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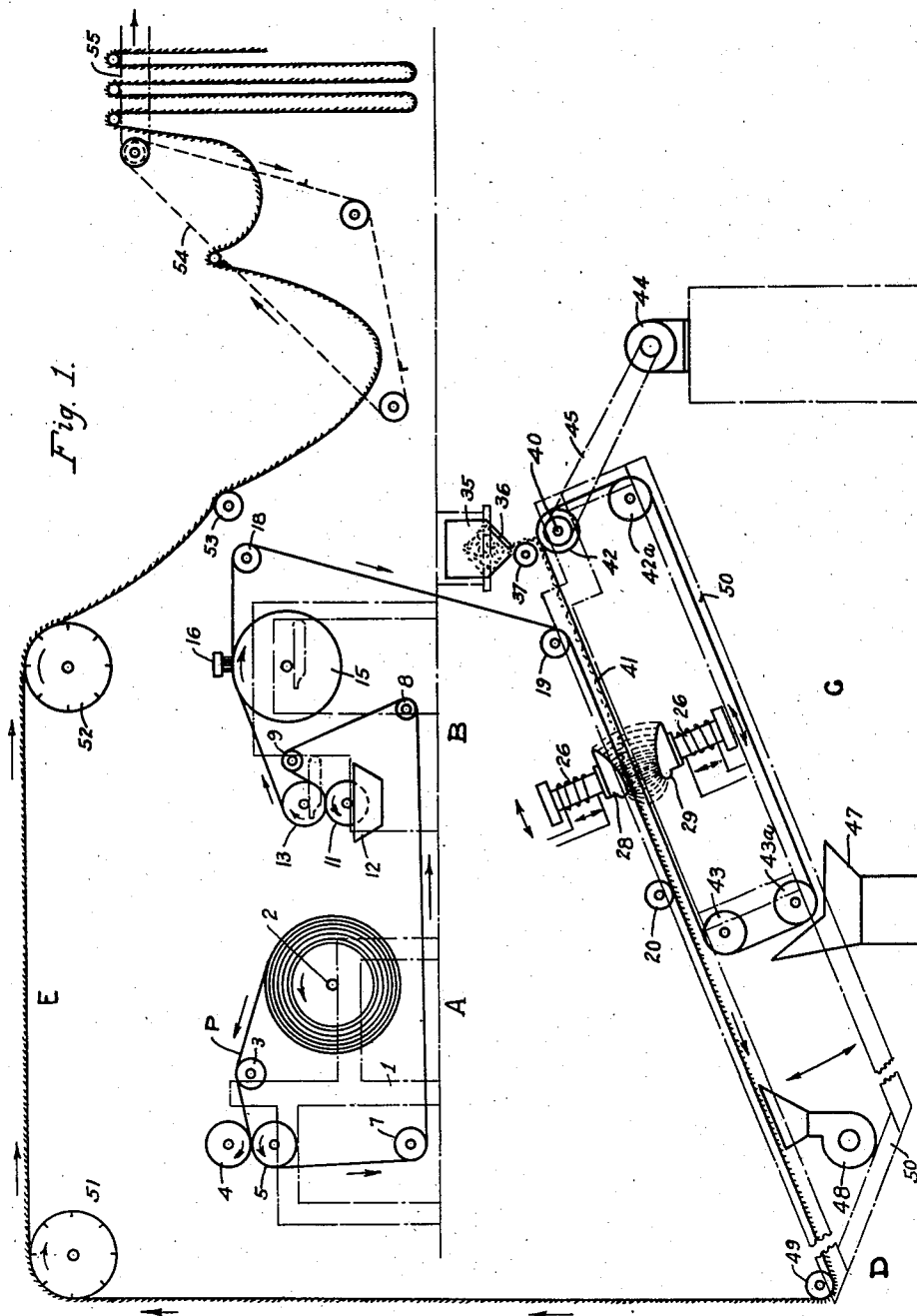
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2,184,348

COATING APPARATUS

Filed Oct. 27, 1932

2 Sheets-Sheet 1



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Fig. 2

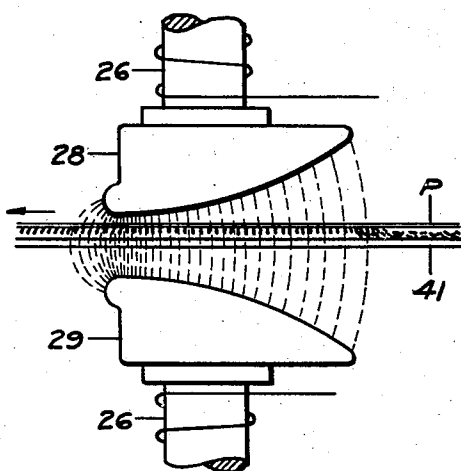


Fig. 3

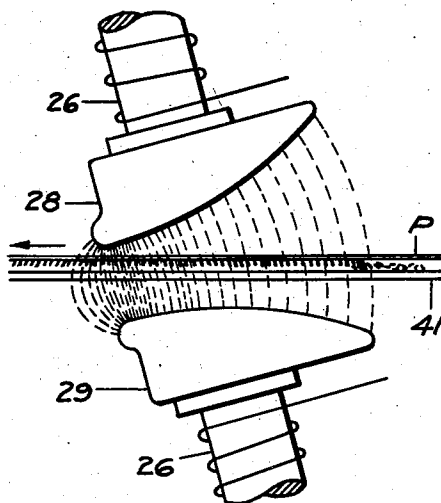


Fig. 4

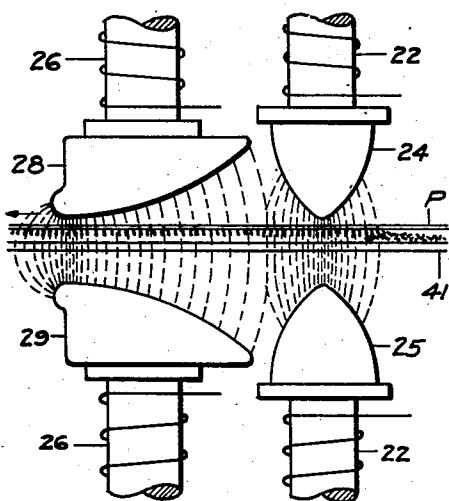
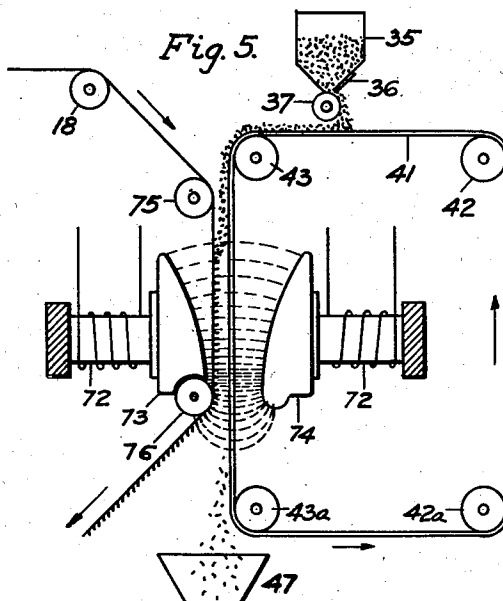


Fig. 5



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## UNITED STATES PATENT OFFICE

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## COATING APPARATUS

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7 Claims. (Cl. 91—18)

The present invention relates to apparatus for the manufacture of granular coated webs of such materials as paper, cloth, or the like, and more especially to an electromagnetic apparatus for securing an inclined orientation of the abrasive particles.

We have found that if abrasive granular material containing or consisting principally of elongated grains is applied to a backing web, such as paper or cloth, with the elongated grains inclined to the paper or cloth, superior cutting or abrasive properties are given to the abrasive paper or cloth. This is believed to be due to the action of the inclined elongated grains in cutting into the material to be abraded somewhat after the manner of inclined saw teeth. The present invention relates particularly to a machine for electromagnetically securing such inclination of the elongated grains of abrasive material.

An understanding of our invention will be had by reference to the accompanying drawings in which:

Figure 1 is a diagrammatic side elevation of one form of apparatus constructed in accordance with our invention;

Figure 2 is an enlarged view of a part of Figure 1;

Figure 3 is a view similar to Figure 2 but showing a part of the apparatus adjusted to a different position;

Figure 4 is another enlarged view illustrating, in part, another form of apparatus; and

Figure 5 is a diagrammatic side elevation of still another form of apparatus.

Referring first to Figure 1, this drawing shows means A for holding and dispensing a roll 2 of the web P; means B for applying adhesive to one face of the web P; means C for angularly applying granular material to the adhesive side of the web P; means D for causing a preliminary set of the adhesive; and means E for drawing the web through the coating apparatus and into a drying chamber.

The means A for holding and dispensing the web P comprises, as is shown in the drawings, a frame 1 that supports the roll 2 of web P; an idler roll 3 for guiding the web; printing rolls 4 and 5 for marking the web with any desired legend or identification; and an idler roll 7 for guiding the web.

The adhesive applying means B comprise, as shown in the drawings, idler rolls 8 and 9 for guiding the web; a roll 11 positioned to dip into a pan 12 of adhesive; a roll 13 for maintaining

contact between the web P and the roll 11; a drum 15 and an adhesive distributing brush 16 positioned above the said drum 15; and an idler roll 18 for guiding the web as it is brought from the distributing brush.

The means C for applying granular material to the web P comprises, as shown in the drawings, idler rolls 19 and 20 for guiding and positioning the web; a magnet 26 with pole pieces 28 and 29, so designed as to set up a distributed magnetic field which is relatively weak at the end where the web enters and of gradually increasing intensity at the opposite end, and which is adjustable both angularly and vertically with respect to the idler rolls 19 and 20; an endless feed belt 41 positioned between the pole pieces 28 and 29 and supported by the pulleys 42, 42a, 43 and 43a; and variable speed driving means 44 for operating the feed belt 41—all of these parts being mounted on a cradle 50 which is adapted for rotation about the axis 40. Means C also includes a unit comprising a grain hopper 35 with an adjustable gate 36 and a roll 37 for dispensing the granular material to the feed belt 41 which may, if desired, be mounted independently of the cradle 50.

The means D for causing the adhesive to acquire a preliminary set comprises, as shown in the drawing, an idler roll 49 and a fan blower 48 for supplying a large volume of air at a low velocity to the adhesive and granular coated side of the web P.

The means E for moving the web P through the coating apparatus and into the drying chamber comprises, as shown in the drawings, one or more suction drums 51 and 52; rolls 19, 20 and 49; an idler roll 53; a rack 55 for supporting the web P, and an endless conveyor 54 for transporting loops of the web P to the rack 55. The rolls 19, 20 and 49 serve the dual function of positioning the web and assisting the suction drums 51 and 52 in the movement of the web.

In the normal operation of the apparatus illustrated in Figure 1 a roll of the uncoated web P, such as paper or cloth, is rotatably mounted on the frame 1 and the web is threaded over the roll 3 and between the printing rolls 4 and 5 and thence in contact with the idler rolls 7, 8 and 9 to the pressure roll 13 and the adhesive roll 11. The adhesive roll 11 dips into liquid adhesive contained in the adhesive tank 12 and, on the upward movement of travel of the roll 11, a layer of adhesive is applied to the web.

The adhesively coated material P passes between the brush drum 15 and a vibrating brush

16 which evenly distributes the adhesive and smooths out any ridges. It is then guided by the idler rolls 18, 19 and adjustable roll 21 into a magnetic field set up between the pole pieces 28 and 29 of the magnet 26.

Granular particles are distributed from the grain hopper 35 onto the grain feed belt 41, which moves through the magnetic field parallel to the web P and in the same direction, as shown in an enlarged view as Figure 2. The field of magnet 26 energizes the granular particles, causing them to become, in effect, miniature magnets with poles at their extreme ends or in other words, in such a manner that their magnetic axes lie along their major axes. Since the feed belt 41 is positioned above the axis of symmetry of magnet 26, the particles are attracted toward the upper pole 28 of this magnet and move toward it so positioned that their major axes are coincident with the magnetic lines of force and thus the longitudinally oriented granules strike the adhesive coating on the underside of the material P and adhere thereto in an oriented position.

Since the web is closer to the pole piece 28 than it is to pole piece 29, in passing out of the concentrated end of the field the particles are caused to assume a position such that their major axes are inclined to the web because the web passes through a part of the field where the magnetic lines are bent outward by reason of the concentration of the field, as will be readily apparent from an examination of Figure 2. The magnet is also so positioned that the orienting lines of force at the concentrated end of the field are substantially vertical and therefore inclined to the surface of the web. It is therefore possible to orient the particles at any desired angle with respect to the web by suitably positioning the web with respect to that part of the field where the web leaves the field. The angular position is maintained by rotating the system about the axis 40 to such an angle that the oriented particles are substantially normal to the earth and are therefore not displaced angularly by the force of gravity. The web is maintained in this position until the adhesive has been at least partially set by the action of the air from the blower 48 whereupon it may be moved in any desired direction without disturbing the orientation of the granular particles.

The magnetized abrasive particles not only impinge upon the adhesive coating but are drawn into the adhesive by the continued action of the magnetic field and thus become more firmly embedded therein. While the abrasive particles may turn slightly as the coated web passes through the magnetic field the desired inclination of orientation is established by the angular relationship between the web and the lines of force as the web leaves the field.

Figure 3 illustrates, diagrammatically, the magnetic apparatus of Figure 1 adjusted to orient the granular particles at a lesser angle with respect to the web. The effect of making this adjustment in reducing the angularity of the inclination of the particles will be apparent from an examination of the relative positions of the web P and the magnetic lines of forces as represented by the dotted lines.

Figure 4 represents, on an enlarged scale, another form of magnetic apparatus which is suitable for use where the granular material is weakly magnetic and it is impractical to construct one magnet to produce a field of sufficient in-

tensity to both project and orient the grains. This form of apparatus comprises a strong magnet 22 with upper and lower pole pieces 24 and 25 respectively, designed to set up a concentrated magnetic field positioned adjacent to the weaker end of a field of gradually increasing intensity of the type described in connection with Figure 1, set up by magnet 26.

In the operation of this form of apparatus the granules are projected to the web by the action of the field of magnet 22 while their angularity with respect to the web is determined by reason of the action of the strong part of the field of magnet 26. As a result of this combination of magnets it is possible to utilize granular material which would otherwise be unsuitable.

Figure 5 is a diagrammatic illustration of a form of apparatus adapted for angularly orienting particles fed into the magnetic field from above. This apparatus comprises a magnet 72 with pole pieces 73 and 74 designed to set up a distributed field, the weaker side of which is positioned upward; idler rolls 18, 75, and magnetic roll 76 for guiding an adhesive coated web into and through the magnetic field; a grain feed belt 41 supported by the pulleys 42, 42a, 43 and 43a and positioned to feed the granular particles into the magnetic field from above; and a grain dispensing device 35, 36 and 37.

In the operation of this apparatus granular particles are fed into the magnetic field by the grain feed belt 41 and upon entering the field are attracted toward pole piece 73 as a result of which they become embedded in the adhesive on the surface of the web. Upon leaving the magnetic field the particles are oriented to an angular position with respect to the web by reason of the fact that they assume positions with their major axes parallel to the magnetic lines of force which are here cut by the web at an angle. The web is then directioned downward at such an angle that the major axes of the particles are substantially vertical and any disturbance of the orientation of the particles by reason of gravity is thereby obviated.

In the operation of apparatus constructed as illustrated, the intensity of the magnetic field is adjusted to such a value that the granular particles on the feed belt are propelled toward the pole piece and strike the adhesive coating on the web P with sufficient force to partially embed themselves and adhere thereto. Other factors remaining constant, we have found that the intensity required to magnetically propel the charged granules into engagement with the adhesively coated web varies in proportion to the size or mass of the granules; that is, a greater intensity is required for the larger grain than for smaller size grains. Thus, by changing the current flowing in the coils of the electromagnets 26, 22 or 73 the magnetic intensity can be adjusted to such a value that grains of a certain specific size will be magnetically deposited on the adhesive coating, whereas any grains of a larger size, which might be present on the feed belt, will remain thereon and be carried into the bin 47.

In order to assure a uniform granular coating and to eliminate difficulties with grain feed rolls we have found it desirable to apply a surplus of grain to the feed belt 41. Different densities of grain coatings can be obtained by varying the current that energizes the magnet so that the lifting power of the magnet is increased

or decreased to raise more or less particles from the feed belt.

The pole pieces of the magnets may be adjusted so as to cause any desired degree of orientation of the abrasive particles in such a manner that their longest dimensions are at some angle between 0° and 90°, preferably between 15° and 75°, to the web to which they are attached.

Abrasive paper or cloth having the abrasive grains so oriented has a different action depending upon the direction in which it is run. For example, a sanding belt made of such paper or cloth when run in the direction of the inclination of the oriented particles may cut or abrade very rapidly while when run in the opposite direction, it has more of a polishing or finishing action. This is an advantage in that it is possible to make one belt serve two purposes.

Not all granular materials are equally affected by magnetic forces, some being readily affected and others being slightly affected or requiring intense or highly concentrated forces to produce an appreciable effect. Apparatus constructed in accordance with our invention is readily adaptable to these different degrees of susceptibility and is positive in action. When used with material that is readily susceptible to magnetic forces, the intensity of the field set up between the poles of the magnet can be adjusted to produce a granular coated web of the desired characteristics. Adjustment of the intensity of the magnetic field to a higher concentration or greater density causes less susceptible particles to act in the same manner as more susceptible particles act in a lower intensity field.

The usual crushed granular abrasive materials contain some grains which are elongated and some grains which are block-like. The elongated grains may be either in the form of needles or splinters in which one dimension is materially longer than the other two dimensions, or may be in the form of plates. This type of grain is susceptible of being oriented so as to produce the desired inclined saw tooth effect of the grain. The other type of grain is block-like and has all of its dimensions substantially equal. Such grain, of course, is not susceptible of orientation and there would be no particular advantage in orienting it. The intermediate type of grain in which one dimension may be somewhat longer than the other dimensions is susceptible of some orientation, depending upon the degree of elongation.

The present machine is adapted to operate upon the usual mixes and will effectively orient the greater part, if not substantially all, of the elongated type of grain. However, if it is desired to produce abrasive cloth or paper having substantially all of the grains oriented, the material can be subjected to separation of the elongated particles from the block-like particles, and this material used. It is found that air separation tends to remove such particles from the block-like particles.

The present machine, of course, is adapted to use only materials which are susceptible to magnetic forces. Such abrasive materials contain iron impurities and are naturally magnetic. Materials which in themselves are not magnetic can be adapted for use by first coating them with an adhesive such as lacquer, varnish or the like, and then applying a thin layer of some iron-containing magnetic material, to render them susceptible to the magnetic orientation.

The machine is presumed to operate because

elongated magnetic particles, when passed into a magnetic field, act as small magnets or doublets upon which the magnetic field has a strong orienting influence. The machine is particularly adapted for use on materials which are both magnetic and conductive, and which because of their electric conductivity have been difficult to orient by electrostatic means. The machine has certain advantages over the electrostatic type of orienting apparatus in that high voltages are not required, but only those voltages usable for actuating electromagnets.

In our apparatus, the magnetized abrasive particles are not only magnetically oriented but are magnetically projected from the feed belt onto the adhesive coated web. This is effective in securing the maximum degree of orientation. The magnetized particles on the web, as they come into the magnetic field, will naturally tend to turn parallel to the magnetic field before they leave the belt. If not fully turned before they leave the belt, they are still subjected to the turning influence of the magnetic field as they travel freely from the belt to the adhesive coated surface. The result is that the particles as they impinge upon the adhesive coated surface are already oriented so that their longest dimensions stand out from the belt. This is far more effective in securing a high degree of orientation than would be an attempt to apply the abrasive material by gravity in a haphazard manner and subsequently orienting the particles.

The effect of gravity in the application of granular material to an adhesive coated surface is to tend to cause the elongated or plate-like particles to lie flat against the adhesive coated surface. In our apparatus, gravity does not tend to deposit the abrasive grains upon the adhesive coated surface, but on the contrary, the grains are drawn against the force of gravity and thereby tend to strike the adhesive coated surface endwise. As shown in the drawings, any effect of gravity on a coated web which is carried in an inverted position during the initial set of the adhesive is to maintain the elongated particles in their oriented position since they hang downwardly somewhat like pendulums. As shown in Fig. 1, the adhesive is given a preliminary set sufficiently to hold the particles in their oriented position before the web is passed over the roller and into a vertical position.

The electric current employed for energizing the electromagnets may either be direct current or a pulsating current. When a pulsating current, such as an intermittent direct current, a rectified alternating current or even an alternating current, is employed, the length of pulsations should be such as to effectively attract and orient the magnetic particles.

Other advantages will be apparent from the foregoing disclosure to those skilled in the art and while specific embodiments have been used to illustrate our invention, it is to be understood that the invention is not limited to those embodiments but is defined by the appended claims.

We claim:

1. Apparatus for the manufacture of granular coated webs comprising a pair of magnet poles positioned opposite one another, the adjacent faces of said poles being convergent toward one end, means for supporting and moving an adhesive coated web between said pole in a position closer to one pole face than the other and in the direction of convergency of the pole faces, the pole faces and web supporting means being so

positioned with respect to each other that the magnetic field at the convergent end of the pole faces intersects the web at an oblique angle, and means for introducing granular material into the magnetic field and in proximity to the surface of the web that is more remote from the web supporting means.

2. Apparatus for the manufacture of granular coated webs comprising a pair of magnet poles positioned opposite one another, the pole pieces of said poles being broad toward their respective cores and narrow at their adjacent edges, another pair of magnet poles positioned opposite one another and adjacent to the first pair of poles, the adjacent faces of said second pair of poles being convergent toward one end which is more remote from the first pair of pole pieces, means for supporting and moving an adhesive coated web between the pole faces of both pairs of poles in a position closer to the corresponding pole faces of the two pairs of poles than to the other corresponding pole faces and in a direction from the first pair of poles toward the second pair of poles, the pole faces and web supporting means being so positioned with respect to each other that the magnetic field at the convergent end of the pole faces intersects the web at an oblique angle, and means for introducing granular material into the magnetic field and in proximity to the surface of the web that is more remote from the web supporting means.

3. Apparatus for the manufacture of granular coated webs having particles oriented at an oblique angle, comprising means for applying magnetically susceptible granular material to an adhesive coated surface of the web, means for producing a magnetic field, and means for passing the granular coated web through the magnetic field and out of said field at an oblique angle to the magnetic lines of force thereof.

4. Apparatus for the manufacture of granular coated webs having particles oriented at an oblique angle, comprising means for producing a magnetic field, means for passing an adhesively coated web into said field, means located on the adhesive coated side of said web for introducing magnetically susceptible particles into said field, magnetic means for depositing said particles on said adhesive surface, and means for passing the

granular coated web out of said magnetic field at an oblique angle to the magnetic lines of force thereof.

5. Apparatus for the manufacture of granular coated webs having particles oriented at an oblique angle, comprising means for producing a non-uniform magnetic field, means for passing an adhesively coated web into said field, a feed belt located on the adhesively coated side of said web for introducing magnetically susceptible particles into said field, said apparatus being adapted to deposit the granular particles onto the adhesive surface and orient the particles at an oblique angle with respect to said web.

6. Apparatus for the manufacture of granular coated webs having particles oriented at an oblique angle, comprising means for applying magnetically susceptible granular material to an adhesive coated surface of the web, means for producing a magnetic field having the magnetic lines of force at one edge at least thereof substantially vertical, and means for passing a granular coated web with its coated face downwardly through such magnetic field at an oblique angle to the horizontal, the direction of travel being such that the web emerges from said field at a point where the magnetic lines of force are substantially vertical, whereby the force of gravity, tends to hold the particles in a substantially vertically oriented position and at an oblique angle to the surface of the web.

7. Apparatus for the manufacture of granular coated webs having particles oriented at an oblique angle, comprising means for producing a substantially vertical field, means for applying magnetically susceptible granular material to the adhesive coated surface of the web and means for passing the web with its coated face downwardly through said field at an oblique angle to the horizontal, whereby the magnetically susceptible particles are oriented at an oblique angle to the web, and means for passing the web having the particles so oriented through a drying zone and out of contact with devices which would destroy such orientation of the particles until the adhesive has set.

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