

- [54] **APPARATUS AND PROCESS FOR THE MAKING AND COATING OF HOLLOW BODIES**
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- [51] Int. Cl. **B21d 51/26**
- [58] Field of Search **113/120 R, 120 A, 1 G; 29/482; 72/347, 348, 267**

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[57] ABSTRACT

Metallic hollow bodies such as cans or other containers, particularly non-ferrous cans such as aluminum, are electromagnetically suspended and coated on their outside and inside surfaces simultaneously by applying, in an electrostatic field wherein the metallic hollow body is grounded, a resinous powder coating material, and whereafter the hollow body is subjected to a heat treatment, to result in formation of a continuous resin film coating on the surfaces of the hollow body. In the case of non-ferrous (e.g., aluminum) cans, cans susceptible to electromagnetic suspension are manufactured from aluminum (or other non-ferrous) sheet by adhering iron mesh to the cup-bottom during the cup-forming step.

3 Claims, 7 Drawing Figures

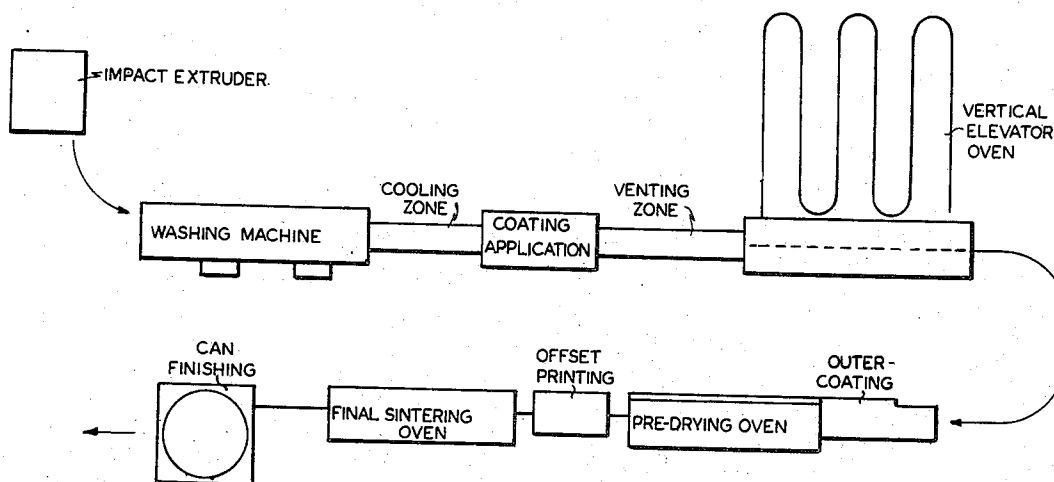
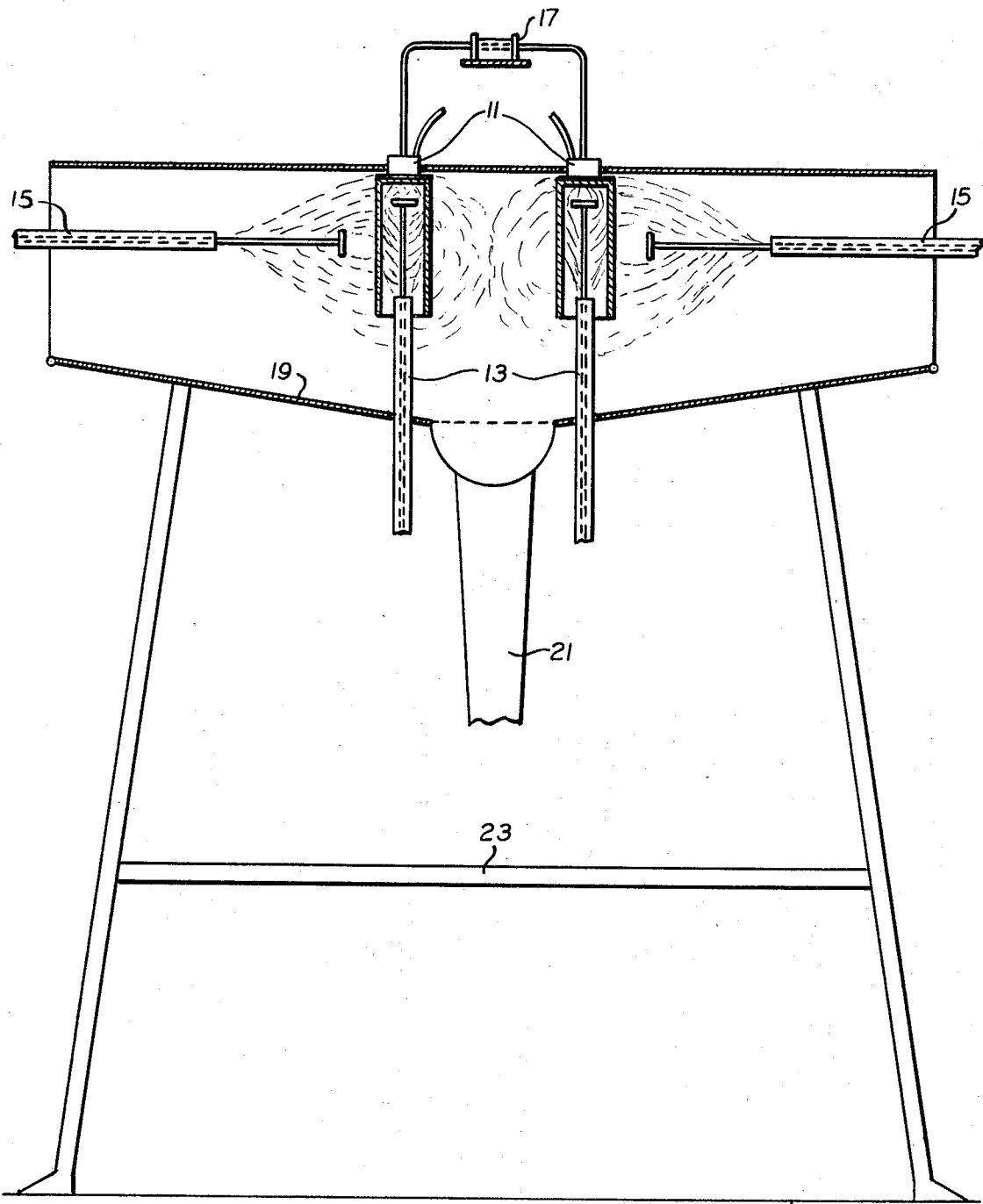


FIG. 1.



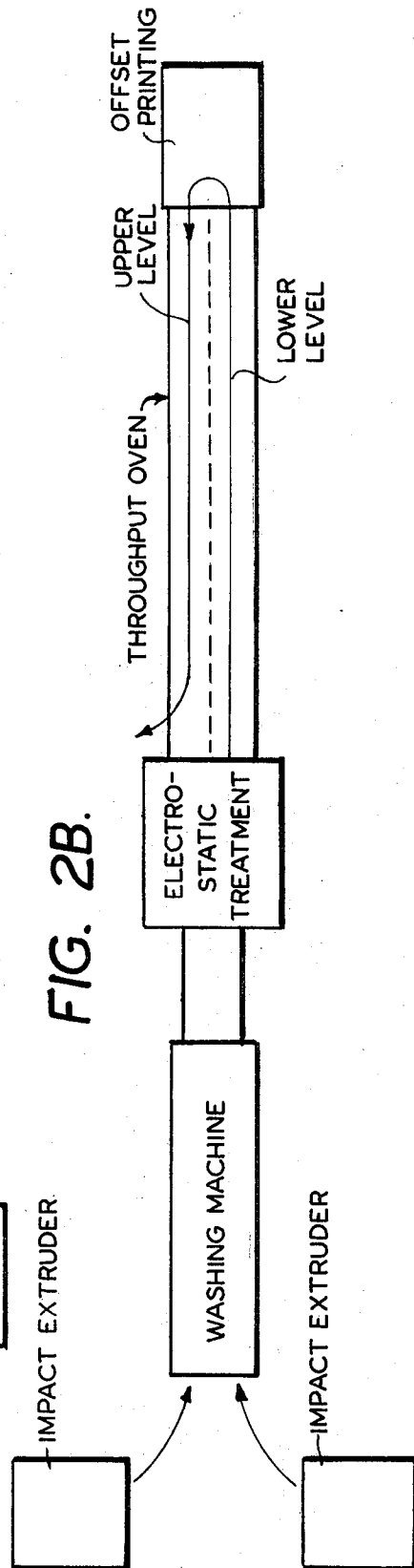
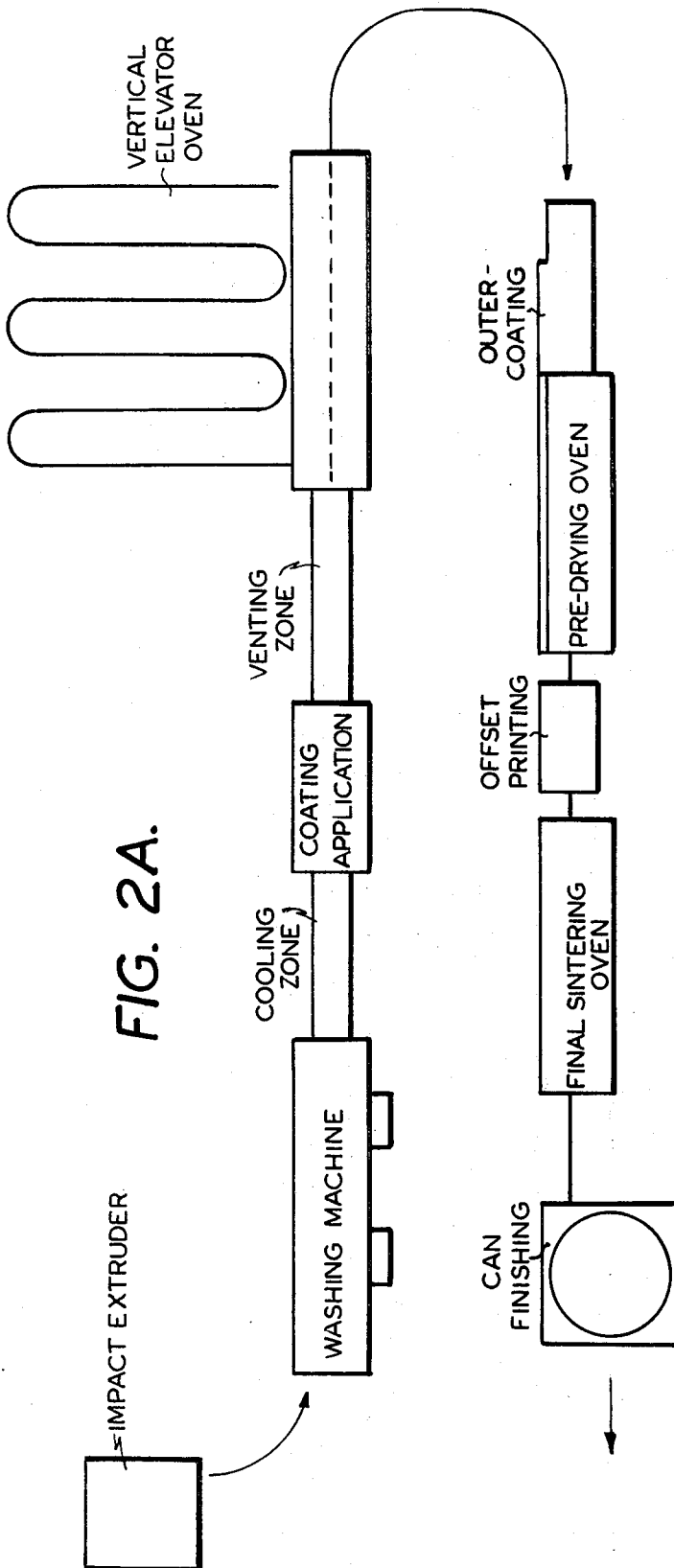


FIG. 3A.

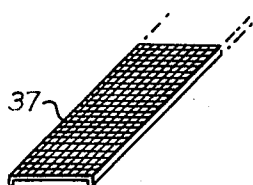


FIG. 3B₁.

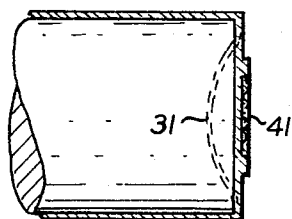


FIG. 3B₂.

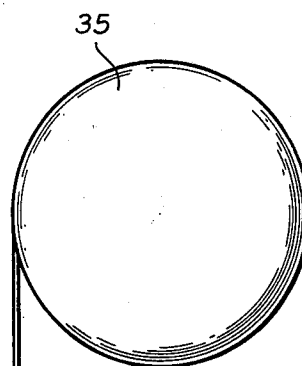
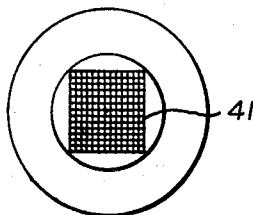
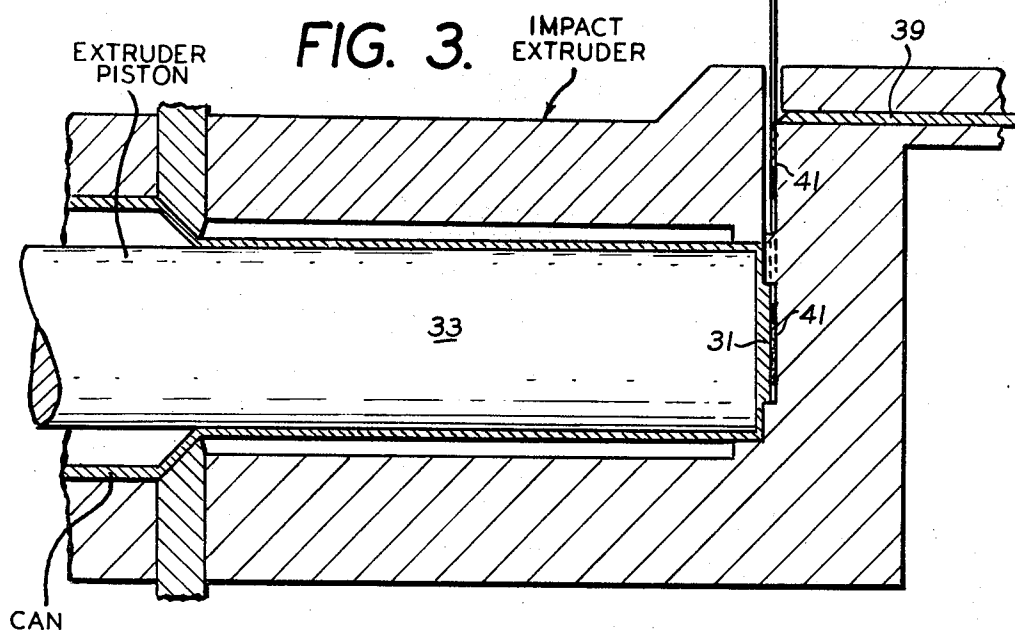


FIG. 3.



APPARATUS AND PROCESS FOR THE MAKING AND COATING OF HOLLOW BODIES

This invention relates to a process for the manufacturing and coating of hollow bodies such as cans, containers and lids. More specifically, the process of the instant invention relates to the manufacture and coating of aluminum cans, e.g., aerosol cans.

It is, of course, conventional to provide hollow metallic bodies, such as containers in general, cans and lids, with a lacquer coating on both their inside and outside surfaces for protection from aggressively acting filling materials or for protection from external influences, and/or for optical and decorative reasons. The application of such lacquer can proceed conventionally through an electrostatic process. This process is based on the fact that electrically charged lacquer droplets move in a field of high electric strength along electrostatic force lines toward the grounded hollow body surface and are discharged thereon. Because the electrostatic potential difference is gradually reduced with increasing lacquer coat thicknesses, the higher potential difference obtaining at unlacquered places of the body automatically causes a relatively uniform lacquering over the entire body surface. To ensure that the lacquer coating will meet all requirements, care must be taken that the lacquer adheres firmly to the surfaces to be protected. In the past, it has been necessary, to serve this purpose, to treat the surface of the goods to be lacquered, in comprehensive pre-treatment steps, to free it of impurities such as oxides, fats and dirt. Depending on the nature of the metal of which the container is made, it must be subjected to cleansing, defatting, and finally, a phosphating step. After this pretreatment, there is normally effected, in the case of hollow metal containers, lacquering of the inside surface of the container and, following this, the inside lacquer is annealed or baked in a kiln or furnace. Thereafter, the hollow bodies, suspended on metal prongs, are lacquered from the outside and pre-dried in a furnace. After the article is imprinted, according to means conventional in the canning arts, there must be applied another, colorless, lacquer coat to protect the printing. This latter coat can be applied "wet on wet" and dried together with the predried article, or it can be applied to the finally dried, e.g., annealed, article and burnt in separately. The final drying is also usually effected in a run-through oven.

Apart from the great number of steps required in prior art processes, such processes are subject to additional disadvantages. Thus, it can frequently happen that the lacquer coat on parts of the article which are difficultly accessible due, e.g., to insufficient cleaning, defatting or phosphating, adheres only partly, or not at all, to the container surface. In the subsequent heating step in the oven, there can thus be formed bubbles, protrusions and pores at such places. Also, the evaporation of the solvent from the lacquer, which takes place upon the heat treatment, can deleteriously affect the pore density of the lacquer film. These disadvantages are substantial because it is possible, if imperfections exist on the inside of the container, that the contained goods are in direct contact with the metal wall of the container. Corrosive goods can thus result in undesired chemical reactions. Due to this, the lacquer film, starting from a very small vulnerable (i.e., insufficiently lacquered or porous) spot exposed to corrosive contained materials, peels gradually from the container wall, and

this can, for instance in the case of spray cans, e.g., aerosol cans, lead to plugging of the aerosol can spray nozzle in which small lacquer particles deposit themselves. Because the spray nozzle cannot be cleaned from the outside, the remainder of the contents of the can can no longer be sprayed out, and is thus rendered worthless. In extreme cases, it can happen that corrosive contents which are in contact with the container wall for prolonged periods, can eat through the entire wall (which is usually quite thin) and thus, lead to spillage of often inflammable contained materials. Apart from damaging the container wall, the reactions between the contents of the can and the container wall can, of course, also deleteriously affect the contained goods. Particularly in the case of canned foods, the danger of, at best, spoiled taste, or, at worst, complete spoilage, of such food stuffs, is substantial. For instance, the oxidation of fats, i.e., rancification, is accelerated in a high degree by heavy metal ions.

To mitigate the above-mentioned drawbacks, it is often necessary to tailor-make the inner lacquer coating to suit the requirements of particular aggressive or corrosive goods which, apart from the extra effort required, has the disadvantage that the so-treated container can often be used for only one kind of contained goods.

Another feature of prior art processes for making and coating cans, particularly in the "drawn-and-ironed" can-making processes currently of commercial prominence, which has proven a draw-back, is the inability of such processes to handle ferrous and non-ferrous materials on the same line without extensive modifications of the equipment and/or process used (see, e.g., "Modern Packaging," June 1972, page 29).

The present invention substantially eliminates the drawbacks of the prior art processes and, specifically, greatly reduces the pretreatment steps conventionally required prior to lacquering, avoids the necessity of two heat treatments, and eliminates the need for a protective additional lacquer coat to protect any imprinting on the can. In addition, the process of the instant invention results in substantially complete avoidance of pores or holes in the lacquer film, thus making impossible contact between the container wall and the contained goods and rendering cans treated by the instant invention particularly suitable for use when canning food-stuffs. Still further, the process of the instant invention cuts down or eliminates the loss of lacquer experienced in conventional processes and apparatus, so that, apart from providing a simpler process, the instant invention provides a more economical process as well.

In specific and preferred aspect of the invention, aluminum cans are manufactured and coated in a sequence of steps which has proven highly efficient not only for the large-volume production of finished and imprinted aluminum cans from aluminum sheet, but which are capable of producing both steel and aluminum cans on the same line without any adjustment being necessary; i.e., the same equipment can be used without modification to produce, alternately, steel and aluminum cans.

Essentially, the instant invention comprises an apparatus and a process for manufacturing an electromagnetically suspendable metal cup from metal sheet, electromagnetically suspending the cup, e.g., aluminum can, to be treated in an electrostatic field, introducing

into said electrostatic field a spray of finely divided solid resinous powder particles, grounding said hollow body to cause said particles to adhere to the surfaces of the hollow body, and then subjecting the hollow body to a heat treatment whereby a continuous resin film covering the entire hollow body surfaces is formed. When the metal can is non-ferrous, e.g., made of aluminum, this invention comprises forming a cup from aluminum sheet while simultaneously adhering a strip of iron webbing to cover at least part of the bottom portion of the cup, or imbedding such iron webbing into the bottom portion of the cup, thereby rendering the raw unfinished cup electromagnetically suspendible.

It has been found that, by use of the invention, a homogeneous, uniform and pore-free coating is obtained by virtue of the electrostatic behavior of the coating particles in relation to the container to be coated and that ferrous and non-ferrous cups can be processed alternately on the same treatment line, without modification of the equipment used.

In contrast to electrostatic lacquering, wherein fluid media are sprayed onto the container surfaces, which media adhere to the surfaces because of binding agents contained therein, the solid powder form resin particles brought into contact with the container surfaces in the instant invention principally adhere to the container surfaces because of the potential voltage difference caused by the electrostatic field and not because of any chemical binding agents. Only upon the subsequent heat treatment of the instant invention are the resin particles melted together to form a continuous, closely adhering film surrounding all container surfaces. Because no organic solvents are involved, complete continuity and absence of pores are obtained in the instant invention. It will be understood that the heat treatment step carried out in conventional lacquering operations, is carried out for the entirely different purpose of removing the solvent contained in the lacquer through evaporation, to dry the lacquer thereby and to adhere it more firmly to the container surface, which, however, often results in pore formation, as explained above.

The use of resin powder in place of the liquid lacquer of prior processes makes possible a substantial reduction in the pre-treatment required in lacquering processes. Thus, when proceeding in accordance with the invention, a defatting of the container, e.g., cans, is all that is required and the separate cleaning and phosphating steps required by prior art techniques are eliminated. Further, even the defatting pre-treatment step required in the instant invention is not as critical as it is in prior art processes; for instance, streaks of fat that may remain on the container surface after defatting, which have to be removed if the container is to be subsequently liquid-lacquered by thorough rinsing or spraying, do not disturb film formation when proceeding in accordance with the instant invention because the powdery resin particles melt together to form a continuous film thereover without being affected by such fats, streaks or smears.

Another substantial advantage of the process of this invention and use of the inventive apparatus is that it is no longer necessary to store the freshly lacquered goods under ventilation, which was required in the prior art lacquering processes. It has been found that powder, as contrasted with liquid lacquer, is adapted in its freshly applied form to continuous-line processing,

easily tolerates the intense heat treatment in the oven (thus simplifying the construction of the oven and the length of time the article needs to be in the oven), thus offering very substantial advantages in processing. In addition, the powder-coated articles made in accordance with the invention facilitate the application of graphic arts designs on the coated can: the imprinted matter is melted into the resin film, in the heat treatment step of the instant invention, so that the prior art requisite of applying an additional protective lacquer coat and heat treatment of same are no longer necessary. Still further, the process of the invention does not require complicated ventilating equipment, because the heat treatment of the powder-treated cans cannot lead to the escape of solvents which may be inflammable or hazardous to operatives.

As set forth supra, there is little loss in resin particle spray in the instant invention, contrasted with the substantial loss of lacquer spray in liquid-lacquer prior art processes by way of spray which is drawn off through the air purification equipment requisite in prior art processes. In the instant process, excess resin powder, i.e., particles which do not reach the can to be coated, are easily collected below the coating apparatus by way of, e.g., a trough disposed within the electrostatic field, and can be easily recycled to the spray nozzles. Other advantages are inherent in the specific properties of the resin material applied, viz., its great resistance to many chemicals (thus leading to universal applicability of the finished goods to hold all types of contained material), its low density, its high elasticity and hardness. Particularly, it is possible, because of the high elasticity of the resin film, to deform bodies so treated after they have been coated, without leading to peeling off or cracking of the coating, which often happens in the case of lacquer-coated cans produced according to conventional techniques.

Also important is the advantage of the instant process in causing much less pollution of the environment, because the excess resin powder is easily collected in the instant process, whereas the lacquer lost in conventional processes often ultimately pollutes the surrounding air or water.

In a preferred aspect of this invention, the inner and outer surfaces of the article to be coated, e.g., a can, are coated simultaneously. This aspect of the instant process can be implemented by providing a set of spray nozzles which are synchronously inserted in the can, in rhythm with the assembly line forwarding of the cans, which spray nozzles apply resin powder to the inner surfaces, while simultaneously a second set of spray nozzles are provided for applying resin powder to the outside surface(s) of the article. By combining these two working steps, the articles to be coated need be exposed to a coating zone only once and also require only a single heat treatment step. It is of course possible to provide in the coating zone for multiple coats optionally with altered resin particle grain size and/or constituency of the resin powder used as the coating materials. The container to be coated may be suspended, in the coating operation, by way of a suction cup having lips made of heat-resistant Teflon or Viton of suitable shore hardness, fastened pneumatically to the outside bottom of the container, and wherein the container so held is grounded through an iron core contained in the suction cups. However, in a preferred aspect of the apparatus of the invention, utilizable for carrying out the

instant process in preferred mode, the hollow body to be treated is suspended in the coating zone as follows:

- a. by way of steel prongs or needles which hold the container and simultaneously act to ground the container, or, most preferably,
- b. electromagnetically;
 - i. in the case of non-ferrous containers, e.g., aluminum cans, this is achieved by impressing into the outer bottom of the aluminum can an iron web of, e.g., 1.5 cm², which serves to ground the container and permits electromagnetic suspension described more fully hereafter (the impressing of the iron web into the bottom of the aluminum can can be conveniently effected while the aluminum container itself is being pressed or formed);
 - ii. in the case of cans or other hollow bodies made of ferrous metals, i.e., iron or steel (e.g., "tin" cans), by providing electromagnetic suspension to the ferrous article;

electromagnetic suspension is particularly preferred because it advantageously provides both physical suspension or mounting of the article to be coated and simultaneous grounding of the article. Further, by regulating the magnetic field of the electromagnetic suspension means (magnet) the suspension and release of the article to be coated can be closely controlled and automatically regulated.

When making and processing aluminum cans in accordance with the invention, the iron web adhered to, or wholly or partly imbedded in, the bottom of the aluminum cup is conveniently so adhered or imbedded during cup formation, i.e., during the conventional impact extrusion process for shaping aluminum cups from aluminum sheet. While the precise mode of supplying the iron webbing to the aluminum cup on formation thereof is not narrowly critical, it is advantageous to dispose a roll of iron webbing above the impact extrusion press and run the iron webbing through the extrusion assembly so that iron webbing is disposed under the aluminum slug prior to punching of the cup therefrom; in this manner, the iron webbing is adhered to the bottom of the cup on the punch stroke of the extrusion press, i.e., simultaneously with cup formation, thus not requiring a separate step for adhering the webbing. It is, alternatively, of course possible, however, to adhere the iron webbing subsequent to cup formation by any suitable mechanical means. To perform application of the webbing during cup formation is however preferred, and particularly also because the webbing so applied falls off during the conventional post-coating steps of strengthening (doming) the bottom of the coated can, during which steps the bottom of the can is rendered concave. Thus, the webbing applied to the flat cup bottom is so deformed on doming of the can bottom that it necessarily detaches itself from the can and can be discarded. It will be appreciated that a square mesh is deformed during the doming operation to result in rhomboids being formed from the mesh squares, thus providing a mechanical detaching action of the web from the cup bottom. The impact extrusion presses used in the "drawn-and-ironed" process for making (two-piece) metal cans, in which iron webbing of the invention can be applied, are conventional; see, e.g., *Aluminum*, published by the American Society for

Metals (1967), Metals Park, Ohio; Vol. 2, Chapter 7, and Volume 3, Chapter 4.

The non-ferrous, e.g., aluminum, can so provided with iron webbing, or the steel can conventionally produced from tinplate, is then subjected to the conventional steps of drawing, ironing, base forming and trimming. Thereupon, the can is subjected to a washing or defatting operation, which is substantially simpler in the process of this invention wherein resin powder is used to subsequently coat the can than in processes wherein a liquid lacquer coating is applied, as explained hereinabove.

After washing or defatting, the can is further processed in accordance with the invention by suspending same, preferably electromagnetically, with equipment known in the art. Suitable apparatus is, e.g., that available commercially from Fleetwood Systems, Inc., of Countryside, Illinois, which equipment is generally designated as "magnetic elevators." In this manner, the cans are forwarded upside down suspended by only the outside bottom portion and exposing all other outside surfaces and all inside surfaces of the can.

The so-suspended can is then forwarded to a coating zone in accordance with the invention. In this coating zone, the suspended can is subjected to an electrostatic discharge field wherein the can, through the magnetic suspension thereof, acts as the ground and, while so subjected to the electrostatic field, sprayed with finely divided resinous coating powder supplied by spray nozzles preferably disposed both on the inside and on the outside of the can. An advantageous embodiment of the coating zone assembly and operation is illustrated in the drawing in which:

FIG. 1 is a schematic representation of the electromagnetic suspension means and the spray nozzles used to deliver resin powder to the can surfaces; and

FIG. 2 is a schematic flow-sheet of (A) a prior art process and (B) the inventive process, for coating and printing cans.

With particular reference to FIG. 1, the cans are suspended upside down from electromagnets which, in turn, are suspended from a conveyor belt or the like, shown in cross-section as member 17; spray nozzles 13 are disposed within each can and spray nozzles 15 are disposed outside the can, to deliver resin powder to all can surfaces (except the outside bottom which remains uncoated). The entire assembly is surrounded by anti-static container means 19 fitted with trough 21 through which loose excess powder can be removed (and optionally recycled to the nozzles); the entire assembly is conveniently supported at some vertical elevation by frame 23.

The spray nozzles as well as the electrostatic field means within which they operate are conventional items of apparatus and are available commercially from, e.g., the Ransburg Electro-Coating Corporation of Indianapolis, Indiana, and a typical overall installation is designated as "A 4.00 R-E-P Automatic" by that corporation. As will be evident to the skilled artisan, the spray nozzles, which are an integral part of the electrostatic discharge system, can be stationary or can be rotated for enhanced uniformity of powder distribution on the can.

The particular resin types which are employable, in powder form, in accordance with the invention are also, per se, known in the art although they have not been used to coat cans and include, for instance, the

acrylics, alkyd resins, epoxy-amine resins, as well as epoxy-esters, and epoxy-phenolics capable of being supplied in fine powder form by the spray nozzles used herein. It will be appreciated that the choice of a particular resin type will depend in part on the end use application of the can to be coated; e.g., if the can is an aerosol can for holding basic or acidic materials, the resin must be impervious to attack therefrom.

It has been found that treated can surfaces in accordance with the invention using an epoxy powder as the coating resin (applied at 180° to 220°C) demonstrated imperviousness to the following materials, when exposed thereto, i.e., immersed therein, for twelve weeks at room temperature in a closed glass container.

Ammonia (10%)

Sodium hydroxide (10%)

Hydrochloric acid (10%)

Acetic acid (10%)

Citric acid (1%)

Tartaric acid (1%)

Oleic acid (conc.)

Ethyl alcohol (50%)

Chlorothene NU

Shaving foam (Gillette)

Hair shampoo creme ("Elidor" and "Schauma")

Hair coloring (Conc.)

Mustard

Tomato paste

Olive oil

Dist. water

Anti-freeze ("Glysantin")

Window wash liquid

It can thus be seen that can surfaces treated by means of the invention tolerate typical contents of, e.g., aerosol cans or food-containing cans as well as much more aggressive materials, to an outstanding extent.

After application of the resin powder on the can surfaces as described above, the cans are forwarded, by the electromagnetic conveyor to a through-put oven wherein the cans are subjected to a heat treatment sufficient to melt the resin particles on the can surface, to form a continuous film covering the entire inner and outer surface of the can. Advantageously, if the can is to be imprinted, as is usually the case, the heat treatment is such that a continuous surface layer of a resin film is formed and partly dried, but is left sufficiently moist to permit imprinting in the "wet-on-wet" mode, as discussed more fully hereinabove. Subsequent to imprinting, the can is desirably subjected to an additional heat treatment to firmly imbed the print and to fully dry the resin coating to form a resilient and strong protective sheath around the can. This can be advantageously achieved according to the invention by providing a single two-level through-put oven wherein the cans are put through one level prior to imprinting and the second level after imprinting. The overall arrangement may be better understood by reference to FIG. 2(B) wherein there are shown, schematically but to approximate scale, two impact extruders (related equipment for drawing, ironing, base forming and trimming, not shown) which deliver cans (e.g., aluminum cans having the bottom iron webbing adhered thereto) to washing equipment which is connected through a short cooling zone to the coating zone wherein the cans are electrostatically sprayed with resin powder. The cans emerging from the coating zone are led through the lower level of a throughput oven which is of sufficient length

to subject the can to a heat treatment (at, e.g., 180°C) for about 5 minutes. The still moist coated can is then subjected to an offset printing operation whereafter the imprinted can is returned to the oven (now to the upper level) and subjected to a finishing heat treatment firmly baking the print into the coating and the coating onto the can.

It can be appreciated, when comparing FIG. 2A (illustrating a typical prior art process) with FIG. 2B herein that the space needs for the equipment required to carry out the instant process is less than one-half of that demanded by prior art processing, quite apart from the greater adaptability of the instant process as regards processing of aluminum cans (which of course are not processable with the electromagnetic suspension techniques of the prior art). The use of the powder resin, as opposed to liquid spray, for coating in accordance with the invention permits a reduced washing operation and, in turn, a shorter cooling zone after washing and combination of inside and outside coating of the can in a single step (thereby eliminating an intermediate drying step between the two coating steps of the prior art). The use of powder according to the invention is inherently more adapted to fast, continuous-line processing than the use of liquid lacquer which necessitates waiting times, and elaborate drying steps after application of the liquid lacquer. Thus, the coating process of the instant invention is capable of producing a number of cans per unit time about 50 percent higher than conventional processes while at the same time the instant process requires less than half as much equipment space. Accordingly, one assembly according to the invention is capable of handling the output of, e.g., two impact extrusion presses where the prior art assemblies could process the can output of only one such press.

A particular advantage of the process of the invention resides in the possibility that the electrostatic field can be reduced to such a level that excess amounts of the coating powder are shaken off through a vibrating means acting on the container, for instance as it is forwarded between the coating zone and the heat treatment zone. Because a certain potential difference, i.e., voltage drop, is maintained between the coating powder and the container surface, which, however, is reduced with increasing distance of the powder from the body surface, vibration of the article causes principally those particles to fall off which are farthest from the body surface, i.e., at the thickest places of the coating. These shaken-off particles are led back, still within the electrostatic field, to a collecting trough and then recycled to the spray nozzles. In this way, it is possible to fully recover all excess coating powder, leading to substantial savings in raw material.

It has been found useful to also lead the coated article through means for tipping the container over, so that its open side points downwardly at least part of the time (this is expediently done when the assembly changes direction) to ensure that excess powder coating material within the container is shaken therefrom.

The following example is illustrative but not limitative of the invention.

EXAMPLE

Aluminum slugs weighing 18 grams (i.e., corresponding in weight and diameter to the 45 mm diameter, 140

mm high cans to be formed) are delivered to a conventional impact extrusion press. While each slug drops into the punch cavity of the press, a piece of square iron webbing of 1.5 cm² surface and a mesh size of 1 × 1 (being unwound from a roll disposed above the press) is placed behind the slug in such a manner that the punch stroke forming the cup results in imbedding the piece of iron webbing into the outside bottom of the aluminum cup being formed, as shown in

FIG. 3 hereof which is a schematic drawing of the web-inserting arrangement employed.

With specific reference to FIG. 3, the aluminum can, being extruded in the impact extruder by extruder piston 33, is so disposed that on formation of the can its bottom end 31 receives web piece 41 which is embedded into the can bottom 31 by pressure of the extruder piston 33 upon termination of the punch stroke of the piston. The web piece 41 is so embedded while in position (B). The iron webbing is supplied from roll 35 disposed above the impact extruder from which an iron webbing strip 37 is intermittently unwound, and cut by web cutter 39 at appropriate length intervals. The resulting cut web piece 41 drops from position (A) to position (B) by gravity. The roll 35 and web cutter 39 are geared into the overall assembly line to be synchronized with the stroke of the extruder piston in the impact extruder, so that one cut piece of iron webbing 41 is supplied for each stroke, i.e., for each can formation. It is desirable to make the bottom end 31 of the can somewhat thicker than the remainder of the can so that, upon doming the bottom of the can in subsequent processing, as shown in FIG. 3B, the resulting domed bottom will be of the same approximate thickness as the remainder of the can; thus, with reference to FIG. 3B₁, the making concave of the can bottom 31 stretches the metal to thin it relative to its thickness during its former squared disposition. During the doming process, web piece 41 drops off and can be discarded (see FIG. 3B₂). FIG. 3A shown an advantageous embodiment of the iron webbing being unwound from roll 35, i.e., containing small lateral guide pieces which facilitate alignment of the strip in the impact extruder to be properly fitted to the middle of the can bottom. The width and length of the iron webbing placed behind the slug is adapted to fit the bottom cup diameter, and to be sufficiently large in relation to the weight of the can to permit subsequent electromagnetic suspension of the can via the imbedded mesh. The mesh width and the strength (diameter) of the individual filaments of the mesh are chosen to permit suspension but also to not adversely affect or weaken the softer aluminum can bottom. For an aerosol can of 5 cm bottom diameter, a piece of iron mesh of 1.5 square cm surface was satisfactory.

The thus-formed can is washed with conventional media at 80°C and dried (the drying step can be omitted if the washing is effected at sufficiently high temperatures, e.g., at over 100°C) and then suspended (bottom mz. up) electromagnetically from a vertically adjustable (magnetic) conveyor belt fitted with lateral guides to center cans of varying diameters on the belt. The so-suspended can, optionally still warm from washing, is introduced into a coating zone comprising conventional spray nozzles and an electrostatic field generator, the suspended can forming the ground of that field. The can is sprayed with epoxy resin powder, ground to a very fine particle size to achieve a thin film,

on both inside and outside surfaces simultaneously to a coating thickness of 0.05 mm. = 50 mz.

(In the electrostatic coating zone, four cans can be simultaneously coated while suspended symmetrically in "clover-leaf" fashion with one nozzle disposed inside each of the cans and other nozzles symmetrically arranged outside the cans). Still within the electrostatic field, the wheel mechanism of the magnetic conveyor belt is led over a 60 cm. long toothed rail, resulting in shaking of the suspended cans and shaking off of excess powder therefrom, thereby leaving on the can only the predetermined amount of powder electrostatically adhering thereto. The excess powder is collected in a trough and recycled to the spray nozzles. The can is then immediately introduced into a drying oven (the prior art step of venting off vapors not being required) as set out schematically in FIG. 2B. Shortly after being introduced into the oven, the cans are turned so that the open side now faces up by twisting of the conveyor belt. (This is done to avoid accumulation of resin material at the lip of the cup, which would occur during the heat treatment if the can were still suspended upside down; such accumulation could interfere with subsequent placement of the can on a prong during printing). The residence time of the can in the lower pass of the oven is 4 minutes at 180°C and is such that the continuous film coating thereby formed on the cans is still moist enough to receive "wet-on-wet" imprinting. After leaving the lower pass of the oven, the can is released from its electromagnetic suspension by interrupting the induction current in the electromagnet means, and placed on the precision prongs of a suitable printing press and imprinted conventionally. After imprinting, the cans are again electromagnetically suspended and are led to the upper pass of the drying oven for 4 minutes at 180°C whereby the printed matter is firmly imbedded into the film coating and the coating finally sintered. The can is now released from the electromagnetic suspension and finished, i.e., by necking-in and flanging. The bottom of the can is pressed inwardly (i.e. made concave) for better inside pressure strength of the can and, during this step, the iron mesh initially adhered to the can bottom falls off or is pried off by the equipment used for doming the can bottom.

It will be understood that the specification and examples are illustrative but not limitative of the present invention and that other embodiments within the spirit and scope of the invention will suggest themselves to those skilled in the art.

We claim:

1. Process for producing imprinted aluminum cans from aluminum sheet, which process comprises:

- forming a cup from the aluminum sheet while simultaneously adhering a strip of iron webbing to cover at least part of the bottom portion of the cup;
- subjecting the thus formed cup, having said iron webbing adhered or partly imbedded in its bottom portion, to a washing step to result in substantial defatting of the cup;
- suspending the washed cup electromagnetically by means of the iron webbing adhered thereto;
- subjecting the thus-suspended cup to an electrostatic field wherein the suspended can acts as the grounding element;
- positioning nozzles capable of delivering particulated resinous coating powder in spray form to the

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outside and inside surfaces of the suspended cup in said electrostatic field;

- f. subjecting the sprayed cup having resin coating particles adhering thereto to a first heat treatment to form a continuous film of molten resin particles covering all sprayed surfaces of the can
- g. while the thus formed film is still incompletely dried, imprinting the film covered can; and
- h. returning said imprinted cup to a second heat treatment to firmly bake on the imprinted matter and to permanently dry the said film coating.

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2. Process as claimed in claim 1 wherein two cup-forming lines supply a single electrostatic coating zone and there is at least one offset printing line to receive the film-covered can from said coating zone after said first heating step.

3. Process as claimed in claim 1 wherein subsequent to said first heating step (f) said can is mechanically deformed at the base thereof to form a concave bottom, resulting in falling out of said iron webbing strip.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,815,535 Dated June 11, 1974

Inventor(s) Georg Becker and Karl Kleindrettle

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 9, line 59,

the wording

"(bottom mz. up)"

should read

--(bottom side up)--.

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents