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 APPARATUS AND METHOD OF PRODUCING
 METAL SHEETS BY SPRAYING ACTION
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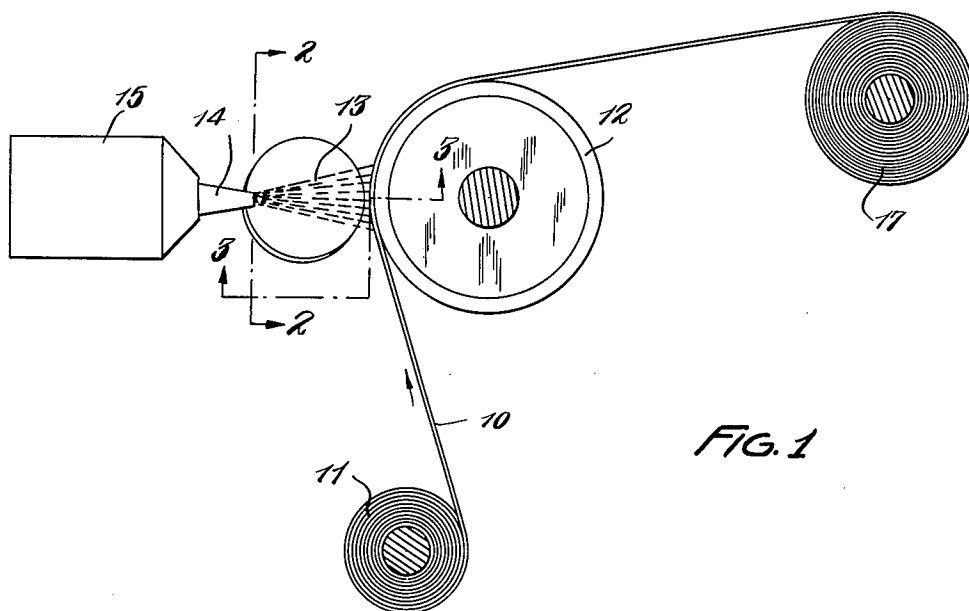


FIG. 1

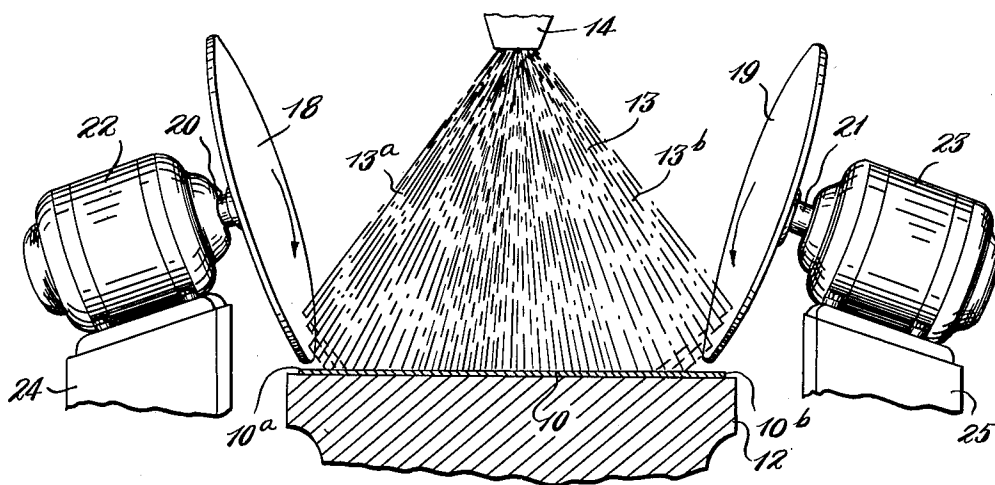


FIG. 3

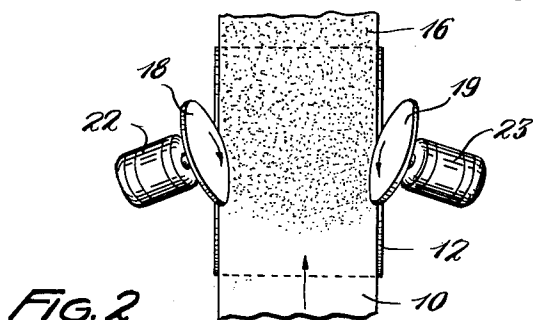


FIG. 2

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APPARATUS AND METHOD OF PRODUCING METAL SHEETS BY SPRAYING ACTION

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9 Claims. (Cl. 117—105)

This invention relates to the production of uniform gauge lengthy metal sheets or strips by means of a continuous spraying operation and wherein there is continuous relative movement between a base strip and the spray means.

Heretofore there have been various methods proposed for the production of thin, porous metal sheets or strips such as are used in the production of various types of electrical condensers. Usually, in the production of strips of this type, a porous gauze or paper base strip is used onto which metallic particles are sprayed to deposit metal on the base strip and form therefrom the continuous, elongate porous metal strip that has desirable properties for use in condenser manufacture.

One difficulty in producing the condenser forming strips is that the sprayed metal particles do not deposit uniformly on the base strip because the sprayed particles tend to be more densely distributed in the center part of the spray zone than at the marginal portions of the spray zone. Also, in many instances, the marginal portions of the zone or field of sprayed metal pass outside of or beyond the edges of the base strip and are wasted and only the center portions of the spray zone produce a deposit on the base strip. Even if attempts are made to salvage the sprayed metal that does not deposit upon the base strip, still such metal must be reprocessed, or at least must be sprayed again in order to effect a utilization thereof.

The general object of the present invention is, therefore, to provide a novel method of depositing metal particles so as to efficiently and economically form a metallic strip which is of a substantially uniform thickness gauge transversely of the strip.

Another object of this invention is to provide a novel method of depositing sprayed metal particles on a base strip in which substantially all of the sprayed particles, including those in the marginal portions of the spray zone, are deposited on the base strip and wherein the application of the sprayed metal particles to the base strip is carried out as a substantially continuous operation and produces a deposit which is of a substantially uniform thickness transversely of the strip.

A further object is to provide a novel method and apparatus for producing such a spray deposited metal strip in which a base strip is moved through a molten metal particle spray field to be impinged directly by a main or central portion of the spray field and in which the metal particles of edge portions of the spray field are deflected during the travel thereof to insure the deposit of such particles on the base strip.

Still another object is to provide a novel method and apparatus of the character just mentioned in which the deflection of the metal particles of the edge portion of the spray field is a surface impingement deflection utilizing a deflecting surface, preferably a rotatably driven disk, located adjacent an edge of the base strip and disposed in angular relation to the face of the base strip.

As an additional object this invention provides a novel

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method and apparatus of the character referred to in which a pair of divergently disposed rotatably driven deflecting disks are located adjacent the edges of a base strip being advanced through a molten metal particle spray field and are impinged by edge portions of the spray field for deflecting the particles thereof onto the edge portions of the base strip.

The foregoing and other objects and advantages of the invention will be made apparent as the specification proceeds.

This application is a continuation-in-part of application Serial No. 15,474, filed March 17, 1948.

Reference is made to the accompanying drawings wherein:

Fig. 1 is an elevation diagrammatically illustrating the method of spraying metal particles in accordance with this invention and showing apparatus for carrying out the method;

Fig. 2 is an elevation looking toward the base strip being coated, the view being taken substantially as indicated by section line 2—2 of Fig. 1; and

Fig. 3 is another elevational view further illustrating the spraying method and apparatus with a portion of such apparatus shown in section, the view being taken substantially as indicated by section line 3—3 of Fig. 1.

In carrying out the spraying operation in accordance with the present invention, a base strip 10 is withdrawn from a supply roll 11 and is led over a backing roll or mandrel 12. In passing over the roll 12, one face of the base strip is presented to a spray field 13 of molten metal particles produced by the spray nozzle 14 of a conventional spray device 15. The portion of the base strip leaving the roll 12 has the desired sprayed metal deposit or strip 16 thereon and passes to the take-up roll 17 on which the coated base strip can be stored.

The base strip 10, as mentioned above, may be a strip of porous gauze or paper, or it may be any other strip material suitable for use as a base in forming the spray-deposited metal strip or coating 16.

The spray device 15 is located adjacent the roll 12 such that the spray field 13 will be directed against the surface of the base strip 10 with the central axis of the spray field substantially normal to the base strip and intersecting the strip substantially at the longitudinal center line thereof. Since the nozzle 14 is a spray nozzle of a conventional type, it produces a molten metal particle spray field of a variable intensity and having a maximum density at its central axis and a minimum density at the outer edges of the spray field. The spray field produced by the nozzle 14 also has an impact width which is greater than the width of the base strip 10 such that the edge portions of the spray field, which are of minimum density, travel along paths which carry them outwardly of the longitudinal side edges 10^a and 10^b of the base strip.

In accordance with the present invention, the relatively thin edge portions of the spray field 13 which are traveling in a direction to pass outwardly of the side edges of the base strip, are returned to the base strip by deflection and deposited thereon to constitute a part of the spray-deposited metal coating 16. As shown in Fig. 3, the deflection of these edge portions of the spray field 13 is accomplished by a surface impingement of these portions of the spray field on deflecting surfaces which are preferably in the form of disks 18 and 19.

The deflecting disks 18 and 19 are located so as to have their lower segments above and immediately adjacent to the longitudinal side edges 10^a and 10^b of the portion of the base strip 10 which is supported by the roll 12. The deflecting disks 18 and 19 are also disposed in a diverging or outwardly inclined relation to the plane of the base strip, such that the deflecting surface of each disk defines an obtuse angle with the base strip.

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The central portion of the spray field 13 impinges directly against the main or central portion of the base strip 10 as shown in Fig. 3 and the edge portions 13^a and 13^b of the spray field impinge against the lower segments of the deflecting disks 18 and 19 and which lower segments overhang the edge portions of the base strip. The metal particles of these edge portions of the spray field are thereby deflected inwardly onto the adjacent edge portions of the base strip. Portions of the edges of the spray field 13 fall on the edge portions of the base strip 10 and would ordinarily produce a relatively thin metal coating thereon but, by the deflection back onto the base strip of those portions of the spray field which strike the disks 18 and 19, the thickness of the edge portions of the deposit will be increased to substantially the same thickness as that of the deposit formed on the central portion of the base strip.

The deflecting disks 18 and 19 are fixed on the shafts 20 and 21 of a pair of variable speed electric motors 22 and 23 which are mounted on suitable supports 24 and 25 adjacent the roll 12. The motors 22 and 23 drive the disks 18 and 19 at the desired speed and in a direction such that the lower segments of the disks are moving inwardly toward the base strip. The rotation of the disks causes a motion component to be imparted to the deflected particles, as through the effect of centrifugal force, by which they are carried inwardly with the desired velocity and impinge against and are deposited on the edge portions of the base strip 10.

In the arrangement above described for the roll 12 and the deflecting disks 18 and 19, it will be seen that the intermediate portions of the base strip 10 are located between the deflecting disks such as to receive the intermediate portion of the spray field 13 by direct impingement thereon. The edge portions of the spray field which are of minimum density and which would ordinarily produce a relatively thin metal deposit on the edge portions of the base strip, strike the deflecting disks 18 and 19 and are deflected flingingly thereby onto such edge portions of the base strip such that the quantity of metal particles then being applied to the edge portions of the base strip will be sufficient to cause the metal deposit being formed on such edge portions of the base strip to be of substantially the same thickness as the metal deposit being formed on the central portion of the base strip. From the drawing it will also be recognized that the lower portions of the rotating disks 18 and 19 provide unidirectionally movable deflecting surface areas against which the minimum density edge portions of the spray field impinge.

Metal coated base strips produced in accordance with this invention have greater electrical capacity than corresponding strips produced in conformity with the prior art. For example, coated base strips produced in accordance with the present invention have shown capacities of between 7.8 and 8.1 microfarads per 6 square inches of material, whereas corresponding areas of base strips produced by other known methods have capacities of only between 5 and 6 microfarads. Both base strips were produced by use of the same amount of sprayed material with the difference being that by practice of this novel method, an efficient utilization of the spray material was achieved.

By previous spraying methods much of the metal travels beyond the edges of the base strip and is not utilized in forming the deposit, whereas in the present method this additional metal is deposited on the base strip and is utilized primarily on the edge portions thereof to produce a deposit of uniform thickness. This has appreciably benefitted the electrical capacity of the resultant strip material. Electrode sheets made in accordance with the prior art have edge portions which are thinner than their center sections and these thinner edge portions have more resistance than the center sections. A condenser made from an electrode sheet of such variable thickness has a greater power-factor loss than a condenser made from a

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uniform gauge electrode strip, such as the one produced by the present invention.

Although it has been indicated at a previous point in this application that the base strip may be formed from paper, gauze or other suitable material, the present invention also contemplates depositing the sprayed metal onto a metal tape. The spray deposited metal may be permitted to remain on such tape, or can be stripped therefrom as a sheet after the sprayed metal has solidified. In such latter instances, it may be necessary to treat the metal tape in known manners to prevent adhesion of the deposited metal to the base metal tape. Another possibility in producing a sprayed metal strip in accordance with this invention, is that of forming a spray deposit of metal on a fibrous base strip after which the excess portion, or all exposed material of the fibrous base strip, is burned off or otherwise removed from the resultant strip.

Sprayed metal strips made in accordance with this invention generally are, for example, about two inches in width and have a thickness of about .0035 inch. Similar strips made in accordance with prior spraying practices have varied appreciably (percentage-wise) in thickness at the edges of the strips and have had a thickness of only about .0025 inch at the edge portions. However, by practice of the present invention wherein the edge portions of a base strip are subjected to a principal and to a secondary spraying action, the base strip produced has a substantially uniform thickness laterally of the strip. Furthermore, the strip produced will be uniform in thickness, width and other properties and characteristics at longitudinally spaced portions thereof. When produced by the present method, the strip can therefore be held to very close tolerances and will be of a uniform gauge both longitudinally and transversely.

From the accompanying drawings and the foregoing detailed description, it will now be readily understood that this invention provides a novel method and apparatus for spraying metal onto a base strip by which a deposit of metal will be produced efficiently and economically on such base strip and will have a substantially uniform thickness transversely of the strip. It will now also be seen that this invention provides for the deposit on the base strip of edge portions of the spray field by deflecting such edge portions so as to cause the metal particles thereof to be returned or deflected inwardly onto the base strip instead of passing outwardly beyond the lateral edges of the base strip. Additionally, it will be seen that the deflection of the edge portions of the spray field is accomplished as a surface impingement deflection in which angularly disposed rotatable disks form the deflecting surfaces.

Although the spraying method and apparatus of the present invention have been illustrated and described herein to a somewhat detailed extent, it will be understood, of course, that the invention is not to be regarded as being limited correspondingly in scope but includes all changes and modifications coming within the terms of the claims hereof.

Having thus described my invention, I claim:

1. In apparatus for producing a sprayed metal deposit on a base strip, supporting means adapted to support a portion of a base strip being advanced, a spray device adjacent said supporting means and adapted to produce a spray field of molten metal particles and to direct said spray field toward said supported portion of the base strip, and a rotatably movable member providing a deflecting surface adapted to be impinged by and deflect a portion of said spray field, said deflecting surface being disposed adjacent said base strip in an angular relation thereto for directing the deflected portion of the spray field onto the base strip.

2. In apparatus for producing a sprayed metal deposit on a base strip, a rotatable member adapted to support a portion of a base strip being advanced, a spray device adjacent said rotatable member and adapted to produce a

spray field of molten metal particles and to direct said spray field toward said supported portion of the base strip, a disk having a deflecting surface adapted to be impinged by and deflect a portion of said spray field, said disk being disposed adjacent said base strip in angular relation thereto for directing the deflected portion of the spray field onto the base strip, and means operable to rotate said disk.

3. In apparatus for producing a sprayed metal deposit on a base strip, a rotatable member adapted to support a portion of a base strip being advanced, a spray device adapted to produce molten metal particle spray field of varying density and of greater impact width than the base strip and having a maximum density adjacent the central axis of the spray field and a minimum density adjacent the edges of the spray field, said spray device being disposed adjacent said rotatable member such as to direct said spray field toward and against the supported portion of said base strip with said central axis intersecting the base strip at substantially right angles thereto and substantially at the longitudinal center line thereof, the central portion of the spray field forming on the base strip a sprayed metal deposit extending for the full width thereof and having relatively thinner portions adjacent the edges of the base strip and edge portions of the spray field extending in a direction to carry the same outwardly of the edges of the base strip, a pair of disks having deflecting surfaces adapted to be impinged by and deflect such outwardly moving edge portions of the spray field, said disks being disposed adjacent the edges of the base strip with their deflecting surfaces in angular relation to the face of the base strip for directing the deflected spray field portions onto the edge portions of said base strip to augment the sprayed metal deposit of said relatively thinner portions, and means operable to rotate said disks during the impingement of said spray field portions thereon.

4. The method of spraying metal onto a base strip comprising the steps of, advancing the base strip longitudinally, spray projecting particles of molten metal to constitute a spray field of a greater impact width than the base strip, directing the spray field against the base strip with portions of the spray field moving in a direction to pass outwardly of the edges of the base strip, and changing the direction and velocity of travel of the particles of such outwardly passing portions to thereby return and deposit said outwardly passing portions on the base strip during the same spray projecting operation, said changing of the travel direction and velocity of the last-mentioned particles being by impingement thereof upon a deflecting surface moving in such manner to impart increased velocity to said last-mentioned particles in a direction toward the base strip.

5. In a method of producing a sprayed metal deposit on a base strip the steps of, advancing a base strip longitudinally, creating a molten metal particle spray field, directing said spray field toward said base strip with the central portion of the spray field impinging directly against said base strip and with the particles of the edge portions of the spray field moving in a direction to pass outwardly of the edges of the base strip, and deflecting such outwardly passing particles such as to change the direction of travel and velocity thereof and thereby returning and depositing the same onto the edge portions of said base strip, the change in the travel direction and velocity of the last-mentioned particles being by impingement thereof

upon a deflecting surface moving in such manner to impart increased velocity to said last-mentioned particles in a direction toward the base strip and the deflection of said last-mentioned particles being produced at least in part through the effect of centrifugal force thereon.

6. In a method of producing a substantially uniform thickness sprayed metal deposit on a base strip the steps of, advancing the base strip longitudinally, spray projecting molten metal particles to constitute a spray field of varying density and of greater impact width than the width of the base strip and having a maximum density adjacent its central axis and a minimum density adjacent its lateral edges, directing said spray field toward said base strip with the central portion of the spray field impinging directly on the base strip and forming thereon a sprayed metal deposit having relatively thinner edge portions and with particles of the edge portions of the spray field moving in a direction to pass outwardly of the edges of the base strip, and deflecting such outwardly passing particles such as to change the direction of travel and velocity thereof to return and deposit the same on the base strip so as to increase the thickness of said relatively thinner edge portions of the deposit to a substantially uniform thickness of the deposit transversely of the base strip, the change in the travel direction and velocity of the last-mentioned particles being by impingement thereof upon a deflecting surface moving in such manner to impart increased velocity to said last-mentioned particles in a direction toward the base strip and the deflection of said last-mentioned particles being produced at least in part through the effect of centrifugal force thereon.

7. In apparatus for producing a sprayed metal deposit on a base strip being advanced longitudinally, supporting means adapted to support a portion of said base strip, a spray device adjacent said supporting means and adapted to produce a spray field of molten metal particles and to direct said spray field toward the supported portion of the base strip with the particles of certain portions of the spray field moving in a direction to pass outwardly of the edges of said base strip, and rotatably movable deflecting members adjacent the edges of the base strip and presenting unidirectionally movable deflecting surface areas in angular relation to said base strip to be engaged by the outwardly passing particles for flingingly deflecting the latter back onto said base strip.

8. Apparatus as defined in claim 7 in which said spray device is adapted to produce a spray field having a maximum density central portion and minimum density edge portions, and in which said deflecting members are rotating disks whose lower portions define said unidirectionally movable deflecting surface areas which are engaged by said minimum density edge portions of the spray field.

9. Apparatus as defined in claim 8 in which said lower portions of the disks overhang the edge portions of said base strip.

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