according to Claim 8, in which a supporting or masking tape of electrically insulating material is mounted to travel through said trough in contact with said tape or strip on the side thereof remote from said roller and between said tape or strip and said spray means.

10. A device as claimed in Claim 9, in which said supporting or masking tape is an endless belt.

11. A device as claimed in Claim 10, in which said supporting or masking tape is an endless belt made of elastic material.

12. A device as claimed in any one of Claims 9 to 11 in which the means for guiding the tape or strip into the trough comprises guide rollers one of which is provided with pick-up pins for engaging the tape or strip so as to ensure the correct location of the tape or strip in relation to the supporting or masking tape.

13. A device according to any one of Claims 9 to 11 in which the tape or strip and the supporting or masking tape are provided with equally spaced apertures or recesses for engagement by projections on co-operating guide rollers ensuring the correct location of the tape or strip with the supporting or masking tape.

14. A device as claimed in Claim 13, in which the pitch of the recesses or apertures in the supporting or masking tape is smaller than the desired pitch of the patterns on the conductive tape or strip so that, when the device is in operation, the supporting or masking tape is pressed with a given amount of stress against the conductive tape or strip.

15. A device substantially as described with reference to Figure 1 of the accompanying drawings.

16. A device substantially as described with reference to Figure 2 of the accompanying drawings.

17. A device substantially as described with reference to Figure 3 of the accompanying drawings.

18. A device substantially as described with reference to Figure 4 of the accompanying drawings.

19. A device substantially as described with reference to Figure 5 of the accompanying drawings.

20. A device substantially as described with reference to Figure 6 of the accompanying drawings.

21. A device substantially as described with reference to Figure 7 of the accompanying drawings.

22. A device substantially as described with reference to Figures 8A, 8B, 8C of the accompanying drawings.

23. A device substantially as described with reference to Figure 9 of the accompanying drawings.

24. A device substantially as described with reference to Figures 10 and 11 of the accompanying drawings.

25. A device substantially as described with reference to Figures 12, 13, 14 of the accompanying drawings.

26. A conductive tape wholly or partially covered with a metal layer which is applied by the method claimed in any one of claims 1 to 7 or by means of the device claimed in any one of claims 8 to 25.

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