

DESCRIPTION

The invention relates to an apparatus for applying a thin layer of a coating material to a web of material running over a counterpressure roller, with a slot nozzle device which comprises a vertical nozzle box with a wide upper nozzle slot between incoming and outgoing nozzle lips and a storage tank for coating material laterally attached to the nozzle box (see DE-A-1964308). In a coating apparatus of this kind, the thickness of the applied layer is essentially determined by the distance between the outgoing nozzle lip and the web of material or the counterpressure roller.

It is the object of the invention to provide a coating apparatus of the kind described hereinbefore, in which the layer thickness remains the same independently of fluctuations in thickness of the web of material and the instantaneous operating speed, without coating flaws and thickened edges.

The basis of this is that on the one hand the physical properties of the layer vary in case of fluctuations in thickness, and that on the other hand the annual consumption of coating material increases considerably in case of fluctuations in the layer thickness for reasons of guarantee of production.

The object of the invention is achieved according to the invention with an apparatus of the kind described hereinbefore by the fact that the storage tank is attached to the nozzle box and connected thereto in such a way that the liquid level of coating material in the storage tank is the same as that in the nozzle box on account of the effect of vessels communicating with each other, and that in the nozzle box under the nozzle slot is provided a driven continuous transport roller which extends over the length of the nozzle box and which is mounted eccentrically in a roller chamber on the path of the coating material, wherein the level of the stationary coating material is below, preferably about 2 to 3 cm below the outlet of the nozzle

slot.

In the coating apparatus according to the invention, a hydrodynamic liquid pressure against the counterpressure roller or the web of material to be coated is built up in the coating material, in particular by rotation of the continuous transport roller. In this case coating material is delivered sufficiently at as low a pressure as possible to the web of material or counterpressure roller to be coated. The required layer thickness is adjusted exclusively by the distance between the outgoing nozzle lip and the web of material or the counterpressure roller.

Many years' experience with a plurality of coating nozzles with built-in positive-displacement pump have shown that coating material may be only deposited, but not pumped, on webs of material or counterpressure rollers, as any pumping pressure overrides the processes in the coating gap and, in the case of minimal geometrical deviations in the nozzle and roller gap, leads to fluctuations in layer thickness. Furthermore, at too low a pressure, coating flaws occurred, and at too high a pressure, a build-up of material at the edges.

This relationship became particularly clear in the case of natural rubber glues which were filled with different iron oxides. The overriding pressure stemming from the pump had two effects:

1. rubber and iron oxide dissociated, which on a transparent film yielded light and dark lines of adhesive, and
2. at an even greater overriding pressure, the coating surface acquired a herringbone pattern.

With the apparatus according to the invention, the moving web of material or counterpressure roller entrains coating material from the nozzle slot by adhesion, and forms a pressure pad between the outgoing nozzle lip and the counterpressure roller. This pressure pad occurring naturally as a result of the speed and viscosity of the coating material is maintained, but not essentially

affected, by the supply of coating material.

Advantageously, over the continuous transport roller are provided an outlet chamber extending over the length of the nozzle box and, adjoining same, a narrow delivery slot leading to the wide nozzle slot.

In order to be able to set any different coating widths, advantageously in the nozzle slot in the region of both ends thereof are provided axially displaceable slides for selectively covering the nozzle slot.

If these slides are displaced to cover the nozzle slot in such a way that a narrower web of material is coated, for example, over half the nozzle length, then the coating material accumulates beneath the covered zones. Since however the continuous transport roller does not produce any significant pumping pressure, the backpressure remains very low and a build-up by an excess of coating material at the coating edges is completely eliminated.

The coating gap, formed from the outgoing nozzle lip and the counterpressure roller, should be a high-precision gap. Advantageously, therefore, the counterpressure roller is a very finely polished chromium-plated steel roller which runs true to about 2 to 3 μm , while the outgoing nozzle lip is very straight with a linearity deviation of less than 1 μm over a length of 100 mm.

Appropriately, the incoming nozzle lip is coated with a resilient material on the side facing towards the counterpressure roller.

Further, advantageously the outgoing nozzle lip and/or the incoming nozzle lip can be arranged exchangeably in the nozzle box.

Completely uniform coating of a web of material running over the counterpressure roller is possible directly from the nozzle slot only if the web of material is very constant in thickness and practically without differences in thickness which affect the layer thickness. This is the case for example with calendered papers, various plastic films, biaxially oriented polypropylene

films and the like.

For webs of material with great fluctuations in thickness, for example 7 to 9 μm in the direction of the web and short intervals, therefore, indirect coating will have to be used. This is particularly true with low-viscosity coating materials, as these follow the unevenness in the web of material. In the case of coating materials with higher viscosities, the inertia of the mass has a levelling effect; the fluctuations in the coating are in each case smaller than the fluctuations in thickness of the web of material.

For this, advantageously there is provided a contact pressure roller which is driven in the same or opposite direction to the counterpressure roller and over which the web of material is guided in contact with the counterpressure roller which is precoated in measured quantities by the slot nozzle device and which works as an applicator roller.

Appropriately, the contact pressure of the contact pressure roller on the counterpressure roller is variable by adjustable stops.

Here, coating is first performed with high precision directly on the counterpressure roller. The web of material here runs over the contact pressure roller, where the previously proportioned layer is taken over from the counterpressure roller running in the same or opposite direction onto the web of material.

Further, advantageously the nozzle box is made easy to open in a plane passing through the vertical longitudinal centre plane of the nozzle slot. This produces a considerable simplification and ease of operation during cleaning of the slot nozzle device in case of a change of coating material, particularly in connection with frequent changing of the charge.

Finally, the storage tank and/or the nozzle box are appropriately capable of being heated.

The invention is described in more detail below by

practical examples and with the aid of the drawings. The drawings show:

- Fig. 1 a partial front view of an apparatus according to the invention for direct coating, partly in section,
Fig. 2 a partial side view of the apparatus according to fig. 1, and
Fig. 3 a partial front view of an apparatus according to the invention for indirect coating, partly in section.

Fig. 1 shows schematically a slot nozzle device 1 for applying a thin layer of a coating material 2 directly to a web of material 4 running over a counterpressure roller 3. The slot nozzle device consists of a vertical nozzle box 5 and a storage tank 6 for coating material 2 attached laterally to the nozzle box 5. The nozzle box 5 has at its upper end a wide nozzle slot 7 between an incoming nozzle lip 8 and an outgoing nozzle lip 9. Through the wide nozzle slot 7 the coating material 2 is deposited directly on the web of material 4.

The storage tank 6 is attached to the nozzle box 5 and connected thereto in such a way that the liquid level of the coating material 2 in the storage tank 6 and in the nozzle box 5 is essentially the same on account of the effect of vessels communicating with each other.

In the nozzle box 5 under the nozzle slot 7 is provided a driven continuous transport roller 10 extending over the length of the nozzle box 5. The continuous transport roller 10 is mounted eccentrically in a roller chamber 11 on the path of the coating material 2 from the nozzle box 5 to the nozzle slot 7. The level of the stationary coating material 2 is located below, preferably 2 to 3 cm below the outlet of the nozzle slot 7.

The continuous transport roller 10 is constructed in one or more sections and held together with two mounting rollers by a tie rod. It can be withdrawn as a whole axially from the nozzle box 5.

Below the continuous transport roller 10 or roller chamber 11 is provided an inlet chamber 12 extending over the length of the nozzle box 5. Above the continuous transport roller 10 is located an outlet chamber 13 extending over the length of the nozzle box 5 and, adjoining same, a narrow delivery slot 14 leading to the wide nozzle slot 7.

By rotation of the continuous transport roller 10, a hydrodynamic liquid pressure against the counterpressure roller 3 or the web of material 4 to be coated is built up. In this case coating material 2 is delivered sufficiently at as low a pressure as possible to the web of material 4 to be coated. The required layer thickness is adjusted exclusively by the distance between the outgoing nozzle lip 9 and the web of material 4 or the counterpressure roller 3. The moving web of material 4 entrains coating material 2 from the nozzle slot 7 by adhesion and forms a pressure pad between the outgoing nozzle lip 9 and the counterpressure roller 3. This pressure pad occurring naturally as a result of the speed and viscosity of the coating material 2 is maintained, but not essentially affected, by the supply of coating material.

A selection of coating materials which can be processed with the apparatus according to the invention, their processing parameters and the end products obtained is indicated in the following table 1.

TABLE 1

Industrial coating material	End product	Viscosity range mPas	Solvent	General dry weight	Coating temperature
Natural rubber glues	Adhesive strip	60,000-800,000	Toluene-hexane	18-22 g/m ²	Room temperature
PU materials	Clothing insulation	2000-8000	MEK	20-30 g/m ²	Room temperature
PVC pastes	Artificial leather	4000-20000	-	300-400 g/m ²	Room temperature
PVC lacquer	Al cover foil	2000-12000	MEK	6-8 g/m ²	Room temperature
Acrylic dispersion	Labels	200-1200	Water	18-22 g/m ²	Room temperature
SBS dispersion	Labels	200-1200	Water	18-22 g/m ²	Room temperature
Starch glues	Wet adhesive strip, presized wallpapers	30000-50000	Water	15-40 g/m ²	80°C
EVA coating hotmelts	Barrier layers for wrappers	2000-12000	-	10-25 g/m ²	170°C
EVA lining hotmelts	Barrier layers for bags	2000-50000	-	20-35 g/m ²	170°C
Atactic polypropylene	Barrier layers for soap powder boxes and wrapping paper for paper rolls	200-1200	-	35-45 g/m ²	190°C
Bitumen	Paper bags	100-1200	-	15-18 g/m ²	190°C
Hotmelt pressure-sensitive adhesive	Labels, adhesive strip	20000-70000	-	17-35 g/m ²	180°C

In order to be able to set any different coating widths, in the nozzle slot 7 in the region of both ends thereof are provided axially displaceable slides 15 for selectively covering the nozzle slot, cf. in particular fig. 2. If these slides 15 are displaced to cover the nozzle slot in such a way that a narrower web of material 4 is coated, for example over half the nozzle length, then the coating material accumulates beneath the covered zones. Since however the continuous transport roller 10 does not produce any significant pumping pressure, the backpressure remains very low and a build-up by an excess of coating material 2 at the coating edges is completely eliminated.

The coating gap 16, formed from the outgoing nozzle lip 9 and the counterpressure roller 3, should be a high-precision gap. Advantageously, therefore, the counterpressure roller 3 is a very finely polished chromium-plated steel roller which runs true to about 2 to 3 μm , while the outgoing nozzle lip 9 is very straight with a linearity deviation of less than 1 μm over a length of 100 mm.

The incoming nozzle lip 8 can be coated with a resilient material 17 on the side facing towards the counterpressure roller 3. Thus very good sealing of the coating material 2 in the region of the incoming nozzle lip 8 is produced.

Further, advantageously the outgoing nozzle lip 9 and/or the incoming nozzle lip 8 are constructed in such a way that they can be arranged exchangeably in the nozzle box 5. Particularly advantageously, these two nozzle lips 8 and 9 are even mounted mutually interchangeably. If now a very thin coating is to be applied, then either the direction of rotation of the counterroller 3 can be reversed in such a way that the incoming nozzle lip 8 coated with the resilient material 17 becomes the outgoing nozzle lip. The resilient material 17 can be pressed directly against the counterroller 3 and thus determines with high precision the thickness of applying the very thin coating. On the other hand, with the direction of rotation of the counterpressure

roller 3 remaining the same, the incoming nozzle lip 8 and the outgoing nozzle lip 9 can be exchanged with each other in order to obtain the same effect.

For webs of material with great fluctuations in thickness, for example 7 to 9 μm in the direction of the web and short intervals, advantageously so-called indirect coating will have to be used. An apparatus for this is shown schematically in fig. 3. The counterpressure roller 3 here works as an applicator roller to which the coating material 2 is applied directly in measured quantities by the slot nozzle device 1 in a precoating process. Here, then, a contact pressure roller 18 is provided, over which the web of material 4 is guided in contact with the counterpressure roller 3 which is precoated in measured quantities. At the point of contact, the coating material 2 is taken over from the counterpressure roller 3 uniformly onto the web of material 4.

In most cases, the contact pressure roller 18 is driven in the opposite direction to the counterpressure roller 3, but if occasion arises in the same direction. The contact pressure of the contact pressure roller 18 on the counterpressure roller 3 is advantageously variable by adjustable stops, not shown.

The nozzle box 5 is advantageously made easy to open in a plane passing through the vertical longitudinal centre plane of the nozzle slot 7. In this case, advantageously the portion of the nozzle box 5 facing away from the storage tank 6 can be pivoted away. This produces a considerable simplification and ease of operation during cleaning of the slot nozzle device 1 in case of a change of coating material 2, particularly in connection with frequent changing of the charge.

Finally, the storage tank 6 and/or the nozzle box 5 can be made capable of being heated, which is considered particularly when the coating temperatures of the coating material 2 are above room temperature.



Patent claims

1. Apparatus for applying a thin layer of a coating material (2) to a web of material (4) running over a counterpressure roller (3), with a slot nozzle device (1) which comprises a vertical nozzle box (5) with a wide upper nozzle slot (7) between incoming (8) and outgoing (9) nozzle lips and a storage tank (6) for coating material (2) laterally attached to the nozzle box (5), characterised in that the storage tank (6) is attached to the nozzle box (5) and connected thereto in such a way that the liquid level of coating material (2) in the storage tank (6) is the same as that in the nozzle box (5) on account of the effect of vessels communicating with each other, and in that in the nozzle box (5) under the nozzle slot (7) is provided a driven continuous transport roller (10) which extends over the length of the nozzle box (5) and which is mounted eccentrically in a roller chamber (11) on the path of the coating material (2), wherein the level of the stationary coating material (2) is below the outlet of the nozzle slot (7).

2. Apparatus according to claim 1, characterised in that the level of the stationary coating material (2) is about 2 to 3 cm below the outlet of the nozzle slot (7).

3. Apparatus according to claim 2, characterised in that over the continuous transport roller (10) are provided an outlet chamber (13) extending over the length of the nozzle box (5) and, adjoining same, a narrow delivery slot (14) leading to the wide nozzle slot (7).

4. Apparatus according to any of the preceding claims, characterised in that in the nozzle slot (7) in the region of both ends thereof are provided axially displaceable slides (15) for selectively covering the nozzle slot.



5. Apparatus according to any of the preceding claims, characterised in that the counterpressure roller (3) is a very finely polished chromium-plated steel roller which runs true to about 2 to 3 μm .

6. Apparatus according to claim 5, characterised in that the outgoing nozzle lip (9) is very straight with a linearity deviation of less than 1 μm over a length of 100 mm.

7. Apparatus according to any of the preceding claims, characterised in that the incoming nozzle lip (8) is coated with a resilient material (17) on the side facing towards the counterpressure roller (3).

8. Apparatus according to any of the preceding claims, characterised in that the outgoing nozzle lip (9) and/or the incoming nozzle lip (8) are arranged exchangeably in the nozzle box (5).

9. Apparatus according to any of the preceding claims, characterised in that a contact pressure roller (18) is provided which is driven in the same or opposite direction to the counterpressure roller (3) and over which the web of material (4) is guided in contact with the counterpressure roller (3) which is precoated in measured quantities by the slot nozzle device (1) and which works as an applicator roller.

10. Apparatus according to claim 9, characterised in that the contact pressure of the contact pressure roller (18) on the counterpressure roller (3) is variable by adjustable stops.

11. Apparatus according to any of the preceding claims, characterised in that the nozzle box (5) is made easy to open in a plane passing through the vertical longitudinal centre plane of the nozzle slot (7).



12. Apparatus according to any of the preceding claims, characterised in that the storage tank (6) and/or the nozzle box (5) are capable of being heated.