Nov. 4, 1969 C. H. COWLES 3,476,082

ELECTROSTATIC COATING DEVICE

Original Filed April 20, 1967 2 Sheets-Sheet 1

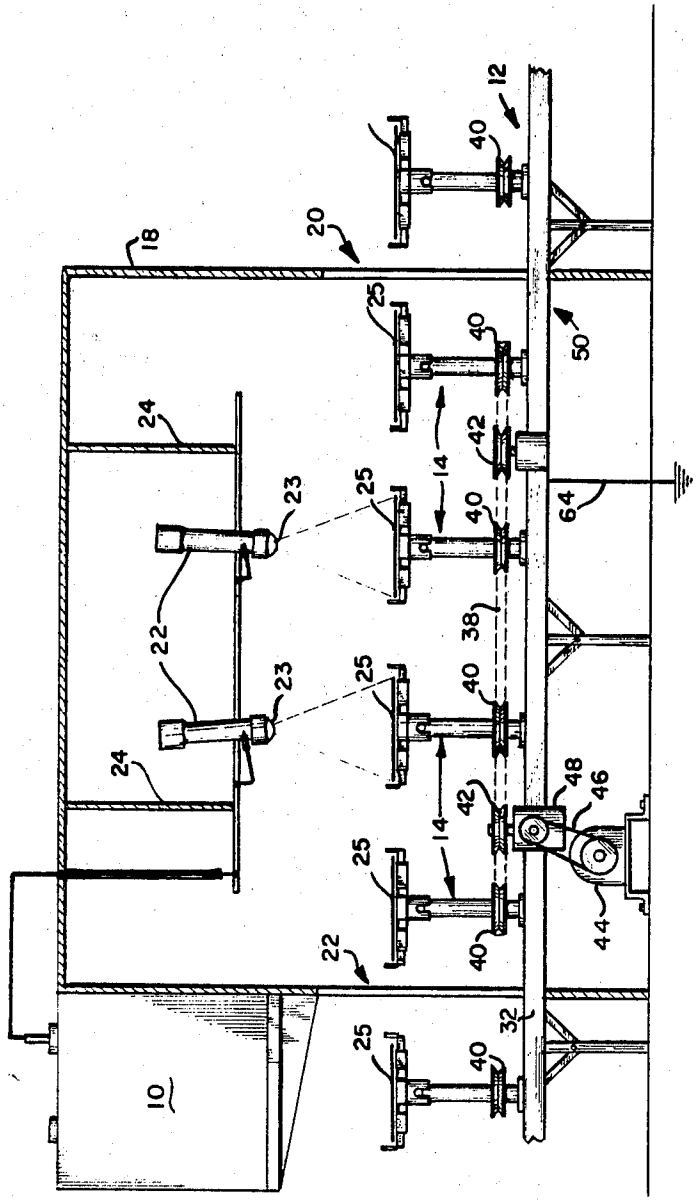

FIG. 1

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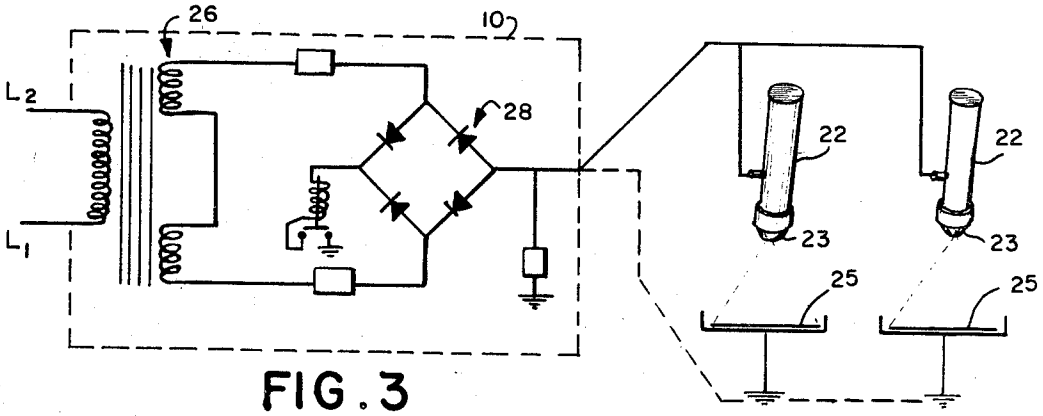

FIG. 3

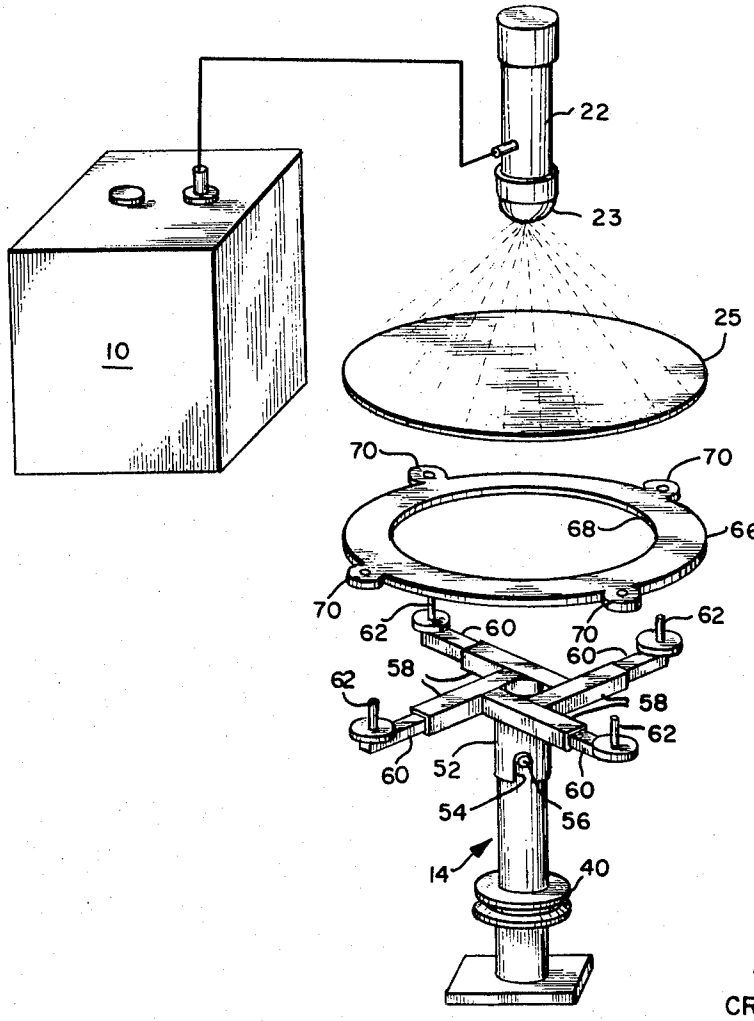

FIG. 2

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ELECTROSTATIC COATING DEVICE

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Continuation of application Ser. No. 632,314, Apr. 20, 1967. This application Apr. 1, 1968, Ser. No. 717,884
Int. Cl. B05b 5/08
U.S. Cl. 118—635 10 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for supporting a product blank or shaped form which is to be electrostatically coated with a coating material such that the electrostatic field is maintained constant over the surface of the blank or form. The apparatus includes an adjustable support for carrying different sized mask plates on which the product blanks are placed prior to movement through an electrostatic spray booth.

This application is a continuation of copending application Ser. No. 632,314, filed Apr. 20, 1967, now abandoned, by Craig H. Cowles.

This invention relates to electrostatic coating systems and is more particularly related to apparatus for supporting articles to be electrostatically coated.

Electrostatic coating of the surfaces of formed shapes is very common in cookwares where, for example, a Teflon coating is applied to the cooking surfaces of frying pans, baking pans, etc. The blanks or forms to be coated are generally supported on a conveyor and moved through an electrostatic field where a number of spray guns are used to spray charged particles of the coated material onto the blanks. The product blanks are generally grounded by means of a single point contact positioned to directly engage and thereby make a direct electric connection to the blank or form to thereby maintain a substantial potential difference between the product blank and the charged particles. The particles of coating material to be deposited on the article to be coated are discharged into this high intensity electrostatic field in the general direction of the grounded article so that the initial direction of motion of the particles is toward the surface of the article to be coated. The electrical field set up between the product blank and the spray gun draws the particles toward the blank to prevent overspray of the coating material. With the point contact type ground connection to the product blank the electrical potential at the surface of the blank to be coated depends on the resistance of this electrical contact connection. A certain amount of overspray is common in this type of system and commonly results in the depositing of some of the charged particles of coating material on the outside surfaces of the product as well as on the point type electrical contact. After a period of use, the electrical point contact becomes coated with the particles to such an extent that the conductive surface thereof does not engage the blank or form, thus reducing the electrical potential between the spray gun and the article to be sprayed to a point where the direction of motion of the charged particles are not appreciably affected by the electrical potential of the product and a substantial overspray results. If the coating material is expensive, the loss through overspray can cause an increase in the cost of coating to such an extent that the cost of the product becomes prohibitive. Moreover, the articles are not uniformly coated. It is important, therefore, that the amount of overspray be kept constant and to a minimum.

One of the principal objects of the present invention is to provide an apparatus for supporting articles to be coated which will maintain the requisite potential difference between the spray gun and the article to be coated over long periods of use.

Another object of the present invention is to provide an improved support for an article to be sprayed which will maintain the intensity for the electrical field on the surface of the article to be sprayed relatively constant regardless of the effect of overspray.

Another object of the present invention is to provide an apparatus for supporting articles to be electrostatically coated, which apparatus minimizes overspray.

A further object of the present invention is to provide an apparatus for supporting articles that are to be electrostatically sprayed, which apparatus can be simply and easily adjusted to accommodate different sizes of blanks.

Another object of the present invention is to provide an improved apparatus for supporting articles to be coated by electrostatic spraying that can be used to control the operation of the electrostatic system according to the absence or presence of an article on the support.

A still further object of the present invention is to provide an apparatus for electrostatically spraying an article which overcomes the problems encountered in using the point contact system.

These and further objects are accomplished by providing a fixture which can be mounted on the top of each of the rotatable type spindles carried by a conveyor system. This fixture includes a number of tubular members secured to and projecting outward from a central support member or hub at equally spaced angular distances. Each of the tubular members can be adjusted to accommodate different size blanks. Mask plates designed to conform to and to cover the bottom or rearward surface of the blank or form to be coated are placed on each of the fixtures with the adjustable arms mechanically connected to the edges of the associated plate. The mask plates are made in sets with each set having an outer contour that just covers and conforms to the bottom or rear surface of a particular type of blank so that the conveyor fixture can be readily converted to accommodate blanks of different shapes and sizes.

The fixture and mask plate are normally grounded through the conveyor to establish and maintain the requisite electrical field intensity at the plate. When a product blank or form is placed on a new mask plate it will be in direct electrical contact with the surface of the plate over a substantial area of the bottom surface of the blank thus assuring positive grounding of the blank or forms, i.e., no small area protrusions are provided on the mask surface which engages the blank. Air operated spray guns are positioned to spray electrically charged particles of coating material downward toward the product blank or form. As the particles of the coating material leave the spray gun their initial motion is directed toward the product blank with most of the overspray being drawn toward the surface of the blanks or forms by the electric field set up between the blanks and the guns.

After several uses the mask plates. also being at ground potential, will become coated with a layer of the coating material due to the small and unavoidable overspray. Since the coating material will ordinarily have a high electric resistance value, this build up of coating material on the mask plates prevents the product blanks from mechanically or directly contacting the conductive surface of the mask plates thereby disrupting the direct electrical ground connection through the conveyor. However, because of the large, closely adjacent areas of the product blanks and the mask plates, the product blanks will still assume a potential very close to that of the mask plate. Consequently, the need for frequent cleaning of the mask plates in obviated and consistent coating of the product blanks is achieved.

Other objects and advantages will become more readily apparent from the following detailed description when read in connection with the accompanying drawings in which:

FIG. 1 is a schematic view of the electrostatic system showing the spray booth and conveyor arrangement.

FIG. 2 is an exploded view of one of the fixtures used to support the product blank.

FIG. 3 is a schematic view of the circuits for the electrical system.

Referring to FIG. 1 of the drawing, the basic equipment used in this system includes an electrostatic control system **10**, conveyor system **12** and a number of spindles **14** equally spaced along the conveyor. The electrostatic control system is mounted on the sidewall of a spray booth **18** which is mounted above a portion of the conveyor system. The spray booth has an inlet **20** at one end and an outlet **22** at the other end for the conveyor system. Electrostatic spray guns **22** are mounted on a support **24** within the spray booth in line with and located above the conveyor.

The electrostatic control equipment includes air operated spray guns, a high voltage transformer **26** connected across lines L1–L2 as shown in the schematic circuit FIG. 3. A bridge circuit **28** is connected to the transformer and to the spray guns to provide up to 100 kv. to the spray guns. This is a conventional type circuit for this equipment and the remaining elements in the circuit need no further description. The control panel is also used to control the operation of the spray guns as well as the conveyor.

The spray guns shown are of the air operated type and are used to atomize the coating material and spray it through nozzle **23** toward the product blank **25**. In this example Teflon is being atomized and sprayed toward product blanks for frying pans and the like. It should be understood that other coating material such as paint or glass frit could also be sprayed from this system. A high intensity electrostatic field is set up at the nozzle of the spray gun where each particle of coating material is electrically charged as it is discharged from the nozzle of the gun and moves in the direction of the article to be coated. The electrically charged particles will be drawn toward the product blanks or forms due to the high potential difference which is maintained between the gun and product blank or mask plate.

The conveyor system includes the spindles **14** equally spaced along a conveyor belt or chain located in a metal grid or track **32**. The track runs through the inlet **20** and outlet **22** of the spray booth **18** and around the back to make a complete circuit. A standard sprocket and motor drive system (not shown) is used to continuously move the conveyor on the track. The spindles are rotated as they move through the spray booth by a continuously driven belt **38** which is mounted on pulleys **42** on the conveyor and driven by a motor **44** connected by belt **46** to guide gear box **48**. Each of the spindles is provided with a pulley **40** which will be brought into engagement with the belt as the spindles are moved into the spray booth and are thereby rotated as they move under the spray guns.

A fixture **50** as shown in FIG. 2 is mounted on the top of each spindle and includes a hub **52** having notches **54** which engage pins **56** on the top of the spindle so that the hub will rotate with the spindle. A number of tubular members **58** are secured to the hub and project outward at equal angles from each other. Arms **60** are slidably positioned within the tubular members and have vertically projecting pins **62** secured to their outer ends. The entire fixture and spindle arrangement is made of electrically conductive material and is grounded through the conveyor by line **64**.

A mask ring **66** having a central aperture **68** is positioned on top of the tubular members to support the product blank. A number of electrically conductive metal

washers or washer type members **70** are secured to the outer periphery of the mask plate at four equally spaced points which correspond to the four pin locations on the fixture. When the mask plate is mounted on the fixture the arms will be adjusted with respect to the tubular members so that the pins are aligned with the washers to thereby hold the mask ring in position. The pins project upward a distance sufficient to prevent the product blank from falling off of the plate as it is turned and moved through the spray booth. The pins will mechanically engage the washers when the mask plate is placed in position providing electrical contact between the plate and the fixture. This mechanical contact will be maintained by the wiping action of the washers against the pins which may result from vibrations in the system.

The product blank or form shown is merely a flat plate which has substantially the same outer diameter as the mask plate. If other product shapes are to be coated with the system of the present invention, the plate should be made with the same corresponding shape to provide a large area of contact between the product blank and the mask plate. The product blank is positioned on the mask plate as it enters the booth, and will be contacted over a major portion of its entire surface area by the mask plate thereby to assure that the product blank is at ground potential as it passes under the spray guns.

Since the plates are designed with an outer shape that closely resembles the shape of the blank, the mask plate also functions as a barrier to physically prevent wrap around spray from excessively depositing on the bottom of the blank or form being sprayed. If a shaped form having upwardly turned sides is to be coated on its interior surface, the mask plate will also have upwardly turned sides to cover the outer surface of this type of a product. Such forms are encountered where the product blank is a pan or the like.

It should be noted that the mask plate automatically locates the arms on the fixture and if a different size blank is to be sprayed the conveyor can be readily converted to the new size by merely replacing the mask plate with a set of smaller or larger type plates.

It is believed that the contact between the fixture arms with the bottom of the mask plate and the pins with the washers assures a constant electrical contact with ground for the mask plate. Since the four pins on the arms project upward into the washers located around the edge of the mask, the mask plate will be held in position but enough movement is provided between the surface of the arm and the bottom of the masked plate to make constant mechanical contact and thus electrical contact. Mechanical contact between the plate and the supporting arms can also be achieved by reversing the washers and pins or by providing a positive electrical connection between the plate and supporting arms.

As previously mentioned above, the charged particles have a tendency to overspray and deposit on the surface of the mask plate. Once a build up of particles has occurred on the surface of the mask plate the product blank will no longer be in electrical contact with the mask plate and will not be directly grounded. However, this will not have an adverse effect on the electrostatic field since the product blank is located in close proximity to the mask plate, and because of the large, closely adjacent areas of the mask plate and the product blank, the product blank will continue to assume a potential very near that of the supporting apparatus.

It may thus be seen that the spray apparatus of the present invention includes an electric coupling between the mask plate and the product blank which may be either a direct electric connection, when the mask plate is free from coating material, or a dielectric connection when the mask plate has become coated. In both of these cases, the blank is maintained, for all practical purposes, at ground potential whereby the effectiveness of the apparatus to prevent overspray remains the same during

prolonged periods of use. The frequency at which the mask plates must be cleaned is, therefore, markedly reduced, and perhaps more importantly, consistency of coating from one blank to the next is greatly improved.

The mask plate can also be used to control an electrical signal device indicating the absence or presence of a blank on the ring. The signal device is normally located below the plate and is directed upward through the hole in the center of the ring. When a product blank is placed on the ring, it will block the signal and a sensing system above the blank will actuate the spray gun. When the fixtures are empty, the signal will pass through the plate and the spray guns will not be actuated. A mechanical device could also be used to stop the action of the spray guns if no blanks are being placed on the plates.

What is claimed is:

1. A fixture for an electrostatic coating system including a conveyor system having a number of rotatable spindles, comprising
   - a hub adapted to be connected to the top of each spindle,
   - a number of outwardly extending adjustable members secured to said hub,
   - a plate supported by said members and having an outer countour substantially similar to the outer contour of the article to be coated,
   - connecting means mechanically and electrically interconnecting said plate and said adjustable members,
   - whereby an article to be coated when placed on said plate will have an electrical field intensity on its surface substantially similar to the electrical field intensity of the plate.

2. A fixture according to claim 1 wherein each of said adjustable members includes
   - a tubular member and an elongate member slidable within said tubular member.

3. A fixture according to claim 1 wherein said connecting means comprises a pin secured to the end of each of said members and a washer secured to the outer periphery of said ring in a corresponding position to the location of said pins whereby said pins mechanically and electrically engage said mask plate.

4. An electrostatic coating system including
   - a spray gun having a charging electrode for electrically charging coating material discharged by said gun and a conveyor for carrying the article to be coated past said spray gun,
   - the combination therewith of means for supporting the article to be coated comprising
   - a rotatable spindle
   - a tubular support operatively connected to said spindle,
   - a number of adjustable arms connected to the support and an electrically conductive mask plate mounted on and electrically connected to said adjustable arms,
   - whereby on placing an article to be coated on said mask plate the intensity of the electrical field on the surface of the article to be coated will remain the same as the intensity of the field on the support.

5. A system according to claim 1 wherein said mask plate has substantially the same outer configuration as the article to be coated to thereby protect the outer surface of said article from overspray and at the same time maintain the electrical field on the surface of the article to be sprayed.

6. An apparatus for uniformly coating one surface of a product blank with teflon comprising
   - a number of electrostatic spray means for directing a spray of electrically charged particles towards the product blank to be sprayed,
   - support means movable in a path of travel past each spray means,

   - said support means including a hub having a number of adjustable arms,
   - a mask plate of a size substantially similar to the size of the article to be sprayed mounted on said arms to support a product to be coated,
   - mechanical means for maintaining an electrical connection between the support means and the plate,
   - drive means for rotating each support means as it passes the spray means,
   - circuit means for establishing an electric potential between the spray gun and the mask plate,
   - and electrical means for establishing a spray cycle each time a product blank moves past a spray means.

7. A fixture for an electrostatic coating system of the type including a spray gun having a charging electrode for electrically charging coating material discharged by said gun and a conductive support for supporting a disc-shaped conductive article to be partially coated with said material, the improvement comprising
   - an electrically conductive annular mask plate resting on and electrically connected to said support,
   - the entire surface area of said mask plate on which said article is adapted to rest conforming in shape to a substantial circumferential portion of said article thereby to provide large abutting areas between said mask plate and said article during the coating of said article,
   - whereby said article is maintained at substantially the potential of said mask plate even if said surface of said mask plate becomes coated with an insulating material.

8. A fixture according to claim 7 wherein said support is grounded.

9. A fixture according to claim 8 and means for rotating said support during the coating of said article.

10. An electrostatic coating system of the type including means
   - for spraying electrically charged particles of a coating material onto a surface of an electrically conductive article, electrically conductive support means for supporting said article at a position to receive said spray, and means for maintaining the potential of said support means at a reference level, wherein
   - said means for supporting said article has a large article supporting surface configuration adjacent to and conforming to a substantial portion of a surface of said article which is to remain substantially free from said coating material, said adjacent surfaces of said support means and said article providing the principal electric coupling between said support means and said article, and
   - a thin layer of insulating material coated on said supporting surface of said support means and insulating said adjacent surfaces from one another,
   - whereby said adjacent surfaces and said layer provide a dielectric coupling between said conductive support means and said conductive article.

References Cited

UNITED STATES PATENTS

2,097,233	10/1937	Meston	118—624
2,191,827	2/1940	Benner et al.	118—630 XR
2,655,128	10/1953	Ransburg	118—635
2,662,833	12/1953	Helmuth	118—635 XR
2,795,516	6/1957	Miller	118—626 XR
2,877,740	3/1959	Friderici	118—635 XR

PETER FELDMAN, Primary Examiner

U.S. Cl. X.R.

118—624; 239—15