United States Patent

[11] **3,547,078**

[72] Inventor **Walter Linneborn**
Cologne, Braunsfeld, Germany

[21] Appl. No. **497,975**
[22] Filed **Oct. 19, 1965**
[45] Patented **Dec. 15, 1970**
[73] Assignee **By mesne assignments to The Singer Company, New York, N.Y., a corporation of New Jersey**
[32] Priority **March 5, 1965**
[33] **Germany**
[31] **No. E28816**

[54] ELECTROSTATICALLY COATING THE OUTER SURFACE OF HOLLOW OBJECTS WITH FLOCK

18 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **118/638;** 117/17, 117/25
[51] **Int. Cl.** **B05b 5/02**
[50] **Field of Search** ..... 118/621, 624, 625, 627, 628, 630, 632—643; 117/17, 25; 222/328

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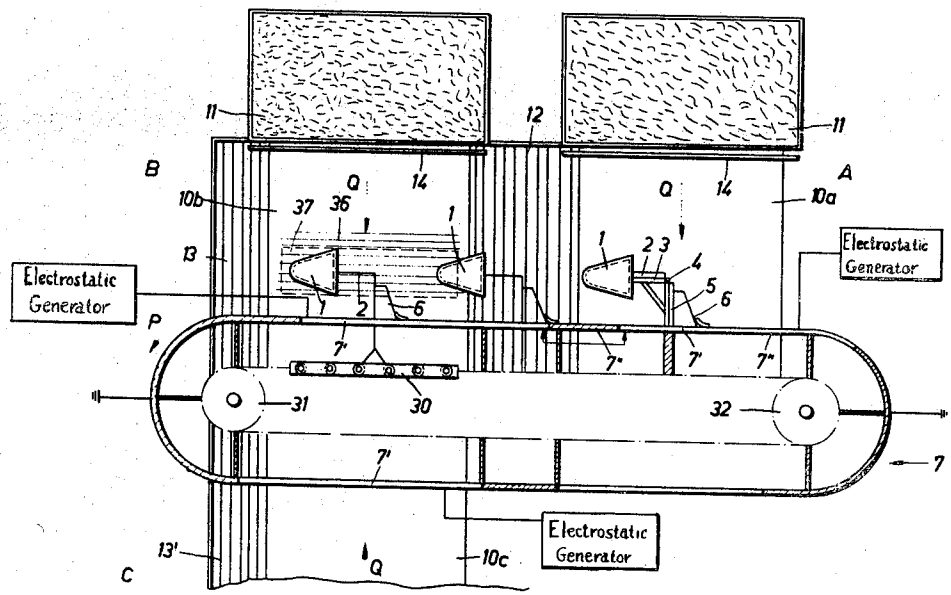
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Primary Examiner—Peter Feldman
Attorney—Owen, Wickersham and Erickson

ABSTRACT: Electrostatic flocking apparatus comprising holding means for supporting objects having an outer surface to which adhesive has been applied, each holding means having a sliding electrical contact, endless conveyor means for transporting the holding means, a plurality of flocking stations, each having flock supply means and electrostatically charged electrodes, and guide rail means comprising first and second guide rail sections in engagement with the sliding contacts, the first sections carrying electrical potential and each being in and closely adjacent to a flocking station, the second sections being insulated and grounded and located between successive flocking stations.



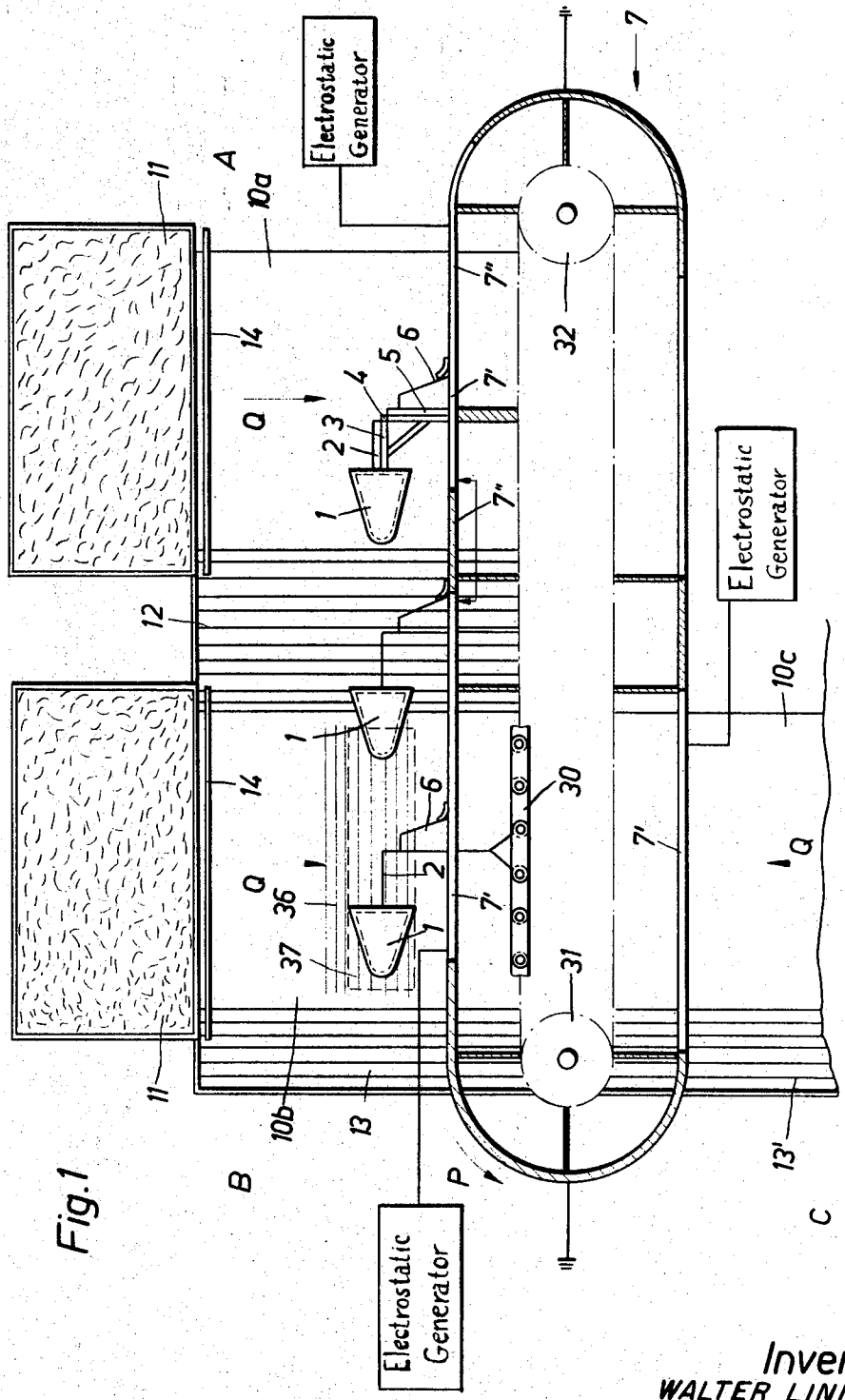
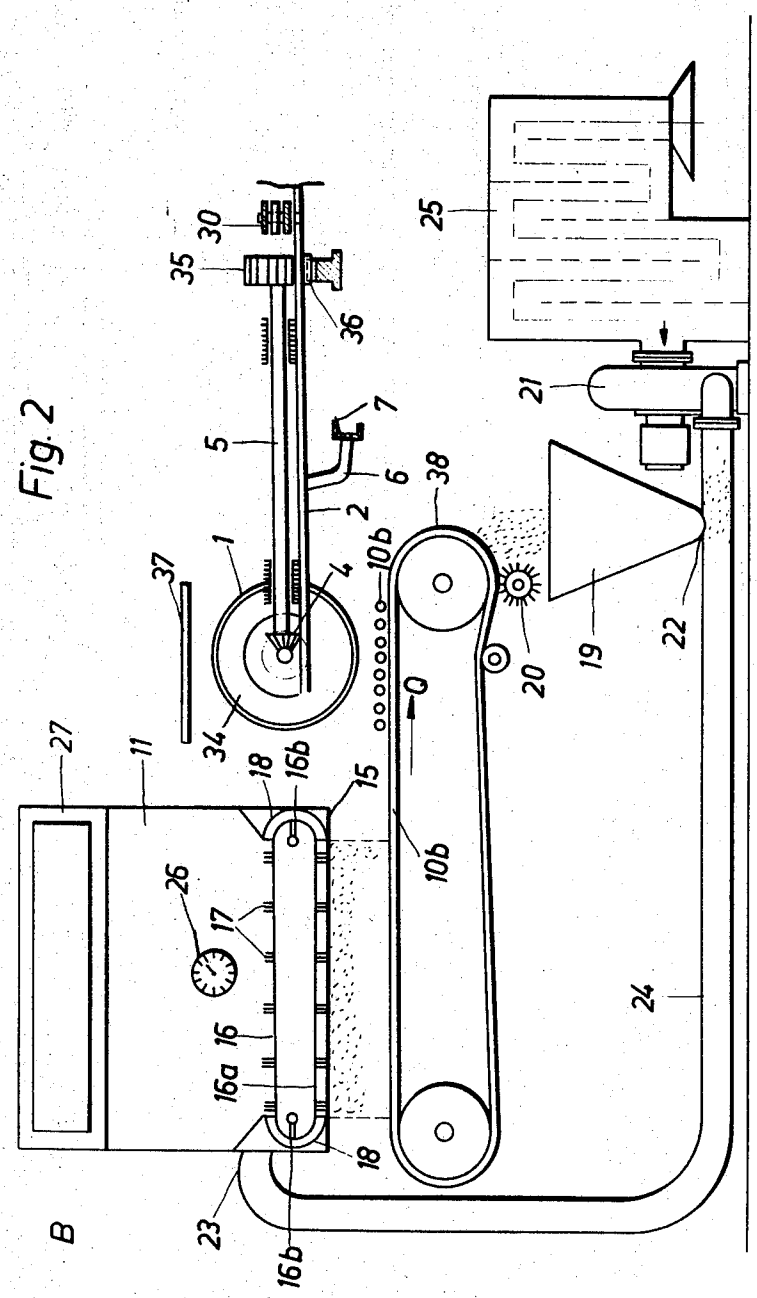


Fig.1

Inventor:
WALTER LINNEBORN
BY
Owen, Wickersham & Erickson
ATTORNEYS

Fig. 2



Inventor:
WALTER LINNEBORN
BY
Owen, Wickersham & Erickson
ATTORNEYS

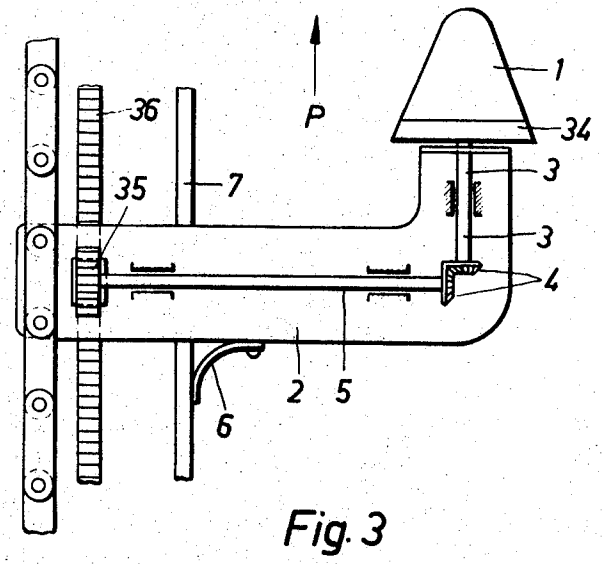


Fig. 3

Inventor:
WALTER LINNEBORN
BY
Owen, Wickersham & Erickson
ATTORNEYS

ELECTROSTATICALLY COATING THE OUTER SURFACE OF HOLLOW OBJECTS WITH FLOCK

This invention relates to coating the outer surface of hollow objects with flock. More particularly, the invention relates to electrostatic flocking.

In a prior art flocking apparatus used for making paint rollers to apply paint on walls and ceilings of rooms, the surface of a roller-type object mounted on a holder that is secured to a chain, is coated with adhesive and then is guided between two electrodes while rotating. With the aid of an air current, fibrous material is blown into the space between the two platelike electrodes, where an electrical field is present. The effect of the lines of force is to position the fibrous material radially in relation to the rollers and to form a brushlike deposit thereon, each hair or each fiber being secured in the adhesive by one of its ends. The rollers carrying the holders are connected to positive voltage by means of sliding contacts, while the electrodes carry negative voltage.

A problem with this prior art device has been that a considerable proportion of the fibers delivered to the flocking station failed to adhere to the adhesive-coated object, and, notwithstanding the presence of the electrical field, escaped to the outside. It was therefore necessary to work with suction hoods so as to keep the atmosphere free of such fibers in the region of the flocking device. However, not only did the installation of such suction devices involve additional costs, but considerable losses of flock material resulted, and it was difficult to recover such material from the evacuated air.

One object of the present invention is to provide an improved apparatus of the above-mentioned type that causes practically all the flock dispensed at the flocking station to reach the treated object and to adhere thereto, so that there is no pollution of the machine itself nor on its surroundings by flock, which is difficult to remove when it forms a layer on the machine parts.

When a plurality of flocking stations is used in series in conventional apparatus, the freely floating flock often penetrates into the range of the adjacent station where, due to the effect of the electrostatic field, part of it is deposited on the object which is being coated there. This, however, is a considerable disadvantage since, for many uses, the objects must be flocked successively, for example with flock of different length or color, each kind of flock being applied separately and not in admixture with others.

In order to avoid these difficulties, the invention proposes guiding the conveyor means successively through a plurality of flocking stations, the sliding contacts on the holders being applied to insulated grounded guide rail sections between said stations. This simple expedient produces the surprising result that the flock no longer strays uncontrolled to the outside or onto the outside of the apparatus and, further, flock no longer passes from one flocking station to the adjacent station; for example, large amounts of shorter fibers from neighboring stations are no longer caught by a particularly potent electrostatic field used for flocking with particularly long fibers.

In accordance with a further proposal of the invention, the electrically conductive guide rail sections are connected to negative potential. It has been found that due to this simple measure, all flock material reaches the objects which are being coated. In accordance with a further proposal of the invention, the electrically conductive rail portions may be connected to electrostatic generators of different voltages, for working with flock requiring electrostatic fields of different intensity.

In order to achieve complete separation of the flocking stations so that flock material from one station cannot reach the adjacent station, the invention further provides grid electrodes disposed between the flocking stations and connected to alternating-current voltage. These electrodes prevent flock which has not yet reached the objects which are being coated from leaving the range of the electrostatic field to which it has been delivered.

To prevent flock material from moving back into the charging device before the adhesive has secured it to the objects which are being coated, special boxes may be used for feeding the material, the boxes being screened by electrodes subject to alternating voltage. Like the electrodes separating the successive flocking stations, these electrodes may be grid electrodes.

To obtain a uniformly flocked product, it is important for the feed of the flock onto the conveyor belt to be uniform. Such uniform feed is particularly difficult to achieve with the flock material here involved because, first, the material tends to accumulate or bunch-up when being moved and, second, while moving it absorbs electrostatic charges even without the presence of an exterior field.

It has now been found that faultless feed of flock from the boxes to the conveyor belt may be achieved by constructing the box floor as a screen and by rotating above that screen floor an endless conveyor with brushes disposed transversely to the direction of the movement of the conveyor. The brushes passing the lower run of the conveyor brush over the screen floor, while, at the turns of the conveyor, guide surfaces are provided which are concentric to the turns and surround the turn at an angle of about 180°. This arrangement insures uniform feed of flock through the screen floor regardless of the level of fill in the box, and the guide surfaces at the turns insure that flock does not accumulate or bunch up particularly at the point of reversal where the conveyor runs downwardly. Thus, compartments, as it were, filled with flock, are created between the individual rows of brushes, and they cannot decrease when entering the turn, nor can additional flock squeeze into them at the turn.

Of particular importance also is the recovery of flock material which did not reach the object being treated. The invention provides a particularly advantageous solution in that a collector device for excess flock material is disposed underneath the terminal point of reversal for the conveyor belt facing away from the box, the collector device being connected to a pneumatic conveyor device leading to the feed box. The collector device consists preferably of a hopper for proper introduction of excess flock into the pneumatic conveyor device, the lower end of the hopper opening into a nozzlelike constricted spot in a tube forming part of the conveyor device.

The flocking process may be carried out without hitch and a faultless product may be obtained only if care is taken of proper conditioning, that is to say, if the flock material is moistened as required at any given time. A particularly simple and effective solution for achieving the required moistening is provided in this invention, in that a sprayer device is provided at the air inlet of the pneumatic conveyor device. The air stream thereby assumes a twofold task, namely, first, to transport the excess flock back and, second, to transmit moisture for maintaining the required humidity.

The invention is described hereinbelow in connection with the attached drawings showing the apparatus in simplified representation.

In the drawings:

FIG. 1 is a schematic top view of apparatus embodying the principles of the invention,

FIG. 2 is a schematic view in side elevation of the apparatus showing flock feed, recovery and conditioning devices, and

FIG. 3 is a top plan view of a support device for holding an article to be flocked.

Hollow objects 1, such as hat bodies, which have already been coated with a suitable glue and are now to be coated with flock, may be supported by holders or arms 2. The holders 2 are secured, in a manner per se known, to a conveyor means, such as an endless chain 30 running around two sprocket wheels 31 and 32 for transporting the holders 2 and thereby also the objects 1 along a substantially elliptical path. The objects 1 are preferably disposed on the holders 2 with the closed end of the hat bodies leading as they are moved forward by the conveyor in the direction indicated by the arrow P. The objects 1 are arranged upon rotatable supports 34, so that the entire surface of each object 1 may be exposed uniformly to the electrostatic field present at the flocking stations. As can be

seen from FIGS. 2 and 3, rotation of the objects 1 about an axis which is horizontal in the illustrated embodiment, can be achieved by a shaft 3 supported in the forwardly angled arm 2 and connected via beveled gears 4 to a shaft 5 supported in the section of the arm 2 which projects transversely from the conveyor means 30. To the inner end of the shaft 5, a toothed gear 35 may be secured, the gear 35 being in engagement with a toothed rack 36 or the like within the range of rotation of the workpiece 1 on the holder.

The metal holding assembly 2,3,4,5 is equipped with a (schematically represented) sliding contact 6 with which it slides on a guide rail 7. The guide rail 7 comprises conductive section 7' and nonconductive sections 7''. The conductive sections 7' are disposed so that the connection to the holders 2 is electrically conductive within the regions of the flocking stations, while, when passing from one station to the succeeding station, the holders 2 are without a conductive connection as a result of their contacts 6 sliding over the nonconductive rail portions 7''.

The conductive rail sections 7' are connected to suitable electrostatic generators (not shown) which supply the high voltage required for carrying out the process. Thus, the holder 2 which reaches into the interior of the hollow object 1, forms an electrode which is effective only when it is passing through a charging station.

The two other electrodes required for carrying out the process and which are connected to a potential different from that of the holders 2, are disposed within the flocking stations above and below the regions which are contacted by the objects 1.

In the embodiment illustrated in the drawing, the flocking stations are designated A, B and C. In each, a conveyor belt 10*a*, 10*b*, 10*c*, disposed below the holders 2 carrying the objects 1, conveys flock material from boxes 11, in the direction of the arrows Q toward the conveyor means. Above the belts 10*a*, 10*b*, and 10*c* of the stations A, B and C, gridlike lower electrodes 36 are provided, each preferably having platelike counter-electrodes 37 secured above the holders 2. At the different flocking stations A, B and C the electrodes 36 and 37 may be connected to potentials of different power, and similarly the holder 2 (acting as a counterelectrode via the sliding contact 6 and the conductive rail sections 7' within the various stations) may be connected to potentials of different magnitude. Thus it is possible to adjust the intensity of the electrical field to the flock material being used at any given time, so that different materials may be worked-up successively at the various stations.

When the conductive sections of the guide rail are connected to negative potential, for example −60,000 V, and when a suitable potential differential is generated by means of the electrodes 36 and 37 disposed above and below the holders 2 in the region of the belts at the stations A, B and C, all flock fed by means of the belts 10*a*, 10*b*, and 10*c* travels to the object 1 which is to be treated, while the object 1, driven by the endless conveyor 30, travels over its respective belt in a direction transverse to the latter.

In order to prevent flock material from passing from station A to station B where a different potential differential is possibly being employed because a different flock material is possibly being used there, a grid electrode 12 connected to alternating voltage may be provided between the stations A and B. Correspondingly, a grid electrode with two sections 13 and 13' may be provided between the stations B and C, again comprising several wires connected to alternating voltage. A distance of, for example 2 cm may be provided between the wires of the grid electrodes. These grid electrodes 12, 13, and 13' prevent flock material from straying from one station to an adjacent station, so that the apparatus in accordance with the invention operates without any pollution of the machine parts or of the surrounding area.

To screen the boxes 11 also against the action of the electrical fields, further grid electrodes 14 under alternating tension are disposed at the outlets of the boxes.

When the holders 2 at two adjacent stations A and B are to be connected to the same potential, the corresponding nonconductive section 7'' of the guide rail 7 may be provided with a bridge which, when not required, may be removed or interrupted.

Adjustable high voltage electrostatic generators are preferably connected to the conductive sections 7' of the guide rail, the generators being of the type known in connection with cable testing devices and with other technological uses which require direct voltage.

In the case of an apparatus of the type described which had been tested in practice, the speed of conveyance of the hollow objects was 1.5—5 meters per minute. When working with flock of 10 mm. length, the objects 1 were sufficiently covered after revolving twice and, when flock was fed on all three belts, after 2 revolutions. When flocking with 10-millimeter-long synthetic flock, a voltage of 40 KV was used with an air humidity of 80 percent.

FIG. 2 illustrates the devices for feeding the flock material, for recovering excess material and for conditioning the same. The storage container or box 11 for flock is provided with a screenlike floor 15. An endless belt 16 is disposed closely above the floor 15, and its width corresponds to that of the box 11. On the smooth surface of the conveyor belt 16, brushes 17 are secured at uniform intervals and extend across the entire width of the belt 16. The distance of the lower run 16*a* of the belt from the floor 15 is somewhat less than the length of the brushes 17, so that the brushes moving on the lower run of the belt brush over the screen floor 15. At the terminal points of reversal of the belt 16, substantially semicircular guide surfaces 18, extending concentrically to the turns 16*b*, are secured in the container 11, and their lower ends are joined to the screen floor 15.

As already explained in connection with FIG. 1, a conveyor belt 10*a*, 10*b*, or 10*c* is provided below each box 11 for receiving flock falling through the floor 15 and bringing it into the effective range of the electrostatic field.

The excess flock remaining on the belt 10*a*, 10*b*, or 10*c* is deposited into a collector hopper 19 at a turn 10*a* of the belt 10, a brush roller 20 being provided at the turn 38 to take care of thorough cleaning of the belt. The lower end of the hopper 19 leads into a conveyor conduit 24 which is constricted at the outlet 22 of the hopper 19 in the manner of a nozzle. A fan 21 blows an air current through the tube 24, which entrains the flock passing through the hopper 19. The tube 24 enters into the box 11 at an inlet 23, the box 11 having an air filter 27 at its upper end, through which air can escape to atmosphere while the flock carried along by it is held back.

Flock of different materials used for electrostatic flocking requires different degrees of humidity for insuring a faultless flocking process. In accordance with the advantageous embodiment illustrated in FIG. 2, this humidity which is instrumental in rendering the flock receptive to the effect of electrostatic fields, is added to the air stream. This not only imparts the required humidity to the recovered flock, but also suitably wets the storage supply in the container 11. Air sucked in by the fan 21 is sucked through an atomizer assembly 25 in which a rapidly swinging member generates a mist of finely divided water droplets in the sucked-in air stream, in known manner.

A hygrometer 26 for adjusting the desired humidity content is mounted in the container 11 and is operatively connected to the assembly 25 for controlling its operation in dependence on the desired value. The length of the conveyor tube 24 between the discharge outlet 22 of the hopper 19 and the container 11, that is, the length of the course within which the recovered flock is exposed to moistened air, is also of importance for a faultless operation, so that a possibility is advantageously provided for altering the length of the tube depending on the flock material employed.

The operation of the device illustrated in FIG. 2 is as follows: As it rotates in the chambers or compartments between the successive transverse rows of brushes 17, in the lower part of the box 11 filled with flock material, the conveyor belt is

filled with a certain amount of such flock material which it receives from the bottom layer of the storage supply. Since the curved guide surfaces **18** surround the turns of the conveyor belt **16**, the flock material cannot become bunched-up by additional material squeezing into the gap, which is usually present at the turn and tapers in the direction of the movement. On the contrary, the guide surfaces **18** insure that the amount of fill between the brushes at the turn remains unchanged. This avoids bunching-up of the flock material, and breakdowns of the plant are thereby avoided.

When passing over the screen floor **15**, the fill of flock corresponding to the size of the compartment between two brushes **17** is simultaneously brushed through said screen floor **15**. It has been found that the trickle of flock material through the screen **15** is particularly good and uniform if the mesh size of the screen floor **15** corresponds substantially to the length of the flock fibers. Any fibers which may have remained in the compartment formed between the two rows of brushes after they have passed over the screen floor **15**, are taken along upwardly at the second turn, the semicircularly curved guide surfaces again taking care that flock material should not form little lumps.

The flock material which has trickled down onto the conveyor belt **10***b* is used for flocking the hollow objects **1**, as explained hereinabove. The excess flock remaining on the belt or falling back thereon, falls into the collector hopper **19** at the turn **38**, the brush roller **20** accomplishing thorough cleaning of the belt. The excess flock received by the hopper **19** arrives laterally into the nozzlelike constricted sector **22** of the conveyor tube **24** and is carried back into the box **11** by the air current generated by the fan **21**, the flock absorbing, mostly superficially, the moisture from the air which had been added thereto by means of the atomizer assembly **25**. The thus moistened flock and the air still containing moisture, are introduced at the inlet **23** into the container **11**, whence the air escapes to atmosphere through the air filter **22**, which holds the flock back.

The invention is not, of course, limited to the illustrated and described embodiment, but can be employed, within the scope of the underlying inventive concept, in the most varied ways, supplemented, and combined.

I claim:

1. Apparatus for electrostatic flocking of the outer surface of objects, comprising holding means for supporting said objects, each said holding means having a sliding electrical contact, endless conveyor means for transporting said holding means, adhesive-applying means for applying adhesive to said surface, a plurality of flocking stations, each having flock supply means and electrostatically charged electrodes, and guide rail means comprising first and second guide rail sections in engagement with said sliding contacts, said first sections carrying electrical potential and each being in and closely adjacent to a said station, said second sections being insulated and grounded and located between successive flocking stations, and adhesive drying means beyond said flocking stations.

2. The apparatus of claim 1 wherein said first guide rail sections are connected to a source of negative potential.

3. The apparatus of claim 1 wherein there are a plurality of electrostatic generators each having a different voltage level and wherein the different said first guide rail sections are connected to different said electrostatic generators.

4. The apparatus of claim 1 having grid electrodes between the successive flocking stations and means for applying alternating voltages to said grid electrodes.

5. The apparatus of claim 1 having flock-feeding flock containers having screening electrodes and means supplying alternating voltage to said screening electrodes.

6. The apparatus of claim 5 wherein said screening electrodes are grid electrodes.

7. The apparatus of claim 5 wherein said flock containers have a floor in the form of a screen, an endless conveyor revolving above said screen floor and provided with brushes disposed transversely to the direction of movement of said endless conveyor, the brushes moving through a lower run and brushing over the screen floor, guide surfaces being provided at the ends of the conveyor which are concentric with the conveyor path there and are connected to the screen floor, and surrounding the turn of the conveyor for an angle of about 180°.

8. The apparatus of claim 7 having a second conveyor belt below said screen floor, a collector for excess flock material under the terminal turn of said second conveyor belt facing away from said flock container, and a pneumatic conveyor leading to said flock container and connected to the outlet of said collector.

9. The apparatus of claim 8 wherein said collector comprises a hopper having a lower end with a nozzlelike constricted outlet which discharges into said pneumatic conveyor.

10. The apparatus of claim 9 wherein an atomizer is disposed at the air intake of the pneumatic conveyor.

11. The apparatus of claim 10 wherein a hygrometer regulating the atomizer is built into the flock container.

12. The apparatus of claim 5 wherein the flock container is provided with an air-permeable filter which holds back the flock material.

13. Apparatus for flocking the outer surface of hollow objects in electrostatic fields, comprising rotatable holders for supporting said objects, each holder having a sliding contact, and endless conveyor means for transporting said holders, adhesive-applying means for applying adhesive to said objects on said holders, a plurality of flocking stations, each having flock supply means and electrostatically charged electrodes, first guide rail sections carrying electrical potential in the area of the electrodes, second insulated grounded guide rail sections between successive flocking stations, said sliding contacts successively engaging said first and second guide rail sections, and adhesive drying means beyond said flocking stations.

14. Apparatus for applying particles such as flocks to moldings against the influence of gravity which comprises at least two separate flocking zones, earthed conductive particle-carrying belt means mounted for corresponding travel through said zones, at least one molding insulated from earth and mounted for travel through said zones in spaced above and facing relation to the particular portion of the belt means thereat, and correspondingly separate means for supplying a different level of high voltage to the corresponding molding solely during passage of such molding through each said separate zone to produce a correspondingly different intensity electric field in each individual zone to cause particles on the particular portion of the belt means thereat to be applied against the influence of gravity to said molding in dependence upon the intensity of such field.

15. Apparatus for electrostatic flocking of the outer surface of objects to which an adhesive has been applied and which is not yet dry, comprising holding means for supporting said objects, each said holding means having a sliding electrical contact, endless conveyor means for transporting said holding means, and a plurality of flocking stations, each having flock supply means and electrostatically charged electrodes, and guide rail means comprising first and second guide rail sections in engagement with said sliding contacts, said first sections carrying electrical potential and each being in and closely adjacent to a said station, said second sections being insulated and grounded and located between successive flocking stations.

16. The apparatus of claim 15 wherein said first guide rail sections are connected to a source of negative potential.

17. The apparatus of claim 15 wherein there are a plurality of electrostatic generators each having a different voltage level and wherein the different said first guide rail sections are connected to different said electrostatic generators.

18. The apparatus of claim 15 having grid electrodes between the successive flocking stations and means for applying alternating voltages to said grid electrodes.