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Waldron et al.

[11] **3,904,930**

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[54] **AUTOMATIC POWDER SPRAY APPARATUS AND METHOD FOR SPRAYING THE INSIDE SURFACES OF CONTAINERS**

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[73] Assignee: **Estey Dynamics Corporation,** Red Bank, N.J.

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[52] **U.S. Cl.** ..... **317/3;** 117/17; 117/18; 117/93.4 R; 118/622

[51] **Int. Cl.**[2] **B05B 5/00**

[58] **Field of Search** ..... 317/3; 118/622, 630; 117/17, 18, 95, 96, 93.4 R

[56] **References Cited**

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Primary Examiner—L. T. Hix

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[57] **ABSTRACT**

An automatic spray device having a rotary type retaining means for holding the containers as they are moved past one or more spray positions. The containers (which may be metal cans) are each mounted horizontally with an open end facing a hole in a rotating circular plate. As the containers move into spraying position they are clamped in contact with the plate by plungers which also connect each container to ground. Spray guns inject ionized fluent powder, wet solvent based particles, or water based coating particles into the containers to coat their interior surfaces. Suitable feeding means are arranged to feed a plurality of containers to the device and to provide exit means from the device to a storage space.

14 Claims, 8 Drawing Figures

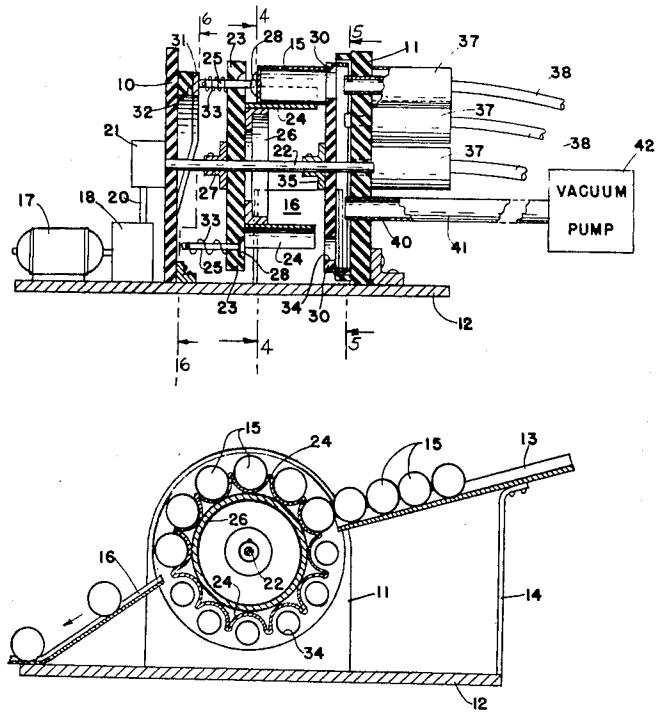


FIG. 1

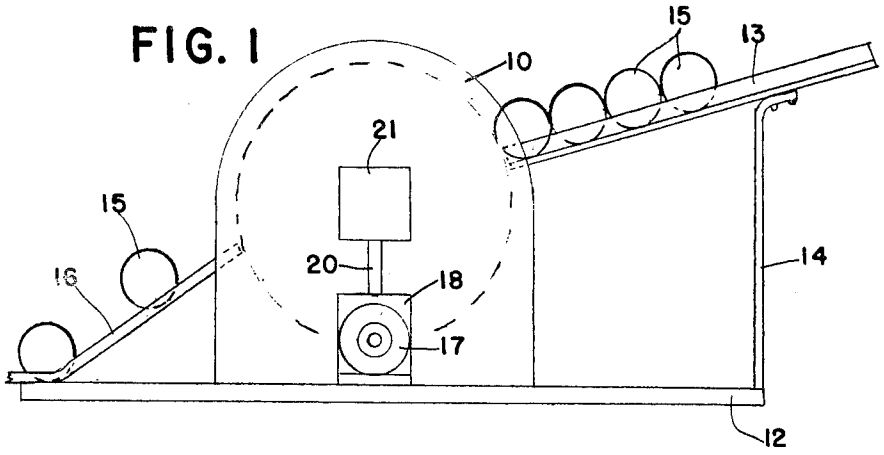


FIG. 2

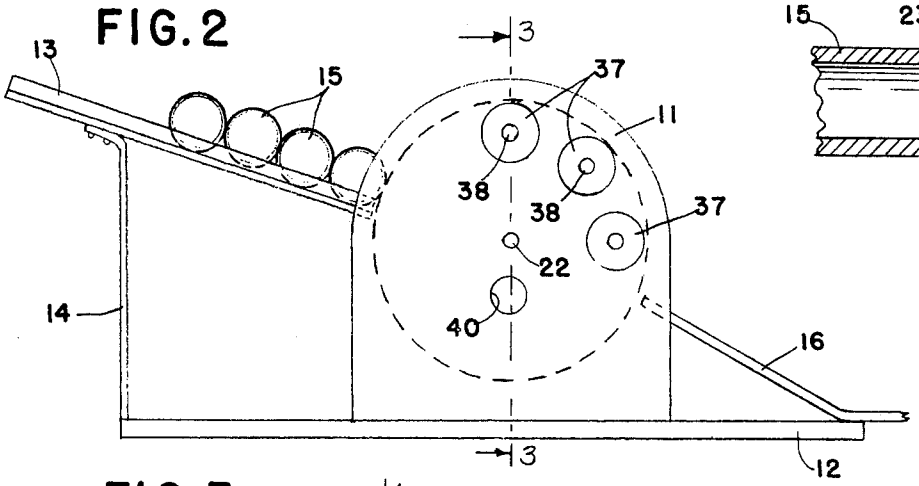


FIG. 8

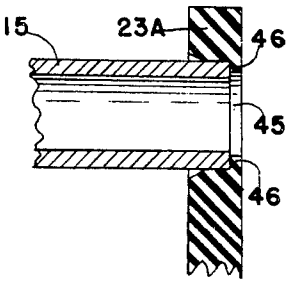


FIG. 3

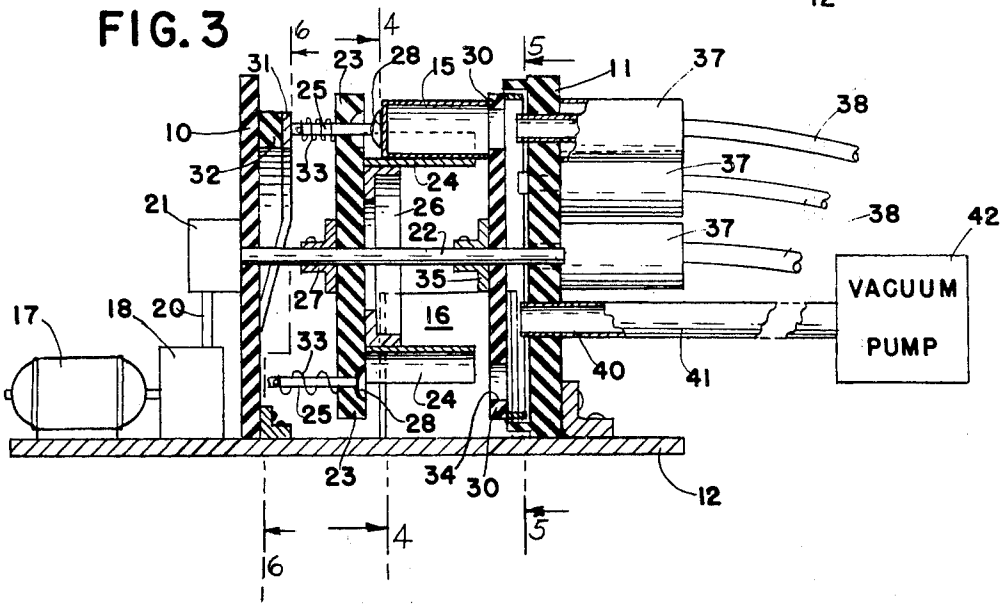


FIG. 4

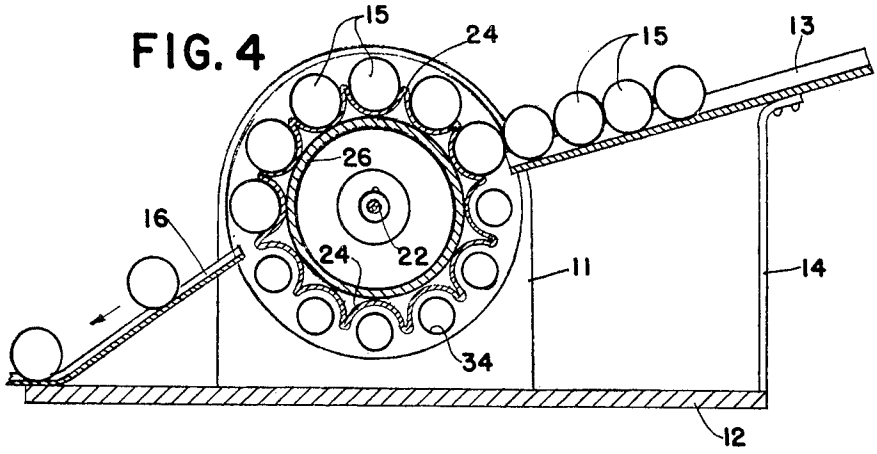


FIG. 5

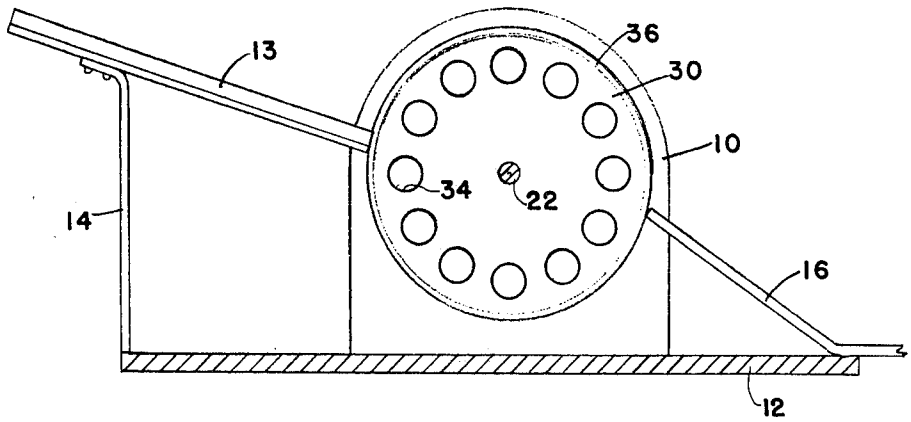


FIG. 6

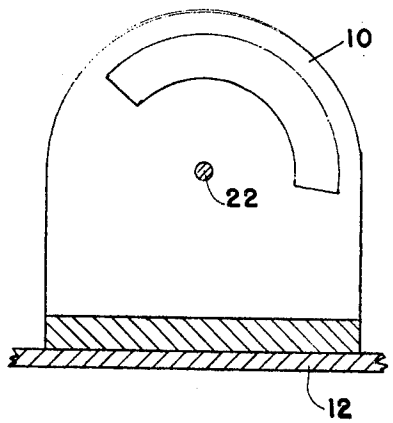
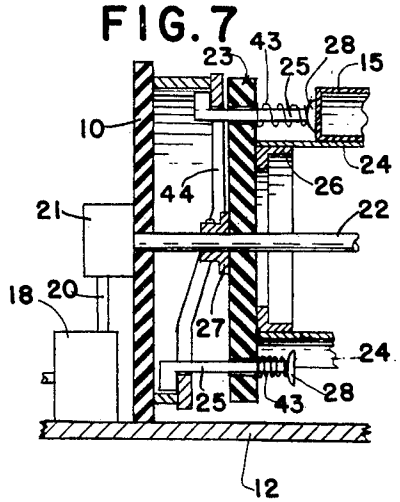


FIG. 7



AUTOMATIC POWDER SPRAY APPARATUS AND METHOD FOR SPRAYING THE INSIDE SURFACES OF CONTAINERS

CROSS REFERENCE TO RELATED PATENTS

This invention is related to a spray gun shown and described in U.S. Pat. No. 3,673,463, issued to Meredith C. Gourdine June 27, 1972. This invention is an improvement on the device shown and described in the above mentioned patent which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Spray guns are old in the art and have been used for spraying solid fluent powders and liquids, with and without electric fields. The use of an electric field between a spray nozzle and the work to be covered confines the sprayed material to a selected area and therefore eliminates wasted spray material. The electric field, however, cannot penetrate holes and entrances to other interior surfaces because of the "Faraday Effect." Electric field spraying is therefore confined to objects having only outside surfaces without re-entrant cavities.

The present invention uses no electric field between the spray gun and the article to be covered. Instead, both the article and the spray gun are grounded and ionized particles are propelled into this field free space. The particles themselves, being ionized create a space charge and this alone produces an electric field between the mass of particles and the inside of an article, coating its interior surface.

A feature of the invention is the use of a grounded article to be covered and a grounded nozzle on a spray gun, the coating action depending on the space charge of a mass of ionized particles sprayed from the nozzle.

Another feature of the invention is the use of solid fine particles of a covering material which are first sprayed onto the interior surface of a container, and then melted by passage through an oven to form a continuous thin protective film. No solvent is used in the operation and polution of the atmosphere is avoided.

Another feature of the invention is the efficient use of the powder in the spray. While the spray guns are continuously spraying all the time the open ends of the containers are rotated past the spray position, the spaces between the containers is filled by a shield and a vacuum system is arranged to pick up the powder deposited on the shield and return it to the powder reservoir. Due to this shielded arrangement no powder can get to the outside surface of the container to cover any portion thereof.

Still another feature of the invention is the speed of coating. As many as **1000** beverage cans per minute can be coated evenly and completely with a protective nonsolvent material.

SUMMARY

The invention includes an automatic powder spray device for spraying the inside surface of cylindrical containers and comprises two supporting plates parallel to each other defining a spray coating space. A rotatable shaft is mounted perpendicular to the plates and is coupled to a power source for rotation. A first feed means is mounted adjoining the plates for delivering a plurality of containers to the device and a similar feed means conveys the coated containers away from the device. A rotatable retaining means is secured to the shaft between the supporting plates and includes a plurality of openings for receiving the containers and rotating them past one or more spray positions. A plurality of grounded plungers are also mounted on the retaining means and are urged by a resilient means for making contact with the containers and for pushing the containers into a sealing contact with the rotatable plate. The action of the plungers is controlled by a cam secured to one of the supporting plates, or alternatively, any other suitable electrical or mechanical means for moving the plungers. One or more spray guns are secured to the other supporting plate and sprays fluent powder through an opening in the plate to coat the inside surface of the containers as they are rotated past the spray positions. The spray gun sprays the ionized powder through a dielectric passageway before entering the containers.

Additional details of the invention will be disclosed in the following description, taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a side view of the powder spray device showing the entrance and exit inclined feed means.

FIG. **2** is a side view of the other side of the device showing the location of three powder spray guns.

FIG. **3** is a cross sectional view of the spray device shown in FIG. **2** and is taken along line **3—3** of that figure.

FIG. **4** is a cross sectional view of the device shown in FIG. **2** and is taken along line **4—4** of that figure. This view shows the details of the container retaining device.

FIG. **5** is a cross sectional view of the device shown in FIG. **3** and is taken along line **5—5** of that figure.

FIG. **6** is another cross sectional view of the device shown in FIG. **3** and is taken along line **6—6** to show the nature and extent of the cam surface.

FIG. **7** is a partial cross sectional view of an alternate arrangement of return spring and surface cam. In this arrangement the spring forces the container into contact with the rotatable plate and the circular cam pulls the plungers away from the containers.

FIG. **8** (on sheet **1**) is a partial cross sectional view showing an alternate method of sealing the containers in the openings of the rotatable plate.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the figures, the automatic powder spray device comprises two supporting plates **10** and **11** secured to a base **12.** A first feeding means **13** which may be an inclined plane, is supported by a brace **14** and carries a plurality of containers **15** which are to be spray coated on their inside surfaces with a powder. After the coating process, the containers **15** fall onto a second feeding means **16** and the containers **15** are fed to a storage means or an oven (not shown).

The base **12** also carries a motor **17** and a first gear box **18.** A vertical shaft **20** connects the first gear box **18** with a second gear box **21** and a horizontal shaft **22** which is journalled in both supporting plates **10** and **11.** Shaft **22** is secured to a retaining means for holding the containers **15** in proper position while they are sprayed. The retaining means includes a nonconductive flat plate **23,** a series of holders **24,** and a plurality of plung-

ers 25 for making contact with the base of the containers prior to the spraying operation. The holders 24 may be any type of supporting means, in FIGS. 3, 4 and 7 they are shown a semi-cylindrical sheets, secured to plate 23 by a bracket 26. Plate 23 is secured to the shaft 22 by a flanged sleeve 27.

It should be noted that FIGS. 3 and 7 show only two plungers 25 and two holders 24 for clarity. As shown in FIGS. 4 and 5 there are twelve container positions, and FIGS. 3 and 7, if complete, would show seven holders 24.

Plungers 25 are formed with a cup 28 which makes contact with the base of the container to force the container into a sealing contact with a plate 30. The plunger shaft 25 extends through a hole in plate 23 and is controlled by a circular cam 31. Cam 31 (see FIGS. 3 and 6) is supported by washer 32 and the first supporting plate 10. Cam 31 is grounded, thereby connecting both the plunger 25 and the container 15 to ground when in the spraying position. Springs 33 restore the plungers to their noncontacting position when the cam 31 releases the plungers and permits the containers to fall to the inclined plane 16.

The rotatable plate 30 is formed with a plurality of openings 34, aligned with the plungers 25 and the holders 24 so that a container 15, when clamped to the plate 30 will have its open end aligned with opening 34. Plate 30 is secured to shaft 22 by a flanged sleeve 35 which maintains its registration with plate 23 at all times. The space between plate 30 and support 11 is traversed by the blasts of ionized powder and some of the particles will become detached from the main streams and move to the walls surrounding the openings 34. To reduce the diffusion to the outside air, a closure strip 36 is secured to the plate 30 to reduce powder escape.

One or more spray guns 37 are secured to the second supporting plate 11, each aligned with an aperture in the plate. A powder supply conduit 38 supplies each gun with powder mixed with a neutral gas under pressure. The details of these guns are shown and described by the above mentioned U.S. Pat., No. 3,673,463. The guns produce a cloud of ionized powder forced into a conductive container maintained at ground potential. In such a case the cloud of ionized particles itself forms one terminal of an electric field comprising a space charge and the peripheral particles move under this electric field to distribute themselves evenly on the inside surface of the container.

An additional opening 40 is provided for removing excess powder from the walls of the closure space. A conduit 41 is connected between this opening and a vacuum pump 42 so that the excess particles can be recovered.

FIG. 7 shows an alternate form of cam movement where the plungers 25 are urged by springs 43 to make contact with the ends of the containers 15 and a cam plate 44 pulls the plungers 25 away from the containers when they are discharged or admitted to the retaining means.

FIG. 8 shows an alternate design of rotatable plate 23A having openings 45 which are large enough to accept the outside diameter of the containers with an inwardly extending ledge 46. This type of seal is more efficient than the one shown in FIG. 3 and prevents the passage of any powder to the space adjoining the outside surface of the containers.

The operation of the device is evident from the above description of the components. The containers are attached on the first incline feed means 13 and the motor started. The conveyor or retaining means rotates counterclockwise as viewed in FIGS. 1 and 4, picking up the containers, moving them past the three spray positions, and then discharging them onto the second incline feed means 16. During this passage, the spray guns 37 inject powdered material into the inside of the containers, the excess being removed by the vacuum system 40, 41 and 42. The containers can now be removed to an oven where the powder is melted to form a continuous protective film. No solvent is used.

The above description relates to a rotary means for handling the containers. It is obvious to arrange the conveying system so that the containers travel in a straight line past the spray guns. In such an arrangement, the retaining means, the plungers, and the shield plate are made part of a conveyor system with units connected to each other by means of swivels similar to a set of chain links. Such a system can easily be extended to move the coated containers through an oven to melt the coated particles.

The embodiments of the invention in which as exclusive property or privilege is claimed are defined as follows:

1. A power spray device for spraying the inside surface of cylindrical containers comprising:
   a. conveyor means for conveying an array of containers through a spray coating space, said conveyor means including a shielding face plate having a plurality of openings aligned with openings in the containers;
   b. a series of grounded plungers disposed opposite each of said openings for resiliently pressing the containers against said face plate and for electrically grounding the containers; and
   c. a spray gun positioned adjacent to the face plate for spraying fluent powder through said openings to coat the inside surface of the containers, said gun spraying electrically charged powder through a grounded conductive passageway before entering the containers.

2. An automatic powder spray device for spraying the inside surface of cylindrical containers comprising:
   a. first and second supporting plates in parallel relationship defining a spray coating space therebetween;
   b. a rotatable shaft mounted perpendicular to said supporting plates and coupled to a power source for rotation.
   c. a first feed means for delivering a plurality of containers to the space between the plates, and a second feed means for conveying the containers to an exterior position after the containers have been coated;
   d. a rotatable retaining means positioned between the supporting plates and secured to said shaft including a plurality of holders, each for receiving a container from the first feed means and for moving the container toward an exit position;
   e. a circular rotatable plate also secured to the shaft and formed with a plurality of openings therein, each opening aligned with the center of a container when supported by a holder;
   f. a plurality of grounded plungers urged by a resilient means and controlled by a circular cam secured to

the first supporting plate for making contact with said containers and for pushing the containers into a sealing contact with said rotatable plate; and,

g. a spray gun secured to the second supporting plate for spraying fluent powder through an opening in the supporting plate and the openings in said rotatable plate to coat the inside surface of said containers, said gun spraying electrically charged powder through a grounded conductive passageway before entering the containers.

3. A spray device as claimed in claim **2** wherein a plurality of spray guns are secured to the second supporting plate, each gun for spraying fluent powder through its respective opening in the supporting plate.

4. A spray device as claimed in claim **2** wherein said plungers are urged by a helical spring toward the container and the cam moves the plungers away from the containers.

5. A spray device as claimed in claim **2** wherein said plungers are urged by a helical spring away from the containers and the cam moves the plungers and containers toward the rotatable plate.

6. A spray device as claimed in claim **2** wherein said containers move under gravity from the exit position to the second feed means.

7. A spray device as claimed in claim **2** wherein said openings in the rotatable plate are formed with a hole the same diameter as the outside diameter of the container supplemented by an inwardly extending ledge against which the edge of the container rests during the coating operation.

8. A spray device as claimed in claim **2** wherein the first supporting plate is made of a conductive metal and is connected to a grounded terminal through the rotatable shaft.

9. A spray device as claimed in claim **2** wherein a vacuum conduit is connected between a hole in the second supporting plate and a vacuum pump for drawing off powder deposited upon said rotatable plate.

10. A spray device as claimed in claim **2** wherein said containers are made of a conductive metal.

11. A spray device as claimed in claim **2** wherein said first and second feed means include inclined planes for conveying the containers to and from the retaining means under the force of gravity.

12. A method of automatically coating the interior surface of plurality of containers with fluent powder comprising: placing the containers on a conveyor means; electrically grounding the containers by connection to a grounded clamping means; spraying an ionized fluent powder into the container from a spray gun during the movement of said conveyor means; and removing the sprayed containers from the conveyor means.

13. A method as claimed in claim **12** wherein said fluent powder is forced through a dielectric nozzle forming a portion of a grounded spray gun after being ionized by an electric field; said powder then deposited on the inside surface of said containers due to the action of the electric field between the grounded containers and the space charge created by the sprayed ionized powder.

14. A method as claimed in claim **12** wherein any excess powder not covering the inside surface of the containers is drawn away by a vacuum system.

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