United States Patent

Cole et al.

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[54] VARIABLE DEPTH COATING APPARATUS

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[73] Assignee: **Brunswick Corporation**

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[52] **U.S. Cl.** **118/629**, 118/63, 118/102, 118/309

[51] **Int. Cl.** **B05c 5/02**

[58] **Field of Search** 118/102, 107, 309, 320, 400, 118/629, 63

[56] **References Cited**

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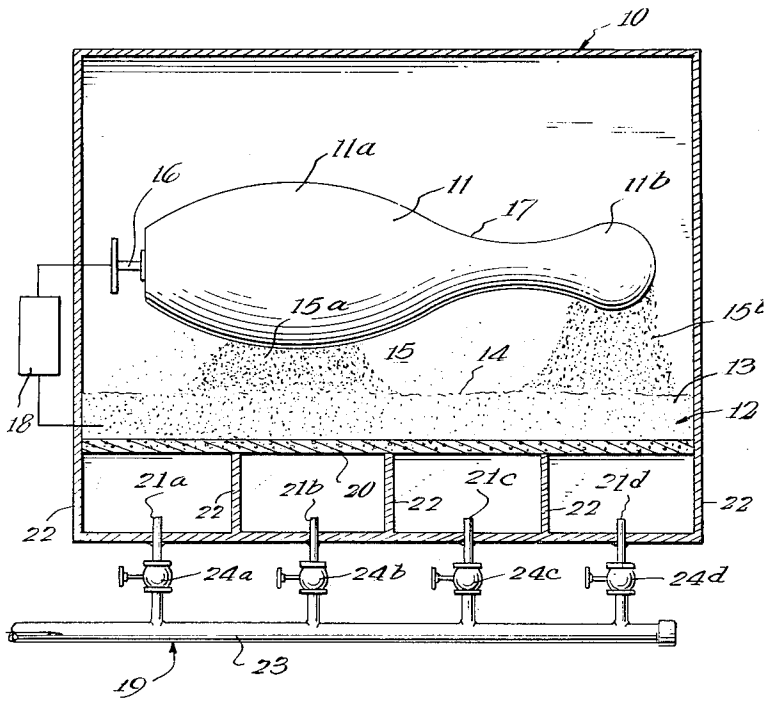
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[57] **ABSTRACT**

Apparatus for coating a body with a variable depth coating by means disposed externally of the body. In one form, the means comprises means for delivering a nonuniform cloud of coating particles to the body for deposit thereon to define a preselected nonuniform coating. In another form, the means comprises means for providing a uniform cloud of coating particles to the body and means for removing at least a portion of the deposited particles. The removing means comprises in one form means for blowing off deposited particles and in another form means for brushing off deposited particles. Electrostatic means may be employed for releasably retaining the deposited particles.

2 Claims, 3 Drawing Figures



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SHEET 1 OF 2

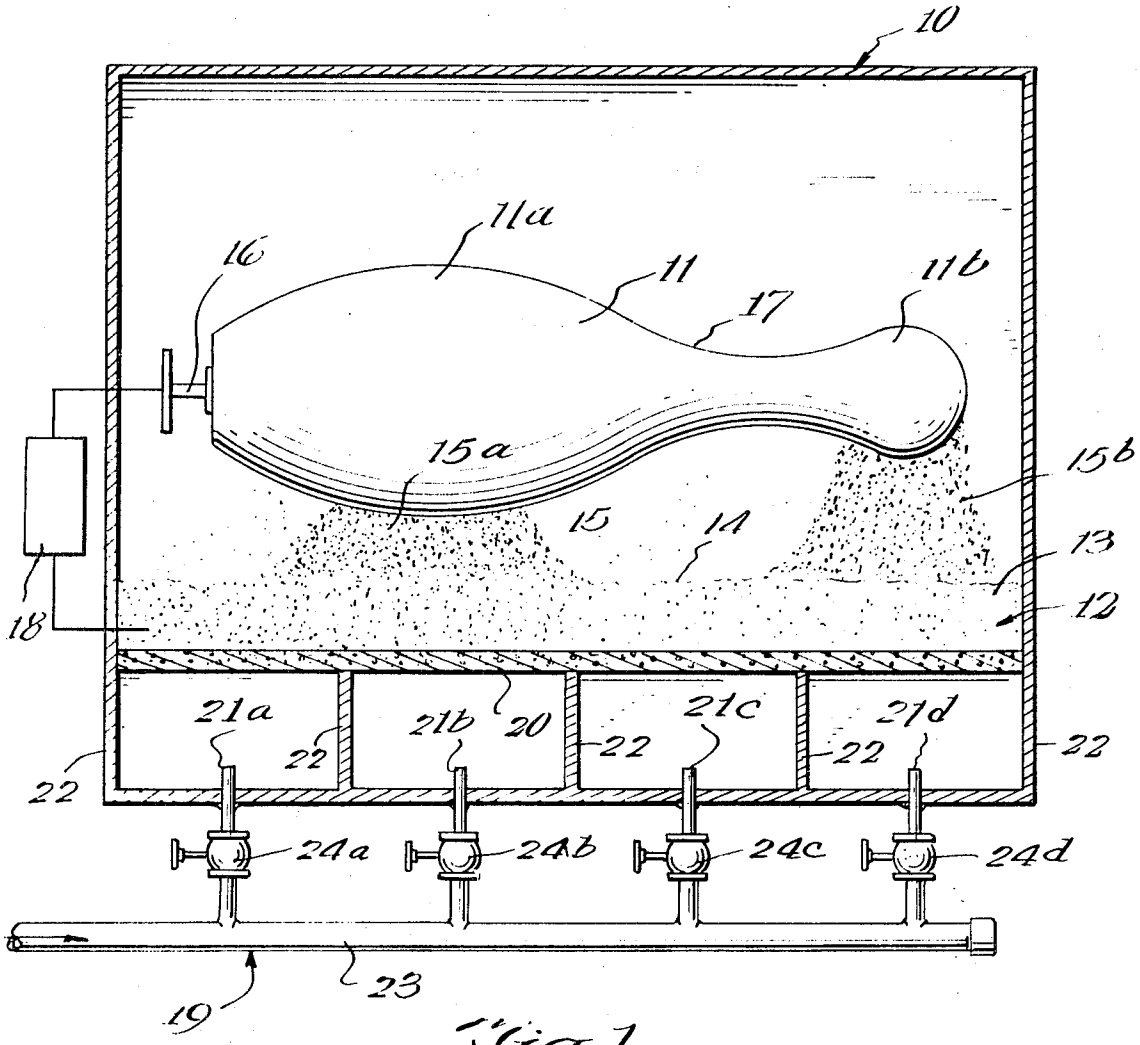
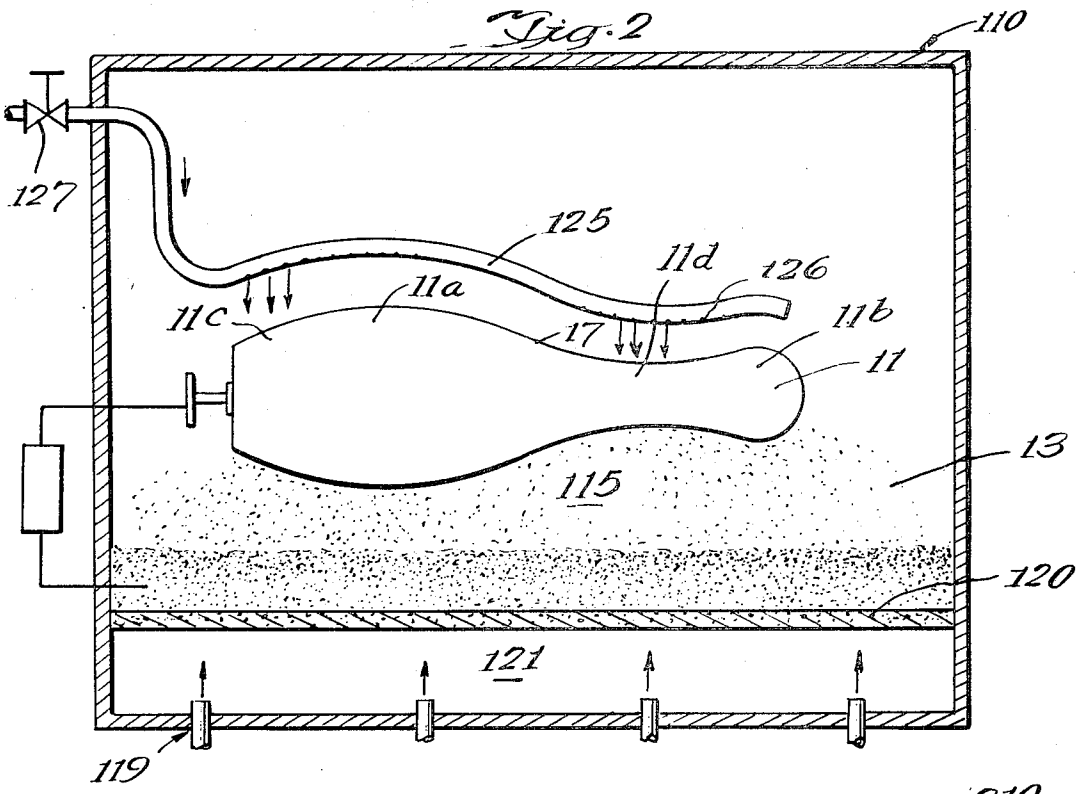


Fig. 1

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Fig. 2


110
127
125
11d
126
11a
11c
17
11b
11
13
115
120
121
119

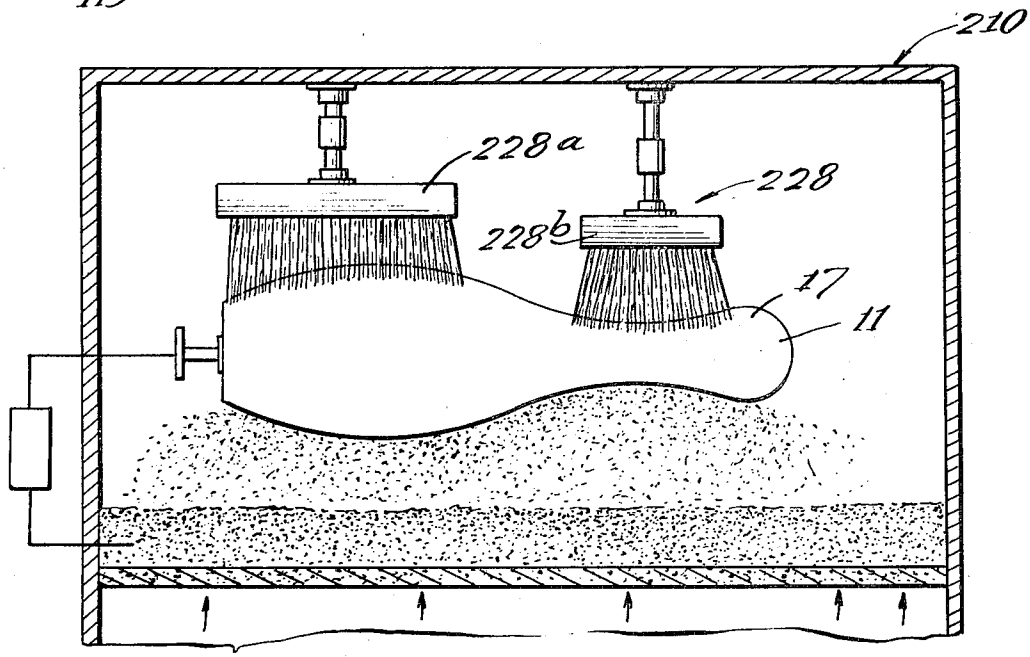

210
228a
228
228b
17
11

Fig. 3

VARIABLE DEPTH COATING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to coating apparatus and in particular to apparatus for providing a variable depth deposit of coating particles.

2. Description of the Prior Art

In one improved form of coating apparatus, means are provided for producing a superjacent cloud from a fluidized bed of coating particles. The body to be coated is disposed in contact with the cloud. Electrostatic means may be employed for causing retention of particles deposited on the body from the cloud so as to provide a desired coat of the particles on the body. It has been found that a variation in the depth of the coating so provided may occur such as due to the configuration of the body being coated. Thus, for example, where the body comprises a bowling pin body rotated about its longitudinal axis in the upper portion of the cloud, a greater depth of the coating tends to occur at the belly and head portions of the pin. While such variable depth coating provides improved coating characteristics, it has been found that such variable depth coating does not necessarily correspond to the requirements of the particular article being coated. Further, it has been desirable to provide further control of the coating depth even in those cases where the coating varies to some extent in the desired manner.

SUMMARY OF THE INVENTION

The present invention comprehends an improved apparatus providing accurate selective control over such depth of coating in a novel and simple manner.

Thus, the present invention comprehends an improved apparatus for coating a body wherein the coating particles are caused to move from a supply to the body to form a coating thereon. Means are provided in the apparatus disposed externally of the body for causing a difference in the depth of the coating on preselected different portions of the body. In one conceptualistic embodiment, the means for causing the difference in the depth of the coating comprises means for providing different rates of delivery of the particles to different preselected portions of the body. In the specific illustrated embodiment, this means comprises a plurality of controlled air delivery elements acting selectively on different portions of the fluidized bed of coating particles.

In a second conceptualistic embodiment of the invention, the apparatus includes means for providing substantially uniform cloud of coating particles. The apparatus further includes means for removing selectively from different portions of the body at least a portion of the particles deposited thereat. In one illustrative specific embodiment, the means for removing the particles comprises means for blowing off the particles and in a second illustrative specific embodiment, the means comprises brush means.

The invention comprehends that the apparatus may provide a combination of the nonuniform delivery means and selective removal means as desired.

The deposited particles may be retained on the body by suitable means such as electrostatic means. As discussed above, the cloud means may cause some variation in the depth of coating and the means of the present invention may be utilized either cumulatively with the electrostatic variable coating depth effect or in opposition thereto depending on the desired coating depth variations.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a vertical schematic section of an apparatus embodying the invention;

FIG. 2 is a vertical schematic section of a modified form of apparatus embodying the invention; and

FIG. 3 is a still further modified form of apparatus embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the exemplary embodiment of the invention as disclosed in FIG. 1, of the drawing, an apparatus generally designated **10** for coating a body illustratively comprising a bowling pin body **11** includes means for forming a fluidized bed **12** of coating particles **13**. A portion of the particles is caused to be delivered upwardly from the upper surface **14** of the bed **12** to define a cloud **15**. The body to be coated is carried on a suitable support **16** to be contacted by the particles **13** in the cloud **15** and resultingly have a coating **17** of the particles formed on the outer surface thereof. Support **16** may comprise a rotative support permitting rotation of the bowling pin body **11** about its longitudinal axis so as to effect a coating of the pin fully circumferentially thereabout. The particles of coating **17** may be effectively retained on the body **11** by suitable electrostatic charging means **18** providing a suitable high potential between the pin **11** and the particles **13**.

As indicated briefly above, the invention comprehends the provision in apparatus **10** of a means for controlling the depth of coating **17** at different portions of the body. Illustratively, it is desirable to provide a substantially greater depth of the coating at the belly portion **11***a* and a substantially greater depth at the head portion **11***b* as compared to the remainder of the pin surface. This is effected in apparatus **10** by causing a difference in the rate of delivery of the particles **13** to the different portions of the pin. More specifically, the depth control is effected in apparatus **10** by causing the formation of more dense cloud portions **15***a* and **15***b* at the pin portions **11***a* and **11***b* respectively.

The variation in cloud density may be effected by suitable means such as selectively controlled fluidizing means generally designated **19**. Fluidizing means **19** may include a permeable bottom wall **20** defining the lower boundary of the fluidized bed **12** adapted to pass fluidizing fluid upwardly therethrough. The space below wall **20** may be divided as desired into different portions, such as space portions **21***a*, **21***b*, **21***c* and **21***d*, by means of suitable walls **22**. Fluidizing fluid such as pressurized air is delivered to the space portions **21***a–d* from a supply manifold **23** and a plurality of discrete means for delivering different amounts of air from the manifold to the different space portions. Herein the air control means comprises adjustable air valves **24***a*, **24***b*, **24***c* and **24***d*. Thus, control valve **24***a* regulates the amount of air delivered to space portion **21***a* and thus the amount of cloud formation about space portion **21***a*. Valve **24***b* similarly controls the cloud formation about space portion **21***b*, valve **24***c* similarly controls the cloud formation about space portion **21***c*, and valve **24***d* similarly controls the cloud formation above space portion **21***d*.

Thus, where a greater depth of coating is desired on the pin body **11** at portion **11***a* overlying space portion **21***b* and pin body portion **11***b* overlying space portion **21***d*, valves **24***b* and **24***d* are adjusted to provide a greater rate of flow through space portion **21***b* and space portion **21***d* than that provided by valves **24***a* and **24***c* through space portions **21***a* and **21***c*.

Resultingly, as shown in FIG. 1, cloud portions **15***a* and **15***b* are caused to be more dense and thereby provide a relatively greater rate of delivery of particles **13** to the pin body portions **11***a* and **11***b*. Thus, the depth of coating **17** at body portions **11***a* and **11***b* is correspondingly increased thereby to provide desired improved air characteristics of the resultant bowling pin. Adjustment of the depth of coating may be readily effected by suitable adjustment of the control valves **24***a*, **24***b*, **24***c*, and **24***d*.

The control of the coating depth by the adjustable valves permits the operator to effect a variation in the depth substantially as desired and, thus, should it be desirable to provide a greater depth of coating on the body portion above space portions **21***a* and/or **21***c*, the valves may be suitably readjusted for

this. Further, the depth of coating of the relatively large depth portions **11***a* and **11***b* may be suitably varied by suitable control of the valves **24***b* and **24***d*. Thus, for example, a somewhat greater depth of coating may be provided on portion **11***a* than on portion **11***b* if so desired.

As will be obvious to those skilled in the art, fine control of the variable depth coating may be provided by increasing the number of separate control valves and space portions. Alternatively, apparatus **10** may be utilized to provide a substantially uniform coating by causing the delivery of air through each of the valves to be similar.

The coating material may comprise any suitable coating material. Illustratively, apparatus **10** is advantageously adaptable for use in coating plastic material such as cellulose acetate butyrate, ethyl cellulose, etc., onto wooden bowling pin bodies.

Turning now to the embodiment of FIG. **2** a modified form of apparatus generally designated **110** for providing a variable depth coating is shown to comprise an apparatus generally similar to apparatus **10** of FIG. **1** but utilizing different means for effecting the depth control. Thus, in apparatus **110** the means **119** for producing a cloud **115** is adapted to provide a uniform cloud which would tend to provide a generally uniform depth of coating on the body **11**. Thus, cloud-producing means **119** may be similar to mans **19** except that the pressurized air is delivered to a single large space **121** underlying the portions wall **120** so that substantially all portions of the fluidized bed are utilized to produce a substantially uniform cloud thereabout.

In apparatus **110** the depth of coating is controlled by removing at least a portion of the particles **13** deposited on body **11** to form coating **17**. The removal of the deposited particles may be effected by a suitable airjet tube having a plurality of apertures **126**. Air is supplied under pressure through a suitable control valve **127** to the tube **125** and directed through apertures **126** against the deposited particles in coating **17**. The air may act to remove substantially all of the deposited particles such as at portions **11***c* and **11***d* while allowing substantially all of the deposited particles to remain at portions **11***a* and **11***b*. The removal of the deposited particles at portions **11***c* and **11***d* may be maintained for a preselected period of time to permit the coating depth at portions **11***a* and **11***b* to reach a preselected desired depth. The coating operation may then be continued for a second preselected period of time with valve **127** closed so as to permit a preselected limited depth coating to be provided at portions **11***c* and **11***d* of the pin body and the depth of the coating on portions **11***a* and **11***b* to reach the desired final coating depth.

Alternatively, the force of the airjet from tube **126** may be controlled so that only a portion of the deposited particles are removed so that the depth of the coating at portions **11***c* and **11***d* merely build up at a slower rate than at portions **11***a* and **11***b*. It has been found, however, that such concurrent variable depth control is somewhat more difficult to regulate than where the apparatus is arranged to provide a two-step deposition as discussed above.

Referring now to the embodiment of FIG. **3**, a further modified form of apparatus generally designated **210** is shown to comprise an apparatus generally similar to apparatus **110** but having mechanical means generally designated **228** for removing deposited particles from the pin body **11** to provide the desired variable depth coating **17**. Thus, as shown in FIG. **3**, the particle-removing means may comprise suitable brushes **228***a* and **228***b* adapted to contact the coating as it is being deposited and remove at least a portion of the deposited particles. Here, again, the brushes may be arranged to remove substantially all of the deposited particles from preselected portions of the body **11** whereupon a subsequent uniform disposition after the brushes are removed from engagement with the coating may be utilized to effect the variable depth overall coating of the pin body. Alternatively, the brushes may be made to be sufficiently light in the brushing action to cause only a portion of the deposited particles to be removed.

Thus, each of apparatus **110** and **210** is similar to apparatus **10** and similar elements thereof are identified by similar reference numerals except **100** or **200** higher. Apparatuses **110** and **210** differ from apparatus **10** in providing a particle cloud tending to deposit the particles uniformly on the body to be coated and having portions of the particles removed subsequent to the deposit to provide the variable depth whereas in apparatus **10** the deposit on the body is controlled so as to provide the desired variable depth of the coating. In all respects, each of apparatus **10**, **110** and **210** functions similarly in providing the desired variable depth coating.

Further as will be obvious to those skilled in the art, a combination of the different methods of controlling the coating depth may be employed within the scope of the invention. Illustratively, the variable density cloud method of FIG. **1** may be utilized in conjunction with either or both of the particle removable methods of FIGS. **2** and **3**. Further, alternatively, different portions of the object may be coated to different depths by utilization of different ones of the methods, such as wherein a maximum depth of coating is provided on pin portion **11***a* by means of the maximum density cloud portion **15***a*, a lesser depth coating is provided on pin portion **11***b* by means of the airjet-removing means **125**, and a minimum density coating is provided on neck portion **11***d* by means of the brush-removing means **228**.

The foregoing disclosure of specific embodiments is illustrative of the broad inventive concepts comprehended by the invention.

We claim:

1. Apparatus for coating a body, comprising: means for holding a supply of coating particles; means for causing movement of the particles from the supply to said body to form a coating of said particles thereon; and means disposed externally of the body for causing a difference in the depth of the coating on preselected different portions of the body wherein said movement causing means is arranged to deliver the particles generally uniformly to said body and said means for causing a depth difference comprises means for removing substantially all of the delivered particles from different portions of the body for a first preselected period of time and subsequently permitting delivery of said particles to said different portions for a second preselected period.

2. Apparatus for coating a body, comprising: means for holding a supply of coating particles; means for causing movement of the particles from the supply to said body to form a coating of said particles thereon; and means disposed externally of the body for causing a difference in the depth of the coating on preselected different portions of the body wherein said movement causing means is arranged to deliver the particles generally uniformly to said body and said means for causing a depth difference comprises means for removing substantially all of the delivered particles from different portions of the body for a first preselected period of time and subsequently permitting uniform delivery of said particles to said body for a second preselected period.

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