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COATING APPARATUS

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Fig. 1.

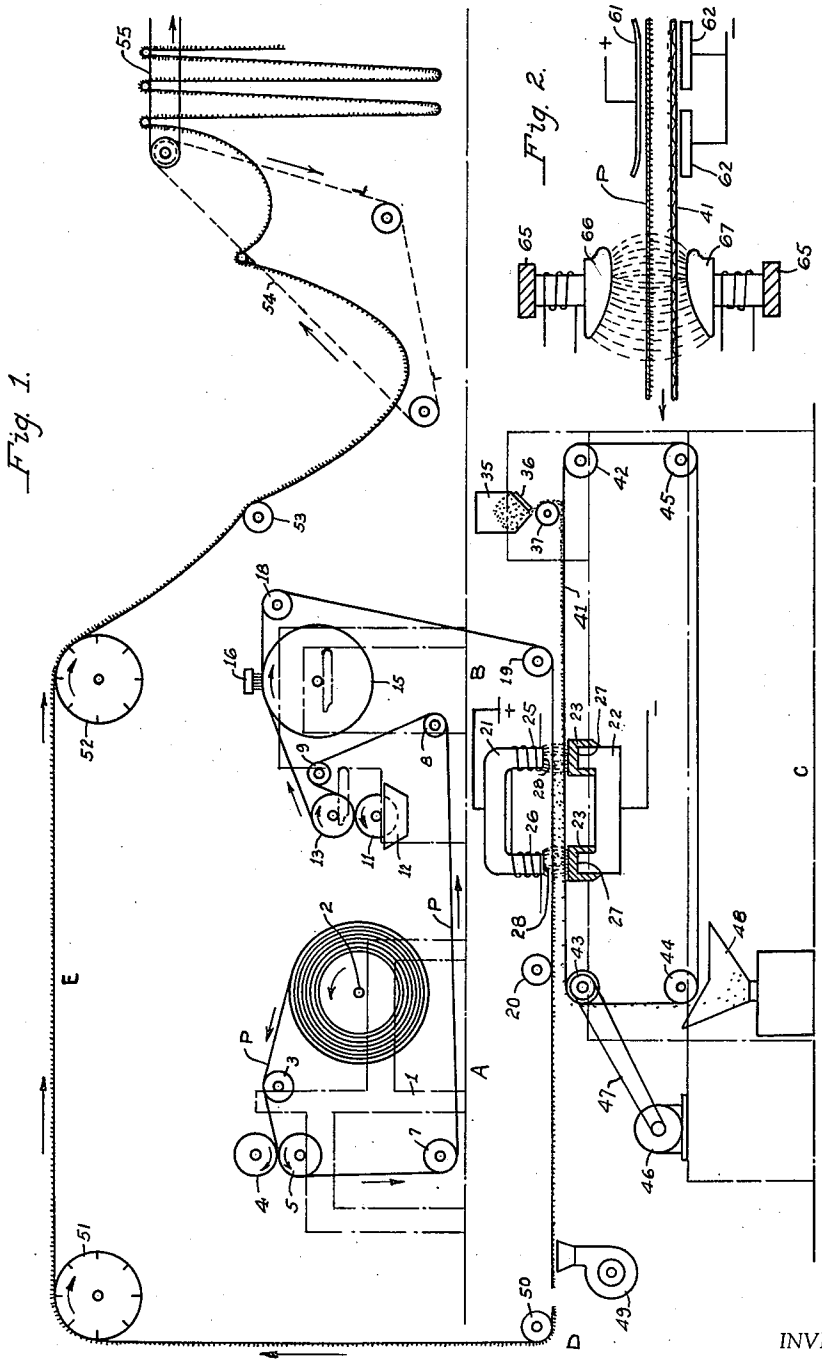

Fig. 2.

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COATING APPARATUS

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Application July 9, 1935, Serial No. 30,540

8 Claims. (Cl. 91—18)

This invention relates to improved apparatus for the manufacture of granular coated webs of such material as paper, cloth and the like, and has for an object the provision of apparatus for the manufacture of superior articles.

Abrasive particles commonly used in the manufacture of abrasive coated webs are of irregular shape and have some surfaces or edges that are sharper than others and more suitable for abrading operations when these sharper surfaces, edges or points, are positioned to engage the material being abraded. The usual method of applying granular particles to a web has been by dropping the particles from a hopper onto an adhesive coated surface, and since the particles, when dropped, fall in a haphazard manner, the usual method has not resulted in an orderly orientation of the particles.

It has been found heretofore that better abrasive coated webs can be produced by causing at least some of the granular particles deposited upon the web to become so oriented that the longer dimension of each grain projects from the surface of the web.

One form of apparatus that has been found to give satisfactory results has included electrostatic means for projecting the abrasive material upwardly and into engagement with the adhesively coated side of the web. In apparatus of this type, the adhesively coated web is supported with an adhesive coated side downward whereby the grains, when projected by the electrostatic means, strike this downward positioned side and adhere thereto. The electrostatic means used in such apparatus has included a high tension electrode positioned beneath the coated web and a low tension electrode positioned above the coated web, with a carrier means such as a canvas belt so positioned that the grain carrying side of the conveyor is between the lower electrode and the adhesively coated web. This apparatus is fully disclosed and claimed in a copending application, Serial No. 636,982, filed October 10, 1932.

The apparatus of the foregoing description operates in the following manner: The abrasive particles being carried by the conveyor come into the electrostatic field set up between the two electrodes and are projected upwardly and into engagement with the adhesively coated web. Apparatus of the kind just described produces a strong translational motion of electrically charged particles but produces a relatively weak turning moment or orienting influence to the elongated particles.

Another form of apparatus that has been found to give satisfactory results has included electromagnetic means for projecting the abrasive particles upwardly and into engagement with the adhesively coated side of the web. In an apparatus of this type the adhesively coated web is supported with an adhesively coated side facing downwardly whereby the grains, when projected by the electromagnetic means, strike this downward positioned side and adhere thereto. The electromagnetic means used in such apparatus has included a magnet having one pole positioned beneath the coated web and a pole of opposite polarity positioned above the coated web, with a carrier means such as a canvas belt so positioned that the grain carrying side of the conveyor is between the one pole face and the adhesively coated web. This apparatus is fully disclosed and claimed in a copending application, Serial No. 637,016, filed October 10, 1932.

The apparatus of the foregoing description operates in the following manner: The abrasive material being carried by the conveyor belt is carried into the magnetic field set up between the two poles of the magnet in such a position that it is projected upwardly and into engagement with the adhesively coated web. Apparatus of the kind just described produces a very strong orienting influence on the elongated abrasive granules but has the disadvantage of a relatively weak translational force and can not always be made to project the larger and heavier particles upwardly to such a distance to engage the adhesive surface of the web. While it is possible to make adjustments in the field intensity to project particles of widely different size, practical limitations in the intensity of the magnetic field that can be produced cause this type of apparatus to be somewhat restricted in its application.

Apparatus built in accordance with the present invention utilizes the combination of electrostatic forces and electromagnetic forces to project elongated abrasive particles onto a moving web and to produce and maintain a desired orientation of the moving abrasive particles. Thus the apparatus is suitable for projecting various kinds of material in which it is desired to produce a maximum translational force and at the same time impart a maximum turning or orienting influence to the projected particles. A better understanding of our invention can be had by referring to the accompanying drawing, in which:

Figure 1 is a diagrammatic side elevation of one form of our improved apparatus; and

Figure 2 is a section of a portion of another form of grain projector.

Figure 1 of the 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 applying abrasive 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 suitable drying chamber.

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

The adhesive applying means B comprises, as shown in the drawing, idler rolls 8 and 9 for guiding the web; a roll 11 positioned to dip into a pan 12 of adhesive; a pressure roll 13 for regulating the thickness of adhesive applied to the web by the roll 11; a revolving 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 adhesive distributing brush and drum.

The means C for applying elongated abrasive particles to the web P comprises, as shown in the drawing, idler rolls 19 and 20 for guiding and positioning the adhesive coated web; an endless feed belt 41 positioned below and substantially parallel to the moving web P and enclosing the supporting pulleys 42, 43, 44, and 45; variable speed driving means 46 and 47 for operating the grain feed belt 41; a grain hopper 35 with an adjustable feed gate 36 and roll 37 for distributing the abrasive particles onto the feed belt 41; electrostatic means for projecting the abrasive particles upwardly from the feed belt and electromagnetic means for imparting additional turning moment to the projected particles so as to insure maximum orientation of the elongated granules when deposited onto the adhesively coated web.

The electrostatic projecting means may comprise a U shape electrode 21 positioned above the web to be coated and a coacting electrode 22 positioned beneath the grain feed belt. The faces of the lower electrode 22 are covered with a poorly conducting material 23 in order to prevent arcing or flash-over when a high potential electromotive force is applied to the said electrodes 21 and 22. A source of electromotive force, the effective potential of which is 30,000 volts or more, not specifically shown in the drawing but indicated by the positive (+) and negative (—) symbols is applied to the electrodes and produces an electrostatic field therebetween. The source of electromotive force may produce a continuous unidirectional current, an intermittent unidirectional current, or a pulsating current, such as rectified alternating current. Ordinarily, and for more efficient operation, the lower electrode is connected to the negative terminal and the upper electrode 21 is connected to the positive terminal of the source of high electromotive force and is grounded also as a precautionary measure.

The upper electrode 21 also serves as the core of an electromagnet and is therefore made of a suitable grade of iron having the desired magnetic properties. Magnet coils 25 and 26 are wound on the projecting arms of the U shaped core 21 and connected to a suitable source of current which, when flowing through said magnet coils, produces a magnetic field of desired intensity between the pole faces 27 and 28. The lower electrode 22 is also made of iron and acts to concentrate the magnetic field between the projecting arms thereby concentrating the magnetic field as shown by the dotted lines in the drawing. Both the upper and lower electrodes may be vertically adjustable so that the character of the magnetic field produced may be altered to suit conditions. For example, the upper electrode may be adjusted so that the coated web passes along the axes of symmetry of the magnetic field whereby the abrasive granules are positioned perpendicular to the surface of the web. Or, if desired, the upper electrode may be lowered to such an extent that the coated web passes out of the field at an angle to the magnetic lines of force and the position of the deposited elongated particles altered accordingly.

Means D for causing the web to acquire a preliminary set comprises, as shown in the drawing, an idler roll 50 and a fan blower 49 for applying a large volume of air at a low velocity to the adhesive and abrasive coated side of the web P. The break in the web indicates a number of feet of travel of the web in a horizontal direction after the abrasive particles are applied to the under side.

The means E for moving the web P from the coating apparatus into the drying chamber comprises, as shown in the drawing, one or more suction drums 51 and 52; an idler roll 53; a rack 55 for supporting the web P; and an endless conveyor 54 for forming and transporting loops of the web P to the rack 55.

The character of the upper surface 23 of the lower electrode 22 appears to be of great importance in the operation of our apparatus and preferably is made of some poorly conducting material. The material should be so poorly conducting that not enough current can flow along or through it to cause arcing between the bottom and upper electrodes, yet it should be sufficiently conducting to allow a small leakage current to supply negative charges to the granular material in order that they may be repulsed from the feed belt across the electrostatic field toward the grounded upper electrode. This material should also be of such character as not to interfere with the magnetic field formed between the upper and lower magnetic poles 28 and 27 respectively.

In the normal operation of the apparatus illustrated herein, 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 the liquid adhesive tank 12 and by its rotation applies a layer of adhesive to the web P.

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 20 into a position over a suitable grain projector which is adapted to project abrasive grains upwardly from the grain feed belt 41, orient such grains so that their longest dimensions are parallel to their path of travel and deposit them onto the downwardly facing surface of the web in a perpendicularly oriented position. The projector illustrated in Figure 1 comprises an electrostatic field set up between the electrodes 21 and 22 for projecting the abra-

sive particles from the feed belt 41 upwardly and into engagement with the downwardly facing adhesively coated surface of the web P. A magnetic field, simultaneously applied to the abrasive particles, produces an additional turning moment to the magnetically susceptible abrasive particles and causes them to become oriented as they move from the feed belt into engagement with the adhesive coated web P. This magnetic force continues to act on the abrasive particles even after they are deposited onto the web and insures a desired positioning of each individual particle.

Granular particles are distributed from the grain hopper 35 onto the grain feed belt 41, which moves through the electrostatic and magnetic fields parallel to the web P and in the same direction therewith. As the abrasive material moves through the electrostatic field the particles leave the feed belt and move upward toward the web, where they become attached because of the adhesive coating. The granular particles acquire an electrical charge upon entering the electrostatic field and this charge reacts with the charged electrodes causing them to be projected upwardly from the grain feed belt. Simultaneously the particles are energized magnetically and become, in effect, miniature magnets with magnetic poles of opposite polarity at their extreme ends, or, in other words, in such a manner that the magnetic axes lie along the major axes. Forces produced by the magnetic field then produce a turning moment which tends to turn the individual particles so that their major axes are parallel to the magnetic lines of force. Thus the abrasive particles are projected by electrostatic forces and magnetic forces assist in producing the maximum turning moment so that the projected particles become oriented and strike the adhesive coated web head-on with the major axes of each individual particle substantially perpendicular to the adhesive coated web P. By passing the coated web through and out of the magnetic field at an angle normal to the magnetic lines of force the elongated abrasive particles are maintained in an upstanding or oriented position.

Provision for causing the adhesive to acquire at least a preliminary set after the granules have been deposited onto the web is made by incorporating a blower 49 capable of delivering a large volume of air at a low velocity against the abrasive coated surface. This blower 49 is located between the grain projecting means and the idler roll 50 and causes the adhesive to set or acquire sufficient firmness to prevent the granules from being positioned in any other manner than that desired before the direction of movement of the web is changed. From the roll 50 the coated web is drawn over the suction drums 51 and 52 to a suitable drying rack 55 where the adhesive is caused to set.

A bin 48 receives the abrasive particles or surplus grains which do not adhere to the coated web, but fall back onto the feed belt and are carried out of the coating zone.

In the modification shown in Figure 2 an electrostatic field produced between the upper electrode 61 and the lower electrodes 62 causes abrasive particles, carried by the feed belt 41, to be projected upwardly into engagement with the downwardly facing adhesively coated side of the web P. The abrasive coated web is immediately thereafter passed through a magnetic field produced by a magnet 65. This magnet has opposing pole faces 66 and 67 so designed as to produce a distributed magnetic field of relatively strong intensity in the area adjoining the electrostatic field and of gradually decreasing intensity at its other end (as represented diagrammatically by the dotted lines of force).

In the operation of the above described apparatus the abrasive particles are projected onto the adhesively coated surface of the web by electrostatic forces and the freshly coated web passed immediately into a magnetic field in which magnetic forces operate to produce and maintain a desired orientation of the abrasive particles.

In apparatus built in accordance with our invention, electrostatic and magnetic forces are caused to coact in producing results not obtainable heretofore with the apparatus known to the prior art. The application of magnetic forces assist in the turning or orientation of the abrasive particles while they are being projected electrostatically onto the surface being coated. This is a distinct advantage in that both the strong translatory action of an electrostatic field and the strong orienting influence of a magnetic field are simultaneously utilized in the projection and orientation of abrasive praticles in the manufacture of abrasive coated materials.

While we have described our invention with specific illustrations, it is not intended that these illustrations shall define the scope of our invention. Various modifications may be made by those skilled in the art without departing from the spirit or scope of our invention as defined in the appended claims.

We claim:

1. Apparatus for applying a coating of oriented abrasive particles to a moving web, comprising electrodes arranged one above another, means for applying a potential difference to the upper and lower electrodes, a magnet having oppositely positioned poles, means for passing the web to be coated between said electrodes and magnetic poles with an adhesive coated surface facing downwardly, a carrier for conveying abrasive particles into the fields between said electrodes and poles, said apparatus being adapted to electrostatically project the abrasive particles upwardly from the carrier against the adhesive coated surface and to subject the said particles to the orienting action of a magnetic field.

2. Apparatus for applying a coating of oriented abrasive particles to a moving web, comprising electrodes arranged one above another, means for applying a potential difference to the upper and lower electrodes, a magnet having oppositely positioned poles, means for passing the web to be coated between said electrodes and magnetic poles with an adhesive coated surface facing downwardly, a feed belt movable between the adhesive coated web and the lower of said electrodes and poles, means for applying abrasive particles to said feed belt to be carried between the said electrodes and poles and beneath the adhesive coated web, and electrostatic means for projecting the abrasive particles upwardly from the belt against the downwardly facing adhesive coated surface of the web while said particles are subjected to the orienting action of the magnetic field between the said poles.

3. Apparatus for applying a coating of oriented abrasive particles to a moving web comprising magnetic poles of opposite polarity located one above the other, the pole faces of said magnets also serving as electrodes for producing an electrostatic field, means for applying a high potential difference between the upper and lower electrodes, means for supporting an adhesive coated

web between said electrodes with the adhesive coated surface downward, means for conveying abrasive particles into the combined electrostatic and magnetic fields, said apparatus being adapted to electrostatically project the abrasive particles upwardly against the adhesive coated web while the particles are subjected to the orienting influence of the magnetic field.

4. Apparatus for applying a coating of oriented abrasive particles to a moving web comprising an electromagnet having a U shaped core positioned on one side of the web to be coated, the pole faces of said core forming one electrode of an electrostatic field, a second magnet core positioned on the opposite side of said web and spaced apart therefrom and forming an electrode of opposite polarity of an electrostatic field, means for applying a high electrical potential difference between the said electrodes and means for conveying abrasive particles into a position between the said web and one of said electrodes.

5. Apparatus for applying a coating of oriented abrasive particles to a moving web comprising an electromagnet having a U shaped core positioned on one side of the web to be coated, the pole faces of said core forming one electrode of an electrostatic field, a second magnet core positioned on the opposite side of said web and spaced apart therefrom and forming an electrode of an electrostatic field, one of said electrode surfaces being covered with a sheath of sufficient conductivity to permit a leakage current to flow therethrough but of sufficient resistance to prevent spark-over or arcing to the electrode of opposite polarity, means for applying a high electrical potential difference to the said electrodes and means for conveying abrasive particles into a position between the said web and one of said electrodes.

6. Apparatus for applying a coating of oriented abrasive particles to a moving web, comprising electrostatic means for projecting abrasive particles onto an adhesively coated web, means for producing a magnetic field and means for passing the abrasive coated web through the magnetic field and out of said field substantially normal to the magnetic lines of force thereof.

7. Apparatus for applying a coating of oriented abrasive particles to a moving web, comprising electrostatic means for projecting abrasive particles onto an adhesively coated web, means for producing a magnetic field and means for simultaneously subjecting the projected particles to the orienting influence of said magnetic field whereby maximum orientation of the abrasive particles is secured.

8. Apparatus for applying a coating of oriented abrasive particles to a moving web, comprising electrostatic means for projecting abrasive particles onto an adhesively coated web, means for producing a magnetic field and means for subsequently subjecting the projected particles to the orienting influence of said magnetic field including means for passing the coated web out of said magnetic field substantially normal to the magnetic lines of force thereof.

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