

UNITED STATES PATENT OFFICE

2,544,641

COMPOSITION FOR FILLING THE PORES OF GRINDING WHEELS AND WHEELS FILLED THEREWITH

Loring Coes, Jr., Brookfield, Mass., assignor to Norton Company, Worcester, Mass., a corporation of Massachusetts

No Drawing. Application April 18, 1950,
Serial No. 156,711

8 Claims. (Cl. 51-295)

1

This invention relates to grinding wheels and a treatment thereof to improve their quality. This application is a continuation in part of my copending application Serial No. 721,665 filed January 11, 1947 and now abandoned.

One object of the invention is to provide a faster cutting grinding wheel. Another object of the invention is to provide a treatment which can be applied to already manufactured grinding wheels to increase the efficiency thereof. Another object of the invention is to provide an improved filler for a grinding wheel. Another object of the invention is to provide a grinding wheel and a treatment for a grinding wheel which enables it to remove a greater amount of stock for a given amount of wheel wear than heretofore.

Another object of the invention is to provide a filler in a grinding wheel which has a chemical action on metal work pieces. Another object is to provide a filler which shall substantially reduce loading of a grinding wheel. Another object of the invention is to set up in a grinding wheel a chemical action on metal chips removed from a work piece and lodged in a portion thereof which shall loosen such chips, thus tending to eliminate loading. Another object is to provide a filler for a grinding wheel which reacts on the hot metal chips removed from the work piece in the grinding action so as to prevent such chips from sticking to the wheel, thus preventing loading in the first place. Another object is to provide a filler for a grinding wheel which reacts on the material of the work piece being ground to form at the grinding line a substance which is weak, brittle, machinable and more easily removed during the grinding operation. Another object is to provide a filler for a grinding wheel which remains in the pores thereof at high wheel speeds.

The invention accordingly consists in the features of construction, combinations of elements, arrangements of parts, all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claims.

I provide a porous grinding wheel having continuous pores such as a wheel bonded with any known vitrified ceramic or resinoid bond. Such a wheel may be made according to any known method. The wheel is completely formed and fired or cured or the bond is otherwise set prior to the treatment now to be described, so far as the preferred form of my invention is concerned.

Having formed the grinding wheel, which may

2

be of any desired size and shape, I make a molten composition of sulphurized fat, mineral oil and a synthetic wax. The preferred composition consists of 80% sulphurized fat, 10% mineral oil and 10% wax. To make the mixture I heat a quantity of unsaturated organic natural fat (which is an ester of glycerine) and sulphur until complete reaction between the sulphur and fat takes place, thus leaving no free fat. The temperature of reaction is about 140° C. and I avoid temperatures which produce hydrogen sulphide. Any unsaturated natural animal or vegetable oil fat such as linseed oil or a mixture of such fats may be used as long as the total unsaturation is sufficient to allow an adequate percentage of sulphur to react with it for the purposes intended. Other fats which can be used are olive oil, cotton seed oil, mustard oil, stearin, butter fat, horse fat, lard, neats foot oil, peanut oil, beef tallow, castor bean oil, corn oil, mutton tallow, pumpkin seed oil.

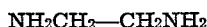
I have found that 20% reacted sulphur in the oil or fat of the composition of the invention is the maximum approximate percentage which can be economically achieved. Sulphur is the active chemical agent of the composition and I thus attempt to keep the total percentage of sulphur as high as possible. At this stage the product is pasty and enough mineral oil is added to produce a free flowing liquid. Any desired proportion of mineral oil from 0 to 50% of the total oil plus fat may be used, preferably I use the minimum amount necessary to reduce the viscosity of the composition to an easily penetrating liquid. I have found that 10% mineral oil (of the total oil mixture) is a good percentage.

I then maintain the temperature at about 140° C. and add a wax in the proportion of 10% of the entire composition. The waxes which I can use are the diamides of ethylene diamine and carboxylic acid selected from the group consisting of myristic acid, palmitic acid and stearic acid and mixtures thereof. These acids are aliphatic straight chain carboxylic acids and are closely related to each other, having formulae as set forth in the following table.

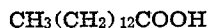
Table I

Acid	Formula
Myristic.....	$\text{CH}_3(\text{CH}_2)_{12}\text{COOH}$
Palmitic.....	$\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$
Stearic.....	$\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$

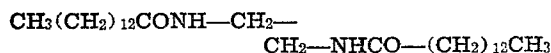
The waxes, therefore, are the diamide of ethylene diamine and myristic acid, the diamide of ethylene diamine and palmitic acid, the diamide of ethylene diamine and stearic acid and mixtures of such diamides. The diamide of myristic acid has a melting point between 137° C. and 139° C. and is soluble in the sulphurized fat at about 140° C. and is the preferred wax. The diamides of palmitic acid and of stearic acid have melting points slightly lower than that of the diamide of myristic acid, but in each case above 120° C. All of these waxes, when molten, are soluble in the sulphurized natural fat at temperatures of about 140° C. and above. When ethylene diamine



is reacted with myristic acid



at a temperature above 100° C., the polymer is formed which has the following structure:



This is the diamide of ethylene diamine and myristic acid. The other diamides of ethylene diamine are similarly formed by reacting ethylene diamine and the acid (palmitic or stearic). In the above reaction water is liberated. The function of the wax is to gel the composition upon cooling. However I maintain the temperature at about 140° C. until the process is completed, as follows.

Having made the composition of the invention and maintained it in a molten state, I submerge the grinding wheel in it to fill the pores of the wheel. The pores may be more completely filled if the composition and wheel are placed in a closed chamber, and the air therein is first evacuated and then readmitted while the wheel is submerged. The wheel is then left in the composition while the composition is allowed to cool. Upon cooling, the composition forms a gel, whereupon the wheel is removed from the composition and the excess cut off. The amount of high melting wax used in the composition is best adjusted so that the gelatinous filling has no tendency to be thrown out of the grinding wheel when it is running at grinding speed. Since the nascent sulphur is the effective agent in improving the grinding action, increasing the percentage of wax content in the composition unnecessarily reduces the effective percentage of sulphur. The purpose of the wax is to form a gel which holds the filler in the grinding wheel against centrifugal force. The amount of wax should be between 5% and 20% of the entire composition.

The wheel may now be used for grinding. A number of grinding wheels were treated (filled) according to the invention as just described, the specific wax used having been the preferred wax, the diamide of ethylene diamine and myristic acid, and these wheels, when used on stainless steel, removed as much as 545%, nearly five and a half times, the stock removed by an untreated wheel of the same grade and structure otherwise. The wheels of the invention had a freer cutting action and less tendency to load. Wheel wear was reduced by as much as 55%.

The improved cutting ability of wheels containing the composition of the invention over wheels not containing it is shown by the following table. In each case the wheels used were made of crystalline alumina abrasive grains of grit size 80, bonded with a vitrified bond and hav-

ing an open, porous structure. The wheels each had a diameter of three inches, a thickness of one half inch and a hole of seven-eighths inch diameter. The specifications for all of the wheels were the same except that the grade of the bond in the wheels numbered 1 to 3 respectively progressed from soft to medium, being designated H, I, and J respectively, where A represents an extremely soft grade wheel and Z an extremely hard grade. Each wheel of a designated number was exactly the same except that the wheels designated "Untreated" contained no filler in the pores, while those designated "Treated" had been filled with the composition of and according to the invention. In each treated wheel the wax was the diamide ethylene diamine and myristic acid but the function of the wax is to produce the gel and the function of the gel is to keep the sulphurized natural fat in the wheels until it is actually consumed in grinding—hence the other two waxes can be used and will give comparable results for they too will produce gels which will keep the sulphurized natural fat in the wheels until actually consumed in grinding. The wheel number 3 designated "Standard treatment" was treated with a composition of beeswax and paraffin heretofore used in treating wheels. These wheels were tested in a grinding machine by grinding a cylindrical test bar of stainless steel one and one half inches in diameter held in a rotating chuck with a total grinding wheel feed of 20 mils at a constant rate for all wheels tested. Units of wheel wear and metal removed are given in mils. Metal removed was measured directly on the diameter of the work piece in each run, and wheel wear was found by subtracting the metal removed in each run from the total wheel feed of 20 mils in each case.

Table II

Wheel No.	Condition	Wheel Wear, Mils	Metal Removed, Mils	Metal Removed per mil of wheel wear, mils
1	Untreated	17.5	2.5	.143
1	Treated	10.3	9.7	.943
2	Untreated	17.5	2.5	.143
2	Treated	8.5	11.5	1.347
3	Untreated	17.8	2.2	.123
3	Treated	8.0	12.0	1.500
3	Standard Treatment	16.0	4.0	.250

All of the above wheels which were treated with the composition according to the invention were also tested on a rotating brass cylindrical test piece. None of these wheels so treated showed any measurable wheel wear in 20 mils total wheel feed. These tests show a marked improvement in the cutting action due to the presence of sulphur in gelatinized form.

Having thus given concrete embodiments of my invention, the same should not be limited by the theories which I have as to the reasons for improved efficiency of grinding wheels made in accordance herewith. Nevertheless for a clearer understanding of the invention I now give my views as to the underlying cause of the improved results. Sulphur and metals, when combined in the presence of heat form metal sulphides. In every efficient grinding operation heat is generated at the grinding line or point of contact where the wheel grinds the work. The heat generated decomposes the sulphurized fat composition of the invention in the grinding wheel pores and frees the sulphur which recombines with the metal being ground to form a sulphide

of that metal. Such metal sulphides are weak, brittle and easily machinable and are thus more easily ground away by the wheel. The sulphides have a much lower melting point than the pure metal and the grinding heat converts them more easily into the soft red hot particles which are seen as a shower of sparks in a dry grinding operation. Every grinding wheel has a tendency to load to some extent, that is to accumulate particles of the material being ground. Loading may involve an actual deposit of material from the work piece into the pores of the grinding wheel or a sticking of the material of the work piece to the abrasive grains or to the bond or a combination of these. The hot particles which are torn away from the work piece by the grinding wheel have a tendency to weld themselves to the wheel. However the production of a chemical reaction on the metal particles by sulphur in the presence of heat to form a metal sulphide reduces the adhesion of the particles to the wheel and tends to prevent loading. If any pure metal has already stuck to the wheel, a chemical reaction involving it will tend to loosen it so that it will fly off the wheel. The composition of the invention forms a gel upon cooling which is resilient and deformable under stress yet does not flow as does paraffin or other solid waxes or fats under continued pressure or stress. The gel is made strong enough to resist the stresses at grinding speeds and so it tends always to return to its original position and shape in the pores of the wheel. Just enough nascent sulphur is then freed by the heat of grinding to form the metal sulphides with no loss of sulphur so that the beneficial effect of the composition of the invention upon the grinding operation is continuous and long lasting.

The nascent sulphur liberated by the decomposition of the sulphurized fat is much more effective in forming sulphides of the material removed as an aid to grinding than sulphur as such would be.

The amides gel holds itself and the total composition in the pores of the wheel as explained. The sulphurized fat and the mineral oil are dissolved in the gel. The mineral oil and the sulphurized fat, when melted by the grinding action, act as lubricants and so promote grinding. The sulphurized fat is sufficiently lubricating so that the mineral oil could be omitted. Its function is chiefly to reduce viscosity at any given temperature, so the temperature of the composition when the wheel is impregnated therewith, can be lower if the mineral oil is included than if it were omitted. Thus the mineral oil facilitate impregnation. The total composition, with or without the mineral oil, is still a gel. This gel, at room temperature, is fairly stiff, about as stiff as paraffin.

It will thus be seen that there has been provided by this invention an article and a composition in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiments above set forth, it is to be understood that all matter hereinbefore set forth is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. A grinding wheel comprising abrasive grains, bond holding the grains together to form the wheel, there being pores in the wheel, and a gel

which is the diamide of ethylene diamine and carboxylic acid selected from the group consisting of myristic acid, palmitic acid and stearic acid and mixtures thereof having in solution therein a sulphurized natural fat, said diamide being from 5% to 20% of the entire composition, the sulphurized fat having from 10% to 20% sulphur and the balance of the composition over the diamide being at least 50% said sulphurized fat, said gel filling some of the pores of the wheel.

2. A grinding wheel comprising abrasive grains, bond holding the grains together to form the wheel, there being pores in the wheel, and a gel which is the diamide of ethylene diamine and carboxylic acid selected from the group consisting of myristic acid, palmitic acid and stearic acid and mixtures thereof having in solution therein a sulphurized natural fat and mineral oil, said diamide being from 5% to 20% of the entire composition, the sulphurized fat having from 10% to 20% sulphur and the balance of the composition over the diamide being at least 50% said sulphurized fat, said gel filling some of the pores of the wheel, said mineral oil being not more than 50% of the total oil plus fat.

3. A grinding wheel comprising abrasive grains, bond holding the grains together to form the wheel, there being pores in the wheel, and a gel which is the diamide of ethylene diamine and myristic acid having in solution therein a sulphurized natural fat, said diamide being from 5% to 20% of the entire composition, the sulphurized fat having from 10% to 20% sulphur and the balance of the composition over the diamide being at least 50% said sulphurized fat, said gel filling some of the pores of the wheel.

4. A grinding wheel comprising abrasive grains, bond holding the grains together to form the wheel, there being pores in the wheel, and a gel which is the diamide of ethylene diamine and myristic acid having in solution therein a sulphurized natural fat and mineral oil, said diamide being from 5% to 20% of the entire composition, the sulphurized fat having from 10% to 20% sulphur and the balance of the composition over the diamide being at least 50% of said sulphurized fat, said gel filling some of the pores of the wheel, said mineral oil being not more than 50% of the total oil plus fat.

5. As a new composition of matter, a gel which is the diamide of ethylene diamine and carboxylic acid selected from the group consisting of myristic acid, palmitic acid and stearic acid and mixtures thereof having in solution therein a sulphurized natural fat, said diamide being from 5% to 20% of the entire composition, the sulphurized fat having from 10% to 20% sulphur and the balance of the composition over the diamide being at least 50% said sulphurized fat.

6. As a new composition of matter, a gel which is the diamide of ethylene diamine and carboxylic acid selected from the group consisting of myristic acid, palmitic acid and stearic acid and mixtures thereof, having in solution therein a sulphurized natural fat and mineral oil, said diamide being from 5% to 20% of the entire composition, the sulphurized fat having from 10% to 20% sulphur, and the composition apart from the diamide being at least 50% said sulphurized fat, said mineral oil being not more than 50% of the total oil plus fat.

7. As a new composition of matter, a gel which is the diamide of ethylene diamine and myristic acid having in solution therein a sulphurized natural fat, said diamide being from 5% to 20%

7

of the entire composition, the sulphurized fat having from 10% to 20% sulphur and the balance of the composition over the diamide being at least 50% said sulphurized fat.

8. As a new composition of matter, a gel which is the diamide of ethylene diamine and myristic acid having in solution therein a sulphurized natural fat and mineral oil, said diamide being from 5% to 20% of the entire composition, the sulphurized fat having from 10% to 20% sulphur and the composition apart from the diamide being at least 50% said sulphurized fat, said mineral oil being not more than 50% of the total oil plus fat.

LORING COES, JR. 15

8

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,240,302	Jones	Apr. 29, 1941
2,425,392	Robinson et al.	Aug. 12, 1947

FOREIGN PATENTS

Number	Country	Date
321,240	Great Britain	Nov. 7, 1929