Oct. 17, 1933. O. S. BUCKNER 1,930,788

APPARATUS AND PROCESS OF MAKING ABRASIVE TOOLS

Filed May 31, 1927 2 Sheets-Sheet 1

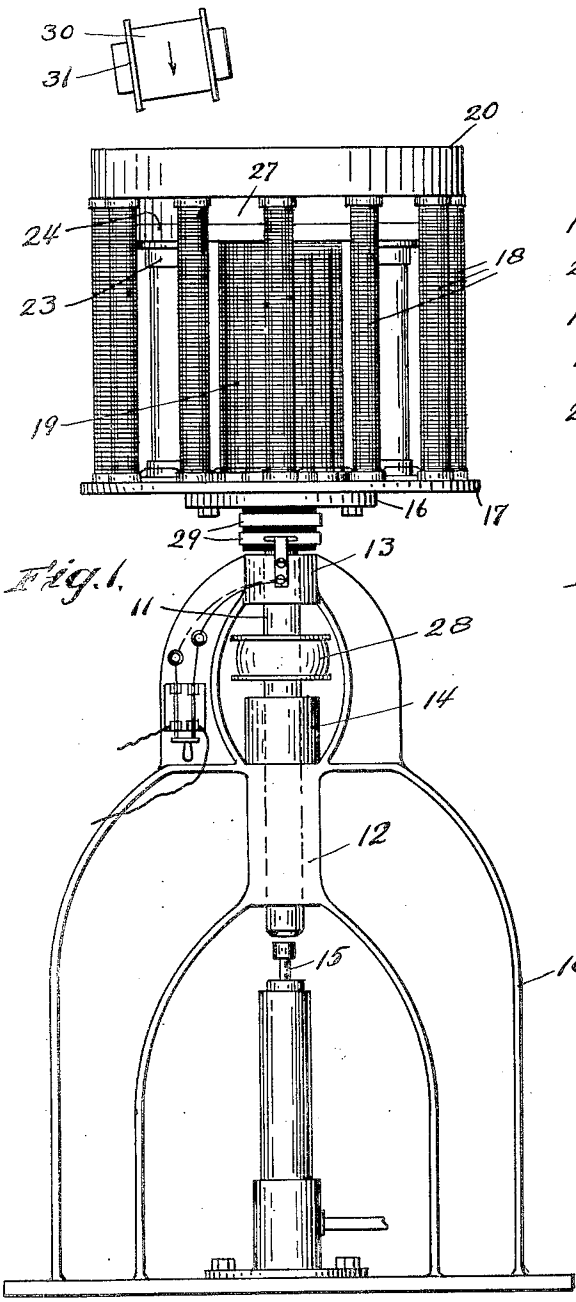

Fig. 1.

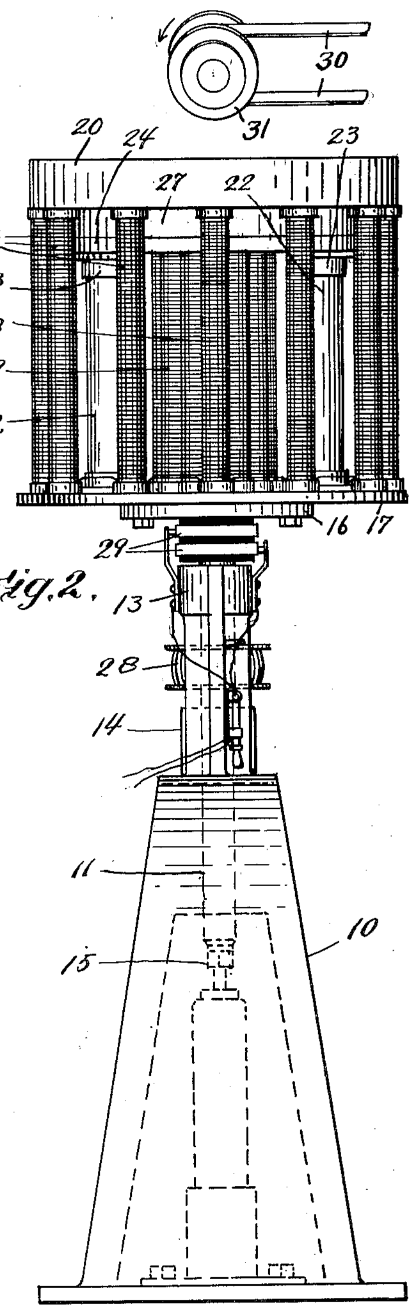

Fig. 2.

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APPARATUS AND PROCESS OF MAKING ABRASIVE TOOLS

Filed May 31, 1927 2 Sheets-Sheet 2

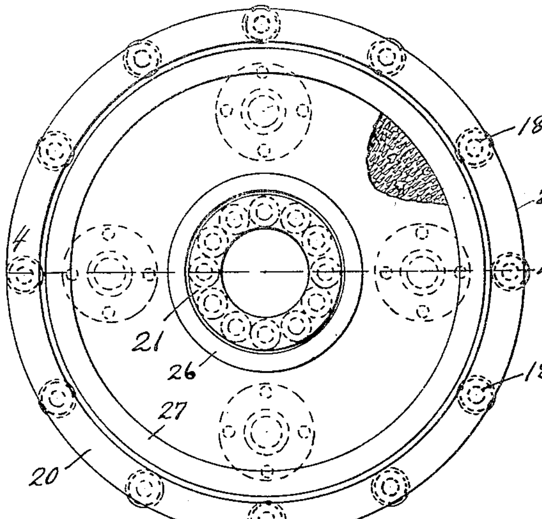

Fig. 3.

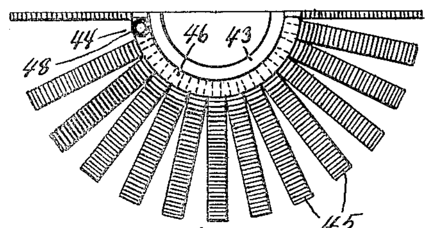

Fig. 5.

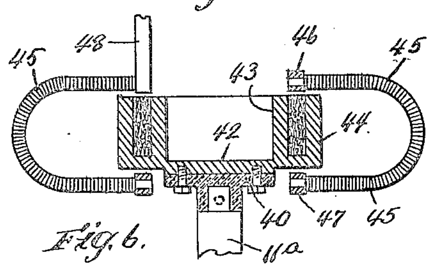

Fig. 6.

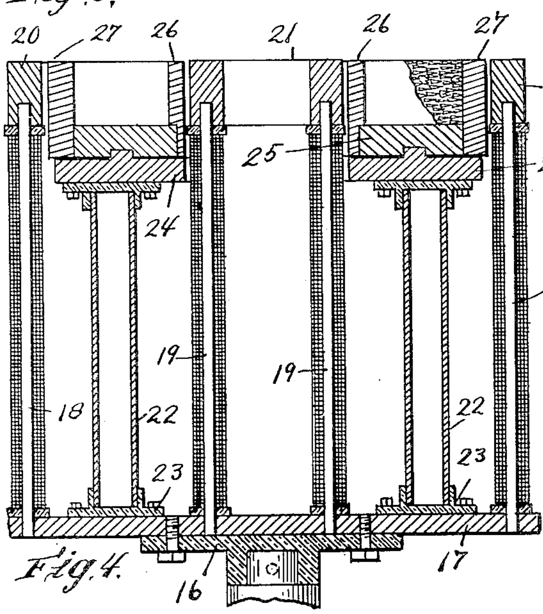

Fig. 4.

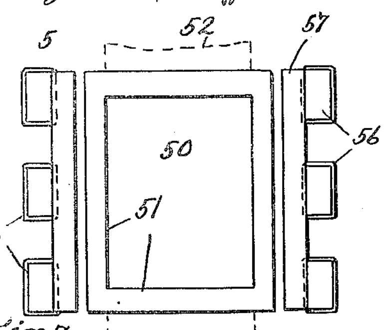

Fig. 7.

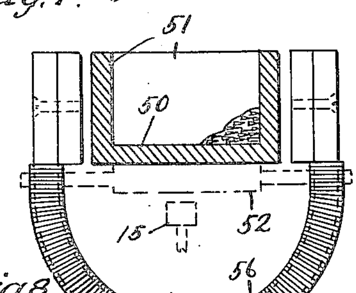

Fig. 8.

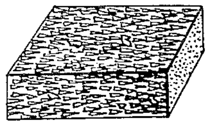

Fig. 10.

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UNITED STATES PATENT OFFICE

1,930,788

APPARATUS AND PROCESS OF MAKING ABRASIVE TOOLS

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Application May 31, 1927. Serial No. 195,383

21 Claims. (Cl. 18—5)

This invention relates to processes and apparatus for producing abrading devices of the non-flexible type, such as wheels, blocks and the like, which are formed by bonding abrasive grains in a mass.

Abrasive materials, such as corrundum, emery, artificial corrundum, crystalline alumina, carbide of silicon, and other well known forms of granular abrasives, are usually composed of irregularly shaped grains, a substantial proportion of which are of distinctly elongated formation, so that one dimension thereof is longer than the others, the presence of elongated grains in large proportion being particularly apparent among grains of the larger sizes, such as are usually employed in the construction of abrasive devices which are to be used for rough work. Abrasive grains of elongated formation necessarily have correspondingly flattened sides, which are much less effective, when engaged with the work, than the ends thereof, even though the ends may not be sharply pointed, or knife edged. Abrasive grains of this character are usually mixed with grains of more nearly cubical formation, which have pointed portions, so that one dimension is somewhat longer than some of the others.

In the construction of abrasive tools such as blocks, wheels, cylinders, etc., it is customary to mix abrasive material with various forms of organic or ceramic bonds which are adapted to be softened or fused when subjected to heat, then to place the mixture in a mold of the shape desired and subject the mass to considerable pressure, so that it is compressed into a cake, which is then baked, causing the bond to become softened or fused, so that, when it hardens, on cooling, the grains will be firmly bound together.

In performing this process, the grains of abrasive have been fixed in the bond in practically the positions in which they chance to fall, when placed in the mold, so that, while some of the elongated grains are likely to lie in approximately perpendicular relation to the work engaging face of the tool, much the greater proportion thereof are likely to lie with their sides either in parallel relation to the face, or at various angles between parallel and perpendicular positions relative thereto. As this condition obtains throughout the mass, it follows that it is indicative of the condition of the work engaging face at any time.

The cutting effect of which an abrasive tool of any given grit size is capable, or the extent to which it is free cutting depends to a large extend on the multiplicity of its cutting points, or the number of cutting points which it has in its abrading surface per unit of area thereof, and, as it is usually desired that an abrading tool be as free cutting as possible, any condition which increases the number of the cutting points in its abrading surface, without detrimental effect otherwise, is desirable, as it increases its efficiency. If the elongated abrasive grains in an abrading tool lie mainly flatwise to its abrading surface, it follows that the number of the cutting points in said surface, and therefore the cutting effect of the tool, will be less than that of a tool in which the elongated grains lie mainly in an approximately perpendicular relation to the surface, and if the abrasive grains which are not distinctly elongated, but are of more nearly cubical formation, are arranged so that the number of cutting points per unit of area in the surface are increased, a corresponding increase in the efficiency or cutting effect of the tool will be secured.

In other words the sharp or pointed ends of the grains have a much greater cutting effect than the sides thereof as the sides present practically flat, or nearly flat surfaces to the work, or points whose included angles are relatively large, so that their action is more nearly a rubbing action which dislodges small particles, than a distinctly cutting or severing action. Moreover, an action, which is more distinctly a rubbing action, has a much greater tendency to cause heat than a cutting action, on account of the fact that the friction is much greater in removing a certain amount of material than it would be if removed by an action which severs.

Where the abrasive grains are largely of elongated formation, and are poured into the mold in the customary manner, the grains lie criss-cross and leave many unfilled spaces, resulting in a tool which lacks solidity and uniformity in its construction. Tests have shown, and it is well known to manufacturers of abrasive tools, that the durability of such tools, and the length of service which they will give, depends to a substantial extent on their weight per unit of volume, or the density of the structure which they form. In consequence it has been the practice to subject the elongated grains to further treatment to reduce them to a more nearly cubical, or polyhedral form, so that the density of structure would be increased and each grain would present a correspondingly large number of sharp points, one of which would be likely to form a part of the working face of the tool.

This further treatment necessary to produce cubical, or polyhedral grains, increases the cost of the abrasive, as compared with the elongated grains before referred to.

The primary object of my invention is to produce an abrading device or tool which will have a substantially increased efficiency, as compared with the efficiency of devices of this character which are made by the methods now generally employed.

Further objects of my invention are to produce an abrasive tool which may be formed largely, or wholly of abrasive grains which are of elongated formation, but which will be practically as solid, or free from spaces between the grains as when formed from grains of the cubical or polyhedral type, so that the less expensive forms of abrasives may be employed, and, at the same time, a tool may be produced which will have increased durability, more effective clearance at the cutting points, and an increased number of cutting points in the working face, so that the efficiency thereof will be substantially increased, as compared with tools formed from grains of the cubical, or polyhedral type.

I accomplish these objects by producing an abrading device which is principally composed of abrasive grains of elongated formation, so that one dimension is substantially longer than the others, and by arranging said grains so that they lie side by side and are packed closely together, with their longer dimensions extending in approximately perpendicular relation to the working face of the tool, or in radial relation thereto when the tool is of the wheel type and has a circular face, said grains being securely bonded in these positions, so that their ends will be presented to the work and they will have deep settings which will prevent them from being dislodged in use.

Inasmuch as the arrangement of the grains of which a tool is formed in any particular manner before bonding, by any mechanical means, is, so far as I am aware, practically impossible, and must be secured, if at all, at but slight increase in manufacturing expense, so that the advantages secured will not be nullified by the expense of manufacture, a further and quite equally important object of my invention is to provide a commercially practical process of producing abrading devices of the character above referred to, in which the mass of elongated abrasive grains of which a particular device is formed will be mainly positioned in approximately perpendicular relation to the working face of the device, and grains of more nearly cubical formation will be mainly positioned with their more pointed portions projecting towards, or into the working face thereof.

I accomplish this object, primarily, by producing within the mold in which the tool is to be formed a magnetic flux, which acts to polarize the abrasive grains, as the latter are placed therein, so that the pointed ends of the grains will be magnetically attracted in a particular direction and a large proportion of the grains will be turned into positions in which said ends will be pointed towards the abrading face of the tool.

Practically all abrasive grains which are at present in use are non-magnetic and consequently will not be either attracted or repelled by a magnetic field. Such grains may be influenced by an electrostatic field, but such a field causes the grains to have a repellent effect on each other, so that if the grains were showered into a mold through an electro-static field, while they might be temporarily influenced to point in a certain direction, as soon as two grains come into contact with each other in the mold there would be an electrical discharge from one to another, which will instantly nullify any positioning effect which had been secured.

A further object of my invention therefore, is to provide a process whereby non-magnetic abrasive grains may be positioned by means of a magnetic flux and I accomplish this object primarily by providing the grains with a thin coating of iron dust, which is adhesively secured thereto, so that they become magnetically responsive.

In the practical application of this process, I produce a magnetic field within the mold in which the tool is to be formed, the lines of force of which are directed approximately perpendicularly to the abrading face of the tool to be formed, so that the grains when showered into the mold, or placed therein in successive layers, will be polarized and caused to be turned into positions in line with the lines of force by which they are effected, or to be turned into positions in which the positively magnetized end of practically each grain will be nearest the negative pole of the magnet which generates the field and the negatively magnetized end thereof will be nearest the positive pole of the magnet, and will be held in this position until the mass is compressed and bonded.

Also in connection with the operation of polarizing and distributing the grains of abrasive in the mold, or other means in, or on which the grains are positioned before bonding, I provide means for assisting or facilitating the effect of the magnetic, or electrostatic action, in tending to turn the grains so that they will point mainly in one direction, by providing means for imparting a slight jarring action to the container into which the grains are delivered.

For a more complete description of the invention and of the means by which it may be performed, reference is now made to the accompanying drawings, in which:

Figs. 1 and 2 are front and side elevations of a form of combined electromagnetic and mechanical apparatus which is preferably employed in performing certain portions of the hereindescribed method and in the construction of a certain type of abrasive tool.

Fig. 3 is a top plan view thereof.

Fig. 4 is a sectional view on line 4—4 of Fig. 3.

Figs. 5 and 6 are respectively plan and sectional views indicating a modified form of apparatus which may be employed in making an abrasive tool of another type.

Figs. 7 and 8 are respectively plan and sectional views indicating another form of apparatus which may be employed in making another type of tool.

Fig. 9 is a detail view indicating an abrasive tool made according to my invention.

As preliminary steps in the method, the abrasive grains are thoroughly mixed with a suitable bond, and in connection with this step the abrasive grains, when of non-magnetic material, as is usual, are coated with a form of magnetic dust, a ferrous dust such as powdered steel being preferable. This may be accomplished in several different ways, all of which are considered to be within the scope of my invention.

Certain bonds or binders which are frequently employed are of a somewhat adhesive nature, as for example certain forms of synthetic resins, which become adhesive when slightly heated above ordinary temperatures. As illustrative of a method of coating with a bond having adhesive characteristics, two pounds of 180 mesh, steel dust, (approximately 2% of the abrasive weight) are mixed with 100 pounds of granular abrasive material, and 25 pounds of powdered phenol-formaldehyde resin, the quantity of the phenol-formaldehyde resin being varied, however, to meet the requirement of any particuluar abrasive article. These materials are mixed in any suitable manner, heat being applied meanwhile until the abrasive is coated with the softened phenol-formaldehyde resin and steel particles. Upon cooling the abrasive grains, which tend to adhere together, are broken apart in any convenient manner, as by a crushing process. The abrasive grains will thus be coated with a mixture of the bond in sufficient quantity to bind the grains together in the finished article when fired, and a thin coating of magnetic material, sufficient to enable the grains to be influenced by magnetic forces.

The steel dust may also be adhesively connected to the abrasive grains by first mixing an adhesive, such as dextrine, or glue, with the abrasive, and by then adding the steel dust, so that the grains become coated therewith after which the abrasive, thus coated, will be mixed with the bond.

Also, if the bond is of an adhesive nature, it may be first mixed with the abrasive, so that the grains are coated therewith, and then the steel dust may be mixed therewith, so that it will cover the surface of the bond on the abrasive grains. That is, the magnetic material may be either mixed with the bond with which the grains are coated, or may be adhesively connected directly to the surface of the grains, or may be applied to the grains after they have been coated with the bond. The abrasive grains must, in each instance, when thus treated, still be in a freely granular condition, or be again reduced to a state in which the grains do not adhere to one another, as by a crushing process, so that the coated grains may be showered into a container.

To perform the next step in the process in a manner to enable the same to be carried on commercially, with reasonable economy, it has been necessary to design special apparatus for the purpose which will be varied according to the particular forms of abrasive devices or tools to be constructed, the more common forms of which are the flat annulus having a peripheral abrading face, and a central hole to receive an arbor, the hollow cylinder having an abrasive face at either end, and also numerous forms of abrasive blocks which are usually solid, but not necessarily so.

It will be understood that the apparatus hereinafter described and shown on the drawings, is to be considered as illustrative of types of apparatus which may be employed, and that numerous variations therefrom may be made in practice, an essential of which, in most instances, is in the provision of positive and negative poles so arranged that the lines of force, or magnetic flux between them will extend in approximately perpendicular relation to the working surface of the abrading device to be formed.

The apparatus shown in Figs. 1 to 4 is primarily designed for the construction of an abrasive annulus having a peripheral working face and a relatively central large aperture. As shown in the drawings, frame 10 is provided, which preferably is of yoke form, and a vertical shaft 11 is journaled in bearings 12 and 13 therein, a shoulder or step bearing collar 14 being provided on said shaft which rests on the upper end of the bearing 12. The lower end of the shaft extends beneath the lower end of bearing 12 in position to be struck on its end by a pneumatic hammer 15, which is placed directly beneath said shaft, so that a slight upward movement of the latter may be caused, permitting corresponding impact when it descends, for purposes to be explained. An insulating plate 16 is mounted on the top end of the shaft 11 and is provided with a circular horizontal top face and a flat circular wrought iron plate 17 is mounted thereon. Two series of circularly and concentrically arranged magnet cores 18 and 19 are mounted vertically in said plate 17, the upper ends of the outer series of cores 18 being fitted into apertures in a wrought iron ring 20 and the inner series being likewise fitted into a similar ring 21, said rings being concentrically arranged and providing a space between their adjacent inner and outer peripheries adapted to receive a mold for forming the annulus to be produced, the thickness of the rings corresponding to the thickness thereof. In case the hole in the annulus to be formed is small, the cores 19 and ring 21 may obviously be combined in a single cylindrical post.

The cores 18, 19 are wound with wire in series, so that the ring 20 will form one pole of an electromagnet and the ring 21 will form the other pole thereof, the plate 17, forming the intermediate part of the magnet, so that when a direct-current is passed through the windings, the rings 20 and 21 will be oppositely polarized. As the inner peripheral face of the ring 20 and the outer peripheral face of the ring 21 are the portions thereof in closest proximity, the magnetic field or flux between the poles will be formed principally between these faces, and the lines of force will extend radially with relation to the center of rings 20, 21. The arrangement of the parts and windings is such that the electromagnetic force of the two rings will be as nearly equal as possible, to reduce loss from leakage.

A mold or receptacle, with suitable means for supporting the same, is provided between the rings 20, 21, the means illustrated comprising a series of non-magnetic metal posts 22 mounted on insulating bases 23, on the plate 17 and a flat annular base ring 24 of similar material, which is supported on the upper ends of said posts and forms a horizontal support for the mold, which, in the present instance, consists of a flat annular horizontal base 25 and annular vertically extending inner and outer sides 26 and 27, all of which are made of non-magnetic material, preferably brass.

Any suitable means for rotating the shaft 11 may be provided, a pulley 28 thereon, for the purpose, being shown, and to provide means for energizing the electromagnet above described, one of the coil terminals is grounded on the frame and the other is connected to a contact ring 29 on the shaft, a contact device being arranged to engage said ring and suitable connections being made with a direct current generator.

The abrasive grains, when prepared for introduction into the mold as already described, are coated with a suitable bond, and must be in a freely granular state, as stated before, so that they may be fed practically separately, or in a shower to the mold and any suitable means which will accomplish this result is within the scope of my invention. This may be done by hand in any convenient manner, or automatically, as by the means indicated on the drawings. The means indicated comprises an endless belt 30, which passes down about a pulley 31, and to which the prepared grains of material are gradually fed, the pulley 31 being located over and in radial relation to the annular mold, so that the abrasive grains will be delivered in a thin shower to the mold transversely thereof, or radially of its axis. The mold will be slowly rotated, so that the grains will be evenly distributed therein, the belt being slightly inclined from its inner to its outer edge, so that the quantity fed will gradually increase from the inner to the outer periphery.

The operation with the above described apparatus is as follows: The electro-magnet will be energized and the shaft 11 will be rotated slowly as the abrasive grains are fed to the mold, and, at the same time, the pneumatic hammer will be operated so as to produce a slight jarring action on the mold and on the grains which are fed thereto. As soon as the grains are delivered into the magnetic field, the magnetic material, with which they are coated, will become polarized, so that, in the case of the grains which are substantially longer than wide, their ends will normally have opposite polarities and consequently there will be a strong tendency to turn the positively magnetized end towards the negative magnet pole and vice versa. The magnetic effect is however not made sufficiently strong to move the grains bodily towards either magnet pole, but only to turn them in the direction of the magnetic flux.

In the case of grains which are more nearly equidimensional, but not actually spherical, but which have various sharp pointed portions or edges, the same polarizing effect will take place as with the distinctly elongated grains, but there will not be the same certainty as to the points which will be polarized. There will, however, be a strong tendency to form one of the poles at the end of the main pointed portion of any particular grain of this form and consequently there will be a tendency to turn this end towards the magnet pole of opposite polarity, so that if the grain has a sharp end portion or edge the electrical attraction will tend to turn the grain so that the end or edge will point toward one pole or the other and if the grain has oppositely located pointed end or edge portions, one of the portions will ordinarily be pointed towards the working face to be formed on the tool.

In the apparatus of Fig. 1 as the lines of force extend radially, the tendency will therefore be to cause the elongated grains to lie in a radial position and the other grains to have one of their pointed portions pointed in a radial direction or towards one side of the mold. The turning or positioning action on the grains is likely to occur to some extend while they are falling into the mold, as they will become polarized as soon as they pass into the electrical field, at which time friction will not have to be overcome in causing the grains to be positioned. The force required to turn the grains when resting on the bottom of the mold is also slight, but, after the bottom has been covered with the grains, there is a tendency for the grains to lodge in positions other than that desired. The tapping, jarring, or vibratory action on the grains caused by the pneumatic hammer acts to dislodge them sufficiently, in most instances, to permit the magnetic force to cause turning movement thereof, so that their pointed portions will be pointed in the direction of the lines of force, as above described. This simultaneous action of the electro-magnetic force and vibration, goes on constantly as the mold is filled, so that the abrasive grains will mainly be turned into positions in which one of the ends or pointed portions thereof will point towards the outer side of the mold, the inner surface of which corresponds to the abrading face of the tool, or other device when finished. This condition is maintained throughout both the thickness and the width radially of the tool, as indicated in Figs. 3 and 4.

After the mold has been filled and the grains have been mainly turned to positions in which they point towards, or are approximately perpendicular to the abrading face to be formed, the usual steps of compressing the grains in the mold and then firing will be performed.

The formation of certain other types of abrasive tools by the above described method requires certain modifications of the apparatus above described. In the construction of a cylinder in which the abrading face is to be at the end, or of a wheel in which the abrading face is to be at either side, an apparatus similar to that illustrated in Figs. 5 and 6 is preferably employed.

In this construction a base 40 is provided, which is mounted on the upper end of a shaft 11*a*, similarly supported and driven to the shaft 11 before described, and has a mold supported thereon which comprises a horizontal bottom 42 and vertical annular concentrically arranged sides 43 and 44, the space between which corresponds to the shape of tool to be formed, and these parts being formed of non magnetic material, as brass. A series of electromagnets 45 are mounted on a fixed support, not shown, in radial relation to the mold, the positive and negative poles respectively of said magnets being connected to wrought iron rings 46 and 47 located directly above and below the space in the mold. A feed tube 48 may be arranged to deliver the abrasive grains to the upper end of the mold between any two magnet poles, so that they may be delivered to the space in the mold, as the latter is rotated.

With this arrangement, when the magnets are energized, the lines of force pass vertically through the space in the mold, so that, as the abrasive grains fall into the mold they will be polarized and tend to stand on end. As the mold is rotated, the pneumatic hammer 15, which will be employed in the same manner as that already described, will shake the mold up and down, so that the grains therein will be agitated and will be free to be moved by the magnetic influence. It has been ascertained by experiment, however, that the above described jolting or shaking down action is only necessary, or desirable when the magnetic action, or strength of the lines of force is weak, and that, when this action is of sufficient strength, practically all of the grains which have unequal dimensions will be polarized and turned so that one of their ends or poles point in the general direction of the flow of the magnetic flux. Also, that while the jolting action may be somewhat effective in causing the grains to be packed more closely together, it is practically ineffective without the use of the magnetic flux, in causing the grains to point in a certain direction.

In forming an oblong abrasive block, in which it is desired that certain opposite sides be employed as the abrading faces, similar apparatus will be employed. In the construction shown in Figs. 7 and 8 a mold of rectangular form is illustrated, having a bottom 50 and upright sides and ends 51 of nonmagnetic material, said mold being mounted on a support 52, so arranged that it may be struck by the hammer 15 to cause suitable agitation of the grains therein. A series of electromagnets 56 are fixed at each side of the mold, said magnets having their poles of corresponding polarity connected to armatures 57 and 58 disposed at opposite sides of the mold 50.

While an automatic feeding and distributing means may be employed in this connection, hand feeding may be satisfactorily employed, so that no feeding means is illustrated. With this construction the magnetic flux will pass horizontally through the mold from one side to the other, causing a polarizing effect on all of the grains of abrasive as they fall therein and tending to move those which are elongated into positions perpendicular to said sides, or those which have definite pointed portions, into positions in which such portions point towards one or the other of said sides adjacent which the magnet poles are located.

A form of article produced by the above described methods is indicated in Fig. 9, but it will be understood that the form of article in which my invention may be embodied may be varied indefinitely, and that similar methods may be employed in coating flexible sheets with abrasive material.

It will be understood that my invention is not limited to an abrasive tool in which the abrasive grains point towards the abrasive face in an exactly perpendicular, or radial direction, as equally advantageous, or possibly even more advantageous results may be secured if the grains point towards the face at a slight inclination, so that it will be understood that any approximation of the direction in which the grains point to a perpendicular, or radial relation to the face, which is found to be advantageous, is within the spirit and scope of my invention.

An abrasive device or tool constructed as above described has substantially greater efficiency than a corresponding article in which the abrasive grains lie mainly sidewise, or nearly so, to the abrasive face, as it will be more free-cutting and less likely to heat the work. Also the wearing qualities will be greater for this and other reasons. The advantages thus secured are believed to far more than offset the slight increase of cost of manufacture in comparison.

I claim:

1. The method of forming an abrading device having an abrading face from granular abrasive material composed of grains each having a pointed projecting portion, which consists in delivering the material to a mold and simultaneously magnetically positioning said grains, as they are delivered, by lines of force directed in angular relation to the abrading face to be formed, to cause the projecting portions to be mainly pointed towards said face and then bonding the grains as positioned.

2. The method of making an abrading tool having an abrading face, which consists in showering granular abrasive material, composed of grains each having a pointed projecting portion, into a forming device, polarizing the grains as they are delivered to said device by lines of force directed to turn the grains to positions in which a projecting portion will be pointed towards the face to be formed, and then bonding the grains as positioned.

3. The method of making an abrading device having an abrading face, which consists in delivering granular abrasive material containing a substantial proportion of elongated grains, to a forming means corresponding to the device to be produced, polarizing said elongated grains as delivered by suitably magnetized poles so that they will be positioned in corresponding angular relation to the abrading face to be formed, and thereafter bonding the grains as positioned.

4. The method of making an abrading device from granular abrasive material containing grains each having a pointed projecting portion, which consists in showering the material into a mold corresponding to the device to be formed, polarizing said grains while being delivered and after delivering to said mold by electrical lines of force directed in angular relation to the abrading face to be formed, so to position said grains that their said projecting portions will mainly point correspondingly, and thereafter bonding said grains as positioned.

5. The method of making an abrading device, which consists in showering granular abrasive material containing a substantial proportion of elongated grains into an open mold one side of which corresponds to the abrading face to be formed on said device, positioning the elongated grains in corresponding angular relation to the face-forming side of the mold by polarizing said grains as delivered thereto by a suitably located electrical flux, and thereafter bonding the grains as positioned.

6. The method of making an abrading device from granular abrasive material containing grains each having a pointed projecting portion, which consists in coating the grains with magnetic material, showering the magnetically coated grains into a forming means and between magnet poles arranged to cause a magnetic flux at an angle to the abrading face to be formed on said device, to position the grains, so that their projecting portions point mainly in the direction of the flux, and thereafter bonding the grains as positioned.

7. The method of making an abrading device from granular abrasive material composed of grains each having a pointed projecting portion, which consists in coating the grains with a sufficient quantity of a magnetic substance to render the grains susceptible to magnetic influence, showering the grains into a mold corresponding to the device to be formed through a magnetic field, the lines of force of which extend in angular relation to the abrasive face to be formed on said device, so to position the grains that their said projection portions will mainly point towards the abrading face to be formed on said device, and then bonding the grains as positioned.

8. The method of making an abrading device

from granular abrasive material containing a substantial proportion of elongated grains, which consists in coating the grains with a sufficient quantity of a magnetic substance to render the grains susceptible to magnetic influence, providing a mold corresponding to the shape of the device to be formed and arranging the poles of an electromagnet in opposite relation to the sides of the mold which correspond to the abrasive face to be formed, showering the material into the mold while the poles are energized to cause the elongated grains to be magnetically positioned in the direction of the flux between the poles and thereafter bonding the grains as positioned.

9. The method of forming an abrading tool from unequi-dimensional grains of abrasive material which consists in providing the grains with a coating of magnetic dust and with a coating of suitable bonding material, showering the grains, as thus coated, into a suitable mold and at the same time polarizing the grains as delivered thereto by magnetic lines of force directed in angular relation to the side of the mold corresponding to the face to be formed, to turn the grains mainly to positions in which a pointed portion thereof will be directed towards said side, and thereafter compressing the grains in the mold as positioned to form them into a cake and then subjecting the cake to a baking operation.

10. The method of forming an abrading device having an abrading face from granular abrasive material composed of grains having pointed projecting portions, which consists in delivering the material to a mold and simultaneously magnetically positioning said grains, as they are delivered, by lines of force directed to intersect the abrading face to be formed, to cause a projecting portion of each grain to be pointed in the same direction, simultaneously subjecting the mold to a rapid jarring action to dislodge the grains after they become supported in the mold and permit the electrical lines of force to position the grains which have not previously been positioned and thereafter bonding the grains as positioned.

11. The method of making an abrading device from granular abrasive material containing grains having pointed projecting portions which consists in showering the material into a mold corresponding to the device to be formed, polarizing said grains while being delivered and after delivering to said mold by electrical lines of force directed to intersect the abrading face to be formed so to position said grains that each has a projecting portion which points correspondingly, simultaneously subjecting the mold to a jarring action by subjecting the same to a rapid succession of blows to dislodge the grains after they become supported in the mold, so that the positioning action of the lines of force may be assisted and thereafter bonding the grains as positioned.

12. The method of making an abrasive device which consists in showering granular abrasive material containing a substantial proportion of elongated grains into an open mold corresponding in shape to the device to be formed, positioning the elongated grains in angular relation to the side of the mold corresponding to the working face to be formed by polarizing the same by means of correspondingly directed electrical lines of force as the grains fall into the mold, and simultaneously subjecting the mold to a rapid jarring action to permit the grains to become rearranged by means of said electrical force after they become supported within the mold, continuing this operation until the mold is sufficiently filled and then bonding the grains as positioned.

13. The method of forming an abrading device having an abrading face from granular material containing elongated abrasive grains, which consists in magnetically positioning said grains, so that they point towards the face to be formed and then bonding them as positioned.

14. The method of forming an abrading device having an abrading face from granular material containing elongated abrasive grains, which consists in magnetically positioning said grains, so that said face will be formed by the ends thereof and then bonding the grains as positioned.

15. The method of forming an abrading device from unequidimensional abrasive grains, which consists in magnetically positioning said grains correspondingly with relation to the abrading face to be formed and bonding them as positioned.

16. The method of forming an abrading device from unequidimensional, non-magnetic abrasive grains, which consists, in providing said grains with a ferrous coating, positioning said grains correspondingly with relation to the abrading face to be formed, by subjecting them to the influence of a magnetic flux and then bonding them as positioned.

17. An apparatus for producing inflexible abrasive tools comprising a mold corresponding to the shape of the tool to be formed, and a magnet having its poles disposed to produce lines of force within the mold which are directed approximately perpendicularly to a face—forming side of the mold.

18. An apparatus for producing inflexible abrasive tools comprising a mold corresponding to the shape of the tool to be formed and arranged with its top side open to permit gradual filling thereof with abrasive grains and a magnet having its poles disposed to produce lines of force within the mold which are directed approximately perpendicularly to a face—forming side of the mold.

19. An apparatus for producing inflexible abrasive tools comprising a horizontally disposed mold having its bottom composed of non-magnetic material and one of its sides arranged to conform to the working-face of the tool to be formed, and a magnet having its poles arranged at opposite sides of the mold to generate lines of force within the mold which are directed approximately perpendicularly to the face—forming sides of the mold.

20. An apparatus for producing annular inflexible abrasive tools comprising a mold having a horizontally disposed bottom and circular, concentric sides extending upwardly therefrom, the outermost of which is adapted to form the working-face of the tool, and a magnet having its poles disposed to produce radially directed magnetic lines of force throughout the entire space within the mold.

21. An apparatus for producing an annular inflexible abrasive tool having a peripheral working face, comprising a mold having circular inner and outer concentric sides, and a magnet having one of its poles disposed within the inner side and the other of its poles disposed about the outer side to produce radially directed magnetic lines of force within the mold throughout its entire circumference.

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