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[54] APPARATUS FOR TRANSFERRING A PARTICULATE MATERIAL TO A WEB

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[58] **Field of Search** 117/13, 21, 25, 38, 111; 118/60, 202, 211, 244, 59, 212, 637, 246, 69, 34, 641; 101/170, 157

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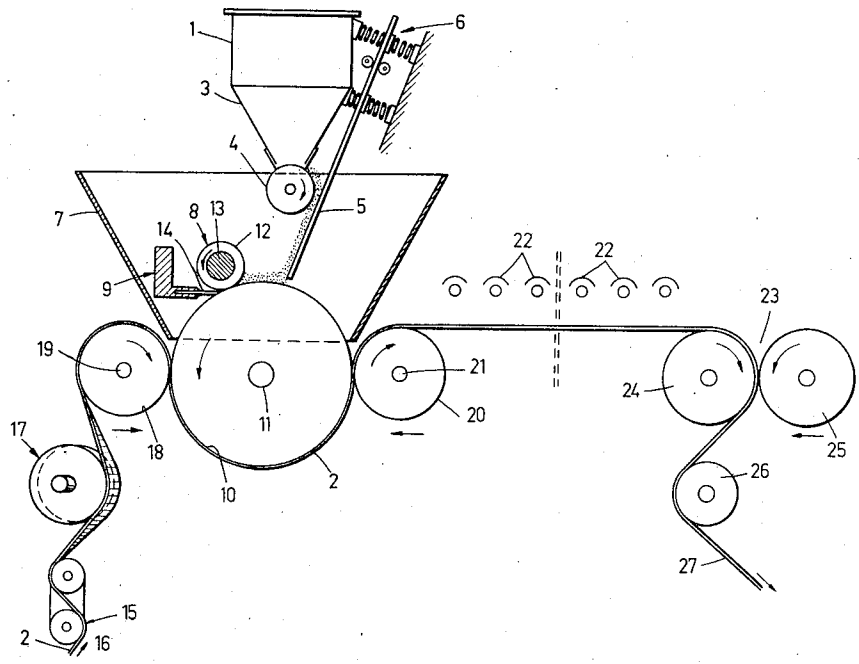
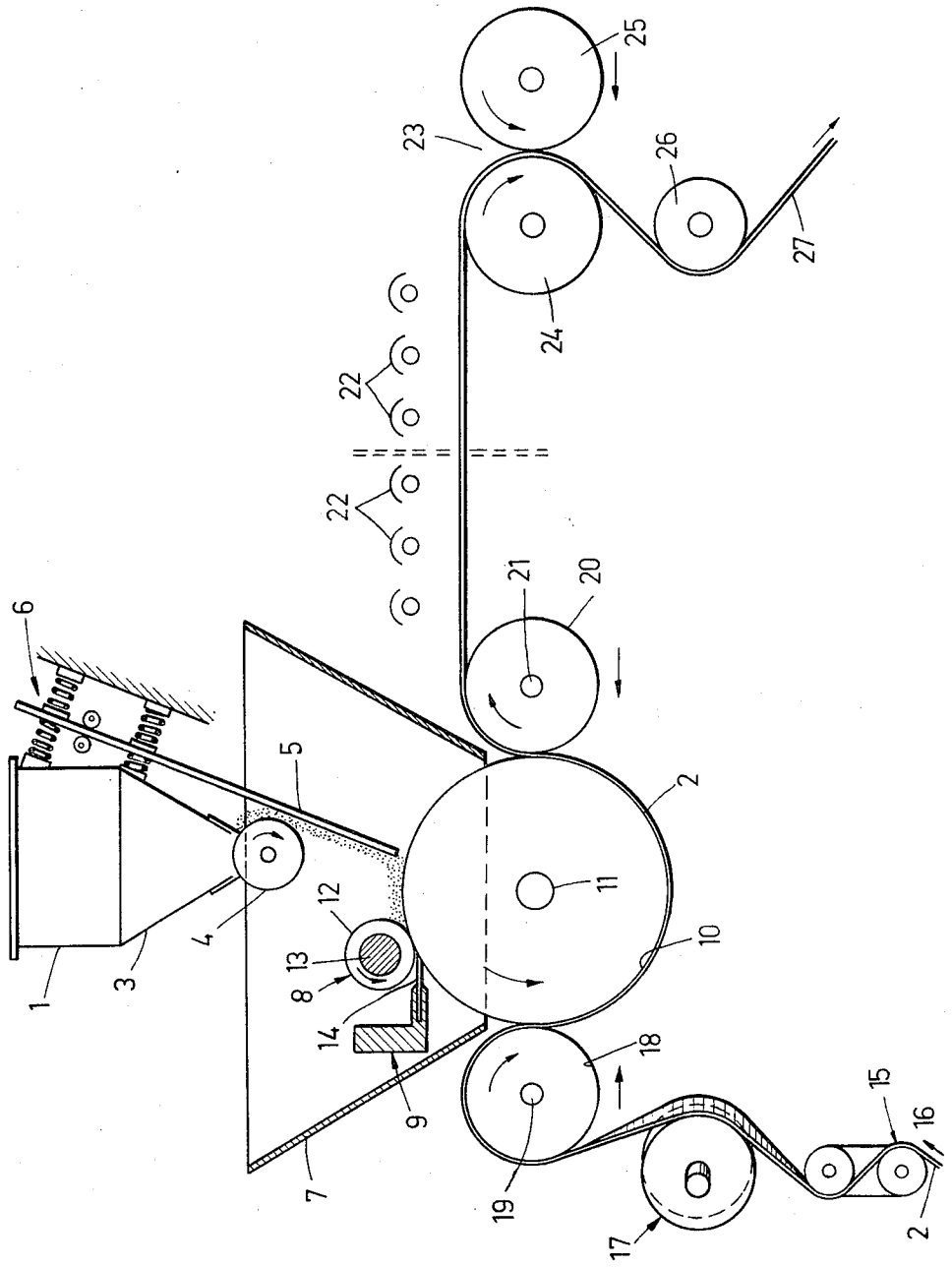
[57] **ABSTRACT**

A device for adding a thermoplastic or thermosetting material to a receiving web includes means for distributing a particulate material throughout recesses or grooves defined on the surface of an endless member such as a continuously rotating drum. The grooves which have been filled with the material are then moved into association with a web of a material such as a textile material which is moved into contact with the drum and at the same speed as the drum while it is maintained at a temperature great enough to cause the tackiness and adherence of the particulate material to the web in the pattern defined by the grooves of the drum. The granules are advantageously directed to the top face of the drum as it rotates and the web is advantageously delivered to a location at which it feeds around a major portion of the lower part of the drum surface. A pressure roller is located at the infeed of the web and at the outfeed of the web and is advantageously maintained in a heated condition to provide a temperature to facilitate the transfer of the thermoplastic material from the grooves of the drum to the surface of the web. The particulate coating material is delivered to the backing material web at a coating station while the material is maintained at a temperature lower than that at which it is applied to the backing material. Conversely, the backing material is maintained at or heated to a temperature at which the particulate material will become tacky and move into adhering engagement with the backing material as it is transported into association therewith at the coating station.

8 Claims, 1 Drawing Figure





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APPARATUS FOR TRANSFERRING A PARTICULATE MATERIAL TO A WEB

SUMMARY OF THE INVENTION

This invention relates, in general, to an apparatus for coating a backing material and, in particular, to a new and useful device for applying a thermosetting or thermoplastic material in a defined pattern to a web.

Various methods of applying a particulate coating to a backing material have been proposed in the past. The expression "backing material" as used in the present specification and claims is intended to include sheets, strips, bands and webs of, for example, textile and other fibrous materials such as plastics, synthetics, resin materials, paper, cardboard, pasteboard, knitted and woven fabrics, slubbings, wadding, fleeces and porous and non-porous foils. The expression "particulate material" as used herein includes materials in the form of powder, granular material, or crystalline material, in the form of discrete particles.

It is difficult, when carrying out the previously proposed methods, to obtain a coating of uniform thickness and even particle distribution. Difficulties may arise as result of the properties of the material being used to form the coating. For example, some powders become electrostatically charged during manufacture or have a tendency subsequent to manufacture to absorb electrostatic charges. Repulsion between similarly charged particles complicates the conveyance of the powder and leads to an uneven distribution of the particles on the backing material. Furthermore, some powders have adhesive properties which may become apparent at elevated temperatures, and some synthetic resin powders become extremely tacky and adhere to any firm object as a result of a very slight rise in temperature above that at which not tackiness is observable.

Coating methods which utilize an intermediate carrier to transfer the coating material from a hopper to a backing material to be coated, have proved advantageous. The intermediate carrier may be in the form of an endless band or roller recessed to carry a desired thickness of coating material in a desired pattern and which passes beneath the hopper outlet and is subsequently wiped by a doctor. Nevertheless, this method has not proved entirely satisfactory when, for example, employed in a process for producing a composite article comprising a moisture, water or steam pervious backing material with a discontinuous impervious film on one or both of its surfaces. In a process for producing such an article, it is desired to apply a coating of powder to a surface of suitable backing material and then compress, plasticize, sinter, vulcanize and harden the powder coating to produce a discontinuous impervious film on the pervious substrate. However, when the particles are of a type which are, or are liable to become, electrostatically charged, or are particularly tacky at the operating temperature, or are extremely fine or hydroscopic, it is difficult to ensure that the distribution of powder takes place in such a way as to obtain the desired discontinuities.

In accordance with the invention there is provided apparatus for applying a particulate coating to a backing material, in which the temperature at which the material intended to form the coating is transported to a coating station is lower than that at which the particulate material is applied to the backing material. Preferably the particulate material is fed from a store onto a conveying surface which is recessed, the pattern and depth of the recesses being in accordance with the desired distribution of the powder on the backing material to be coated. The aforesaid lower temperature depends for its exact value largely upon the chemical constitution of the particulate material. If, by way of example, polyamide powders are to be conveyed and distributed, then application onto the conveying surface must be carried out at about 15° C, so the temperature of transportation is considerably below the temperature at the coating station. If, on the other hand, polyethylene powders are to be distributed, then the temperatures of the conveying surface must be increased to 50°–60° C. The higher temperatures, on the other hand, at which the particulate material is removed from the conveying surface and transferred onto the underlayer that is to be coated on an intermediate carrier, can be raised to values which correspond to the respective plastification temperature of the powder or lie only slightly above or below it.

In the case of particles which are already electrostatically charged, such particles may, in accordance with a preferred feature of the invention, be passed through a Faraday cage in which the charge is led off towards the cage surface. In order to prevent the particles from becoming charged during the process it is possible to utilize procedures similar to those which, for example, are employed in the case of paper machines, to ensure that no charge is built up during travel of the paper rolls.

The invention also provides apparatus for applying a particulate coating to a backing material, comprising: a hopper, an arrangement for feeding particulate material from the hopper to an endless carrier surface, at least one pressure roller for urging the backing material into contact with the carrier surface, and means for maintaining the temperature of the pressure roller above that of the carrier surface.

Accordingly, an object of the invention is to provide an improved device for transferring a thermosetting or thermoplastic particulate material in a defined pattern onto a web or backing sheet.

A further object of the invention is to provide an apparatus for transferring a particulate material first onto a grooved surface of a rotating drum and for moving a web into association with a portion of the surface of the drum in a manner such that the particulate is transferred to the web, the web being maintained at a temperature to cause the tacky adherence of the material and its transfer out of the grooves of the drum as the drum is rotated and the web is advanced.

A further object of the invention is to provide an apparatus for applying a particulate material to a web in a defined pattern which comprises distributing the particulate material over a defined surface which is moved, and directing a backing web into association with the defined surface while maintaining the web at a temperature which is greater than that of the surface in order to provide for the tacky adherence of the material to the web during the course of travel of the web over the defined surface.

A further object of the invention is to provide an apparatus for applying a particulate coating to a backing material which includes the transporting of the particulate coating material from a storage supply to a coating station and applying the material to the backing material at the coating station, the material being maintained during transportation at a temperature less than that at which it is applied to the backing material.

A further object of the invention is to provide a device for applying a thermosetting or thermoplastic material to a web in a defined pattern which is simple in design, rugged in construction and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The only FIGURE of the drawings is a partial longitudinal sectional and partial elevational view of a device for applying a coating of material to a web constructed in accordance with the invention.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in the drawing, a hopper **1** is filled with powder to be applied to a continuous textile web **2** in such a way that on one surface of the web the powder is in the form of discrete spaced particles, the thickness of the coating thus provided being completely uniform and the distribution of the discrete particles being even.

A rotary discharge roller **4** is located in the outlet **3** of the hopper, and ensures that powder is taken from the hopper and passed to a downwardly-directed guide plate **5** in an even stream. A cam-operated vibration device **6** serves to vibrate the plate **5** so that the powder trickles in a loose layer down the guide plate **5**. The guide plate terminates at its lower end slightly above a distribution drum **10**. The upper part of this drum, together with a doctor roller **8**, a stroking doctor **9** with a blade **14** and the lower part of guide plate **5** and discharge roller **4**, are located within a shield in the form of a hollow, inverted truncated pyramid **7**. The peripheral surface of the distribution drum **10** is recessed or provided with grooves arranged in a pattern depending upon the distribution of powder to be obtained on the web **2**. The recesses, which may be of depressed-mammilated form, may contact one another or be narrowly spaced, and are so dimensioned as to receive a single powder grain or a plurality thereof as desired. A number of interchangeable drums may be provided, each having a respective different pattern so that by making a suitable selection from the drums available a desired particle distribution may be obtained.

The circumferential and axial spacings of the recesses and their distribution, which may be as desired, determine the distribution of the powder grain or of the powder grain accumulations, whilst the selection of the depth of the recesses makes it possible to provide the powderous layer of the desired thickness. Heating and cooling devices (not shown) make it possible to keep the surface of the drum **10** at a predetermined temperature or to alter this in a predetermined manner. Ducts passing through the drum body are especially suitable and may conduct a coolant, for example brine, or a heating agent, for example oil. The drum **10** rotates in the counter-clockwise direction (with reference to the drawing). Initially, the loose layer of powder falling upon the drum from the plate **5** reaches the doctor roller **8**. The doctor roller **8** has a heavy core **13** and a resilient, foamed material sleeve **12**, which under the effect of the weight of the core, distributes the powder layer among the recesses in the surface of drum **10**. Surplus powder is removed by the doctor blade **14** of the stroking doctor **9**, the edge of the blade **14** coinciding with the peripheral surface of the drum **10**, that is the surface in which the recesses are formed, ignoring the depth and distribution of the recesses.

The web **2** of a textile material is fed in the direction firstly through a damping device **15** to eradicate vibration and then over a spherically surfaced expansion roller **17** to stretch the web. The web is then carried over a heated pressure roller **18** revolving on or with a shaft **19** and heated by conventional means, for example ducts conducting heated oil, such ducts not being shown in the drawing. The shaft **19** of the pressure roller **18** is either under spring pressure or the bearings supporting it are adjustably arranged in such a way that the pressure roller **18** applies the web **2**, with an adjustable pressure against the peripheral surface of the drum **10**. Contact of the web **2** with the drum **10** leads to transfer of the powder retained in the recesses formed in the surface of the said drum onto the web. No relative movement takes place between the web and the drum **10** between the points where the web and drum **10** meet and separate. In addition, the powder particles are securely trapped between the peripheral surface of drum **10** and the web itself so that the powder is not subject to external forces acting in the space surrounding the apparatus, thus the thickness and distribution of the coating is unchanged by draughts, convection currents or vibrations for example. A second pressure roller **20**, which is likewise heated and revolves about or with its shaft **21** in the clockwise direction, serves to separate the web **2** from the drum **10**. As will hereinafter be explained, the coating has become bonded to the web **2** in the time taken by the web to pass from roller **18** to roller **20** and consequently the separation of the web from the drum **10** does not dislodge the powderous coating.

It is therefore possible, with the aid of infra-red heating means **22**, to carry out the plastification of the powder grains or powder grain accumulations absorbed by the web **2**. After this, the web **2** enters the nip **23** between the calendar rolls **24**, **25** and is withdrawn at **27** after deflecting and, if necessary, cooling on the roller **26**.

The drawing shows only those devices which are necessary to coat any desired web with a coating of discrete particles evenly and with constant coating thickness. However, the calendar represented at **23** to **25** could be used to feed further materials, which are to be cladded with the coated web. Further, the web **2** may be coated on both sides with the discrete particles and then be interposed as a lining material between two webs of other materials. The use of such additional and, what is more, known methods is not precluded by the diagrammatically described and represented exemplified embodiment, but the introduction of such processes into the method to be performed in accordance with the invention introduces the advantage of simplified technical performance and a higher economy since the number of heatings and/or coolings can in this way be substantially reduced.

Because the drum **10** can be brought to a temperature at which the powder, irrespective of its chemical constitution, does not possess any adhesive effects, or only such weak ones that the powder is incapable of adhering to surface parts of the drum **10**, the conveying and distribution process can be performed without the disadvantages engendered by this property becoming manifest. Exact details regarding the temperature of the distribution drum **10** have been given above. The relationships thereby given between the points at which the drum **10** receives the powder and the drum **10** via web **2** contacts the roller **18**, change however in the regions of this zone of contact. The roller **18** is normally heated to about 200° C and kept at this temperature. The temperature of the web **2** increases correspondingly so that the powder grain present in the recesses of the drum **10** are brought rapidly to temperatures at which they develop strong adhesive properties. This leads to a transfer of the individual grain or grain accumulations from drum **10** to the web **2** in exactly the same pattern as the powder grains or grain accumulations form when lying in the depressions of the drum **10**. The drum **10** is maintained at a lower temperature than the web and there is thus no tendency for the particles to adhere to the drum. The effect of gravity on the loose particles carried on drum **10** as this drum rotates can be compensated for by increasing the height at which roller **18** is disposed. In practice the dimensions of the shield **7** in the peripheral direction can be less than those shown, which have been exaggerated for illustration purposes.

It is impossible for the grains to change their position once they are located between the web **2** and the drum **10** because they are firmly trapped in position. Not until the web, by means of the pressure roller **20**, (likewise heated to about 200° C) is removed from the surface of the drum **10** does the enclosure of the absorbed powder grain on both sides cease. Even then, the tendency is for the grains to adhere to the web because of the presence of the heated roller **20**. Subsequently the grains are carried on the upper side of a horizontal strand of the web tensioned between rollers **20**, **24**. At this stage the powder is heated by infra-red heaters **2**.

Thus, due to the measures taken, it is ensured that the distribution of the powder particles on the web corresponds to the pattern of recesses on the drum **10**. In this way, the product leaves roller **27** in a formation which exactly corresponds to the respectively existing operating regulations.

It should be appreciated that the particulate material may be transported on the drum **10** through the coating station which is defined between the nip of the drum **10** and the roller

18 at a temperature less than the ambient temperature in those instances where the particulate material is of a characteristic which may make this desirable. At the coating station, the particulate material is advantageously brought into contact with the backing material at about the plastification temperature of the particulate material. Temperature control means (e.g. electrical or liquid heaters not shown) are usually provided for controlling the temperatures of the pressure rollers 18 and 20 and in some instances a similar temperature control element is connected to the drum 10 for regulating its temperature. The drum 10 may be maintained at a temperature below ambient temperature and the temperature of the pressure rolls maintained at about the plastification temperature of the particulate material.

What is claimed is:

1. Apparatus for applying a particulate coating formed of discrete particles which particles become tacky when heated to a certain temperature, to a backing material, comprising a hopper for the discrete particles in a non-tacky condition, an endless carrier member defining a support surface for the backing material, the support surface of said endless carrier member being patterned for forming recesses therein arranged to receive the discrete particles, feed means for conveying the discrete particles from said hopper to the support surface of said endless carrier member and for positioning the discrete particles into the recesses formed therein and for removing any discrete particles from the remainder of the support surface with the discrete particles being at a temperature below the temperature at which they become tacky, means arranged for moving and placing the backing material into contact with the support surface of said endless carrier member including at least one pressure member arranged in juxtaposed relationship to the support surface of said endless carrier for contacting the backing material against the support surface, means for driving said endless carrier member for moving its support surface relative to said feed means and to said pressure member, and heating means associated with said support surface for heating the backing material in contact with said pressure member so that it is at a temperature at which the discrete particles become tacky when it is placed into contact with the support surface of said endless carrier member so that the discrete particles in the recesses in the support surface of said endless carrier member become tacky when contacted by the heated backing material for transferring the discrete particles to the backing material.

2. Apparatus, as set forth in claim 1, wherein said pressure member is a pressure roller and said means arranged to move and place the backing material being arranged for directing the backing material over a considerable portion of the circumferential surface of said pressure roller.

3. Apparatus, as set forth in claim 2, wherein said means to move and place the backing material including a second pressure roller spaced angularly about said drum from said pressure roller and being arranged in juxtaposed relationship to the support surface of said drum so that the backing material contacts said drum between said pressure roller and said second pressure roller, and said heating means being associated with said second pressure roller for heating the backing material.

4. Apparatus, as set forth in claim 3, wherein a heating device being located adjacent the path of the backing material extending from said second pressure roller for heating the particles which adhere to the backing material.

5. Apparatus, as set forth in claim 1, wherein said endless carrier member comprises a rotatable drum, and said means for driving said endless carrier member comprises a shaft on which said drum is mounted for rotation.

6. Apparatus, as set forth in claim 5, characterized in that cooling means is associated with said drum for maintaining said drum at a temperature at which the discrete particles do not become tacky.

7. Apparatus, as set forth in claim 5, wherein said hopper and said feed means being located above said drum, said feed means comprising an oscillatable downwardly directed guide plate positioned in the path of the discrete particles issuing from said hopper and with its lower end closely spaced above said drum, a shield member extending downwardly from the discharge end of said hopper about said guide plate and having its lower end enclosing the upper part of said drum, a doctor roller located within said shield member and in contact with the circumferential surface of said drum and positioned downstream from said guide member in the rotational direction of said drum, and a doctor blade located within said shield member and downstream from and adjacent to the contact between said roller doctor and said drum, said blade having its edge coinciding with the circumferential surface of said drum for removing discrete particles from the surface without affecting the discrete particles within the recesses in the surface.

8. Apparatus, as set forth in claim 1, wherein said means arranged to move and place the backing material including a spherically shaped roller arranged to stretch the backing material before it passes over said pressure roller.

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