

May 21, 1940.

J. A. WILLIAMSON

2,201,196

MANUFACTURE OF GRANULAR COATED MATERIALS

Filed June 27, 1939

2 Sheets-Sheet 1

Fig. 1.

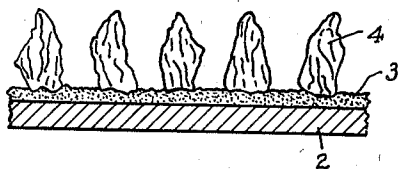


Fig. 2.

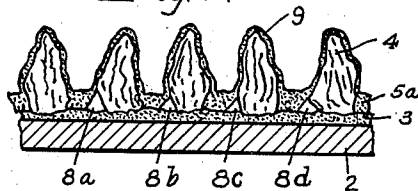


Fig. 3.

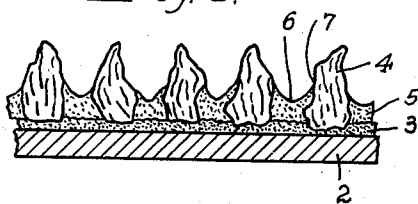


Fig. 4.

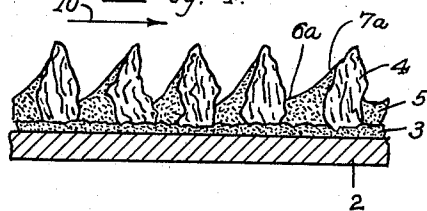
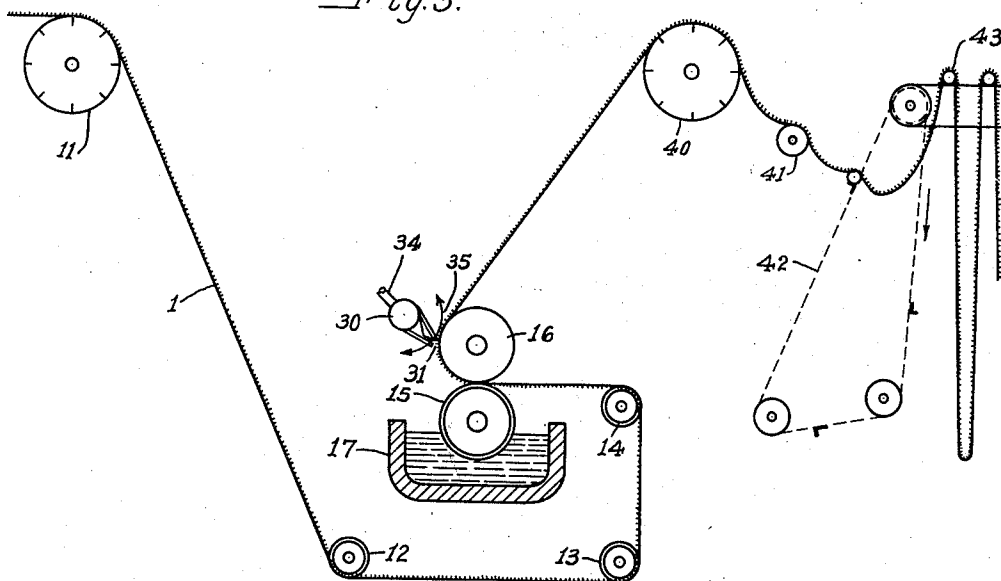


Fig. 5.



INVENTOR.
JOHN A. WILLIAMSON

BY

RCB
ATTORNEY.

May 21, 1940.

J. A. WILLIAMSON

2,201,196

MANUFACTURE OF GRANULAR COATED MATERIALS

Filed June 27, 1939

2 Sheets-Sheet 2

Fig. 6.

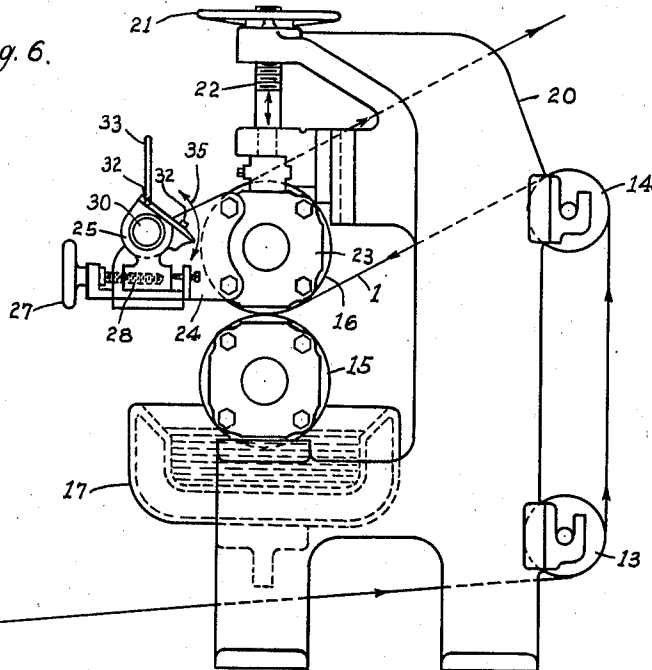
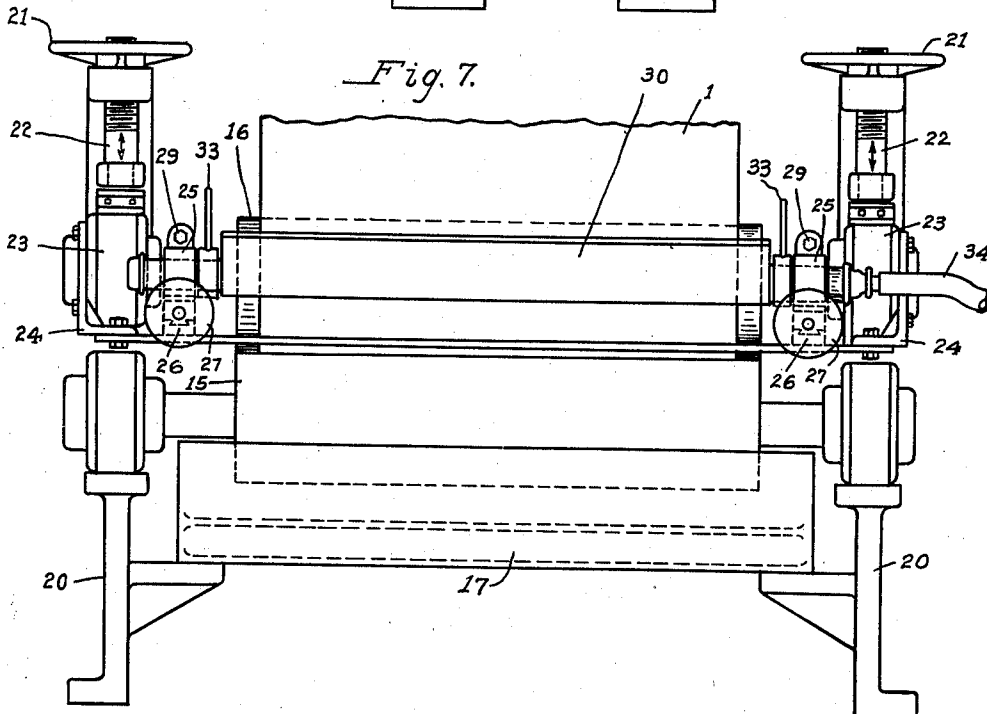


Fig. 7.



BY

INVENTOR.
JOHN A. WILLIAMSON

RE Benner

ATTORNEY.

UNITED STATES PATENT OFFICE

2,201,196

MANUFACTURE OF GRANULAR COATED MATERIALS

John A. Williamson, Niagara Falls, N. Y., assignor
to The Carborundum Company, Niagara Falls,
N. Y., a corporation of Delaware

Application June 27, 1939, Serial No. 281,421

8 Claims. (Cl. 51—278)

This invention relates to the manufacture of granular coated webs of such material as paper, cloth and the like. More particularly, this invention relates to the application of the sizing coat of adhesive to abrasive coated webs.

In the usual process, by which coated abrasive materials have been made for many years, it has been customary to coat the backing sheet of paper or cloth with a layer of glue or other suitable adhesive and then apply a layer of abrasive grains to the adhesively coated sheet. After this first layer of adhesive had set, a second or sizing layer of adhesive was applied over the layer of abrasive grains in order to more firmly attach the grains to the web backing. This sizing layer of adhesive was applied by means of a rubber covered roll partially immersed and revolving in a pan of liquid adhesive and contacting with the abrasive coated surface. When this sizing layer dried or set, the adhesive shrunk around the bases of the grains and held them firmly in position.

The quantity of adhesive applied by the glue roll was regulated by varying the pressure of the glue roll against the abrasive coated surface and supporting pressure roll and thereby squeezing the layer of adhesive to a desired thickness. In most instances, and particularly with the finer grit sizes, it was necessary to use considerable pressure on the rolls and this resulted in the abrasive grains being flattened against the sheet backing.

Thus the layer of sizing adhesive was applied as a sheet or blanket along on top of the layer of abrasive granules. Due to the fluidity of the adhesive and the pressure exerted by the rolls, the adhesive was caused to flow down the sides of the grains and partially filled the space between adjacent grains to more firmly anchor them to the base coating of adhesive. While this process was effective in anchoring the abrasive granules securely in place it was disadvantageous in that the entire surface of the abrasive grains remained covered with a film of adhesive and the sharp projecting points of the grains did not abrade at the maximum efficiency. Furthermore the adhesive coated surface of the granules which softened by heat retained particles of abraded material and quickly filled or clogged the spaces between the abrasive granules. This reduced the cutting efficiency of the abrasive and materially reduced its effective life.

The above difficulties were even more pronounced with the recently developed abrasive paper and cloth commonly known as oriented abrasive paper and cloth in which elongated granules

of the abrasive grain have been oriented with respect to the surface of the backing material, so as to be upstanding therefrom and therefore in a position to afford a maximum cutting or abrading action. Pressure exerted by the adhesive applying rolls tends to turn over the upstanding granules and lay them flat against the backing material.

I have found that the above difficulties of roll sizing can be overcome and the sizing coating of adhesive applied without detrimental effect to the abrasive coated surface. This is accomplished by eliminating the usual pressure rolls, applying a layer of adhesive of excess thickness and then removing the excess adhesive by means of an "air knife" or gas jet extending transversely across the coated web and adapted to direct a stream of high velocity gas against the coated abrasive surface. This gas is suitably heated and/or treated with a solvent of the adhesive so that it will not set or chill the adhesive when directed against the grain tips but will cut away and remove the excess adhesive leaving a layer of desired thickness and also drive the adhesive from the uppermost points of the grains down and around the bases of said grains. Thus a layer of sizing adhesive of proper thickness is applied without the deleterious effect of pressure rolls and at the same time the cutting points of the grains are cleared of the adhesive film. Furthermore a stronger bond is produced at the base of the grains and a greater space is provided between the grains for cutting clearance and the formation of chips during subsequent abrading action.

A better understanding of the invention may be obtained by reference to the accompanying drawings, in which:

Figure 1 is an enlarged section through a fragment of the abrasive coated web at one stage of its manufacture;

Figure 2 is a similar section showing a fragment of an abrasive coated web in which the sizing adhesive has been applied in the usual way;

Figure 3 is a similar section showing a fragment of an abrasive coated web embodying my invention;

Figure 4 is a similar section showing a fragment of an abrasive coated web embodying an alternative form of our invention;

Figure 5 is a diagrammatic elevation of apparatus for manufacturing abrasive coated materials in accordance with my invention;

Figure 6 is a detailed side elevation of the ad-

hesive applying mechanism shown diagrammatically in Figure 5; and

Figure 7 is a front view of the apparatus shown in Figure 6.

- 5 Referring to Figure 3 which illustrates a fragment of an abrasive coated web made in accordance with my invention, the reference numeral 2 indicates the web or backing which may be of any of the usual flexible materials such as paper, 10 cloth, vulcanized fiber or a combination of these or other suitable materials. Applied to one face of the web is a base coating 3 of adhesive, such as 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. The sizing layer of adhesive 15 5 is deposited principally around the base of the upstanding grains 4 filling the bottoms of the valleys and crevices between the adjacent grains. It will be noted that the tops of the grains are free of the sizing adhesive and that the sharp projecting points are in condition for most efficient abrading. Furthermore the sizing adhesive applied to and built up around the bases of the elongated granules fills any depressions or irregularities in the surface of the grains and thereby increases the supporting action of the adhesive to hold the grains in position during subsequent use of the abrasive material.

- Figure 1 shows a granular coated material prior to application of the sizing or reinforcing layer of adhesive. 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 abrading stresses when the coated web is used as an abradant. It is necessary therefore to apply a size coating of adhesive to the abrasive coated web and more firmly anchor them to the base coating and web backing material.

- Figure 2 shows a granular coated web produced by the usual process, in which a blanket of adhesive 5a was applied over the granular 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. In addition to covering the sharp points of the abrasive material, many adhesives soften during actual grinding, causing retention of abraded material and clogging the spaces between the grains. This renders the abrasive material unfit for further use.

- 60 The preferred procedure in manufacturing granular coated webs in accordance with my invention will now be described. The previously coated abrasive material, such as that illustrated by Figure 1, is moved from suitable drying racks 65 (not shown) by means of the suction drum 11, passed around the rubber-covered idler rolls 12, 13 and 14, and in contact with the supporting roll 16. Adhesive is applied to the granular coated surface of the web by any convenient means such as the rubber-covered adhesive roll 15 which is partially immersed and revolves in the liquid adhesive contained in the pan 17. As the roll 15 revolves it carries a film of adhesive into contact with the granular coated surface but does not 70 exert sufficient pressure against the coated web

to disturb the positions of the individual particles. If desired, the roll 15 may be dispensed with and the roll 16 lowered so that the granular coated surface of the web is brought into direct contact with the surface of the adhesive contained in the pan 17 or a layer of adhesive applied by the so-called "kiss coating" method. The roll 16 is adjustably supported above the glue pan 17 and provided with adjusting means (see Figure 6) whereby its vertical position may be 10 changed to suit various conditions of coating.

After the adhesive has been applied, the coated web is moved past a jet of high velocity gas issuing from the adjustable orifice 31 of the "air knife" generally indicated by the reference numeral 30. This jet of high velocity gas serves to remove the excess adhesive and also to drive the residual coating of freshly applied layer of adhesive from the tips of the abrasive grains and cause it to flow down and around the bases of the grains. 20

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 25 in a drying or curing chamber to fully set the adhesive. After drying or curing, the coated web is taken down from the rack and cut into pieces of various sizes and sold.

Referring now to Figures 6 and 7, the operation 30 of the gas jet will be described in more detail. The adhesive pan 17 is supported by a suitable frame 20, which also supports the adhesive roll 15 in such a manner that said roll revolves in a liquid adhesive and applies a film or layer of said adhesive to the coated web 1. The 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 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. However, for most satisfactory operation, I have found that the rolls 15 and 16 should be widely spaced so that an excess of adhesive will be applied to the granular coated surface. With such spacing of the rolls there is no appreciable pressure exerted against the upstanding granular particles and hence no tendency to roll them over flat against the web backing. 40

The gas jet 30 is mounted on the bearing 23 by a suitable bracket 24 and moves up or down with any vertical adjustment of the roll 16. Thus the adjustment of the jet 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 jet. 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 60 threaded portion of the base of the said cradle 25. By loosening the clamping bolt 29, the jet 30 may be rotated by means of the handle 33 to any desired angle so that the impingement of the gas stream against the coated web can be at 90° thereto or at any desired oblique angle. 70

The thickness of the gas stream 31 issuing from the jet 30 may be adjusted by means of the bolts 32 which regulate the orifice opening of the jet 30. This orifice opening is readily adjustable from 75

.002" to .025" and extends the full width of the web 1. It has been found that too thick a stream of gas causes splattering of the adhesive and does not cause the adhesive to flow down and around the bases of the grains as desired. Moreover, the impact of too thick a jet of high velocity gas will tend to blow over or entirely dislodge the upstanding granular particles on the coated web. I have found that a jet of approximately .005 inches in thickness is satisfactory for most purposes, though with drastic changes in size of granular particles, it may sometimes be necessary to increase or decrease the orifice adjustment. I have also found that the leading edge of the gas orifice should be spaced from about $\frac{1}{8}$ inch to $\frac{1}{4}$ of an inch from the tips of the granular particles carried by the coated web.

The gaseous medium employed is supplied to the jet 30 by means of a flexible hose connection 34, which connects to a suitable source of supply not shown. The internal construction of the air knife 30 is such that the gas pressure is equalized and the stream of gas from the orifice is of uniform velocity throughout. The velocity of this gas stream appears to be of considerable magnitude, though it is difficult to express in actual units. I have found, however, that such velocities may be obtained with a suitably designed jet at relatively low gas pressures ranging from 2 to 15 pounds per square inch gage and with an orifice opening of approximately .005 of an inch. The gas velocity, and hence gage pressure, required will, of course, depend upon the character, condition and thickness of the particular adhesive being used. With thick viscous adhesives, 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.

I have found the character and composition of the gas stream to be of particular importance in carrying out the method of the present invention. With adhesives that harden by evaporation of a solvent, I find it advisable to introduce a solvent of said adhesive into the gas to prevent setting of the adhesive before it is cleared away from the tips of the granules. When using thermoplastic adhesives, I may heat the gas sufficiently to prevent premature chilling and hardening of the adhesive, and with certain adhesives I may add both a solvent and heat to the gas. Hide or animal glue, which falls in the latter classification, is the adhesive most generally used in the coated abrasive industry and, for this reason, will be discussed in more detail. Such hide glue is applied to the coated web at a temperature of approximately 150° F. and jells very quickly when the temperature drops much below 140° F., or if there is any substantial evaporation of moisture. If the adhesive is permitted to become set or jelled, it cannot be properly removed from the tips or cutting points of the grains. For this reason it is necessary that the gas stream directed against the coated web 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 I have found it convenient to use a mixture of heated compressed air and steam. The compressed air is heated to approximately 150° F. by means not shown, and sufficient steam mixed therewith to saturate the air with water vapor. It is necessary that the compressed air and steam be thoroughly mixed and, for this reason, a separate mixing chamber

(not shown in the drawings) is provided. I have found in certain instances that dry steam may be used alone as the gaseous medium, but for most purposes, it is desirable to use a mixture of compressed air and steam.

Certain adhesives, such as varnishes and synthetic resins of the alkyd, urea and phenol formaldehyde types, become softer and more liquid during the initial heating period. With these adhesives I prefer to use hot compressed air as the gaseous medium and to heat the air to a temperature of 100° F. to 300° F., depending upon the particular solvent employed in the adhesive used.

I have also found that the character of the coated abrasive material produced by the herein-described process can be altered by varying the angle of impingement and velocity of the jet. This jet of high velocity gas serves to remove the excess adhesive and to drive the residual film of freshly applied adhesive from the tips of the abrasive grains and cause it to flow down and around the bases of the grains. The force of the jet produces a depression (indicated by the reference numeral 6 in Figure 3 of the drawings) in the adhesive film 5 between adjacent grains and forces the film of adhesive up along the sides of the grains, as indicated by the reference 7, thereby surrounding the base of each individual granule in a mound of adhesive. When the angle of impingement of the jet is approximately 90° with respect to the surface of the coated web, the depression 6 of the adhesive film is approximately midway between adjacent grains, as shown in Figure 3. In an abrasive article of this character, the granules are supported against lateral displacement in an equal manner regardless of which direction the coated web is moved during subsequent grinding action.

By varying the angle of impingement of the gas stream so that it strikes the coated abrasive surface at an oblique angle, I am able to build up the mound of adhesive to a greater height on one side of the individual grains than on the other. This feature is clearly illustrated in Figure 4 of the drawings, in which the layer of sizing adhesive, generally indicated by 5, is shown as extending well up the back of the grains 4, as indicated by the reference 7a. The depressed portion 6a of the adhesive film is well over near the front of the next succeeding grain. Thus a greater reinforcing or supporting action is obtained by a given amount of sizing adhesive when the abrasive material is moved in the direction indicated by the arrow 10. This feature is of particular importance in connection with abrasive belts used in grinding wood, metals and other materials, and increases the rate of cut and effective life of the article to a marked degree. Grinding tests show an increase of as much as 25% in cutting rate and material abraded. Obviously, the abrasive belts must be driven in the proper direction in order to obtain maximum benefits from such a product. For this reason, the belts are suitably marked with an arrow to indicate the proper direction of movement.

The optimum angle of impingement of the gas jet depends upon the character of the abrasive coating desired and also upon the size, shape and position or degree of orientation of the grains with respect to web backing. For this reason, I provide means for readily adjusting and maintaining the angle at which the jet of gas is directed at the surface of the adhesive coating 5 on the web 1. The jet may be adjusted through

a wide arc, as indicated by the arrow 35 in Figures 5 and 6, by loosening the clamping bolt 29 and rotating the jet in the journals of the bracket 25. Such movement is facilitated by the handle 33, and when the angle is properly adjusted, the jet is securely locked in position by tightening the bolts 29. In producing coated abrasive material, such as that shown in Figure 4, I have found that satisfactory results are obtained when the angle of impingement of the gas stream is between 20 degrees and 75 degrees with respect to the surface of the coated web. More particularly, it has been found that the best results are obtained when the angle between the jet and the web is approximately 50 degrees.

Since the stream of gas strikes the coated web with appreciable force, it has been found desirable to set or cure, at least partially, the base coating of adhesive 3 before subjecting the abrasive coated web to the further treatment of a sizing coating of adhesive, as described in the present application. Such curing or setting of the base coating is effected in a suitable curing zone through which the web is moved prior to passing over the drum 11. This initial set or cure of the base coating prevents the upstanding abrasive grains 4 from being laid flat or entirely dislodged by the force of the gas stream. However, any loosely adhering or improperly attached granules are removed from the coated web.

Other advantages in the herein-described process for applying the sizing layer of adhesive to abrasive coated articles will be apparent from a comparison of the sections of the coated webs illustrated by Figures 2, 3 and 4. The granular particles 4 are very irregular in shape and surface contour, particularly so with abrasive particles, so that a layer of sizing adhesive applied in the ordinary manner entraps air around the bases of a large portion of the grains. In Figure 2, which shows a section of granular material made by the usual process, reference numerals 8a, 8b, 8c and 8d indicate voids around the bases of the grains 4 which are not filled with adhesive. These voids are caused by the fact that a sheet or blanket of liquid adhesive is applied to the granular coated web in the usual process and the fluidity of the adhesive and pressure of the rolls are the only forces acting to cause the adhesive to fill the interstices between adjacent grains. Since the adhesive is fluid at the time of application, it does tend to flow down the sides of the granules to the bases thereof. Any crevices, however, are not properly filled because of the surface tension of the blanket of adhesive and the air entrapped in the said crevices. Obviously, these voids, such as 8a, materially weaken the anchorage of the granules and when the coated material is used as an abrasive, the grains are broken away from the backing before their useful life is spent.

In the granular coated material produced by the present process and illustrated by Figures 3 and 4, the above difficulties have been entirely eliminated. In addition to driving the film of adhesive from the tips of the granules, the force of the solvent treated gas stream is sufficient to flow the adhesive into any crevices at the base of said grains and to displace any air which may have been entrapped therein.

While I have specifically illustrated and described the preferred embodiment of our invention, it is to be understood that the invention may

be otherwise embodied and practiced within the scope of the following claims.

I claim:

1. The method of manufacturing granular coated webs which comprises the steps of applying a layer of liquid adhesive of excess thickness to the granular surface of a web previously coated with granular particles and then directing a high velocity stream of gas against the said adhesive layer whereby the excess adhesive is removed and the peaks of said granular particles are cleared of the residual coating of adhesive.

2. The method of manufacturing granular coated webs which comprises the steps of applying a layer of liquid adhesive of excess thickness to the granular surface of a web previously coated with granular particles and immediately thereafter directing a high velocity jet of gas against the said adhesive layer whereby the excess adhesive is removed and the residual coating of adhesive is driven from the peaks of said granular particles and deposited around the bases thereof.

3. The method of manufacturing granular coated webs which comprises the steps of applying a layer of liquid adhesive of excess thickness to the granular surface of a web previously coated with granular particles and immediately thereafter directing against the said adhesive layer a high velocity jet of gas containing a solvent of said adhesive whereby the excess adhesive is removed and the residual coating of said adhesive is driven from the peaks of said granular particles and deposited around the bases thereof.

4. The method of manufacturing granular coated webs which comprises the steps of applying a layer of liquid adhesive of excess thickness to the granular surface of a web previously coated with granular particles and directing against the said adhesive layer a high velocity jet of gas emerging from an orifice extending across the full width of said web whereby the excess adhesive is removed and the residual coating of said adhesive is driven from the peaks of said granular particles.

5. The method of manufacturing granular coated webs which comprises the steps of applying a layer of liquid adhesive of excess thickness to the granular surface of a web previously coated with granular particles and directing against the said adhesive layer a high velocity stream of gas of .002 to .025 inch in thickness and extending across the full width of said web whereby the excess adhesive is removed and the residual coating of said adhesive is driven from the peaks of said granular particles.

6. The method of manufacturing granular coated webs which comprises the steps of applying a layer of liquid adhesive of excess thickness to the granular surface of a web previously coated with granular particles and directing against the said adhesive layer a high velocity stream of gas of approximately .005 inch in thickness and extending across the full width of said web whereby the excess adhesive is removed and the residual coating of said adhesive is driven from the peaks of said granular particles.

7. The method of manufacturing granular coated webs which comprises the steps of applying a layer of liquid adhesive of excessive thickness to the granular surface of a web previously coated with granular particles and directing against the said adhesive layer a high velocity stream of gas emerging from an orifice under gage pressure of 2 to 15 pounds per square inch,

said orifice having an opening of .002 to .025 inch and extending across the full width of said web, whereby the excess adhesive is removed and the residual coating of said adhesive is driven from the peaks of said granular particles.

5 8. The method of manufacturing granular coated webs which comprises the steps of applying a layer of liquid adhesive of excess thickness to the granular surface of an abrasive coated

web while maintaining the contact pressure against said coated surface sufficiently low to prevent disturbance of the position of the up-standing granules and then directing a high velocity stream of gas against the said adhesive 5 layer whereby the excess adhesive is removed and the peaks of said granular particles are cleared of the residual coating of adhesive.

JOHN A. WILLIAMSON.