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C. E. WILSON

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ABRASIVE WHEEL

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fig. 1.

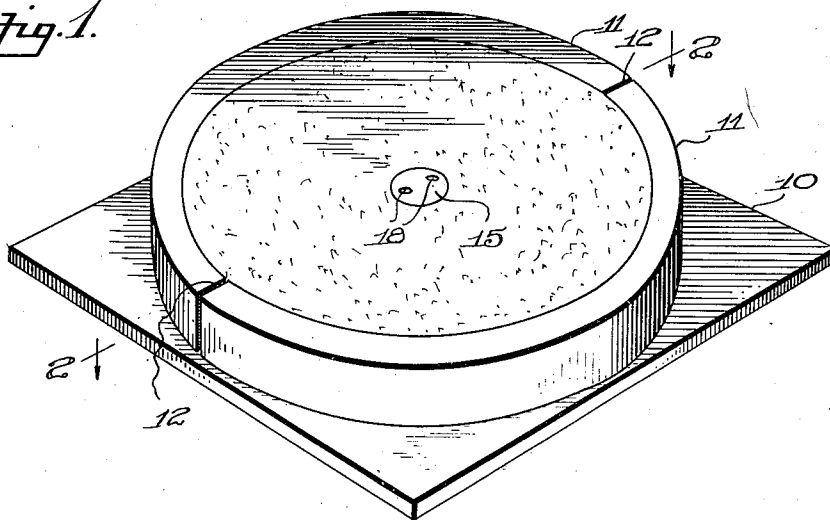


fig. 2.

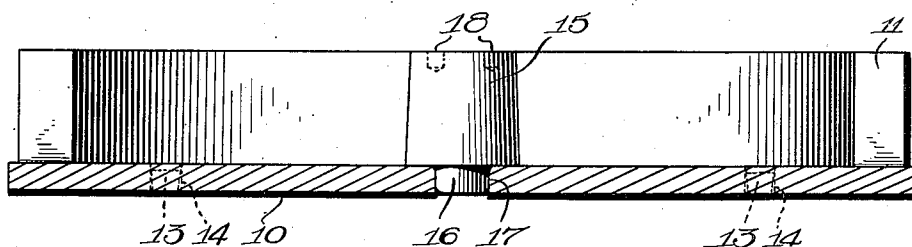
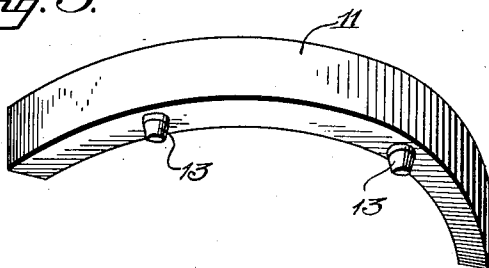


fig. 3.



Inventor
CECIL E. WILSON

By

C. H. Parker, Jr.
Attorney

UNITED STATES PATENT OFFICE

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ABRASIVE WHEEL

Cecil E. Wilson, Covington, La., assignor, by direct and mesne assignments, to Independent Grinding Wheel Company, Inc., a corporation of Louisiana

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18 Claims. (Cl. 51—278)

This invention relates to abrading devices and more particularly to abrasive and cutting wheels.

The principal object of this invention is to produce abrading devices, such as abrasive and cutting wheels, which possess all of the advantages of known similar products but which avoid the disadvantages of such products.

An important object of this invention is to provide abrasive and cutting wheels which are efficient in operation, economical of production, and which can be manufactured in a short period of time.

Another object of the invention is to provide abrasive and cutting wheels which are intended for the same uses as conventional abrasive and cutting wheels produced by vitrifying processes but which can be produced in a materially shorter time.

A further object of the invention is to provide cutting wheels, which may be of varying degrees of hardness, and which are adapted for "cool-cutting" of metals to prevent the "burning" thereof during the cutting operation.

A further object of the present invention is to provide abrasive and cutting wheels which may be operated at materially higher speeds than similar wheels heretofore used.

A further object of the invention is to provide abrasive and cutting wheels which, for any given standard, are uniform.

A further object of the present invention is to provide abrasive and cutting wheels which do not tend to become glazed in the use thereof and which may be used for the grinding of heated metal.

A further object of the present invention is to provide abrasive and cutting wheels at a materially lower cost than similar wheels used for like purposes heretofore produced.

A further object of the present invention is to provide a process of producing abrasive and cutting wheels wherein heat and pressure operations are avoided.

Other objects and advantages of the invention will become apparent during the course of the following description.

The conventional grinding wheels commonly used at the present time are produced according to four principal processes, which are known as the vitrified process, the Bakelite process, the silicate process and the shellac process. By far the greatest number of grinding wheels in general use are made according to the so-called vitrified process. It has been estimated that over 90 per cent of the grinding wheels commonly used in this

country are made by this process. In the vitrified process, abrasive grains are bonded together by means of clays of various kinds and other materials found suitable for the purpose and the resulting material is moulded to suitable shape and put in a kiln and fired at a high temperature. When the kiln is loaded with moulded wheels the heat is turned on gradually to a maximum temperature and then gradually cooled. After a relatively long period, ordinarily several weeks, the grinding wheels are removed from the kiln and are then babbitted and arranged in mountings for use.

While grinding wheels made according to the vitrified process are in extensive use, there are many known disadvantages attending the manufacture and use of such wheels. For example, a period of approximately five or six weeks is ordinarily required for completing the manufacture of grinding wheels according to the vitrified process and expensive machinery and high temperature kilns are required. The prolonged heating required in this process also introduces a large cost element into the process. In addition, the firing of the moulded wheels results in a large loss due to breakage of the wheels during the firing operation. In the use of the grinding wheels made according to the vitrified process there is a tendency of the outer edge of the wheels to glaze when the wheel is operated at high speeds. Accordingly, the speed of operation of these wheels is limited. Ordinarily, a vitrified wheel of 10" diameter has a practical maximum peripheral speed of about 4500' per minute. In high speed operations of the vitrified wheels, the wheels tend to heat up and it frequently happens that when cutting metal at high speeds with vitrified wheels the metal is "burned". Another important disadvantage of the vitrified wheels is that they are not practically suited for grinding heated metal. For this reason, the metal to be ground is customarily cooled before the grinding operation. In the production of the vitrified wheels difficulty has been encountered in producing uniform wheels, with respect to given standards. For example, an "extra hard" wheel prepared in a given operation of the process may not be of exactly the same hardness as another "extra hard" wheel prepared in another run. Finally, the cost of manufacture of wheels according to the vitrified process is extremely high and the selling price of such wheels is correspondingly high. For example, in a recent catalogue of a prominent grinding wheel company a 24" x 4" grinding wheel was priced at \$169.00;

a 30" x 4" grinding wheel was priced at \$277.00; and a 48" x 5 1/4" grinding wheel was priced at \$1,072.00. The prices for wheels of other diameters and widths were correspondingly high.

As a result of extensive research directed to the production of grinding wheels possessing the desirable properties of the grinding wheels produced in accordance with the vitrified process, while at the same time avoiding the disadvantages attending the manufacture and use of such wheels, I have discovered a process of producing grinding wheels which are not only more efficient in use than the vitrified wheels but which may be manufactured and used without the disadvantages encountered in the production and employment of the vitrified wheels.

In its broad aspect, my process comprises preparing a mouldable mixture of argillaceous material, abrasive grains, calcined magnesite and magnesium chloride solution, introducing such mixture into a mould of desired shape and permitting it to remain in such mould until the mixture sets sufficiently to permit handling, removing what I term "surface mud" from the sides and edge of the moulded product and permitting the resulting product to set to completely harden.

In the practice of my process moulds of various sizes, shapes, and construction may be employed. However, in the accompanying drawing I have illustrated a form of mould which I have found to be particularly suitable for use in the practice of my process. In this showing,

Figure 1 is a perspective view of the mould with a moulded grinding wheel therein,

Figure 2 is a vertical section taken on line 2-2 of Figure 1, and

Figure 3 is an underside perspective of one of the semicircular complementary mould members.

Referring to the accompanying drawing, the base of the mould preferably consists of a flat sheet 10 preferably formed of metal such as brass. Two semicircular complementary mould members 11 are arranged on the base 10, the contiguous ends of the mould members 11 being slightly spaced apart as at 12 for a purpose to be described. The mould members 11 are maintained in position on the base 10 by means of dowels 13 which are adapted to be received in openings 14 in the base plate 10. As shown in the drawing, the dowels 13 are tapered slightly toward their outer ends to permit of a slight tipping or rocking movement of the complementary mould members 11 toward each other. The spaces 12 between the contiguous ends of the mould members 11 permit slight rocking or tipping of these mould members toward each other. A substantially cylindrical center core 15 is provided on the under side thereof with a restricted cylindrical portion 16 which is adapted to be snugly received in an opening 17 in the center of the base plate 10. As shown in Figure 2, the center core member 15 is slightly tapered, the purpose being to permit the core to be readily removed from a moulded wheel after the composition in the mould has set. The upper face of the center core 15 is provided with recesses 18 to receive a spanner so that the core 15 may be rotated from time to time while the composition in the mould is setting to facilitate removal of the center core after the wheel has been removed from the mould.

In the practice of my process, I first prepare a solution of magnesium chloride of desired concentration. While a refined product may be em-

ployed, I may use a commercial grade of magnesium chloride in preparing the solution. Preferably, in the preparation of the solution, I employ pure drinking water which is substantially free from metallic salts, especially iron compounds, and which is preferably of zero hardness. If necessary, the solution is filtered after its preparation to remove extraneous matter therefrom. The strength of the magnesium chloride solution will vary considerably according to the particular type of grinding wheel which is to be produced in the process. However, a magnesium chloride solution of from 19° Bé. to 28° Bé. is generally prepared. Where a hard grinding wheel is to be produced I employ a magnesium chloride solution of say 28° Bé., whereas for the preparation of a relatively soft grinding wheel a magnesium chloride solution of say 19° Bé. may be employed.

The magnesium chloride solution is mixed with a dry mixture of abrasive grains, argillaceous material and calcined magnesite, the relative proportions of the ingredients in the dry mixture varying to a considerable extent according to the type of wheel to be produced. The resulting mixture is mixed thoroughly for from say 5 to 15 minutes to produce a uniform mass having the approximate consistency of cake dough. For best moulding practice, the mass should have a somewhat thicker consistency than pancake dough but should not have as thick a consistency as bread dough.

In preparing the mixture to be moulded, I preferably employ a mixing container with a round bottom and provided with an efficient stirring device. Into this mixing container I first introduce the required amount of abrasive grains of the desired characteristics. I may use any conventional abrasive grains such as are customarily used in abrasive, grinding, cutting and polishing wheels in common use. Many different types of these abrasive grains are available on the market. Two outstanding examples of these grains are an oxide of aluminum (Al₂O₃) in crystalline form, and crystalline carbide of silicon.

I next mix with the abrasive grains in the mixing container the argillaceous material to be employed. I preferably use a high grade ceramic clay, such as china clay, which is free from sand although other clays may also be used. For example, for some purposes I have found it advantageous to use a mixture of equal parts of ordinary white or grey clay and fuller's earth. The clay should be thoroughly dry and in powder form. The exact fineness of the powder is not of controlling importance but I have found it advantageous to use the clay in the form of a powder approximating talcum powder in fineness.

The abrasive grains and powdered argillaceous material are thoroughly mixed to provide a uniform mixture. Thereafter, I add to the mass in the mixing container commercial calcined magnesite. This product is commercially available in the form of a powder almost as fine as talcum powder and I have found this commercial product very satisfactory for use. Of course, should it be desired, the equivalent of the calcined magnesite may be obtained from other sources or produced in the laboratory, but since the commercial calcined magnesite is entirely suitable for use I recommend that it be employed.

The calcined magnesite or its equivalent is thoroughly mixed with the other ingredients in the mixing container to secure a substantially uniform mixture. Thereafter, the magnesium chloride solution which has been prepared is added to

the dry mixture with stirring. It is advantageous to add the magnesium chloride solution reasonably slowly while agitating the mass but this is not essential since the entire amount of magnesium chloride solution to be employed to produce a mass of desired consistency may be added at one time and the mass thereafter stirred to effect complete mixing.

After the mass has been thoroughly mixed it is then poured into a suitable mould, such as that shown in the accompanying drawing. The mould is shaken several times during the addition of the mass in order to make certain that the mould is completely filled with the mass and air spaces avoided. After the mould has been filled it is advisable to pass a straight-edge scraper across the upper edges of the mould members to remove any excess of material in the mould and provide a flat surface for the material in the mould.

The mass is permitted to stand in the mould until it has set to a sufficient degree to permit the removal of the mould members and the handling of the product without breaking or distortion. Ordinarily, this condition will be reached after the mass has been in the mould for about 2 to 3 hours, although a longer period may be required in some instances. However, a skilled operator can readily determine after a few experiments the exact time for the removal of the mass from the mould.

After the mass has been allowed to set in the mould for the required period, the mould members are removed and the center core is also removed. When the partially hardened wheel is examined at this stage of the process, it will be observed that on both sides of the wheel and on the edge there will be a thin film of a mud-like substance which is practically entirely free from abrasive grains. I term this substance a "surface mud". This surface mud is removed from the wheel by scraping with a wire brush, knife, or the like. This film of surface mud should be carefully scraped off so that the remaining surface will be provided with the abrasive grains employed in preparing the product. If this surface mud is not removed at this time, or before the wheel has set to such a degree that the removal thereof is not possible, the resulting wheel will not be suitable for use for abrading purposes. As a result of numerous tests, I have found that if a grinding wheel is prepared according to the present process without the removal of the surface mud and the wheel is permitted to set to complete hardness, large chunks of the wheel will be broken out of the edge when it is used for cutting and grinding purposes.

After the partially hardened wheel has been removed from the mould it is permitted to set on a flat surface for about 4 to 5 hours. During this period the wheel becomes relatively hot but gradually cools off and reaches room temperature at the completion of the setting. Thereafter, the wheel is ready to be babbitted and set in conventional mountings for use.

The general process of preparing my new wheels is described above and I will now set forth several specific examples of the process for purposes of specific illustration.

Example 1

In preparing a hard wheel, 7" x 1", for the purpose of cutting hard steel or the like, I first mix approximately 2½ pounds of conventional steel cutting abrasive grain with 10 ounces or suitable clay and mix these ingredients together.

I then add 15 ounces of calcined magnesite and thoroughly mix these with the other ingredients. Thereafter, approximately 20 liquid ounces of a 26° Bé. magnesium chloride solution is then thoroughly mixed with the mass. The resulting mass is then placed in a mould in the manner described above. After about 2 hours or slightly longer, the partially hardened mass is removed from the mould and the surface mud removed. Thereafter the wheel is permitted to stand for 4 or 5 hours and the wheel is then ready to be babbitted and set in mountings for use.

Example 2

In preparing a medium hard wheel, 7" x 1", for sharpening tools or the like, I mix together 2½ pounds of steel cutting grain, 12½ ounces of clay, 14 ounces calcined magnesite and 12 liquid ounces of a 20° Bé. magnesium chloride solution, in the manner described above. This mass is introduced into a mould in the manner set forth above and is permitted to stand in the mould for approximately 2¼ hours or longer, after which the partially hardened wheel is removed from the mould and the surface mud is removed and the resulting product permitted to set.

Example 3

In preparing a soft wheel, 7" x 1", for cutting iron, brass or the like, I mix 2½ pounds of an iron cutting grain, such as carbide of silicon, 14 ounces of clay, 20 ounces of calcined magnesite, and 20 liquid ounces of a 19° Bé. magnesium chloride solution. This mass is moulded as described above and after approximately 2½ hours or longer the partially prepared wheel is removed from the mould and treated in the manner described in the preceding examples.

The abrasive wheels made in accordance with the present process possess numerous important advantages over similar wheels prepared by the vitrified process, as well as wheels prepared by other processes now in use. For example, my abrasive wheels are particularly suitable for running at very high speeds. In actual tests it has been demonstrated that a wheel of 10" diameter can be run at a peripheral speed of 7500' per minute whereas a vitrified wheel of the same diameter had an approximate maximum peripheral speed of 4500' per minute. Moreover, my wheels have been found to be cool-cutting wheels and do not have the tendency possessed by the vitrified wheels to heat up and "burn" material being ground. Moreover it has been demonstrated that my wheels are suitable for cutting heated metal. In a specific case, one of the grinding wheels made according to the present process was used for cutting a bar of iron which had been heated to a cherry red color and the bar was quickly cut without injury to the metal or to the wheel. A further advantage of the wheels produced in accordance with the present invention is that they last approximately twice as long as corresponding wheels made by the vitrified process. They do not have the same tendency to break as the vitrified wheels and, therefore, may be shipped with less likelihood of breakage during transit. Also, due to the nature of the process of production, wherein no heat and pressure are employed, the loss from breakage during manufacture is insignificant. A very important advantage of the wheels is that they can be produced at extremely low cost in comparison with vitrified wheels of corresponding dimensions. For example, it has been found that a 24" x 4" 75

vitrified wheel which is listed in a recent catalogue of a prominent abrasive wheel company to sell at \$169.00 would cost, finished and mounted, approximately \$1.20 when produced in accordance with the present invention. A 30" x 4" wheel can be made, finished and mounted for approximately \$1.25, whereas a vitrified wheel of the same dimensions is listed to sell in the neighborhood of \$277.00. A 48" x 5 3/4" wheel produced by the present process can be manufactured, finished, and mounted at an approximate cost not to exceed \$92.00, whereas vitrified wheels of the same dimensions are priced to sell at about \$1,072.00. Finally, it will be readily apparent that the present process possesses a tremendously important advantage in that the period required for the manufacture of abrasive wheels according to the present process is many times shorter than that required for manufacturing wheels by other processes commonly in use.

While I have described in detail the preferred practice of my process and the preferred form of mould to be used in connection therewith, it will be understood that the details of procedure of the process and the size, shape and arrangement of parts of the mould may be variously modified without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. A process of the character described which comprises preparing a mouldable mixture of abrasive grains, calcined magnesite, argillaceous material and magnesium chloride solution, and moulding said composition in a desired shape.

2. A process of the character described which comprises preparing a mixture of abrasive grains, argillaceous material and calcined magnesite, adding a solution of magnesium chloride thereto, mixing the resulting mass, introducing the mass into a mould, and permitting the mass to set to at least partial hardness in said mould.

3. A process of the character described which comprises preparing a mouldable mixture of abrasive material, argillaceous material, calcined magnesite, and magnesium chloride solution, introducing the resulting mixture into a mould, permitting the mass to set to partial hardness in said mould, removing the resulting product from the mould, and removing a film of material from the surface of the moulded product.

4. A process of the character described which comprises preparing a mixture of abrasive particles, argillaceous material, and calcined magnesite, mixing a magnesium chloride solution therewith to provide a mouldable composition, introducing the resulting composition into a mould, permitting the mass to remain in the mould until it has set to partial hardness, removing the resulting product from the mould, and removing a film of material from the surface of the moulded product.

5. A process of the character described which comprises preparing a mouldable mixture of abrasive grains, clay, calcined magnesite and magnesium chloride solution, introducing the resulting composition into a mould, permitting the mass to set to partial hardness, removing the resulting product from the mould, removing a film of material from the surface of said product, and permitting the resulting product to set to complete hardness.

6. A process of the character described which comprises mixing a major proportion of abrasive material with a minor proportion of argillaceous material and a minor proportion of calcined mag-

nesite, adding thereto a relatively strong magnesium chloride solution to bring the mixture to a mouldable consistency, and moulding the resulting mass.

7. A process of the character described which comprises mixing a major proportion of abrasive particles with a minor proportion of finely divided argillaceous material, and a minor proportion of finely divided calcined magnesite, adding to the resulting mixture a relatively strong magnesium chloride solution to bring the mixture to a mouldable consistency and moulding the resulting product.

8. A process of the character described which comprises intimately mixing a major proportion of abrasive grains with a minor proportion of finely divided clay and a minor proportion of finely divided calcined magnesite, mixing with such mixture a relatively strong magnesium chloride solution to bring the mixture to a mouldable consistency, and moulding the resulting mixture.

9. A process of the character described which comprises preparing an intimate mixture of abrasive particles, clay, and calcined magnesite, adding thereto sufficient magnesium chloride solution of from approximately 19 to 28° Bé. strength to bring the mass to a mouldable consistency, and moulding the resulting mass.

10. A process of the character described which comprises mixing a major proportion of abrasive particles with a minor proportion of finely divided argillaceous material and a minor proportion of finely divided calcined magnesite, adding to the resulting mixture sufficient magnesium chloride solution of from approximately 19 to 28° Bé. strength to bring the mass to a mouldable consistency, and moulding the resulting mass.

11. A process of the character described which comprises mixing a major proportion of abrasive grains with a minor proportion of finely divided clay and a minor proportion of finely divided calcined magnesite, adding to such mixture a magnesium chloride solution of approximately from 19 to 28° Bé. strength to bring the mass to mouldable consistency, and moulding the resulting product.

12. A process of the character described which comprises mixing a major proportion of abrasive particles with a minor proportion of argillaceous material and a minor proportion of calcined magnesite, adding a solution of magnesium chloride to bring the mixture to mouldable consistency, introducing the mass into a mould, permitting the mass to set to partial hardness, removing the partially hardened product from the mould, and removing a film of material from the surface of said product.

13. A process of the character described which comprises mixing a major proportion of abrasive grains with a minor proportion of finely divided clay and a minor proportion of finely divided calcined magnesite, mixing with such mixture a relatively strong magnesium chloride solution in an amount sufficient to produce a mouldable mass, introducing the mass into a mould, permitting the mass to set to partial hardness, removing the resulting product from the mould, removing a film of material from the surface of the product, and permitting the resulting product to set to complete the hardness.

14. A process of the character described which comprises mixing a major proportion of abrasive grains with a minor proportion of finely divided clay and a minor proportion of finely divided calcined magnesite, mixing therewith a mag-

nesium chloride solution of from 19 to 28° Bé. strength to produce a mouldable mass, introducing the resulting mass into a mould, permitting the mass to set in the mould to partial hardness, removing the product from the mould, removing a film of material from the surface of the product, and permitting the product to set to complete hardness.

15. A composition for use in preparing moulded abrasive products which comprises an intimate mixture of abrasive particles, argillaceous material, calcined magnesite, and magnesium chloride solution.

16. A composition for use in preparing moulded abrasive products which comprises an intimate,

mouldable mixture of abrasive grains, clay, calcined magnesite and magnesium chloride solution.

17. A composition for use in preparing moulded abrasive products which comprises an intimate mouldable mixture of abrasive grains, finely divided clay, finely divided magnesite, and magnesium chloride solution.

18. A composition for use in preparing moulded abrasive products which comprises an intimate, mouldable mixture comprising a major proportion of abrasive grains, a minor proportion of finely divided clay, a minor proportion of finely divided calcined magnesite, and magnesium chloride solution of approximately from 19 to 28° Bé. strength.

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