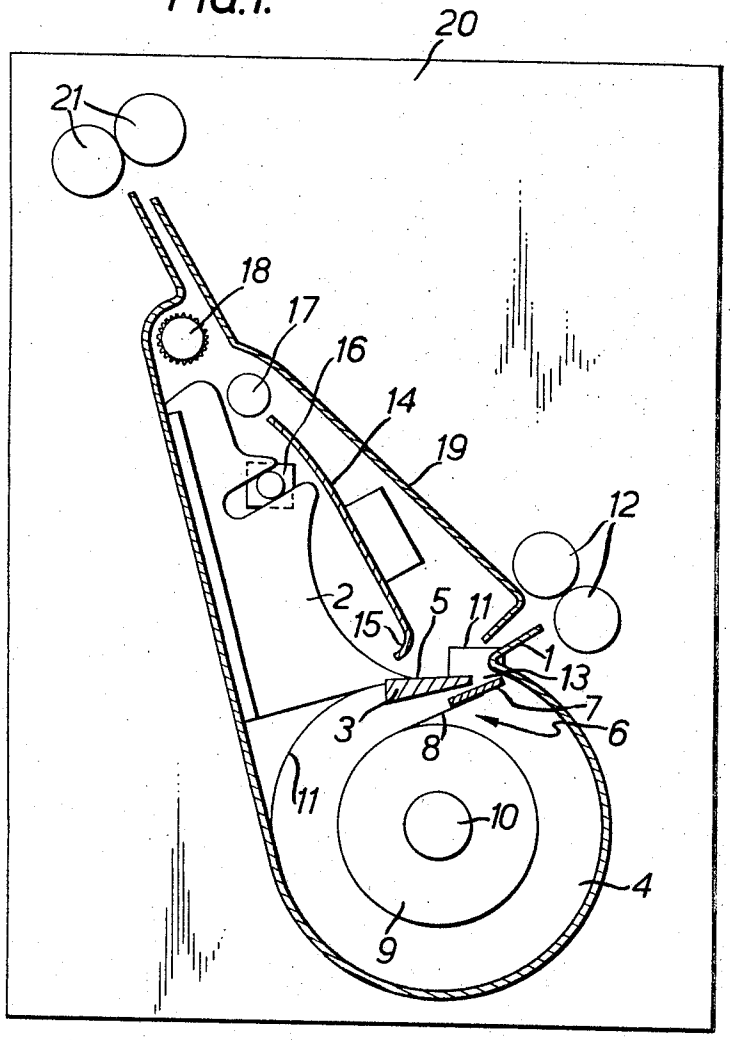
Oct. 24, 1967 P. GILBERT ET AL 3,348,960

POWDER APPLICATION

Filed Feb. 17, 1966 2 Sheets-Sheet 1

FIG.1.



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Filed Feb. 17, 1966 2 Sheets-Sheet 2

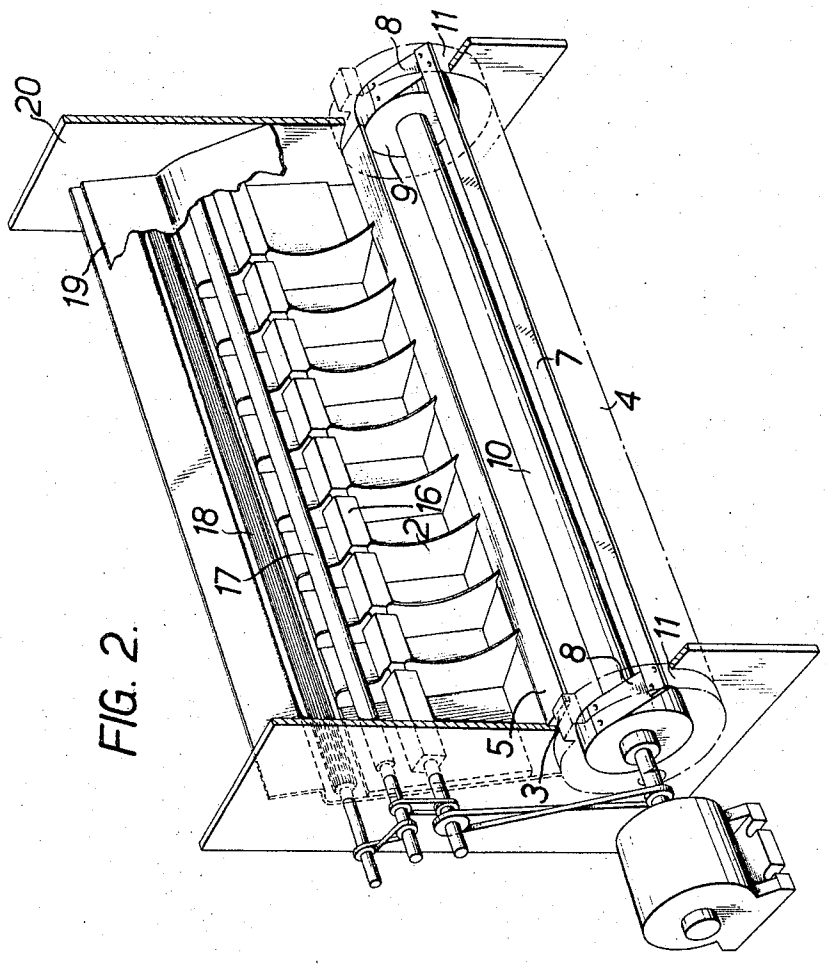

FIG. 2.

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POWDER APPLICATION

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12 Claims. (Cl. 117—17.5)

ABSTRACT OF THE DISCLOSURE

Successive sheets with latent images pass image-upwards in a path determined by guide means over a platform surface piled with powder in the way of sheet movement so that the sheet picks up powder which then spills down over the sheet's upper side. A constant-size pile of powder is provided for each sheet by (a) transferring powder from a reservoir below the platform by a resilient paddle lifting powder to such surface, and (b) using aperturing in such guide means as a powder drain preventing deposition of surplus powder on the surface by the transfer means.

The present invention relates to the application of powder to sheets. For example powder may be applied to a printed sheet while the ink is still wet to produce raised letters in the bronzing process or, in a copying process, powder may be applied to a sheet carrying an electrostatic or condensed oil latent image so as to adhere to and thereby develop the image.

The present invention provides a device for applying powder to a sheet comprising a reservoir for the powder, guide means which define a predetermined path for the sheet, a platform having an upper surface located in said path, and means for transferring a quantity of powder from said reservoir onto said platform surface.

A sheet can then be fed along said path and beneath (and possibly partly through), the quantity of powder on said platform surface; and with such a device the size of platform can be readily chosen to carry the correct quantity of powder for a sheet. This enables the device to handle thin papers since it is not necessary for the sheet to be forced under a large pile of powder. Also the amount of powder in the reservoir has little effect on the quantity transferred to the platform, which allows the device to operate consistently for longer periods without replenishment.

Preferably the reservoir is located below said platform and the guide means is apertured or discontinuous so as to allow any surplus powder to fall back into the reservoir; and preferably said transfer means is arranged to transfer powder onto said platform surface without crossing said predetermined path. The latter feature allows a sheet to be fed along said path and beneath powder on said platform surface at any time after the platform surface has been filled, without introducing synchronisation problems or the risk of damage to the original in the event of the transfer means striking the original.

In a preferred embodiment of the invention in which the reservoir is located below said platform the transfer means comprises a paddle and a rotary driving means which is arranged to move said paddle through powder in said reservoir and thereby to transfer a portion of said powder onto said platform surface. Preferably the paddle is resiliently mounted on said driving means and located so as to allow said paddle to wipe against said platform, thereby allowing powder to pass through the aperturing or discontinuity onto the platform surface.

Preferably means are provided for restraining said paddle against the action of its resilient mounting to follow a predetermined path through said reservoir and for releasing said paddle when adjacent said platform to allow it to wipe against said platform. The restraining means is preferably an almost circular cam track.

Powder can be raised from said reservoir to said platform by arranging said paddle to closely follow the internal surface of the reservoir so that powder will be held between the paddle and said internal surface.

An embodiment of the invention will now be described by way of example with reference to the accompanying diagrammatic drawings in which:

FIG. 1 shows a sectioned side elevation of a device for applying powder to a sheet of paper and

FIG. 2 shows a perspective view of the device shown partly cut away and partly transparent for clarity.

The device comprises guide means **1**, **2**, defining a predetermined path for a sheet, a platform **3** and a reservoir **4**, located beneath the platform and guide means. The platform **3** has an upper surface **5** located in the predetermined path defined by guide means **1**, **2**. A transfer means **6** is located within the reservoir **4** and comprises a paddle **7** and a resilient mounting in the form of a pair of phosphor bronze springs **8** connecting the paddle to a pair of wheels **9** driven by a shaft **10**. A pair of cam tracks **11** located at the ends of the reservoir constrain the paddle **7** to follow a substantially circular path closely following the internal surface of the reservoir except in the vicinity of the platform **3** where it is released to wipe against the platform **3**. The spacing between the paddle and the internal surface of the reservoir will be small enough to prevent any appreciable quantity of powder falling therebetween during rotation but large enough to prevent physical contact and consequent wear.

A pair of rollers **12** is provided for feeding a sheet into the device and the guide means consists of a lead-in guide **1** and a number of vertically upstanding plates **2**, whose edges are shaped to define the predetermined path. The guide means has a discontinuity **13** between the lead-in guide **1** and the platform **3** to allow powder to be transferred onto the platform or fall back therefrom and there are spaces between the plates **2** to allow surplus powder to fall back into the reservoir **4**. It will be noted that the reservoir being situated below and out of the sheet path simplifies replenishment of the reservoir when necessary and that this can be done for example via a closable opening at a convenient point in the reservoir casing.

The feed-out path for the sheet includes a deflector plate **14** to keep a sheet in the correct path and this has a bent over end **15** to control the tail end of the sheet after it has left the nip of the rollers **12**. A beater **16** consisting of a square cross-section shank arranged to be driven in opposition to the direction of feed of the paper is provided to knock surplus powder off the sheet as it passes through, and a guide roller **17** and pinion shaft **18** are provided to control passage of the sheet at this stage. A pair of rollers **21** is arranged to draw the sheet out of the device. It will be appreciated that other arrangements for the feed-out path are possible and the particular arrangement described for determining the feed path can be varied without materially affecting the operation of the device.

The device has a cover **19** and side walls **20** which may be part of some larger apparatus with which the device may be associated. The resulting structure is thus almost fully enclosed, except for the sheet entry and exit points, so that in operation powder disturbed by the paddle **7** or beater **16** will be unlikely to pervade any associated adjacent mechanisms, for example other parts of a copying machine. The cam tracks **11** and bearings for the

shaft 10 are located outside the side walls 20 to reduce the possibility of powder clogging.

In operation the shaft 10 rotates and causes the paddle to pass through powder in the reservoir 4 and thus lift, by co-operation with the internal wall surface of the reservoir, the powder to the platform 3. At the point shown in FIGURE 1 the paddle is released from the restraint of the cam tracks 11 so that, under the action of the springs 8, powder is partly thrown and partly wiped from the paddle on to the platform surface 5. In practice depending on the speed of rotation and the strength of the springs 8 the wiping action generally predominates.

The shaft 10 continues to rotate so that after a few revolutions the platform surface 5 is completely filled with powder and powder starts to fall off the back of the platform between the plates 2 and back into the reservoir 4, thereby maintaining a constant amount of powder on the platform.

A sheet of paper bearing an image on its upper side to which powder will adhere can then be fed into the device via the rollers 12 and will be directed under the dosed pile of powder on the platform surface 5. The sheet will pick up a quantity of powder and as it progresses upwards through the device the powder will fall down the surface of the sheet and eventually back into the reservoir. Powder will adhere to the image on the sheet and the beater will knock any surplus powder off the non-image areas.

In a modification of the device as described, the lead-in guide 1 and an adjacent portion of the casing of the reservoir 4 were flexible, by being of a suitable plastics material, so enabling the lead-in guide to be capable of being forced towards the platform 3 to close the discontinuity 13. (The same effect could be achieved by pivoting or use of a "plastics hinge" at a suitable point on the casing of the reservoir. A solenoid actuated by a microswitch in the copy sheet path caused the discontinuity 13 to be closed when a copy sheet passed through, thereby reducing the likelihood of the paddle 7 forcing powder against the back of the copy sheet, and the discontinuity 13 to be open at other times to allow charging of the platform surface 5.

In an actual example of the device, shaft 10 rotated at 25 r.p.m. thereby providing a dosed quantity, 1.5 grm. of powder on the platform in 2 to 3 revolutions of shaft 10. Foolscap size sheets were driven through the machine at 15 ft./min. and the beater 16 rotated at 1440 r.p.m. in opposition to the direction of feed of paper through the machine.

What is claimed is:

1. In apparatus adapted to supply powder to separate sheets and comprised of guide means definitive of a predetermined feed path for said sheets and disposed on the underside of said path to support sheets fed therethrough, said apparatus having an upward-facing surface on the underside of said path and adapted to hold powder in the way of movement of a sheet in said path, and said sheets being relatively moved in time succession in said path and over said surface to pick up powder on the upper side of each sheet, the improvement comprising, a platform providing such surface, a powder reservoir below said platform and having a substantially greater storage capacity for powder than said surface, means to transfer powder from said reservoir to said surface, said transfer means being a repetitive supplier of new accumulations of powder on said surface so as to form a succession of fresh piles of powder of which each is presented to a respective one of said sheets moving successively in said path and means rendering said guide means apertured so as to allow surplus powder to fall back into said reservoir.

2. The improvement according to claim 1 in which said transfer means is arranged to transfer powder onto said surface without crossing said predetermined path.

3. The improvement according to claim 1 in which the transfer means comprises a transfer member and rotary driving means which is arranged to move said transfer member through powder in said reservoir and thereby to transfer a portion of said powder onto said surface.

4. The improvement according to claim 3 in which said surface is the surface of a platform and said transfer member is resiliently mounted on said driving means and located so as to allow said transfer member to wipe against said platform, thereby allowing powder to pass through the aperturing onto the platform surface.

5. The improvement according to claim 4 comprising means for restraining said transfer member against the action of its resilient mounting to follow a predetermined path through said reservoir and for releasing said transfer member when adjacent said platform to allow it to wipe against said platform.

6. The improvement according to claim 5 in which the restraining means is an almost circular cam track.

7. The improvement according to claim 3 in which said transfer member is arranged to closely follow the internal surface of the reservoir during its movement so that powder will be held between the transfer member and said internal surface in order to be raised from said reservoir to said powder-holding surface.

8. The improvement as in claim 1 in which said surface is disposed along said path between lead-in and feed-out portions of said guide-means, said feed-out portion is shaped to give the corresponding portion of said path an upward slant greater than the slippage angle of powder on such sheets so as to cause powder to spill down over said sheets, and in which at least part of said aperturing is formed in said feed-out portion of said guide means and serves at least in part as a drain to said reservoir for said spilled down powder.

9. The improvement as in claim 2 in which said surface is disposed along said path between lead-in and feed-out portions of said guide-means, said improvement further comprising means forming between said lead-in portion and said surface a discontinuity providing a passage by way of which powder is transferred by said transfer means from said reservoir to said surface.

10. The improvement as in claim 9 in which said transfer means conveys powder to said surface by moving in a vertical plane containing such discontinuity.

11. In apparatus adapted to apply powder to separate sheets and comprised of guide means definitive of a predetermined path for said sheets and disposed on the underside of said path to support sheets fed therethrough, said apparatus having an upward-facing surface which is disposed along said path on the underside thereof between lead-in and feed-out portions of said guide means, and which is adapted to hold powder in the way of movement of a sheet in said path, and said sheets being relatively moved in time succession in said path and over said surface to pick up powder on the upper side of each sheet, and said feed-out portion of said guide means being shaped to give the corresponding portion of said path an upward slant greater than the slippage angle of powder on said sheets so as to cause powder to spill down over said sheets, the improvement comprising a powder reservoir disposed below said surface, aperture means formed in said feed-out portion of said guide means and serving as a drain into said reservoir for said spilled down powder and for surplus powder deposited on said surface, means providing a discontinuity between said surface and said lead-in portion of said guide means, and means to transfer powder from said reservoir by way of said discontinuity to said surface.

12. In a method for applying powder to a succession of separate sheets having latent images thereon in which each of said sheets is moved with its latent image upwards relative to and over an upward facing powder support surface having thereon a pile of powder disposed in the way of such movement so as to cause

powder from such pile to be picked up in the course of such movement by the upper side of the leading edge of such sheet, and in which powder on said sheet is then caused to spill down over the remainder of the upper side of said sheet by advancing said sheet upwardly at a slant greater than the slippage angle of said powder on said sheet, the improvement comprising, transferring powder from externally of said surface to said surface to effect repetitive new accumulations of powder thereon so as to form a fresh pile of powder on said surface before each movement of one of said successive sheets over said surface, and draining away surplus powder deposited on said surface in the course of forming each such fresh pile so as to maintain substantially constant in size the piles of powder which are successively and respectively presented by said surface to said succession of sheets.

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