April 30, 1968 D. T. N. WILLIAMSON ET AL 3,380,436

PRINTING APPARATUS

Filed March 21, 1966 2 Sheets-Sheet 1

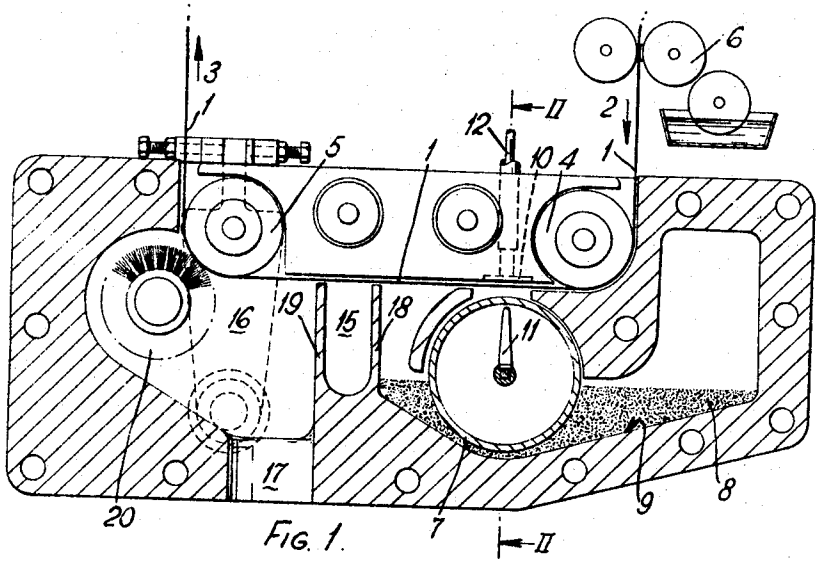


FIG. 1.

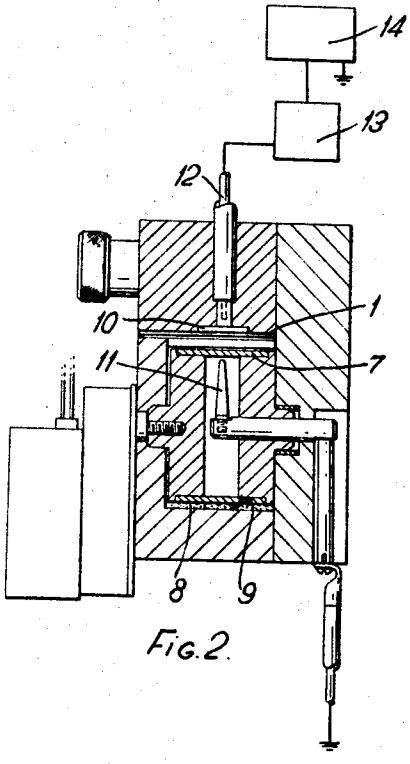


FIG. 2.

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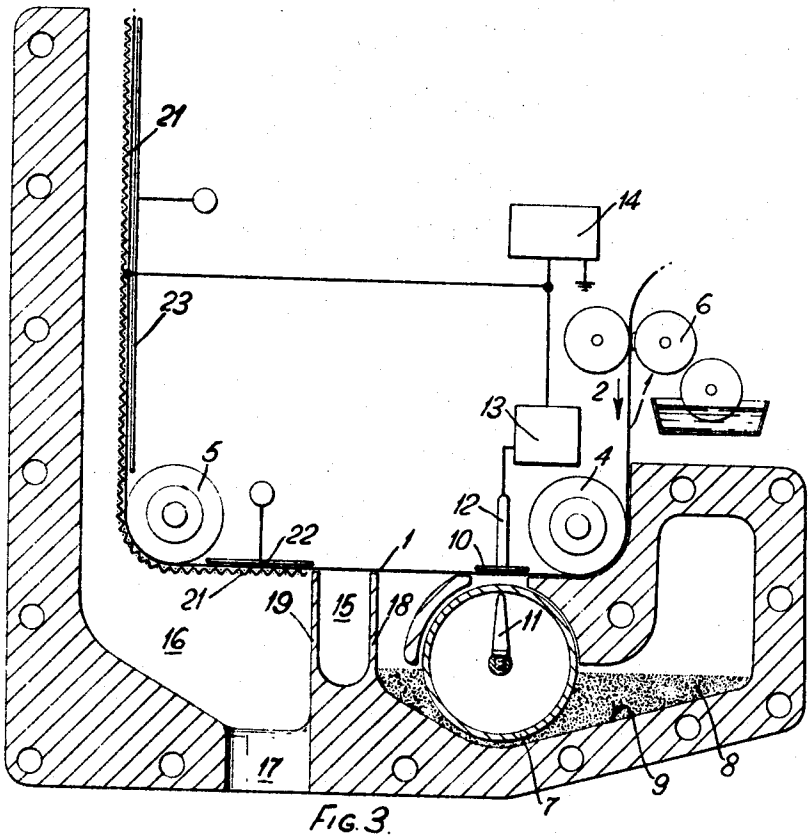


FIG. 3.

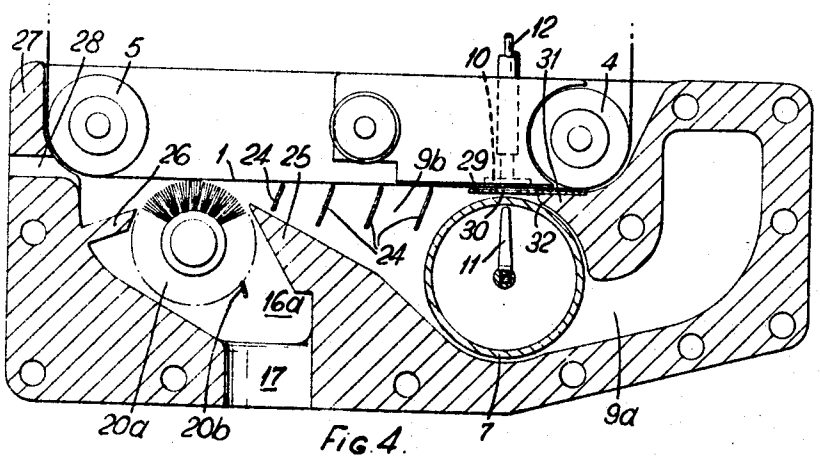


FIG. 4.

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PRINTING APPARATUS

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12 Claims. (Cl. 118—637)

ABSTRACT OF THE DISCLOSURE

Printing apparatus is disclosed comprising means for feeding a strip to be printed past an applicator which applies adhesive to areas to be printed, then past a powder reservoir where powder is propelled on to the strip by an electric field which is switched on as each area of adhesive passes, and lastly to a cleaner which removes excess powder.

This invention relates to printing apparatus and particularly to apparatus for printing by the application of dry solid particles to paper or the like.

An advantageous use of the invention is in the printing of cigarette-paper in a continuous-rod cigarette-making machine, especially where the printing is to be effected by the application to the paper of metallic particles rather than conventional ink. Apparatus for this purpose is usually termed a "bronzer" as a bronze finish is most commonly required, although such apparatus can readily be employed in the application of particles of various metals to give printing of desired appearance.

It is an object of the present invention to provide an improved printing apparatus in which dry solid particles are applied to paper or the like.

According to the invention, there is provided printing apparatus comprising means for feeding a paper or like strip to be printed in a predetermined path past an adhesive applicator, a power dispenser, and a strip cleaner in that order, said adhesive applicator being arranged to apply adhesive to the strip in a pattern corresponding to matter to be printed thereon and said strip cleaner being arranged to remove excess powder from the strip, in which the powder dispenser comprises a powder reservoir and means for producing an electric field extending from said reservoir through the path of the strip to impel powder from said reservoir into said path.

While a constant electric field may be applied, it is preferred to apply said field intermittently, the field producing means being operated in synchronism with the adhesive applicator so that whenever an area of the strip carrying adhesive is in a position to receive power impelled by the electric field that field is in existence. The field is however not present at other times and therefore powder is not unnecessarily impelled from the reservoir towards parts of the strip not carrying adhesive; it will be appreciated that this reduces the amount of work required of the strip cleaner.

The powder reservoir preferably contains a rotatable transfer roller arranged that as it rotates it picks up powder on its surface and carries the powder to a position adjacent to the strip. The transfer roller may for example be a bronze roller, provided with a coating of material such as emery cloth for efficient powder pick up, and the electric field producing means may be arranged to create a potential difference between said roller and an electrode aligned with said roller but on the other side of the path of the strip. The powder reservoir may also be provided

with internal baffles, as this tends to reduce air turbulence created by movement of the strip over the reservoir.

Said strip cleaner may take various forms, as cleaning may be effected mechanically and/or electrostatically. For purely mechanical cleaning we may employ a rotary brush, while for electrostatic cleaning we may provide a grid extending parallel to the path of the strip and means for producing an electric field between said path and said grid to impel excess powder carried by the strip, but not adhesively secured thereto, away from said strip. Suction means may in either case be provided to complete the removal of such excess powder, and in particular we may arrange for suction to the applied in a region where the strip is changing direction e.g. is passing around a guide roller, so that an air stream created by the suction acts on the surface of the strip at a time when any excess powder thereon is subjected to centrifugal force due to the strip's change of direction.

In order that the invention may be well understood, preferred embodiments thereof will now be described, reference being made to the accompanying drawings, in which:

FIGURE 1 is a sectional view of one form of apparatus embodying the invention;

FIGURE 2 is a further sectional view in the plane II—II of FIGURE 1; and

FIGURES 3 and 4 are views similar to FIGURE 1 of modified forms of apparatus.

Referring first to FIGURE 1, a continuously fed paper strip **1** is shown entering the apparatus at **2** and leaving at **3**, passing around two guide rollers **4**, **5** on its way. Before reaching the first guide roller **4**, the strip **1** passes an offset applicator roller **6** which applies to the strip **1** a pattern corresponding to matter to be printed on said strip; however the said pattern is applied not in ink but in an adhesive.

Between the guide rollers **4**, **5** the strip **1** travels horizontally, with the face carrying the adhesive pattern facing downwards, and shortly after passing around the guide roller **4** the strip **1** passes above a rotating hollow roller **7** which extends horizontally at right angles to the direction of travel of the strip **1**. Said roller **7** has its lower part surrounded by powder **8** carried in a powder reservoir **9** and serves to carry a film of said powder up to the vicinity of the strip **1**.

Above the path of the strip **1**, and in vertical alignment with the roller **7**, there is provided an electrode **10**. An earthed counter-electrode **11** is provided within the roller **7**, said roller being made of electrically non-conductive material, and the electrode **10** is connected via a connector **12** and switching device **13** (FIGURE 2) to an electric supply device **14** capable of producing a sufficient voltage on electrode **10**, relative to earth, to establish an electric field between said electrodes sufficient to impel powder carried on the surface of roller **7** up to the strip **1**.

The switching device **13**, which may be a simple mechanical commutator, is arranged to operate in synchronism with the adhesive applicator roller **6** so that the electrode **10** is only connected to the supply device **14** at such times as areas of the strip **1** carrying adhesive are passing above the roller **7**, as at other times it is pointless to impel powder against the strip **1**.

After passing over the roller **7**, the strip **1** passes first over a chamber **15** which is vented to atmosphere and then over a chamber **16** connected by a port **17** to a suction pump (not shown). Between the powder reservoir **9** and chamber **15** is a wall **18**, and between the chambers **15**, **16** is a wall **19**, both walls **18**, **19** extending upward to a level very close to the path of the strip **1**. The chamber **15** and walls **18**, **19** together serve

to prevent the suction pump (not shown) from undesirably influencing the powder 8 in reservoir 9.

As the strip 1 passes over the chamber 16, the suction applied thereto via port 17 tends to remove any excess powder carried by the strip 1, i.e. powder not held to the strip by the adhesive previously applied thereto by roller 6. To ensure as complete a removal of such excess powder as is possible, a rotary brush 20 is mounted adjacent to guide roller 5 and arranged to engage the lower surface of the strip 1 as it passes round guide roller 5 and sweep the said lower surface of the strip 1 in opposition to its own motion, i.e. towards the chamber 16.

A modified form of apparatus is shown in FIGURE 3. Here it will be seen that, while much of the apparatus is similar to that of FIGURES 1 and 2, the rotary bush 20 is omitted. In its place, a grid 21 extends adjacent to the path of the strip 1 as it passes over chamber 16, around guide roller 5, and for some distance thereafter. Counter-electrodes 22, 23 are provided behind the path of the strip 1 over that part of its length on either side of the guide roller 5 which is covered by the grid 21. The grid 21 is connected to the live side of device 14 while counter electrodes 22, 23 are earthed, thus a constant electric field is produced between the strip 1 and grid 21, in the opposite sense to that produced by electrodes 10, 11 (when operative). Any loose powder on strip 1 is impelled away from said strip as it passes between grid 21 and electrodes 22, 23 and passes through the interstices of said grid to come under the influence of suction applied via port 17 which creates a downward air-stream past said grid 21.

In FIGURE 4, a third form of apparatus is shown which, while in many respects similar to the apparatus of FIGURE 1, yet includes certain detail modifications. Those parts which are unchanged are marked with the same reference numerals as used in FIGURE 1 and will not be again described.

The powder reservoir is of different shape although the main part 9*a* of said reservoir (to the right of roller 7 as seen in the drawing) is of generally similar shape to the corresponding part shown in FIGURES 1 and 3. The region (here marked 9*b*) of the powder reservoir to the left of the roller 7 is of tapered form, its depth decreasing progressively away from the roller 7, and in this region 9*b* are provided four baffles 24. The baffles 24 are regularly spaced and are slightly inclined from the vertical so that their lower ends are slightly farther downstream (in terms of the motion of strip 1) than their upper ends. The baffles 24 serve to reduce turbulence which tends to occur in region 9*b* when the strip 1 is moving at speeds of the order of 500 feet per minute as is a typical requirement, such turbulence being apparently a cause of poor printing quality.

With this form of powder reservoir, chamber 15 is omitted and a rotary brush 20*a* (corresponding to brush 20) is mounted below the path of strip 1 immediately downstream of the end of the reservoir. Said brush 20*a* is partially covered by masking members 25, 26 (the member 25 serving also as part of the bottom of the powder reservoir) so that although as before the rotary brush is mounted in a chamber 16*a* (corresponding to chamber 16) connected by port 17 to a suction pump (not shown) the suction is not directly applied to the strip 1 but is only applied via relatively narrow gaps between the brush 20*a* and members 25, 26. The suction accordingly serves to remove excess powder detached from the strip 1 by brush 20*a* (a scraper 20*b* serving to turn to loosen such powder from the brush) and (as atmospheric pressure acts on the upper surface of the strip 1) to maintain the strip 1 in contact with the brush, the strip 1 in this instance not being supported by the roller 5 while subject to the action of the brush. The brush may be placed sufficiently high to cause a slight deflection of the paper strip from the horizontal.

After passing over rotary brush 20*a*, the strip 1 travels a further short distance horizontally before encountering roller 5. As it passes round said roller 5, the strip 1 is only a short distance from a part 27 of the main body or frame of the appartus and in this part 27 there is provided a port 28, connected to a suction pump (not shown); so placed that any excess powder which is remaining in any part of the strip 1 is subjected to the air stream created by the suction through port 28 as that part of the strip 1 is passing round roller 5; at this time any such excess powder is subject to contrifugal force tending to detach it from the strip 1 and the combined effect of the air stream and centrifugal force is of assistance in removing any such excess powder which the rotary brush 20*a* has not swept off.

Above the roller 7 but below the strip 1 there is provided a masking plate 29 having an aperture 30 permitting the passage of powder to the strip over a defined area; the size and shape of aperture 30 depends upon the matter to be printed and plate 29 is therefore arranged to be easily interchangeable. The presence of such a plate has been found to reduce the amount of excess powder reaching the strip 1.

In all three forms of apparatus described, it is found advantageous to cover or coat the working surface of roller 7 with material such as emery cloth providing a small-grained rough surface which ensures that a sufficient quantity of powder is carried by the roller from the reservoir up into the region in which the electric field is applied when required to transfer powder to the strip 1. It will also be noted that that part of the surface of the roller 7 which at any instant is powder-laden passes at the position 32 close to a part 31 of the casing or frame of the apparatus. The spacing at 32 between the roller 7 and part 31 should be kept small as this reduces the excess of powder on roller 7. Although there is a tendency for powder to clog in the small gap at 32, the movement of the roughened surface of the roller 7 offsets this tendency.

Thus it will be seen that apparatus embodying the invention is simple in form and provides a neat and straightforward means of applying any desired marking to paper strip or the like. It will be appreciated that such apparatus may provide for the application of more than one form of powder to the strip 1, as several rollers similar to roller 7 may be placed below the strip 1 between guide rollers 4 and 5, and a more complex switching device 13 may be arranged to energise several corresponding electrodes 10 at such times, relative to the operation of roller 6, that different powders are applied to different portions of the pattern of adhesive applied to the strip 1 by roller 6.

What we claim as our invention and desire to secure by Letters Patent is:

1. Printing apparatus comprising an adhesive applicator, a powder dispenser, and a strip cleaner, and means for feeding a strip of material such as paper past said applicator, dispenser, and cleaner in that order, said applicator being arranged to apply adhesive to the strip in a pattern coresponding to matter to be printed thereon, said cleaner being arranged to remove excess powder from the strip, and said powder dispenser comprising a powder reservoir and means for producing an electric field extending from said reservoir through the path of the strip to impel powder from said reservoir into said path, said field producing means including switching means arranged to operate in synchronism with the adhesive applicator so that the electric field is in existence only when an area of the strip carrying adhesive is in a position to receive powder impelled by the electric field.

2. Apparatus as claimed in claim 1, in which the powder reservoir contains a rotatable transfer roller arranged to pick up powder on its surface and carry the powder to a position adjacent to the strip.

3. Apparatus as claimed in claim 2, in which the transfer roller is a bronze roller with a covering of emery cloth.

4. Apparatus as claimed in claim 2, in which the electric field producing means is arranged to create a potential difference between said transfer roller and an electrode in alignment with said roller but on the other side of the path of the strip.

5. Apparatus as claimed in claim 1, including an apertured masking plate between the powder reservoir and the path of the strip.

6. Apparatus as claimed in claim 1, in which the powder reservoir is provided with internal baffles to reduce turbulence of said powder.

7. Apparatus as claimed in claim 1, in which the strip cleaner includes a chamber having an opening adjacent said strip, a rotary brush in said chamber for engaging the surface of said strip, a suction pump and means connecting said suction pump to said chamber to remove said excess powder.

8. Apparatus as claimed in claim 1, in which said strip cleaner includes means for creating a further electric field of polarity opposite that of said first field through the path of the strip to impel excess powder therefrom.

9. Apparatus as claimed in claim 1 wherein said means for feeding said strip includes means for changing the direction of travel of said strip while being fed past said strip cleaner such that said excess powder is subjected to centrifugal force tending to detach it from the strip and said strip cleaner includes means for generating an air stream adjacent the surface of said strip.

10. Apparatus as claimed in claim 1, in which the strip cleaner includes a rotary brush engaging said strip, a chamber surrounding a part of said rotary brush said chamber including masking means to isolate said strip from said chamber, and means connecting a suction pump to said chamber to remove excess powder from said brush.

11. Printing apparatus comprising an adhesive applicator, a powder dispenser, and a strip cleaner, and means for feeding a strip of material such as paper past said applicator, dispenser, and cleaner in that order, said applicator being arranged to apply adhesive to the strip in a pattern

corresponding to matter to be printed thereon, said powder dispenser comprising a powder reservoir and means for producing an electric field extending from said reservoir through the path of the strip to impel powder from said reservoir into said path, and said cleaner being arranged to remove excess powder from the strip said cleaner including means for creating a further electric field of polarity opposite that of said first field through the path of the strip to impel excess powder therefrom.

12. Printing apparatus comprising an adhesive applicator, a powder dispenser, and a strip cleaner, and means for feeding a strip of material such as paper past said applicator, dispenser, and cleaner in that order, said applicator being arranged to apply adhesive to the strip in a pattern corresponding to matter to be printed thereon, said powder dispenser comprising a powder reservoir and means for producing an electric field extending from said reservoir through the path of the strip to impel powder from said reservoir into said path, and said cleaner including means for generating an air stream adjacent the surface of said strip, said means for feeding said strip including means for changing the direction of travel of said strip while being fed past said strip cleaner such that said excess powder is subjected to centrifugal force tending to detach it from the strip.

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