Jan. 9, 1945. R. L. MELTON 2,366,926

COATING AND TREATING MATERIAL

Filed Jan. 5, 1942 3 Sheets-Sheet 1

Fig. 1.

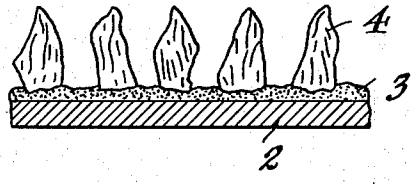


Fig. 2.

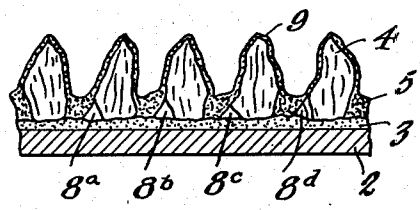


Fig. 3.

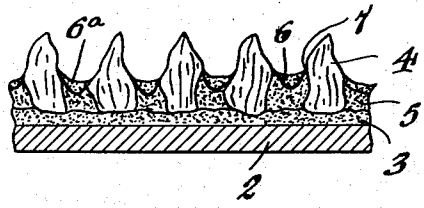
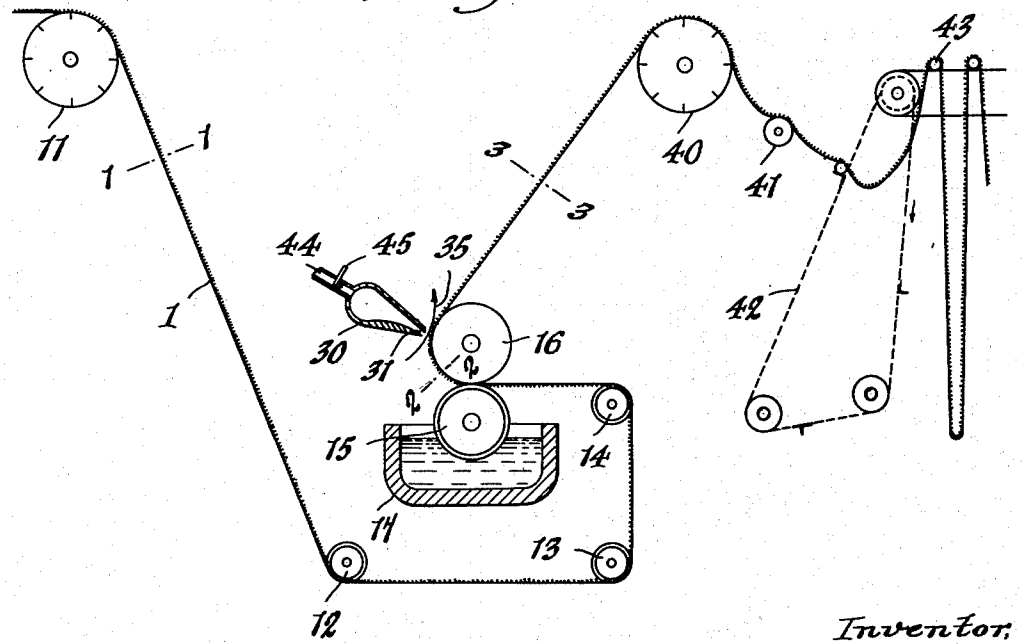


Fig. 4.



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Fig. 5.

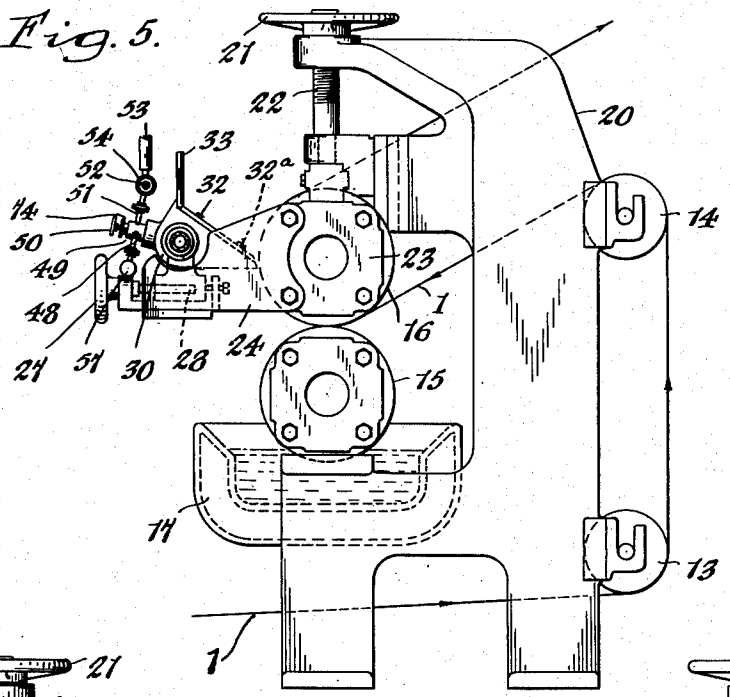
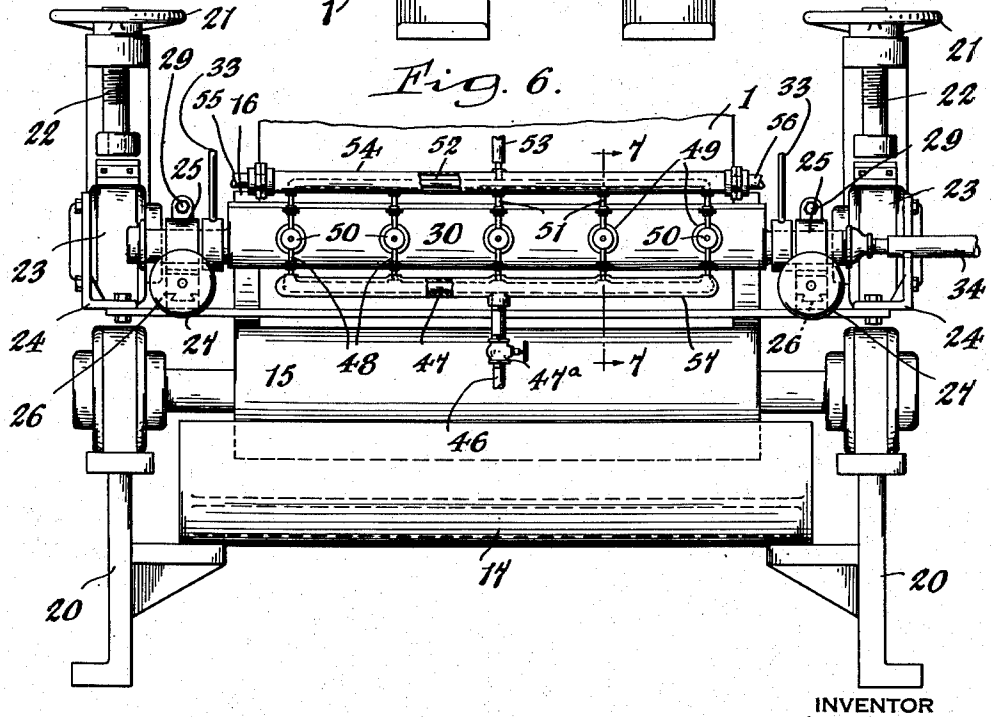


Fig. 6.



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COATING AND TREATING MATERIAL

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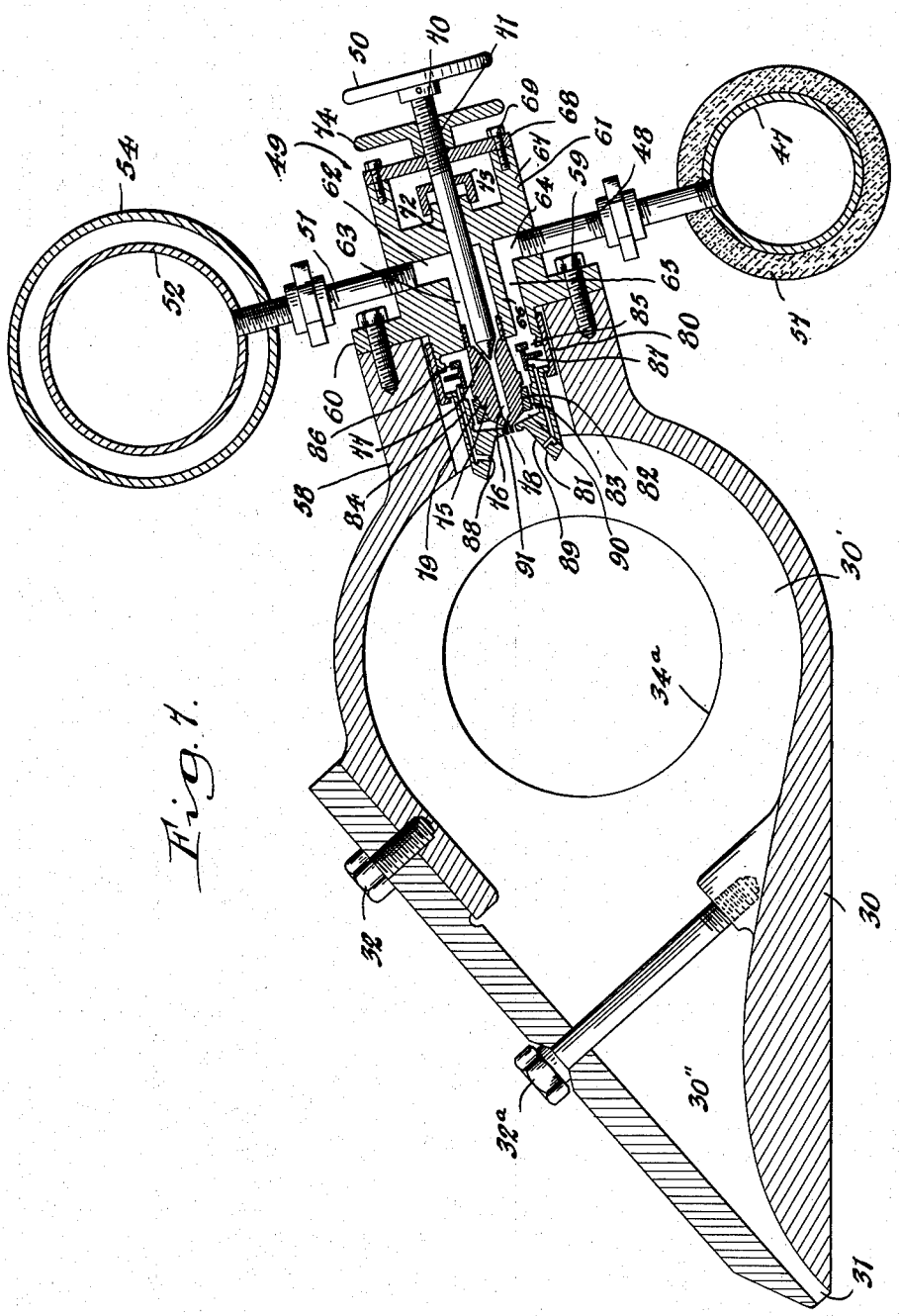


Fig. 1.

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Patented Jan. 9, 1945

2,366,926

UNITED STATES PATENT OFFICE

2,366,926

COATING AND TREATING MATERIAL

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Application January 5, 1942, Serial No. 425,621

2 Claims. (Cl. 91—45)

This invention relates to the manufacture of coated webs of such material as paper, cloth, and the like, particularly those having a granular coating thereon.

The object of the invention is to provide improved apparatus for applying adhesive coatings to webs and for subsequently treating them by the use of a high-velocity gas jet impinging on the coated surface. This and other objects will become apparent in the following disclosure.

The present invention provides, in one embodiment thereof, an apparatus by which an abrasive coated web, formed by coating a moving web with a coating of adhesive and applying a layer of abrasive grains to the adhesively coated sheet, has applied thereto a sizing layer of adhesive over the layer of abrasive grains, as by use of a roll applicator, and subjecting the thus coated web to the action of a jet of gas, extending across the full width of the web, said gas containing adhesive in atomized or finely divided form. The gas jet clears the size coating from abrasive granule tips and drives the size coating down into the valleys between grains, and the adhesive carried by the gas reinforces said sizing coat between grains. The adhesive carried by the gas jet may be altogether different from the sizing coat. If desired, it may be a waterproof adhesive or it may be a waterproofing solution for the sizing coat.

The invention will be better understood by reference to the accompanying drawings, in which:

Figure 1 is an enlarged cross-section of the web taken on the line 1—1 in Figure 4;

Figure 2 is a similar view taken on the line 2—2 in Figure 4;

Figure 3 is a similar view taken on the line 3—3 in Figure 4;

Figure 4 is a schematic view of apparatus for size coating abrasive coated webs, with means for clearing the abrasive granule tips and for applying an additional layer of adhesive;

Figure 5 is a detailed side elevation of the adhesive applying mechanism shown diagrammatically in Figure 4;

Figure 6 is a front view of the apparatus shown in Figure 5; and

Figure 7 is a detailed cross section of the air jet and spray device taken on the line 7—7 in Figure 6.

Figure 1 illustrates a fragment of an abrasive coated web material 2 prior to application of the sizing or reinforcing layer of adhesive. The backing 2 may be of any of the usual flexible materials such as paper, cloth, vulcanized fiber, or a combination of these or other suitable materials. Adhesive 3 may be a glue, varnish, silicate, or synthetic resin. The particles of abrasive grain 4 are shown in oriented or upstanding position with respect to the backing, and are so deposited onto the adhesive base coating 3 by suitable means not shown in the present application. As shown in Figure 1, only the bottoms of the granules 4 are in contact with the base layer of adhesive 3. This gives a very limited and insufficient support to the abrasive granules to maintain them against lateral pressure and grinding stresses when the coated web is used as an abradant. It is necessary, therefore, to apply additional adhesive around the bases of the abrasive granules 4 so as to anchor them more firmly to the base coating and web backing material 2.

Figure 2 shows a granular coated web produced by the usual process, in which a blanket of adhesive 5 was applied over the granular coated surface and permitted to flow down between the grains of its own accord. The tips of the granular particles 4 are covered with a film of adhesive indicated by the reference 9. This film of adhesive is very detrimental when the coated material is used for abrasive purposes, since the tips of the grains are capped with the adhesive. Furthermore, voids 8*a*, 8*b*, 8*c*, 8*d* are apt to be formed under any overhanging parts of the granules, thus producing a weak bond.

Figure 3 illustrates a fragment of an abrasive coated web made in accordance with one modification of the invention. This product has the sizing coat 5 driven down into the valleys between granules, the tips of the granules cleared of adhesive, and an additional coating 6*a* of a suitable material, which may be additional adhesive of such character as to strengthen or waterproof the sizing coat 5.

The procedure in manufacturing granular coated webs of the character shown in Figure 3 will now be described.

The previously coated abrasive material, such as that illustrated by Figure 1, is moved from suitable drying racks (not shown) by means of the suction drum 11, Figure 4, passed around the rubber covered idler rolls 12, 13, and 14, and between the adhesive roll 15 and cooperating pressure roll 16. The rubber-covered adhesive roll 15 is partially immersed and revolves in the liquid adhesive contained in the pan 17 so that a layer of sizing adhesive is applied to the abrasive side of the coated web. The pressure

roll 16 is adjustably supported above the adhesive roll and provided with adjusting means (see Figure 5), whereby the spacing between the rolls may be varied and thereby regulate the quantity or thickness of the layer of adhesive applied to the abrasive side of the coated web.

After passing between the adhesive applying rolls 15 and 16, the coated web is moved past a jet of high velocity gas with entrained adhesive in atomized or finely divided form issuing from the adjustable orifice 31 at the rear of the gas jet or "air knife" generally indicated by the reference numeral 30. The device 30 is provided at one side with a gas inlet 44 and a nozzle means 45 for projecting finely divided liquid adhesive into the incoming stream of gas from inlet 44. The resulting jet of high velocity gas with entrained finely divided droplets of adhesive from orifice 31 serves to drive the freshly applied layer of adhesive 5 from the tips of the abrasive grains and to cause it to flow down and around the bases of the grains. At the same time the entrained adhesive or other substance is deposited on the sizing coat to form an additional layer indicated at 6*a*. Because of the velocity with which this adhesive is projected, it does not adhere to the granule tips. Furthermore, because of the flowing of the sizing coat 5 under the action of the air jet, the line of demarcation 6 between coats 6*a* and 5 is not sharp, since the additional adhesive is driven into and mixed with the sizing coat for a considerable depth at the interface between layers 6*a* and 5. For that reason, adherence between layers 5 and 6*a* is very good and, since it is keyed into layer 5 in such manner, it seals the top of the sizing coat on the abrasive product effectively from the atmosphere.

The coated web then passes over the suction drum 40 and idler roll 41 to a suitable drying rack, where it is formed in loops by the festooning device 42 and hung on the supporting bars 43 in a drying or curing chamber to set the adhesive fully. After drying or curing, the coated web is taken down from the rack and cut into pieces of various sizes.

In the air jet device schematically shown in Figure 4, the material introduced into the "air knife" may, as an alternative to a liquid, be an adhesive in the form of a finely divided powder, and may be forced through the nozzle means 45. The pressure on the finely divided material at the nozzle or opening, plus the temperature of the incoming gas stream and the action of a solvent carried by the gas stream "melt" the powder to a liquid form.

The "air knife" and its incorporated material spraying means shown schematically in Figure 4, and the specific embodiment shown in Figures 5, 6, and 7 and subsequently to be described, may be used to carry out various processes other than that above described in applying and conditioning adhesive coatings on various materials.

As one example, the web backing material for a flexible abrasive may be coated in a conventional manner with a heavy viscous adhesive layer such as heavy glue, silicate, resin, etc. The coated material is then passed, while suitably supported, under an air knife having an incorporated spray means. The additional adhesive may be of glue, of less viscosity than the first layer of adhesive. The air jet from the air knife smooths and levels the first layer of adhesive and drives against it the second adhesive, which is likewise leveled on top of the first, and modifies and conditions the first layer for optimum reception and retention of abrasive granules to be applied.

As another example, a base or making layer of adhesive is applied in a conventional manner to a web backing, a layer of abrasive granules is deposited thereon, and such coated web is then passed, while suitably supported, under an "air knife" having an incorporated spraying means. In this instance the spraying means is supplied with an adhesive suitable for use as a sizing coat on the abrasive coated sheet and which softens the top of the first applied adhesive layer as it contacts it in the valleys between abrasive granules. Because of the velocity with which the second adhesive is projected, it does not adhere to the abrasive granule tips, but is driven between them, thus insuring a strong lateral support for the granules in the finished product.

Referring now to Figures 5, 6, and 7, the construction and operation of one embodiment of the "air knife" with incorporated spray means will be described in detail. The adhesive pan 17 is supported by a suitable frame 20, which also supports the adhesive roll 15 in such manner that said roll revolves in a liquid adhesive and applies a film or layer of said adhesive to the coated web 1. The pressure roll 16 is also journaled on the frame 20 and adapted to be adjusted vertically by means of the handwheel 21 and screw-threaded shaft 22. Such vertical adjustment of the pressure roll 16 varies the spacing between the coated web 1 and the adhesive roll 15 and thereby regulates the thickness of the layer of adhesive applied to the moving web. With a wide spacing between the rolls, a thick layer of adhesive will be applied, and with a close spacing, a relatively thin film of adhesive will be applied.

The "air knife" 30 with its incorporated spray means is mounted on the bearing 23 by a suitable bracket 24 and moves up or down with any vertical adjustment of the pressure roll 16. Thus the adjustment of the "air knife" with respect to the surface of the coated web remains constant regardless of any vertical adjustment of the roll 16. However, the jet is adjustable with respect to the roll 16 and web 1 and means are provided for both angular and horizontal movement of the "air knife." Cradle supports 25 are suitably mounted in gibs 26 secured to the bracket 24 and adapted to be moved horizontally by means of the small handwheel 27 and screw-threaded shaft 28 which are journaled on the bracket 24 and engage a threaded portion of the base of the said cradle 25. By loosening the clamping bolt 29, the jet 30 may be tilted by means of the handles 33 to any desired angle so that the impingement of the gas stream against the coated web can be at an angle of 90° thereto or at any desired oblique angle, as indicated by the arrow 35 in Figure 4.

The thickness of the stream of gas with entrained particles of adhesive which issues from orifice 31 may be adjusted by means of bolts 32 and 32*a* which regulate the orifice opening of the jet 30. This orifice opening is adjustable from .002" to approximately .025" and may extend the full width of the web 1 or, if desired, a number of such jets may be employed to cover the entire width of the web. A jet of approximately .005" in thickness is satisfactory for most purposes, though with drastic changes in the size of granules on web 1 or with changes in the character of adhesive entrained in the gaseous medium, it may sometimes be necessary to in-

crease or decrease the orifice opening. The leading edge of the gas orifice should generally be spaced from about ⅛'' to 3/16'' from the tips of the granular particles carried by the coated web, although it may sometimes be necessary to increase or decrease this distance, depending upon the type of adhesive sprayed through orifice 31.

The gaseous medium is supplied to the spray means incorporated in jet 30 by means of a flexible hose connection 46 which connects to a suitable source of supply not shown. Hose 46 connects through regulating valve 47a with a cross pipe 47, which feeds five vertical pipes 48 leading to spaced spray means, shown generally in Figures 6 and 7 as 49, on the front of the jet 30. Five such inlets are shown, spaced to give substantially uniform distribution of the atomized adhesive over the width of the jet 30. Obviously in certain cases, as when the "air knife" width is relatively small, only one spray means needs to be used. Furthermore, more than five spray means may be employed if found necessary to produce the desired uniformity of distribution under certain conditions. Pipe 47 is heat insulated by covering 57. The adhesive medium to be sprayed is supplied to spray means 49 by means of a flexible hose connection 53, which connects to a suitable source of supply not shown. The adhesive flows from hose 53 into a cross pipe 52, which in turn connects with vertical pipes 51 leading to the spray means 49 on the front portion of jet 30. Adhesive supply pipe 52 is jacketed by concentric tube 54, to which is connected inlet hose 55 and outlet hose 56. A heating medium such as hot water or steam is flowed through jacket 54 for the purpose of keeping the adhesive in pipe 52 at proper temperature and thus of sufficiently low viscosity to be sprayed readily.

The main supply of gaseous medium to the jet 30 is supplied to the jet through an opening 34a (Fig. 7) in the end wall and trunnion therefor by means of a flexible hose connection 34, which connects to a suitable source of supply, not shown. The internal construction of the jet 30 is such that the gas pressure is equalized and the stream of gas issuing from the orifice is of uniform velocity throughout, and so that the emergent gas stream is substantially non-divergent. The velocity of this gas stream appears to be of considerable magnitude, although it is difficult to express in actual units. It has been found, however, that the required velocities may be obtained with a suitably designed jet at relatively low gas pressures ranging from 2 to 15 p. s. i. gage and when an orifice opening of approximately .005 of an inch is employed, the gas velocity, and hence the gage pressure, required will, of course, depend upon the character, condition and thickness of the particular sizing adhesive being used. With thick viscous adhesives employed as the sizing coat on web 1 in Figure 4, a high gas pressure will be required, and with thin or less viscous adhesives, a relatively lower pressure will be required to clear such adhesive from the tips of the granular particles and produce a supporting mound of adhesive around the bases of the granules.

As shown in Figure 7, each spray means 49 is mounted on a boss 58 on the front of jet 30 by means of bolts 59 threaded into the boss and passing through flange 60 on the spray means. The spray means 49 consists of a main body 61 having a transverse passage 62 therein connected outwardly to the adhesive supply pipe 51 and inwardly to an axial passage 63. Another transverse passage 64 communicates outwardly with the gaseous medium supply pipe 48 and inwardly with passage 65 which is parallel with the longitudinal axis of the spray means and separated from passage 63 by partition 66. The outer end of body 61 is provided with a cylindrical coaxial projection 67 on which cover plate 68 is secured by bolts 69. A valve stem 70 projects through an axial hole in plate 68, and has threaded engagement therewith; said valve stem also extends through the cylindrical axial guide opening 72 in the body 61 and has a fluid tight connection therewith by reason of the packing gland indicated generally at 73. The valve stem is provided with an operating hand wheel 50 on its outer end, and with a lock nut 74 having threaded engagement 71 therewith and abutting the outer face of plate 68.

An intermediate portion 75 of the liquid nozzle which is screw-threaded into body 61 at the inner end of passage 63, has a passage 76 therethrough of smaller diameter than passage 63, and has at its rear end a tapered valve seat cooperating with the conical forward tip 77 on valve stem 70 to regulate the amount of liquid fed through passage 76. The passage 76 is diminished in bore at its inner end to form the liquid spray orifice 78. Held on to the inner end of the spray means body 61 by screw-threaded retaining ring 80 is an air nozzle 81 which interfits with body 75 along contacting conical surfaces 79 and 82, on parts 75 and 81, respectively. Air nozzle 81 has two sets of passages therein, a plurality of inner passages 83 equally spaced circumferentially and being located parallel to the passage 65, and two outer parallel passages 84, one at the top and the other at the bottom of the nozzle 81. Passages 84 communicate with gas conducting passage 65 by means of the holes 85 through flange 86 and the passage around baffle 87; the inner passages 83 communicate with passage 65 through the space between flange 86 and body 75.

Outer passages 84 lead to outlet orifices located on the flared surface 89 of air nozzle 81. Inner passages 83 lead to the approximately radially disposed passages 90 which lead the gaseous medium to an annular orifice 91 surrounding the central orifice 78.

Adhesive under pressure is fed through pipe 52, and during its passage it is heated to a freely mobile state by heating means such as steam in jacket 54. It then travels through passages 63, 76, and orifice 78, being limited in amount fed through the orifice by the position of needle valve 77, which is adjusted by hand wheel 50. A suitable gaseous medium is supplied under pressure by pipe 47 in the amount determined by the setting of valve 47a to pipe 48 and thence to passages 65, 83, 84 and orifices 88 and 91. The liquid adhesive stream emerging from orifice 78 tends to expand gradually in diameter and the tubular gas sheath emerging from orifice 91 likewise expands in radial thickness both inwardly and outwardly. Consequently the gas sheath and the liquid stream impact against each other forwardly of the outlet of both, thereby atomizing the liquid into a forwardly diverging conical spray.

The gas emerging from the two orifices 88 impinges on this conical spray and produces a flattened fan shaped spray lying in a plane through the axis of valve rod 70 and at right angles to the paper in Figure 7, the liquid in said spray

being distributed with great uniformity in a finely divided or misty form.

The spray devices are so located and adjusted that the horizontal spray from them is substantially uniform over the extent of the width of the air knife. This spray is met in the plenum chamber 30' of the air jet 30 by the inrushing gaseous medium from pipe 34 through opening 34a, and because of the speed of the gas through opening 34a and thus the swirl and eddy which it creates within the said plenum chamber of the jet 30, the atomized liquid is thoroughly and uniformly mixed throughout the gas, so that a uniform mixture of gas and adhesive passes through throat 30'' of the jet and issues from orifice 31 throughout the width thereof. The volume of gas entering through opening 34a is many times that entering through the spray devices. In some instances it may prove desirable, because of great width of the air jet 30, the character of the adhesive, etc., to supply the main body of gas to jet 30 from both ends thereof, in which case the feed line 34 shown at the right hand end of the jet in Figure 6 is duplicated to feed the gas to both the right and left hand ends of the jet.

It has been found that the character and composition of the main body of gas, entering the jet 30 through hose 34, and also that entering through pipe 47 by way of the spray devices is of particular importance in carrying out the described treatment of the sizing coat on an abrasive coated web. When the method diagrammatically illustrated by Figure 4 is carried out using as the sizing coat an adhesive that hardens by evaporation of a solvent, it is advisable to introduce a solvent of said adhesive into the gas entering through opening 44 to prevent setting of the adhesive before it is cleared away from the tips of the granules or built up around the bases thereof. When using thermoplastic adhesives, the gas through opening 44 may be heated sufficiently to prevent premature chilling and hardening of the adhesive, and with certain adhesives, there may be added both a solvent and heat to the gas.

As an example, when hide glue is employed as the sizing coat on the abrasive coated web, the gas stream directed against the coated web may be humidified with water vapor, which is a solvent for the glue, and heated to a temperature of 150° F. or above. In actual practice it has been found convenient to use a mixture of compressed air and steam. The compressed air fed to hose 34 is heated to approximately 220° F. by means not shown, and sufficient steam mixed therewith to saturate the air with water vapor. In certain instances dry steam may be used alone as the main supply of gaseous medium fed into the "air knife" but for most purposes it is desirable to use a mixture of compressed air and steam. With certain adhesives, such as varnishes and synthetic resins of the alkyd, urea, and phenol formaldehyde types, which become softer and more liquid during the initial heating period, hot compressed air is employed as the gaseous medium through hose 34, said air being heated to a temperature of 100° F. to 300° F., depending upon the particular solvent employed in the adhesive used.

The gaseous medium employed in the spray means may also differ, depending on the character of the adhesive sprayed into the "air knife" 30. If an animal or hide glue is employed, either steam or warm air which is saturated with moisture may be employed as such gaseous medium. When gum solutions or varnishes are used as such adhesive, steam or humidified air may not be required. In such cases a gaseous vehicle saturated with the solvent used for the adhesive may be employed.

The use of the "air knife" or gas jet with the incorporated spray means presents several advantages. The device is simple, easily controlled, and, by reason of its application of the additional adhesive at high velocity and in a finely divided state to the previously applied adhesive coating on the web, it produces a strong bond between the two. In the case in which the additional adhesive is waterproof, the high velocity application of it insures a complete sealing of the previously applied adhesive from the atmosphere.

Any variety of adhesive, such as glue, varnish, silicate, or synthetic resin, and any desired amount and viscosity of the adhesive may be used with the spray means incorporated in the "air knife;" and the amount and viscosity may be changed easily by altering the amount fed through the adjustable nozzle or opening into the "air knife." Because of the high velocity of gas entering and issuing from the "air knife," no difficulty is experienced with building up a coating of adhesive on the inner surfaces or orifice of the "air knife," and thus the adjustment of the spray means the main gaseous medium supply, and the "air knife" orifice need not be disturbed after having once been set for a particular operation.

Although the spraying of an additional adhesive by the spray means associated with the "air knife" has been particularly described, other materials may obviously be sprayed into the plenum chamber of the air jet 30. Thus it may be desired to spray a tanning solution such as formaldehyde or potassium bichromate on to the sizing coat 5, if such coat is an animal or hide glue, in order to render such sizing coat waterproof, simultaneously with the clearing of the abrasive granule tips by the air jet.

Having fully described the invention, I claim:

1. Apparatus for the manufacture of granular coated webs comprising means for moving and supporting a granular coated web, means to apply a layer of adhesive to the granular coated side of the web, means to clear the still mobile adhesive from the tips of the abrasive granules and to apply a further layer of adhesive to the spaces between abrasive granules consisting of a jet body comprising an elongated plenum chamber of relatively large cross sectional area, a throat chamber coextensive with the plenum chamber and formed by elongated lip portions converging from the plenum chamber to an elongated narrow discharge orifice, said throat chamber and said discharge orifice being of substantially the same length as the plenum chamber, said discharge orifice located substantially parallel to the length of the plenum chamber, transverse to the web, and near and directed toward the adhesive coated side of the web, means to supply a relatively large volume of a gaseous medium to the jet body cavity in a direction parallel to the length of the discharge orifice of the jet body, and means mounted on said jet body at a point remote from the elongated discharge orifice thereof to introduce into said gaseous medium an atomized adhesive in such manner that the adhesive is distributed substantially uniformly throughout the length of the jet body, said means projecting the atomized adhesive in a di-

rection toward the discharge orifice of the jet body and substantially at right angles to the stream of the large volume of gaseous medium entering the jet body, whereby a thorough mixing of the gas and adhesive results and the adhesive content of the gas issuing from the elongated orifice is substantially uniform throughout the extent of the orifice.

2. Apparatus for the manufacture of granular coated webs comprising means for moving and supporting a granular coated web, means to apply a layer of liquid adhesive to the granular coated side of the web, means to clear the still mobile adhesive from the tips of the abrasive granules and to apply a further layer of adhesive to the spaces between the abrasive granules consisting of a jet body comprising an elongated plenum chamber of relatively large cross-sectional area, a throat chamber coextensive with the plenum chamber, and formed by elongated lip portions converging from the plenum chamber to an elongated narrow discharge orifice, said throat chamber and said discharge orifice being of substantially the same length as the plenum chamber, said discharge orifice located substantially parallel to the length of the plenum chamber, transverse to the web, and near and directed toward the adhesive coated side of the web, means mounted on the jet body plenum chamber at a location remote from the discharge orifice and lying substantially in a plane which contains the discharge orifice and runs through the center of the plenum chamber for projecting atomized adhesive into the plenum chamber in a direction toward said discharge orifice, said adhesive projecting means providing a substantially uniform adhesive spray in the rear of the plenum chamber and throughout the length thereof, and means for introducing a relatively large volume of a gaseous medium lengthwise of the plenum chamber in a direction substantially parallel to the lips of the discharge orifice and substantially at right angles to the direction in which the adhesive is projected by the adhesive projecting means, whereby the atomized adhesive mixes thoroughly with the relatively large volume of gaseous medium and the gas discharged from the elongated orifice contains a substantially uniform amount of adhesive per unit volume at any point taken along the length of the orifice.

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