AP Apparatus for Applying Small Particles to Articles in an Electric Field

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APPARATUS FOR APPLYING SMALL PARTICLES TO ARTICLES IN AN ELECTRIC FIELD

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1. Field and Background of the Invention

The present invention relates to an apparatus for applying small particles, e.g., floccules, to a moving surface coated with an adhesive, which apparatus consists of a conveyor band with a charging device and an electric flocculating field.

One difficult problem in all the known processes of this kind is that of introducing the floccules in dosed quantities into the electric field and charging them there. Processes are known in which dosing, introducing the material into the field and charging it are carried out simultaneously, and other processes are known in which these operations are carried out in three separate process steps in the given sequence. In known processes of the latter kind (e.g. German patent specification 881,635), the particles to be charged are dosed onto a conveyor band by a suitable device and conveyed on this band into the flocculating field. Since the particles to be applied do not come into any electrical contact with a high voltage electrode in this process, it remains uncertain what charge, if any, these particles will take up in the flocculating field. Flocculating devices of this kind are unreliable in operation and have not been found satisfactory in practice.

In addition, German patent specification 900,447 discloses an apparatus in which the conveyor band for the floccules is earthed and the article to which the floccules are to be applied, in this case a web of fabric, is contacted with a high voltage electrode on the surface which is not to be covered with floccules. A disadvantage of this apparatus is that the application of floccules depends on the electric resistance of the material to which the floccules are to be applied. If the material has a good conductivity, it will be under high voltage over its whole length, in other words from the feed drum through the point where adhesive is applied and through the drying over right up to the point where the web is rolled up, including all rollers making contact with the band. Since the high voltages required for the flocculating process are of the order of 100,000 volts, an apparatus of this kind is technically not feasible. If, on the other hand, the material to be flocculated has poor conductivity, it can be moved over earthed parts of the plant, but electric breakthrough then occurs on the material to the earthed layer of adhesive which is in any case more highly conductive. This disturbs the flocculating process, and plants operating by this process are therefore also not widely used in practice.

The above mentioned disadvantages are overcome in the apparatus according to the invention by forming the electric flocculating field between the conveyor band and the adhesive layer of the surface to be coated. The conveyor band travels over two conductive and earthed rollers spaced apart and over at least one conductive roller situated between the first two rollers and connected to a source of high voltage. The adhesive layer of the moving surface to be treated is connected to the earthed terminal of the high voltage source through an earthed coating device. The floccules are applied to the conveyor band in a field-free space by a dosing apparatus. The conveyor band carries the floccules into the flocculating field which is adjustable and slowly increases in intensity. The moving conveyor band constitutes the high voltage electrode of the localized electric field and it defines the boundaries of the field. This makes it necessary for the conveyor band to have a suitable electric resistance.

The principle of the invention is illustrated in the drawing which shows diagrammatically and by way of example an electrostatic flocculating arrangement for textile webs.

The textile web 1 to be flocculated is taken from the feed drum 2 and carried under the guide roller 3 to the point where the adhesive is applied, in this case a doctor knife 4. The coated web is then deflected over the roller 5 so that in the flocculating field 21 between the deflecting rollers 12 and 13, the adhesive layer is on the underside of the web. The web is then pulled through a drying channel 22 by means of a winding device (not shown). The floccules 6 to be applied are contained in a storage container 7 and dropped onto the bottom of this container on to a brush 8 which is set in rotation by a drive (not shown). The brush 8 then applies the floccules to the endless conveyor band 19 through a screen 9 having a mesh corresponding to the length of the floccules, and the conveyor band 19 carries them into the flocculating field 21. Both the container 7 and the screen 9 are made of metal and are at ground potential. The electric flocculating field is formed on the one hand by the semi-conductive conveyor band 19 which is connected with the high voltage source 20 through the insulated metal rollers 10 and 11, and on the other hand by the web 1 to be flocculated, whose conductive layer of adhesive is connected to the earthed terminal of the high voltage source 20 through the earth doctor knife 4. The flocculating process is thus independent of the electric conductivity of the material to be treated. In contrast to the metal rollers 10 and 11, which carry a high voltage, the metal rollers 12, 13, 14, 15, 16 and 17 are earthed. The roller 15 is set in rotation by a drive (not shown) and it drives the conveyor band 19 in the direction of the arrow from the station where the floccules are supplied to the flocculating field 21. By way of the semi-conductive conveyor band 19, whose resistance between the rollers 10 and 14 on the one hand and the rollers 11 and 17 on the other hand is about 10^6 to 10^14 ohms, preferably about 10^8 ohms, an electric potential gradient is produced from the high voltage contact points on the rollers 10 and 11 both to the earth contact point on the roller 14 and to the earth contact point on the roller 17. However, within the region of the contact rollers 10 and 11, the band 19 has a uniform high voltage potential. A homogeneous field 21 is therefore formed in the region of the rollers 10 and 11 between the conveyor band 19 and the web 1 which is earthed through the adhesive. The voltage drop on the band 19 between the high voltage roller 10 and the earthed roller 14 leads to a corresponding reduction in the field strength in the region of the field 21 in the region of the rollers 11 and 17. The conveyor band 19 is suitably a woven band coated on both surfaces with pigmented polyurethane.

The flocculating operation proceeds as follows on the apparatus described. The conveyor band 19 is at ground potential between the metal rollers 14 and 15, i.e., below the device for dosing the floccules. The floccules 6 are thus applied to the conveyor band solely by gravity in a field-free space. The conveyor band carries the applied floccules over the roller 14 into the electric field which exists between the conveyor band and the metal coated with adhesive and which increases in intensity towards the roller 10. By altering the high voltage on the rollers 10 and 11, the electric field strength is adjusted so that in the direction of travel as
far as the roller 10, all the floccule particles become so highly charged by electrostatic induction and by contact with the path carrying a high voltage that they shoot towards the web. The web 1 and the conveyor band 19 move in opposite directions. Consequently, the greatest quantity of floccules is applied to the material to be treated when it leaves the flocculating field. This results in an intensive after-flocculation to produce the desired high thickness of floccules on the web. The floccules which are not anchored to the web 1 at this point, i.e. near the rollers 10 and 12, and which are thus excess floccules, jump back to the conveyor band 19 which conveys them into the homogeneous flocculating field 21 where they jump backwards and forwards between the conveyor band 19 and the web 1 due to repeated charge reversal until finally, at the end of the flocculating field near the rollers 11 and 13, they are anchored to the web which is not yet covered with floccules.

In some cases, it may be advantageous to arrange for the conveyor band 19 to move in the same sense as the material to be treated with floccules. Excess floccules are removed from the field of decreasing intensity from the roller 11 to the roller 17 by the conveyor band 19 and removed by suction through a gap 18 from the band 19 which is again at ground potential after it has passed the roller 17. The speed of the conveyor band 19 is adjusted to the speed of the brush 8 so that the floccules lie side by side on the conveyor band with as little contact with each other as possible. If the floccules are too densely packed, they may fail to be removed singly in the electric field but be applied in clumps to the web to be treated. The density of the floccules can be regulated by the speed of the web 1. It is also possible to influence the density of the floccules on the material to be treated by the varying quantity of floccules applied to the conveyor band 19 in unit time. This may be done, for example, by increasing the speed of the brush 8 or by using a wider mesh screen 9. The speed of the band 19 should also then be increased, as explained above.

We claim:

1. An apparatus for applying flocculated material to a moving web surface coated with an electrically conductive adhesive, which comprises a high voltage electrical source, an electrically conductive member connected to a first output terminal of said source and disposed for contact with the adhesive coating on the web to establish said coating at a generally uniform electric potential corresponding to that of said first terminal and at a high voltage difference with respect to the electric potential of a second output terminal of said source, guide means disposed for engagement with said web to direct the movement thereof lengthwise along a predetermined path passing through a flocculated material collection zone, a conveyor band of limited electrical conductivity disposed for

lengthwise movement along a path extending through said collection zone in spaced-apart relation to web sections passing therethrough and facing the adhesive coating on such web sections, means operable to deposit flocculated material upon said conveyor band for transport thereby into said collection zone, a first pair of electrically conductive members each connected to said second output terminal and disposed for contact with said conveyor band at separated positions along the movement path thereof within said collection zone to establish therein a generally uniform electric field acting between the adhesive coating of web sections passing through said zone and conveyor band sections passing therethrough between said separated contact positions of said first pair of conductive members, and by said electric field to electrostatically apply to such adhesive coated web sections for collection thereby flocculated material transported into said collection zone by said conveyor band, and a second pair of electrically conductive members each connected to said first output terminal and disposed for contact with said conveyor band at positions outside said collection zone, one before the conveyor band entrance to said zone, and the other after the conveyor band exit from said zone to generally confine said electric field within said zone, and to establish the conveyor band, other than those sections thereof passing between said second pair of conductive members, at an electric potential substantially equal to that of the web adhesive coating.

2. The apparatus according to claim 1 wherein said conveyor band has an electrical resistance ranging from 10$^6$ to 10$^{11}$ ohms between portions thereof passing between corresponding conductive members of said first and second pairs thereof.

3. The apparatus according to claim 1 wherein said conveyor band is formed as a woolen band coated on both surfaces with pigmented polyurethane.

4. The apparatus according to claim 1 wherein said web and conveyor band are disposed for movement in opposite lengthwise directions within said collection zone.

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