My invention relates more particularly to machines for spreading powder upon wet printed matter so that the printed characters become raised above the plane of the paper thereby simulating engraved printing so closely as to make the product substantially indistinguishable from such work using steel dies or copper plates. Such process embossing or engraving as herein referred to requires that the powder be applied to the print while the first impression is still wet so that such powder will adhere to the printed design. The superfusible powder is then brushed, shaken or blown off, after which the powder-covered print is heated to a temperature sufficient to fuse or dissolve the powder material and then the print is allowed to cool to complete the process embossed product.

The objects of my invention are, among other things, to provide a new and improved machine for applying the film of powder to the wet printed matter in motion; for removing the surplus powder effectually from the printed matter during its forward travel with the collection of such surplus powder, followed by the return of same to the source of supply for immediate re-use without handling; and for sifting or otherwise segregating the powder in the receiving hopper so that minute particles of substantially uniform fineness may be distributed therefrom over the surface of the wet printed matter, thereby avoiding the spreading of any lumpy powder or powder of different degrees of fineness that might mar the final product.

My improvements also comprehend a novel construction of the carrier for the printed matter with novel means for removing the superfusible powder as such matter is being advanced through the machine, and also of other details of operation and apparatus, all of which will be hereinafter fully described and then particularly pointed out in the claims.

In the annexed drawings, Fig. 1 is a side elevation of a preferred construction embodying my improvements;

Fig. 2 is a top plan view taken on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged detail view on the line 3—3 of Fig. 2;

Fig. 4 is an enlarged vertical section on the line 4—4 of Fig. 2;

Fig. 5 is an enlarged vertical section on the line 5—5 of Fig. 2;

Fig. 6 is a perspective view of the valve carriers shown in Fig. 4;

Fig. 7 is an enlarged section taken on the line 7—7 of Fig. 1;

Fig. 8 is a side elevation, partly in section, of the hopper for holding the powder with its pipe connections;

Fig. 9 is a sectional view on the line 9—9 of Fig. 8; and

Fig. 10 is a diagrammatic view of the air and suction connections between the hopper and powder collecting and supply receptacle.

Similar numerals refer to similar parts throughout the several figures.

Referring more particularly to Figs. 1 and 2, the side-frames 11 and 12 are suitably mounted on the base 13 and carry the transverse rollers 14 and 15 around which passes the feed-belt carrier 16, preferably of wire-mesh, moving in the direction of the arrow (Fig. 1). The shaft 17 of the roller 15 carries the sprocket 18 which is driven by the chain 19 from the sprocket 20 fast to the stub shaft 21 journaled in the side-frame 11. The shaft 21 also carries the outer sprocket 22 around which passes the chain 23 which is driven from the sprocket 24 mounted on the shaft 25 journaled in the side-frame 11 at the forward end of the machine (left end in Figs. 1 and 2).

The shaft 25 has keyed thereto the pulley 26 driven in an anti-clockwise direction (Fig. 1) by the belt 27 which passes around the pulley 28 mounted on the shaft 29 which shaft also has keyed to it the pulley 30 driven by the belt 31 from any suitable source of power, such as the electric motor 32.

The lower run of the chain 23 passes to the right in Fig. 1 over the idler sprocket 33 and tension roller 34 on the arm 35 to the sprocket 36 fast on the hollow shaft 37 (Fig. 4) journaled in the side frames 11 and 12. This hollow shaft 37 is one of a series of similar hollow shafts 38 and 39 (three be-
ing shown in the present embodiment) which are arranged in an upwardly-inclined position (Figs. 1 and 4) to comprise part of the mechanism for removing the surplus powder from the wet printed matter. Each of these shafts 37, 38 and 39 is of similar construction and have the radially extended nozzles 40 (four such nozzles in spaced-apart pairs being shown in the present embodiment in Figs. 2 and 4).

These nozzles 40 extend slightly above the plane of the wire-mesh belt carriers 41, 42 and 43 arranged in alignment (Fig. 1) which pass around the hollow shaft 37 over the shaft 38 and around the shaft 39, and then have a forward run to the left end of the machine (Fig. 1) around the roller 44 mounted on the cross-shaft 45 journalled in the side-frames 11 and 12. The shaft 45 carries the sprocket 46 which engages the drive chain 28 to actuate the belt carriers 41, 42 and 43 in unison in the direction of the arrows shown in Fig. 1.

Telescopically within the hollow shafts 37, 38 and 39 are the pipe valves 47, 48 and 49 respectively having longitudinal slots 50 cut therein (Figs. 4 and 6) to coact with the nozzles 40 as shown in Fig. 4, as the latter are rotated in proximity to the belt carriers 41, 42 and 43, the solid walls of the pipes 47, 48 and 49 effectually sealing the other nozzles 40 (Fig. 4). The pipe valves 47, 48 and 49 are extended to connect with the cross-pipe 50, connected to the tapered chamber 51 in which a suitable suction is created by mechanism hereinafto to be described. The relative positions of the pipe valves 47, 48 and 49 within their respective hollow shafts 37, 38 and 39 may be shifted to control the duration of the suction on the particular set of nozzles 40 projecting between the belt carriers 41, 42 and 43 to accommodate for stock of different lengths.

The hollow shafts 38 and 39 are driven in unison with the shaft 37, the shaft 39 by the chain 23 which passes around the idler sprocket 55 and then around the sprocket 53 on the shaft 39, while the shaft 38 is driven by the short chain 54 which passes around the sprocket 55 on the shaft 38, the idler sprocket 56 and the driving sprocket 57 on the shaft 39, the chain 54 moving in the direction of the arrows shown in Fig. 1.

Refferring to Figs. 1-4, I have arranged a blower roll 58 extending across the top of the machine between the side-frames 11 and 12 (Fig. 2), which comprises the rotatable tubular shaft 59 having the outer end disks 60 and 61 adjacent the side frames 11 and 12 respectively and the center disk 62. Fastened to the end disks 60 and 61 outside the periphery of the shaft 59 are a series of mutually parallel rods 63 (Fig. 3) to form the outer cylindrical surface of the blower roll 58. One end of the shaft 59 is connected to the air-blast pipe 64 (Fig. 1), and the shaft 59 is formed with a longitudinal slot 65 to permit the air blast to pass between the rods 63 not only to blow off surplus powder from the sheet 66, but also to bend down the leading margin of the sheet on belt-carriers 41, 42 and 43 (Fig. 4).

The tubular shaft 59 is driven by the sprocket 67 around which passes the short chain 68 which is actuated by the sprocket 69 keyed to the cross-shaft 70 journalled in the side-frames 11 and 12. The shaft 70 is driven by the sprocket 71 which engages the upper run of the drive chain 23 (Fig. 1), and the chain 68 also passes over the tension roller 72 and is actuated in the direction of the arrow shown in Fig. 1. The shaft 70 also carries the roller 73 over which the belt carriers 41, 42 and 43 travel on their lower rearward run.

Refferring to Figs. 1, 2, 5, 8 and 9, the double-walled powder hopper 74 is preferably formed in the shape of an inverted cone with the cover 75 and sloping side walls 76 and 77 providing the annular space 78 between the side walls 76 and 77. The hopper 74 is mounted on the rectangular chamber-box 79 fastened to the side-frames 11 and 12, and the hopper 74 has the outlet opening 80 arranged at the top of the chamber-box 79 which outlet 80 is closed and opened by the pivoted door 81 (Fig. 5).

The bottom of the chamber-box 79 is also opened and closed by the pivoted door 82 (Figs. 1 and 5). Within the hopper 74 is the conical distributor 83 having the legs 84 (Figs. 8 and 9) for supporting the distributor 83 by resting against the inner side-wall 76, thereby permitting the powder P to pass over the rim 85 between the legs 84 and collect around the outlet opening 80 as shown in Fig. 5.

The doors 81 and 82 are operated in unison by the following mechanism: The door 81 is mounted on the rock-shaft 86, see Fig. 1, and the door 82 is mounted on the rock-shaft 87, these shafts being journalled in the side-frames 11 and 12 and also in the box 79 (Figs. 1, 2 and 5). The outer ends of the shafts 86 and 87 (adjacent the side-frame 11) carry the rock-arms 88 and 89 respectively to which are pinned the cam-rollers 90 and 91 which ride on the cam 92 by the tension of the springs 93 and 94 bearing on the rock-arms 88 and 89 (Fig. 1). The cam 92 is keyed to the stub-shaft 93 which is driven by the pinion 96 fast to the shaft 95, the pinion 96 engaging with the drive gear 97 fast to the stub-shaft 98, the shafts 95 and 98 both being journalled in the side-frame 11. Inside the gear 97 on the shaft 95 (Fig. 2) is mounted the drive sprocket 99 which is driven by the chain 19 as shown in Figs. 1 and 2.

Below the chamber-box 79 is fitted the rectangular powder spreader 100 having the 130
Front end 101 and rear end 102, and sides 103 and also the sloping bottom 104 having the perforated screen 105 projecting therefrom to screen and spread the powder P upon the sheet 66 on the carrier 16 as shown in Fig. 5. The spreader 100 is arranged to have a compound shaking movement up and down as well as laterally of the machine in order that the powder may be distributed evenly along the bottom 104 and screen 105 before such powder is spread uniformly over the surface of the wet printed matter, such as the sheet 66.

The lateral or transverse movement of the spreader 100 is attained by the following mechanism: At each lower forward corner of the spreader 100, see Fig. 2, are the brackets 106 carrying the cam-rollers 107, which engage the cams 108 fast to the cam-shaft 109 adjacent the side-frames 11 and 12 (Fig. 2). The cam-shaft 109 is rotated by the pinion 110 fastened to the shaft 109, and the pinion 110 is driven by the gear 97 as shown in Figs. 1 and 2. The rear end 102 carries the brackets 111 each having the projecting bars 112 which ride on the rollers 113 fast to the side-frames 11 and 12 during the transverse movements of the spreader 100. The springs 114 between the brackets 111 and the side-frames 11 and 12 (Figs. 1 and 2) tend to hold the bars 112 on the rollers 113 during the up and down movement of the spreader 100 which I will now describe.

Fastened to the front end 101 are a pair of bracket-arms 115 having the pivoted rollers 116 to engage with the notched wheel 117 (Figs. 2 and 5) mounted on the cam-shaft 109. As the rollers 116 successively engage the notched wheel 117, the spreader 100 is given a quick up and down movement which acts to evenly distribute the powder P along the sloping bottom 104 and screen 105.

Suitably fastened to the side-frames 11 and 19 is the surplus powder collecting receptacle 118 (Figs. 1 and 9) having the sloping bottom members 119 and 120 which extend below the belt-carrier 16 and the hollow feedshafts 37, 38 and 39 (Fig. 1) by which all surplus powder not adhering to the wet printed matter on the sheets 66 is collected in the receptacle 118 and falls into the outlet pipe 121 which is sealed by the cap 122 (Fig. 7).

The surplus powder is partially removed from the successive sheets 66 as they pass from the belt carrier 16 to the carriers 41, 42 and 43 passing over the nozzle shafts 37, 38 and 39 and below the tubular shaft 59 by a combined suction and air-blast mechanism that will now be set forth in detail. As shown in Figs. 1 and 2, the rotary fan 123 is mounted on the cross-bar 124 carried by the side-frames 11 and 12, the fan 123 being driven by the motor 125. Air is drawn into the fan 123 through the main feed pipe 126 which is connected to the tapered chamber 51 joined to the cross-pipe 50a whereby suction or exhaust pressure is created in the hollow shafts 37, 38 and 39 and also the nozzles 40 projecting through the belt carriers 41, 42 and 43 as has hereinbefore been described. The outlet pipe 127 from the fan 123 causes an air-blast which is carried to the chamber 128 and a portion of the air-blast is carried by the pipe 64 to the tubular shaft 59 to bend the leading margin of the sheet 66 to the belt carriers 41, 42 and 43 (Fig. 4) as well as blow off surplus powder as has been described. The main body of the air blast passes down the pipe 130 to the pressure-release bag 131 and thence through the tapered nozzle pipe 132 which is fastened within the outlet pipe 121 (Figs. 7 and 10) and delivers its air-blast through the spout 132a projecting concentrically within the larger port outlet 133, integral with the pipe 121, to which is fitted the hose 134 connected with the vertical pipe 135 having an inlet 136 leading to the annular space 78 in the hopper 74 beneath the cover 75. By this device the surplus powder from the receptacle 118 is carried with the air-blast through the hose 134 to the hopper inlet 136.

As shown in Fig. 9, the air blast from the air-inlet 136 carrying the surplus powder from the receptacle 118 is caused to travel in a circuitous path delivering some of the powder through the flaring outlet 137 (Figs. 8 and 9) formed in the top of the hopper 74 beneath the cover 75. Centrifugal force tends to keep the major portion of the surplus powder within the annular space 78 and such powder drops to the bottom of the hopper 74. The air blast purged from the powder which falls into the annular space 78 as well as into the main portion of the hopper due to the swirling or “cyclonic” movement of the air as indicated by the arrows in Fig. 9, passes out of the hopper 74 through the radially disposed outlet pipe 138 and thence through the right-angled pipe 139 to main feed-pipe 136 (Fig. 1). The arrows in these air-blast and suction connections in Figs. 1, 2, 4, 7–10 show the direction of the air currents creating the suction and air-blast as required for the proper operation of my machine.

The structure and operation of the air-blast and suction connections within the hopper 74 more particularly as shown in Figs. 8, 9 and 10 afford an automatic and highly efficient mechanism of lifting the powder within the hopper 74 and surrounding annular space 78, so that particles of substantially uniform fineness will be segregated and sifted, and then be collected on the upper door 81 (Fig. 5) preparatory to being periodically delivered to the vibrating spreader 100 as hereinbefore described. By this mechanism I may sift and grade powders of varying degrees of fineness so that a predetermined
The quantity of a uniform fineness may be automatically delivered from the feeding hopper 74 or any other suitable receptacle into which the powder in bulk form may be poured through the cover 75. Also such structure enables one to take any quantity of dust-laden air which is then passed through the hopper 74 in the manner just described and thereby remove therefrom the dust or powder which is collected in the hopper 74 while the air as purified is carried out through the pipe 139.

The operation of my machine is substantially as follows: The powder P is placed in the hopper 74 with the cover 75 clamped on the top of the hopper and the machine is started so that the powder may be segregated and passed into the spreader 100 and distributed over the bottom 104 and screen 105 of the vibrating spreader 100 as shown in Fig. 5. The apparatus is preferably lined up with a printing-press so that the pressman may feed the wet printed sheets 66 directly on the mesh belt carrier 16 which carries such sheets, one by one, beneath the screen 105 (Fig. 5), whereby the top surface of the sheet 66 is lightly covered with an even film of powder. At the end of the top run of the carrier 16, the sheet 66 is seized by the pair of suction nozzles 40 of the shaft 37 projecting through the mesh carriers 41, 42 and 43 as the latter pass around the revolving shaft 37, which nozzles forward the sheet up the inclined path over the nozzles 40 of the shafts 38 and 39, the suction in the series of nozzles 40 holding the sheet 66 in proximity to the carriers, but the nozzles themselves successively tap or strike the under surface of the sheet 66 during the rotation of the shafts 37, 38 and 39 (Fig. 4), thereby causing the major portion of the surplus powder that does not adhere to the printed matter to be shaken from the sheet 66 and slide backwardly into the sloping bottom 120 of the collecting receptacle 118. As the sheet 66 reaches its Fig. 4 position, its leading margin is bent down by the air-blast from the shaft 59 toward the mesh-carriers 41, 42 and 43 which advance the sheet from the zone of the suction nozzles 40, and at the same time the remaining portion of the surplus powder is blown off the sheet 66 by such air-blast.

The sheet 66 then passes forwardly from the air-blast shaft 59 on the carriers 41, 42, 43 until it reaches the forward end of the machine (left end in Figs. 1 and 2), when the sheet is passed onto a carrier (not shown) running into and through a baking oven where the powder is fused with the ink, and the finished embossed product then emerges from the oven and is cooled in the regular way. The operation of the suction and air-blast in conjunction with the collecting receptacle 118 and hopper 74 with the segregation of the surplus powder in the bottom of the hopper 74 and the return of the purified air to the fan 123 through the pipe 139 has heretofore been set forth. The path of the successive sheets 66 through the machine is shown in Fig. 1.

Various changes in the construction and arrangement of the several parts shown and described may be made without departing from the scope of my invention or sacrificing its advantages in operation. I claim as my invention:

1. In a machine of the class described, means for applying powder to wet printed matter, and a conveyor having means to grip and advance said printed matter, said gripping means also successively tapping said printed matter during its forward travel to shake surplus powder therefrom.

2. In a machine of the class described, means for applying powder to wet printed matter, a carrier to advance said printed matter from said powder-applying means, and a rotary suction shaft having suction nozzles radially-extending through said carrier and nozzles being adapted to grip and intermittently vibrate said printed matter during its forward travel to shake powder therefrom.

3. In a machine of the class described, means for applying powder to wet printed matter, a carrier to advance said printed matter from said powder-applying means, and a series of rotary suction shafts each having radially-extending suction nozzles projecting through the plane of said carrier, said nozzles being adapted to grip and vibrate said printed matter during its forward travel to shake powder therefrom.

4. In a machine of the class described, means for applying powder to wet printed matter, a carrier to advance said printed matter from said powder-applying means, and a series of rotary suction shafts in transverse alignment with the forward travel of said printed matter having suction nozzles projecting through the plane of said carrier, said nozzles being adapted to grip and vibrate said printed matter during its forward travel to shake powder therefrom.

5. In a machine of the class described, means for applying powder to wet printed matter, a combined carrier and suction conveyor to advance said printed matter, said conveyor having means to vibrate said printed matter to shake surplus powder therefrom, and an air-blast means for simultaneously blowing surplus powder from said printed matter and bending the latter to the carrier as said printed matter is advanced from said conveyor.

6. In a machine of the class described, means for applying powder to wet printed matter, a combined carrier and suction conveyor to advance said printed matter, said conveyor having means to vibrate said printed matter to shake surplus powder.
therefrom, and an air-blast means downwardly inclined against the travel of said printed matter for simultaneously blowing surplus powder from said printed matter and bending the latter to the carrier as said printed matter is advanced from said conveyor.

7. In a machine of the class described, a sheet conveyor, means for powdering the sheet in motion, and an air-blast means including spaced-apart rods between which the air blast intermittently passes for blowing surplus powder from the sheet together with separate means for holding same on the conveyor.

8. In a machine of the class described, a sheet conveyor, means for powdering the sheet in motion, and an air-blast means including spaced-apart rods between which the air blast intermittently passes to impinge intermittently and obliquely on the sheet counter to its travel for blowing surplus powder from the sheet while bending its leading margin to the conveyor, together with separate means for holding same on the conveyor.

9. In a powder-distributing machine, a powder supply hopper, means for applying powder from the hopper to wet printed matter, a conveyor having means to grip, advance and vibrate said printed matter during its forward travel to shake surplus powder therefrom, means for removing and collecting surplus powder from said printed matter, compressed air means for returning the surplus powder to the hopper and separating within the hopper the surplus powder from the air blast, and means for returning the purified air to the compressed air supply.

10. In a powder-distributing machine, a cylindrical double-walled powder supply hopper forming concentric compartments, means for introducing commingled air powder under pressure to the outer compartment of the hopper, and means for creating circuitous air currents within the hopper to separate the powder from the air between the said compartments by centrifugal force, and means for returning the purified air to the compressed air supply.

11. In a powder-distributing machine, a cylindrical double-walled powder supply hopper forming concentric compartments, means for introducing commingled air and powder under pressure to the outer compartment of the hopper, means for creating circuitous air currents within the hopper to separate the powder from the air between the said compartments by centrifugal force, and an outlet centrally disposed in the hopper for conveying the purified air to the compressed air supply after the powder has been separated therefrom.

12. In a powder-distributing machine, a powder supply hopper, a spreader for applying powder to wet printed matter, means for intermittently feeding powder from said hopper to said spreader, and means for simultaneously reciprocating said spreader both vertically and laterally with respect to said printed matter.

13. In a machine of the class described, means for powdering a sheet and a suction conveyor for advancing and shaking the surplus powder from the sheet comprising a rotary suction shaft having radially-projecting suction nozzles to intermittently grip, advance, and successively tap the under surface of the sheet.

14. In a machine of the class described, means for powdering a sheet and a suction conveyor for advancing and shaking the surplus powder from the sheet comprising a series of transversely aligned rotary suction shafts, each having radially-projecting suction nozzles to intermittently grip, advance, and successively tap the under surface of the sheet during its forward travel.

15. In a machine of the class described, means for powdering a sheet and a suction conveyor for advancing and shaking the surplus powder from the sheet comprising a rotary suction shaft having a plurality of radially projecting suction nozzles to intermittently successively grip, advance, and successively tap the under surface of the sheet.

16. In a machine of the class described, means for applying powder to wet printed matter during its travel through the machine, and an air blast means including spaced-apart rods between which the air blast intermittently passes and impinges on said moving printed matter counter to its direction of travel to blow surplus powder therefrom.

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