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METHOD OF AND MEANS FOR THE MANUFACTURE OF ABRASIVE CLOTH

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METHOD OF AND MEANS FOR THE Manufacture of Abrasive Cloth

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My invention relates generally to an electrostatic means which will automatically deposit and deposit fine particles upon a suitable backing, and more particularly relates to the manufacture of abrasive cloth, such as sandpaper, emery paper or cloth, and the like. In such articles, the abrasive particles are held by a binder on a backing of paper, cloth or some suitable material. In this specification I employ the term "abrasive cloth" as generic to articles of this character, regardless of the specific backing, be it paper, cloth or any other appropriate material.

Usually, the abrasive cloth is manufactured by the depositing of abrasive particles upon a suitably treated backing. In some instances, the backing is first coated with an appropriate binder, of which many are well known to the art. For instance, a glue may be utilized which is sticky in the region where the particles are applied, but which dries rapidly after the application of the particles. Heat or heated air may aid in the drying process.

Another common method of manufacturing abrasive cloth is to coat the backing with a melted or softened binder. The abrasive particles are then applied while the binder is still in its sticky state and prior to solidification. Whatever binder is used, or whatever manner the binder is made to hold the abrasive particles to the backing, is not a part of my invention.

Whatever material is chosen for the backing and binder, it is manifest that any abrasive cloth upon which the particles are fixed haphazardly is not as efficient as a cloth in which the particles are fixed with sharp edges at the rubbing contact surface, and a process which attains this result is highly desirable. It is further desirable in the manufacture of abrasive cloth to deposit the relatively larger particles of the abrasive on the backing prior to the depositing of the relatively smaller particles. This enables the smaller particles to be dispersed among the larger particles. Where haphazard depositing is resorted to, smaller particles may be the first to contact the binder and the larger particles frequently fall upon and cover such smaller particles. By first depositing the larger particles a more satisfactory abrasive cloth is obtained and an unnecessarily thick abrasive layer is avoided.

It is accordingly an object of my invention to produce a device which will automatically deposit the larger particles upon the backing prior to the smaller particles, and automatically align substantially all the particles with their sharp edges towards the rubbing contact surface of the cloth.

My invention is particularly adaptable for a continuous process of manufacture of abrasive cloth, and which with my invention can be made to function at an extremely rapid rate.

Briefly, I achieve my results by dropping fine abrasive particles into an ionized atmosphere of extended depth, and created by a corona field, so that they assume electrical charges. An attracting force propels the now charged particles toward a backing upon which they are made to adhere by the binder thereon.

When particles move through a gas, the gas resistance causes the particles of different sizes to move at different rates, the coarser particles moving more rapidly than the finer particles in accordance with Stokes' law, as is well known. This holds true for the movement of particles due to either a gravitational field or an electrical field of force, or both. I make use of this principle in my device.

The backing with the binder thereon is moved in a direction counter to that of the moving particles, while a charged plate to the rear of the backing attracts the charged particles toward the backing. Because of the relative movement between the particles and the backing, the larger particles deposit themselves first upon the backing, with particles of decreasing size depositing themselves thereafter as the backing moves upward.

For a more specific description of the general principles of my invention, reference may be had to the accompanying drawing; in which:

Figure 1 is a sectional view of the essential parts of an abrasive cloth manufacturing device according to my invention, shown somewhat diagrammatically; and

Fig. 2 is a side view taken along the line II—I of Fig. 1 of the hopper and ionizing wires.

The apparatus disclosed in the drawing comprises a hopper or feeding chamber adapted to feed a continuous, thin layer of fine abrasive particles of the grade desired to be deposited upon the backing.

A conveyor may be used to replenish the hopper continually. The hopper or feeding chamber is so arranged that the fine particles fall freely in a substantially vertical plane. Below and to the side of the hopper is a frame having fine wires stretched horizontally therein. I have found that very efficient results are obtained by the use of wires of the smaller sizes which give a strong corona for relatively low
voltage. The frame 17 may be of insulating material, and as an added precaution the wires 9 may be connected between insulators 11 secured to the frame in any appropriate manner. I prefer to dispose the frame vertically and close to the bottom of the falling abrasive particles, but I have provided clamps 13 for positioning the frame 17 along any angle desired and at any distance relative to the falling particles. The clamps 13 are shown as of a common variety permitting of adjustment and fastening in three dimensions and clamp upon rods 15 extending from the frame 17 for holding the frame in the desired position. The clamps 13 also support the frame in the particular device shown. However, it is obvious that any other suitable adjusting and supporting means may be employed depending upon operating conditions or the particular desire of the manufacturer.

At the other side of the falling particles is disposed a metallic plate 17 which may also be adjustably supported by any suitable means, shown diagrammatically in three dimensions and clamp upon rods 15 extending from the frame 17 as shown in Fig. 1 as clamps 13. Immediately to the front of the plate 17 is the backing strip 21 having a binder coat 23 applied thereon by any suitable means (not shown). The strip passes over rollers 25 and 27, which may be mounted for adjustment horizontally or vertically or both. A receptacle 28 is disposed below the space generally indicated at 31 for collecting any particles that fail to be deposited upon the strip 21, as hereinafter described.

The wires 9 and the plate 17 are oppositely charged by any suitable electrical apparatus. I have shown a wire 33 connecting the separate wires 9 so that they may be at a common potential. The wire 33, in turn, is connected to a terminal of a source of direct current, indicated at 35, the other terminal of which is grounded, as indicated at 37. The charging circuit is completed to the plate 17 by means of a ground connection 29. I have chosen battery and ground connections as the simplest form of indicating a potential source, but in actual practice, I prefer to use rectified alternating current since high potentials are necessary. Also, instead of a grounded return, a complete metallic circuit may be within the equivalence of my electrical connections.

The particles will deposit themselves upon the strip regardless of the relative polarities of the wires 9 and the plate 17. The wires 9 may be positive with respect to the plate 17 or vice versa. However, I prefer to connect the source so that the wires 9 are negative and the collector plate positive, inasmuch as better results are obtained with this connection.

The collecting electrode is spaced from the feeding means a distance sufficient to permit the particles to attain different speeds proportional to their size, as stated by Stokes' law.

In the operation of my device, the wires 9 are preferably constructed of fine wire in order that a corona discharge may be produced without undue high voltages. The wire 33 may, if desired, pass through an insulator 35 in the frame 17, and extend to the hopper 1 to charge the same.

The fine abrasive particles are conveyed by the conveyor 5 to the hopper 1 and fall freely from the cam of the hopper. The wire 33 charges the hopper 1 so that some of the particles may attain a charge thereon by direct contact with the hopper 1. However, this feature is optional in my invention. As the particles fall they come within the ionizing atmosphere created by the corona surrounding the charged wires 9 and assume electrical charges. The attracting action of plate 17 causes the particles to migrate toward the strip 21, and if the strip 21 is assumed to be stationary, the finest particles will be deposited at the upper portion of the strip 21, while increasingly coarser particles will be deposited as the distance downward increases.

The moving particles are attracted in this manner and gradually acquire a net charge, causing them to move slower toward the collector plate than the larger particles, and with a greater relative acceleration. The total effect as it occurs in my device may be summarized generally by stating that in a unit of ionized space the smaller particles tend to be deflected towards the collector plates earlier in their path than the larger particles which move a great distance downward before attaining the same deflection. If now the strip 21 is made to move upward as shown by the arrows, the coarser particles present in the lower region of the space 31 will deposit themselves first upon the strip. As the segment A of the strip rises, it moves into regions of particles of gradually decreasing size and which are deposited upon the segment in that order.

The charged particles attempt to align themselves with their sharpest points toward the ionized zone and are so deposited upon the strip 21. The physical explanation for this action is that particles moving through a gas tend to align themselves so as to present the least resistance to their movement. To do this, the largest surface of a particle is foremost in the direction of its movement and the more pointed surface extends rearward. The electrostatic attraction also aids to force this "streamline" arrangement in that the total charge on any surface of the particle is a maximum on that surface of the particle having the greatest flat component of area. Therefore, this surface has the greatest attracting force, and will be the leading surface of the particle in moving towards the collector plate.

The intensity of the stressed field may be regulated to conform to the size of the particles being treated, either by changing the spacing between the electrodes 9 and 17, or by adjusting the angle of either of them with respect to the vertical, or by controlling their potential difference, or by a combination of these factors. The adjustments may also be employed to control the grading effect upon the particles. I have found also that it may at times be desirable to adjust the position of the strip 21, and the particular physical relationship between the elements 9, 11 and 21 is a matter of choice, determined primarily by experimentation for the particular work at hand. Moreover, the speed of the strip itself can be controlled for further refinements in the process of manufacture.

While I have illustrated my invention in the form in which I now believe to be the best mode of application thereof, it is obvious that many changes may be made within the spirit and scope of the novel system which I have introduced. It is desired, therefore, that the appended claims be given the broadest construction consistent.
with their language and limited only by the prior art.

I claim as my invention:

1. The method of manufacturing abrasive cloth strip and the like which consists of dropping finely divided abrasive particles through an ionized zone so that they become charged, attracting said particles sidewise towards an oppositely charged element, depositing the particles upon a sticky strip which is interposed in the attracting path, and moving said strip with a component of upward motion relative to said particles.

2. The method of making abrasive cloth strip and the like which consists of first depositing larger abrasive particles upon the strip and then depositing finer particles thereon whereby the latter particles are interspersed among the former particles.

3. The method of making abrasive cloth strip and the like which consists of gradually graduating abrasive particles from fine to relatively coarse in a zone, relatively moving said strip in said zone from the coarse end to the fine end, and depositing said particles on said strip during such movement.

4. The method of making abrasive cloth strip and the like which consists of gradually graduating abrasive particles from fine to relatively coarse in a zone, electrically charging said particles, relatively moving said strip with sticking material thereon in said zone from the coarse end to the fine end, and attracting said charged particles to said strip during such movement.

5. Apparatus for making abrasive cloth and the like, comprising means for establishing an ionized zone, dropping finely-divided abrasive particles through said zone, moving a sticky strip with an upward component at one side of said zone, and applying a high potential between electrodes, one at said one side of said zone, and the other at an opposite side with the said strip between them, to deflect said particles in graduated sizes from relatively fine at the top of said zone to relatively coarse at the bottom.

6. Apparatus for making abrasive cloth and the like, comprising a means for discharging particles of different sizes in a thin downwardly directed stream, ionizing means at one side of said stream, oppositely charged means at the opposite side of said stream, and means to support a sticky depositing strip between said ionizing means and said oppositely charged means, in proximity to the latter.

7. Apparatus for making abrasive cloth and the like, comprising a means for discharging particles of different sizes in a thin downwardly directed stream, ionizing means at one side of said stream, oppositely charged means at the opposite side of said stream, and means to support a sticky depositing strip between said ionizing means and said oppositely charged means, in proximity to the latter.

8. The method of making abrasive cloth and the like which consists of establishing an ionized zone, dropping finely-divided abrasive particles through said zone, moving a sticky strip with an upward component at one side of said zone, and applying a high potential between electrodes, one at said one side of said zone, and the other at an opposite side with the said strip between them, to deflect said particles in graduated sizes from relatively fine at the top of said zone to relatively coarse at the bottom.

9. Apparatus for making abrasive cloth and the like, comprising means for establishing an ionized zone having a distributed electrostatic field, means for dropping finely-divided particles through said zone to charge said particles, and means to move a sticky strip upwardly at one side of said zone, whereby said particles will be deflected to said strip in graduated sizes, relatively fine at the top of said zone to relatively coarse at the bottom.

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