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(54) Improvements in apparatus for coating sheet material.

(57) A process for coating sheet material at high speed with a low viscosity low coat weight coating comprising the steps of forming, on an endless transfer surface, a fluid film of a coating mix to be applied to the sheet material whilst moving the endless transfer surface on a convex path through a coating station, and in the second direction of movement of the transfer surface, and simultaneously passing the sheet material to be coated around an endless guide surface at said coating station, whilst maintaining the spacing between the transfer and guide surfaces at a spacing substantially equivalent to the combined thickness of the sheet material and the film of coating mix on the transfer surface.

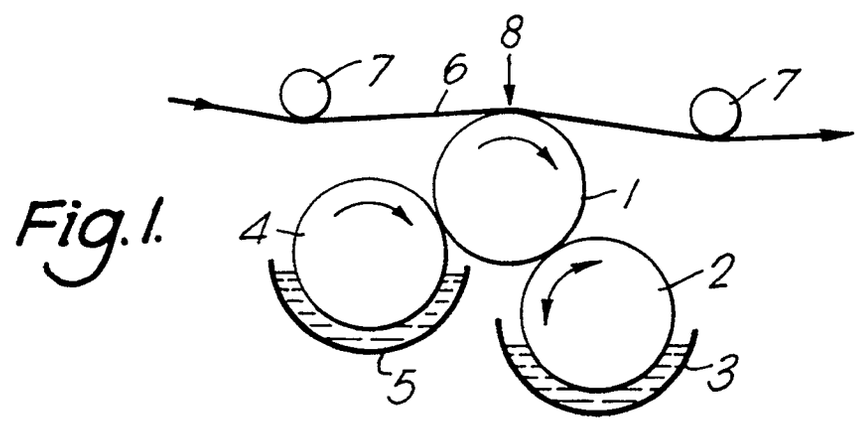

Fig. 1.

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This invention relates to apparatus for coating sheet materials with fluid coating, and more particularly to roll coating equipment for that purpose.

One form of roll coating apparatus currently in use comprises an applicator roll on which a film or a fluid coating mix is formed and metered. Sheet material to be coated with the coating mix is drawn around the roll under tension so that the coating mix is transferred from the roll to the sheet material. Apparatus of this kind is described in UK Patent No. 1 151 690.

It has however been found that in using roll coating apparatus of the aforementioned kind, when operating with low viscosity coatings at coat weights typically about 16-20 grams/square metre wet which equates to 4 - 5 grams/square metre when dry on the sheet and at high speed, that is more than 750 metres per minute, the maintenance of sufficient tension in the sheet to ensure complete transfer of the coating film to the sheet (that is, the avoidance of uncoated areas or "skip" coating), results in frequent breaks in the paper. In consequence, the coating machine must be stopped or slowed down to enable the sheet to be refed through the machine dryers, and substantial losses in production result.

It is among the objects of the present invention to substantially alleviate the aforementioned problem by providing a process and apparatus for ensuring effective transfer of the coating to the sheet while under substantially reduced tension.

The invention therefore provides a process for coating sheet material at high speed with a low viscosity, low coat weight coating, and comprises the steps of forming, on an endless transfer surface, a fluid film of a coating mix to be applied to the sheet material whilst moving the endless transfer surface in a convex path through a coating station, and in the direction of movement of the transfer surface, and simultaneously passing the sheet material to be coated around an endless guide surface at said coating station, whilst maintaining the spacing between the transfer and guide surfaces at a spacing substantially equivalent to the combined thickness of the sheet material and the film of coating mix on the transfer surface.

According to another aspect of the invention apparatus for coating sheet material at high speed with a low viscosity low coat weight coating comprises a rotatable applicator roll, means for forming a film of coating mix on said applicator roll, means defining an endless guide surface for guiding sheet material past and in the same direction of movement as said applicator roll, and means for maintaining the spacing between the applicator roll and the guide surface substantially equivalent to the combined thickness of the sheet material and the film of coating mix on said applicator roll.

In a typical arrangement the spacing between the applicator roll and the surface of the sheet material can be 3 - 4 thousandths of an inch (75 - 100 μ) and the spacing between the applicator roll nd the guide surface for use with a 50 gram sheet which has a caliper (i.e. thickness) of 75 - 100 u would be 150 - 200 μ.

The applicator roll may form part of a three roll coating system in which the other components comprise a pick up roll which transfers coating from a reservoir in the applicator roll, and a metering roll. Such a system is described in UK Patent No. 1 151 690.

The guide surface may comprise a rotatable hold down or presenter roll which is driven at substantially the same surface speed as the speed of the sheet material. Where the hold down or presenter roll is to be used for supporting paper for back coating which has previously been coated with microcapsules, the roll surface can be provided with a surface covering having a hardness, typically or about 35° Shore which prevents damage to the microcapsules whilst ensuring that the back coating is properly applied.

The applicator roll may be driven so as to rotate at a surface speed less than the line speed of the sheet material so that the coating is effectively "metered" onto the sheet for the achievement of low coatweights.

The invention will now be further described with reference to the accompanying drawings in which :-

Figure 1 is a semi-diagrammatic side elevation of a known coating apparatus,

Figure 2 is a semi-diagrammatic side elevation of a coating apparatus according to the invention,

Figure 3 is an enlarged side elevation of part of the embodiment of Figure 2 showing the mode of operation of the apparatus according to the invention,

Figure 4 is a front elevation of a coating apparatus according to the invention,

Figure 5 is a view on the line V-V of Figure 4, and

Figure 6 is a sectional elevation on the line VI-VI of part of the apparatus of Figure 5.

Referring first to Figure 1, this shows a known coating apparatus comprising an applicator roll 1, a pick up roll 2 running in a pan 3 of coating mix, and a metering roll 4 running in a pan 5 which receives surplus mix metered from the roll 1. Sheet material 6, for example paper, is drawn past and in contact with the roll 1 with some degree of wrap around the roll being generated by the positioning of two guide rolls 7, one upstream and one downstream of the roll 1.

The apparatus operates in "forward" mode. In Figure 1, the applicator roll 1 rotates in the same direction as the movement of the sheet. The pick up roll 2 may rotate in either direction, but the metering roll 4 will rotate in the same sense as the applicator roll 1.

In operating a coated configuration of the kind shown in Figure 1, it has been found that in order to avoid "skip" coating (that is areas of paper to which

the coating has not been applied), substantial tension has to be generated in the sheet 6. This is effected by maintaining a speed differential between the two guide rolls 7 and downward pressure of the sheet 6 on the roll 1 is thereby maintained as indicated by the arrow 8. This tension produces frequent breaks in the paper and in consequence, the coating machine has to be stopped or slowed to permit the sheet to be re-fed through the dryers. As a result, there is both loss of production and paper wastage.

Figure 2 shows a three roll coater system generally of the kind described above with reference to Figure 1, the same parts being identified by the same reference numerals. In the arrangement shown however, and in accordance with the invention, the paper sheet 6 is drawn around a hold down or presenter roll 10 driven at a surface speed substantially the same as that of the sheet 6. The roll 10 does not however form a nip with the applicator roll 1 but is controllably spaced therefrom as described in greater detail below with reference to Figure 3. The configuration of Figure 2 is suitable for high speed coating operations of more than about 750 metres per minute in which the sheet 6 could be degraded by downward pressure as shown in Figure 1.

Turning now to Figure 3, this shows a detail from the configuration of Figure 2, with the applicator roll operating in forward mode. As will be seen, the spacing between the rolls 10 and 1 indicated by the arrows A is substantially equivalent to the total of the thickness B and C respectively of the paper sheet 6 and coating 12 being applied to the roll 1. In a typical process the space C between the paper 6 and the applicator roll 1 is about 3 - 4 thousandths of an inch (75 - 100 μ) with a 50 gram paper having a caliper (thickness) of 75 - 100 μ so that the space between the rolls 1 and 10 is about 150 - 200 μ . Essentially, the roll 10 presents the sheet material to the applicator roll 1 for coating and does not apply pressure.

The applicator roll is arranged to run with a surface speed of approximately 1/6 of the line speed of the sheet 6 so that the coating mix is effectively "metered" onto the sheet for the achievement of low coat-weights. Thus the thickness of coating on the sheet is less than the space C. The coating mix is of low viscosity, and has a typical coat weight of about 16 - 30 grams per square metre wet, which equates to 4 - 5 grams per square metre when dried on the sheet which has been coated. In order to achieve the layer of coating mix on the applicator roll surface, so that it is metered as set forth above, it is necessary to apply a mix which is about 6 times the required gram weight of the coating. Thus for a 16 gram per square metre coating weight the mix has to be about 96 grams per square metre which equals about 100 μ on the applicator roll.

Turning now to Figures 4, 5 and 6, these show a further configuration of roll coating apparatus according to the invention. In the drawings, the apparatus 20 comprises a frame 21 formed from two side members 22 carried on a base 23 and spaced by struts 24. As best seen in Figure 5, each of the side members 22 comprises two vertical members 25 spaced by an upper strut 26 and an intermediate strut 27.

A shaft 28 of an applicator roll 29 is journalled for rotation at its ends in bearings 30 forming part of the struts 27.

Beneath the applicator roll 29, a pick up roll 31 is mounted for rotation in a pan of coating mix so as to transfer a film of the mix to the applicator roll 29 during co-operative rotation of the two rolls. A metering roll 33 is also mounted for rotation in a drain pan 34 so as to meter a film of coating mix previously applied by the roll 31 during co-operative rotation of the rolls 29 and 33. The roll coating system shown in Figure 5 is of well known kind as described above and in UK Patent No. 1 151 690.

A hold down or presentation roll 37 is mounted immediately above the applicator roll 29 on a shaft 38 journalled for rotation in bearing blocks 39. The bearing blocks 39 carry sliders 40 (as best seen in Figure 5) mounted for vertical movement on a slideways 41 formed on the inner faces of the vertical members 25.

Spindles 42 secured to the bearing blocks 40 extend upwardly through the struts 26 and form extensions of the piston rods of pneumatic piston and cylinder units 43. The piston and cylinder units 43 can be used to control the approximately vertical positioning of the hold down roll 37 in relation to the applicator roll 29.

Each of the bearing blocks 39 carries a dependent threaded pin 44 on which a capped nut 45 is engaged at the lower end. The cap 46 of the nut 45 can be brought into engagement with the anvil 47 of a height adjustment mechanism 48 by rotation of the nut 45.

The height adjustment mechanism 48 is shown in detail in Figure 6 and is of the kind generally described in UK Patents Nos. 1 429 727 and 1 561 984 granted to Purpose Engineers Limited. As shown in Figure 6, the mechanism comprises a double wedge 49 formed on the end of a horizontally movable spindle 50 between a roller 51 journalled in the anvil 47 and a reaction roller 52 journalled in trunnions 53 supported from the actuator body 54. The spindle 50 extends into engagement with a series of pneumatically operable pistons 55 pressurizable through ports 56. The system is arranged such that pressurisation of each piston 55 produces a different incremental movement of the spindle 50. A corresponding cumulative vertical incremental movement of the anvil 47 is thus produced by the action of the double wedge 49 as it is driven horizontally between the rollers 51 and 52. By providing an extended taper on the wedge 49, very small incremental movements of the anvil 47 can be effected, typically of the order of 50 microns.

In order to set up the apparatus for use, the piston cylinder units 43 and the nuts 45 are adjusted so as to bring the surface of the hold down roll 37 just into contact with the applicator roll 29, that is at a "zero" setting. The pneumatic cylinders 55 of the actuator units 48 are then selectively pressurised to raise the anvils 47 against the pneumatic load being applied by the piston and cylinder units 43 by an amount equivalent to the combined thickness of the paper 57 to be coated and the coating to be applied thereto as a film from the applicator roll 29. It will thus be appreciated that the coating is applied without the application of nip pressure.

Claims

1. A process for coating sheet material at high speed with a low viscosity low coat weight coating comprising the steps of forming, on an endless transfer surface, a fluid film of a coating mix to be applied to the sheet material whilst moving the endless transfer surface on a convex path through a coating station, and in the direction of movement of the transfer surface, and simultaneously passing the sheet material to be coated around an endless guide surface at said coating station, whilst maintaining the spacing between the transfer and guide surfaces at a spacing substantially equivalent to the combined thickness of the sheet material and the film of coating mix on the transfer surface.

2. A process as claimed in claim 1 which includes providing a guide surface formed by a rotatable hold down or presenter roll driven at substantially the same surface speed as the speed of movement of the sheet material.

3. A process as claimed in claim 1 which includes providing an endless transfer surface formed by a rotatable applicator roll driven at a surface speed less than the speed of movement of the sheet material so that the coating mix is metered as it is applied.

4. A process as claimed in claim 2 in which the coating is applied as a back coating to a sheet of material which has previously been coated on its front surface with microcapsules.

5. Apparatus for coating sheet material at high speed with a low viscosity low coat weight coating comprising a rotatable applicator roll, means for forming a film of coating mix on said applicator roll, means defining an endless guide surface for guiding sheet material past and in the same direction of movement as said applicator roll, and means for maintaining the spacing between the applicator roll and the guide surface substantially equivalent to the combined thickness of the sheet material and the film of coating mix on said applicator roll.

6. Apparatus as claimed in claim 5 in which the applicator roll forms part of a three roll coating system which includes a pick-up roll which transfers coating mix from a reservoir roll, and a metering roll.

7. Apparatus as claimed in claim 5 or claim 6 in which the guide surface comprises a rotatable hold down or presenter roll.

8. Apparatus as claimed in claim 7 in which the hold down or presenter roll is driven at substantially the same surface speed as the speed of movement of the sheet material.

9. Apparatus as claimed in any one of preceding claims 5 to 8 in which the applicator roll is driven at a surface speed less than the speed of movement of the sheet material.

10. Apparatus as claimed in any one of claims 7, 8 or 9 in which the hold down or presenter roll is provided with a surface covering having a hardness of approximately 35° Shore.

Fig.1.

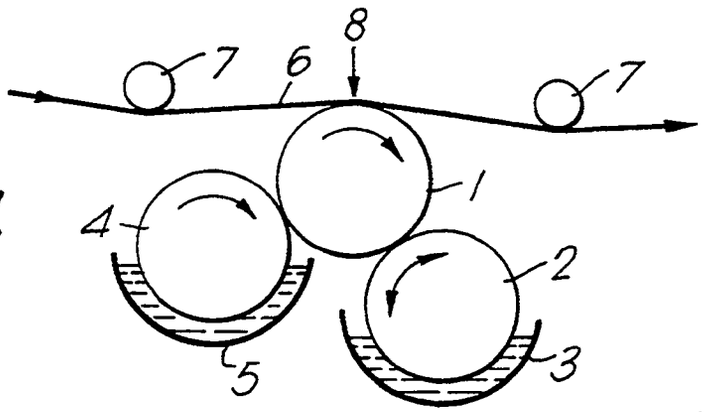

Fig.2.

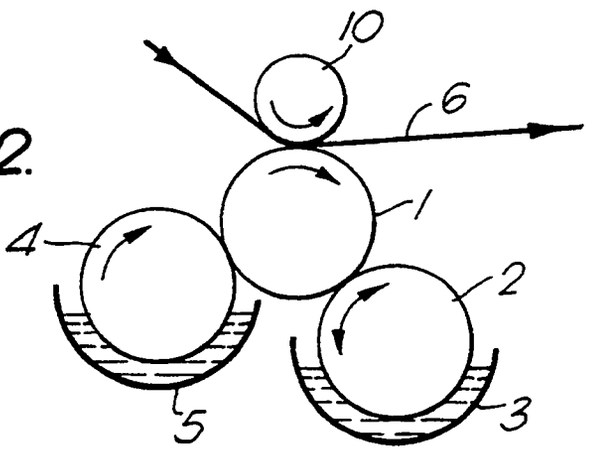

Fig.3.

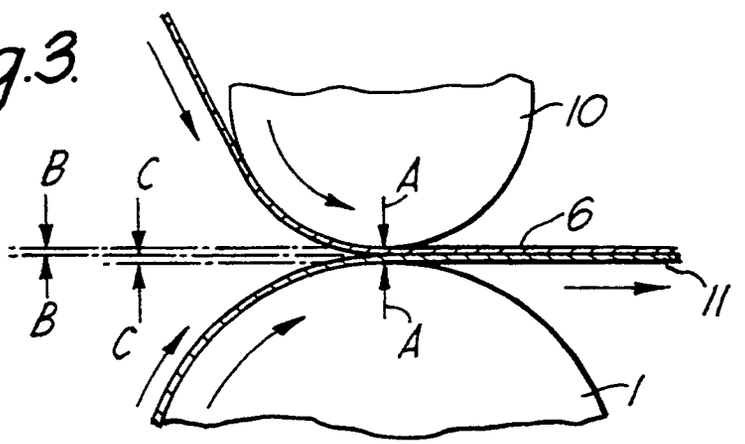

Fig.4.

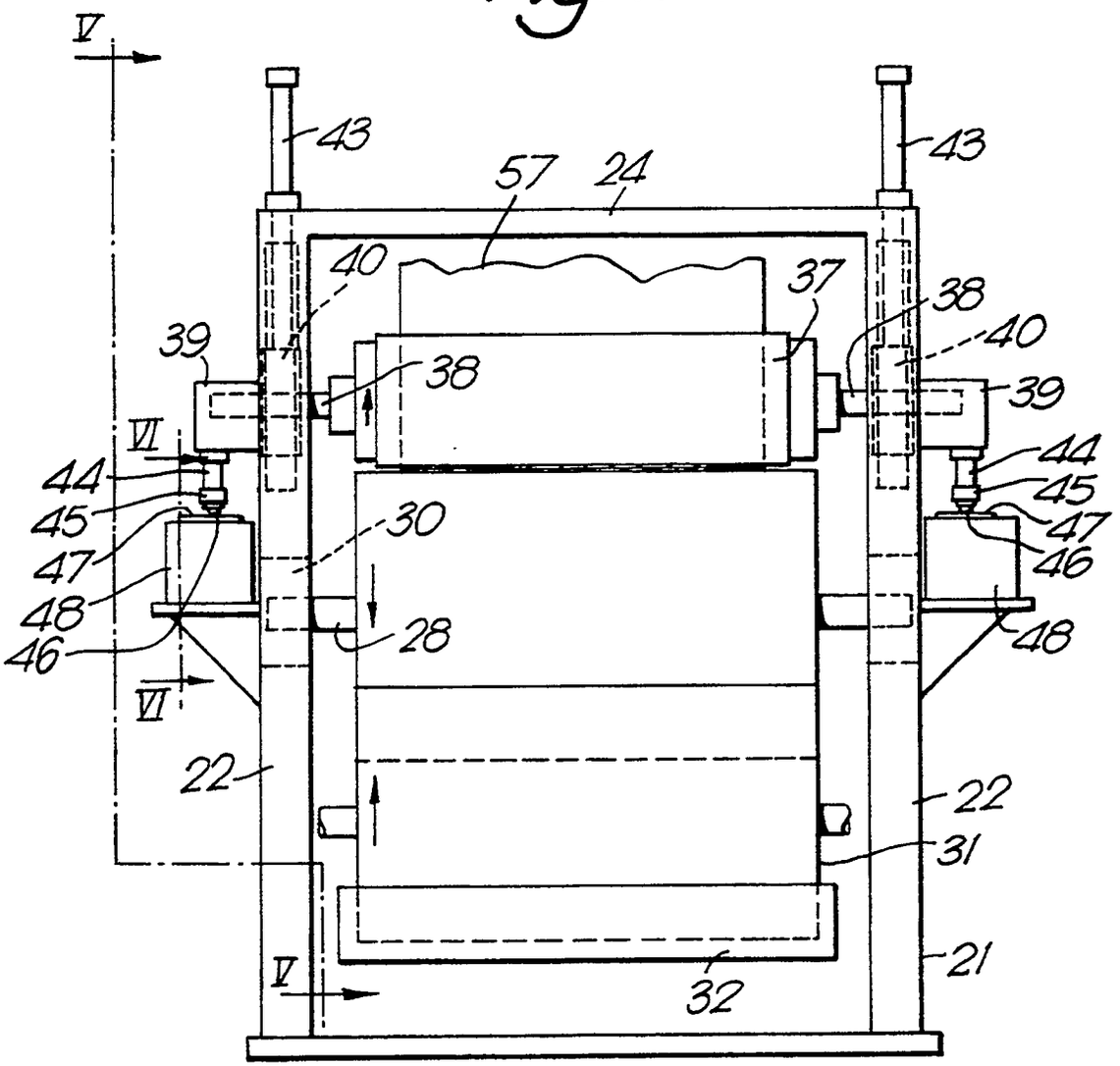
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Fig.5.

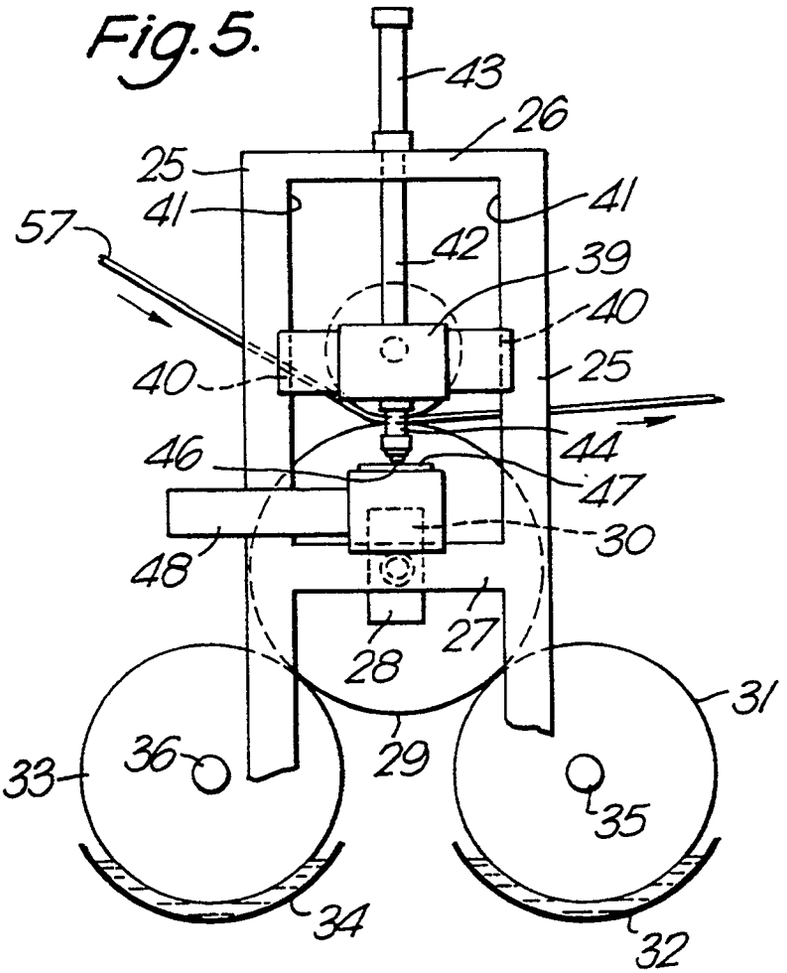
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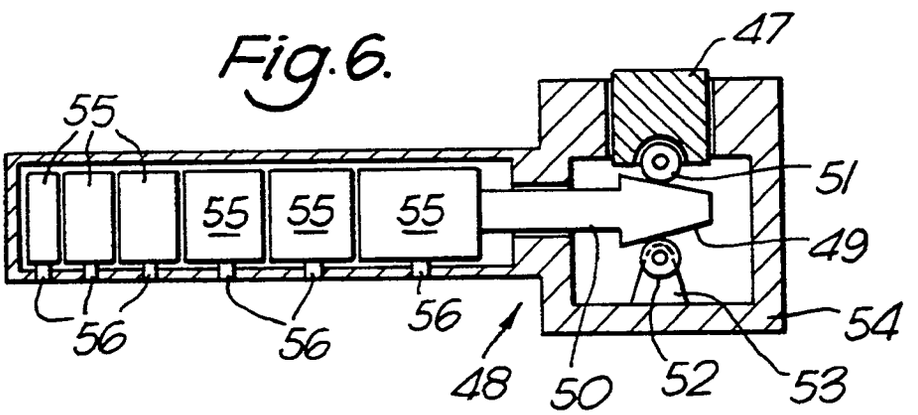
Fig.6.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