ELECTROSTATIC FLOCKING APPARATUS

Fig. 1

Fig. 2

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AGT.
This invention relates to an apparatus for electro-static flocking of the type where suitably prepared fibers are deposited from a rotating cylindrical screen onto a material previously coated with an adhesive, whereby a high voltage is applied to said cylindrical screen and the screen is covered by a sheet-metal hood.

An apparatus of this type is known where said cover is bent at a certain distance almost entirely around the periphery of the cylindrical screen so as to leave only a small slot for the flock. The cover in said known apparatus is suspended insulated from the electrodes and can, therefore, assume any voltage with respect to the cylinder screen. With such an apparatus, no exact dosage of the flock per unit area of the fabric to be coated can be obtained, and the flock density on the finished fabric is, therefore, subject to more or less strong variations.

Our investigations have convinced us that said variations are due to the electrical field between the cylindrical screen and the cover as well as to variations in the quantity of flock contained in said cylindrical screen or perforation drums.

In order to eliminate said drawbacks, the flocking apparatus described hereinabove was modified as follows: The cylindrical screen or perforated drum is rotated on a perforated hollow shaft which ensures a steady feed of flock; the cover has a cross-section in form of a bell, and the rim of the bell is extended outwardly and slightly curled upwardly; a wire screen is inserted into the opening of the cover. Said wire screen and the cover are connected to the same terminal of a high voltage source as the cylindrical screen so that there is no electric field between the cylindrical screen, and wire screen. As a result, there is no interference with the mechanical feed in that space, and the delivered amount of flock is independent of the field applied.

These and additional advantageous features of the invention are illustrated in the accompanying drawings showing, by way of example, a preferred embodiment of the invention.

In the drawings,

FIG. 1 is a perspective view of an apparatus according to the invention, parts broken away;

FIG. 2 is a transverse sectional view,

FIG. 3 is a sectional elevation of the apparatus, and

FIG. 4 is a view, partly in cross-section of an apparatus containing three rotating drums in parallel arrangement.

Referring to FIG. 1, numeral 1 indicates a rotating perforated drum of which the shell consists of a wire gauge or screen or of perforated sheets. Such shell elements are readily exchangeable which makes it possible to adapt the meshes of the gauge or the size of the perforations to the flow properties of the flock. We may also arrange two or more such drums in series, particularly when a large amount of fibers is to be charged per unit of time. The direction of rotation of the drums may be with, or opposite to, the direction of travel of the adhesive layer 10. We have found it of advantage to rotate the first drum in a direction opposite to the direction of travel of the moving material. The fiber flock is introduced into the drum continuously by means of the conveyor screw 13 through the perforated hollow shaft 12, driven by disc 24. The speed of rotation of the conveyor screw by means of driving disc 29 is infinitely variable, thus ensuring at all times a uniform charge of the drum. The hopper 14, equipped with a stirrer 15 driven by discs 21, provides for the admission of the fiber flock from a storage bin to the conveyor screw.

The rotation of the drums imparts turbulent motion to the fibers which fall through the meshes of the screen surface into the distributing space 6 (FIG. 2) defined by the cover 2, drum 1, and wire screen 3. All these members are connected to the same high voltage so that no electric field forces can act on the fiber flock in the distributing zone 6. The fibers fall only under the influence of gravity and centrifugal forces out of the rotating drums to the direction toward the screen 3. The form of the cover 2 is adapted to the trajectory of the fibers and has a bell-shaped cross-section. At the inside, the cover is completely smooth and without projections or edges in order to prevent adhesion of the flock to the walls and formation of lumps. As there is no electric field in the space 6, the amount of fibers falling through the meshes of the screen is a function of the speed of rotation and the amount of fibers inside the drum only. By varying the speed of rotation while maintaining the charge constant, the amount of flock deposited can be exactly controlled.

We have observed that a low speed of rotation of the drum (30 r.p.m.) produces essentially uniform flock densities on the adhesive-coated material 10, provided that the flock has good flow properties.

The screen 3 is vertically displaceably mounted on vibrating members 17 and consists essentially of metal wires mounted as a net in a metal frame. The wires have a diameter of about 0.3 to 0.5 mm. Depending on the type of fiber used, the screen may be rigidly arranged or it may be vibrated horizontally and/or vertically at various frequencies by vibrators 18. The distance between screen 3 and the material 10 to be flocked is variable among members 17 and has to be adapted to the type of flock and adhesive used. An electrically conductive support 11, e.g. a metallic belt, connected to the outer terminal of the high frequency source, carries the material to be flocked with the adhesive layer 10. The field strength obtained between the screen 3 and the carrier 11 is preferably in the range of 4 to 6 kv./cm.

When the fibers transferred from the drum 1 into the chamber 6 pass through the screen 3, they become subject to the action of the electric field produced through line 26 over the high-voltage apparatus 23 over lines 22 in the flocking space 8. Under the influence of the field forces, the fibers are parallelly vertically aligned and travel, each time with charge reversal between the adhesive layer 10 and screen 3 until they stick in the adhesive layer. In order to keep the electric field homogeneous at the edge of the flocking space 8, the edge of the conveyor 25 is extended outwardly and slightly curled upwardly. This arrangement produces a kind of boundary electrodes 4 and 16, the latter being supported by brackets 19. The electrode 4 extending into the direction of travel of the adhesive layer 10 projects much farther than the other boundary electrodes and causes deposit of not only adhered fibers but that it maintains the electric field to a considerable distance from the drum (FIG. 2).

The boundary electrodes are shaped so as to weaken the field strength with increasing distance between the support 11 and the electrodes 4, 16. It is important to avoid a deformation of the lines of force. Said lines should follow a path which is as vertical as possible because the fibers impinging on the adhesive layer align themselves in the direction of the force lines. When the force lines are inclined to the vertical, the adhered fibers take the same inclined position so that they prevent subsequently at-
tracted fibers to reach the adhesive layer and to become anchored therein. The weaker the field becomes, the slower becomes the oscillating movement of the fibers between the boundary electrode and the adhesive layer, until such movement ceases completely.

An embodiment of the invention using three parallely arranged drums is shown in FIG. 4.

The use of the apparatus for the manufacture of piled fabrics or rugs is illustrated in the following examples; it will be understood that the apparatus can be used also in the flocking of other adhesive-coated materials such as paper or plastic films.

Example 1
Diameter of drum 300 mm., screen aperture 1.2 mm. Speed of rotation of drum 30 r.p.m. (against the direction of travel of the material), belt speed 1.1 m./sec.
Flock=fibers 20 den./2.5 mm., blue;
Mechanically fed amount of flock 385 g./m.²;
Flock deposited on the rug 372 g./m.²;
Yield 96.6%; rel. humidity 60%;
Electrode spacing 12 cm.; voltage 60 kv.;
Field strength 5 kv./cm.; spacing of wires in wire screen 10 mm.; thickness of wires 0.3 mm.

Example 2
Diameter of drum 300 mm.; screen aperture 1.2 mm. Speed of rotation of drum 90.9 r.p.m.; belt speed 1.1 m./min.;
Electrode spacing 12 cm.; voltage 40 kv.;
Field strength 3.3 kv./cm.; spacing of wires in wire screen 10 mm.;
Wire diameter 0.3 mm.; rel. air humidity 60%;
Flock=fibers 20 den./3.0 mm. rusty red;
Mechanically charged amount 359 g./m.²;
Flock adhered on the fabric 343 g./m.²;
Yield 95.6%

Example 3
Diameter of drum 300 mm.; width of mesh 12 mm.
Speed of rotation of drum 90.9 r.p.m.; belt speed 1.1 m./min.;
Distance between electrodes 12 cm.; voltage 60 kv.;
Field strength 5 kv./cm.; distance of wires in screen 10 mm.;
Wire diameter 0.3 mm.; relative humidity of air 70%;

Flock fibers 20 den./2.5 mm., blue;
Mechanically delivered flock 518 g./m.²;
Flock fixed in the adhesive 448 g./m.²;
Yield 86.5%.

5. We claim:

1. An electrostatic flocking apparatus comprising a perforated hollow shaft, a perforated rotating elongated drum driven by said shaft, a cover in form of a belt covering said drum in spaced relationship thereto, the rim of said cover being outwardly extended and slightly bent upwardly, a screen in the bottom of said cover, a high alternating voltage source, said drum, cover, and screen being connected to the same pole of said high voltage source, a traveling support connected to the other pole of said high alternating voltage source and located below said screen and spaced therefrom to produce an electric field therebetween, and means feeding flock into said perforated shaft.

2. The apparatus claimed in claim 1 wherein the rim of the cover extending in the direction of the travel of said support is farther extended than the other parts of said rim.

3. The apparatus claimed in claim 1 comprising a conveyor screw inside said shaft and vertical feed hoppers feeding flock into the ends of said shaft.

4. The apparatus claimed in claim 1 comprising a plurality of parallely arranged drums under a single cover.

5. The apparatus claimed in claim 1 wherein said screen is arranged for horizontal rocking.

6. The apparatus claimed in claim 1 comprising means for adjusting the distance between said screen and support.

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