United States Patent Office 3,462,251 Patented Aug. 19, 1969

3,462,251

AQUEOUS BASED LAPPING COMPOSITION

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No Drawing. Filed Oct. 8, 1965, Ser. No. 494,246
Int. Cl. C08h 17/12
U.S. Cl. 51—302 2 Claims

ABSTRACT OF THE DISCLOSURE

Aqueous base lapping compositions having a viscosity of 100–1000 centipoises are made of a particulate abrasive, a xanthan gum thickener, and an emulsified oil. The compositions are useful in lapping metals including ferrous components such as automotive hypoid gearsets.

This invention concerns a process for lapping ferrous metals and a lapping composition useful in that process. This process is particularly useful in lapping the gear teeth of hypoid gearsets extensively used in the differentials of automobiles, trucks and other vehicles.

Lapping ferrous metals and alloys susceptible to corrosion has traditionally been done with lapping compositions prepared from oil bases thickened with grease or clay. Aqueous base lapping compositions containing glycols or alcohols have been used as lapping pastes for nonferrous surfaces but have not attained success as pumpable lapping compositions for use on ferrous surfaces because of inferior lapping properties and corrosion tendencies.

Lapping properties of lapping compositions are particularly critical when lapping the gear teeth of hypoid gearsets used in rear axles of automotive vehicles. Unless properly lapped, these hypoid gearsets produce objectionable noise and have a significantly decreased useful life. In the past, only specially formulated oil base lapping compositions have been capable on a commercial basis of supplying the lapping properties essential to lapping hypoid gearsets.

This invention provides a process for lapping ferrous metals which comprises preparing a lapping composition consisting essentially of a suspension of water emulsifiable oil and particulate abrasive in a thickened aqueous base, applying said composition to a surface of said ferrous metal and moving said composition relative to said surface to eliminate surface roughness remaining after machining.

Use of the process of this invention decreases the cost of the overall lapping operation since removal of lapping composition from lapped metals can be accomplished by washing with aqueous solutions. Drying parts lapped by this process can be accomplished without causing abnormal health hazards or dangers since a major portion of the vapors being removed is water. When used to lap hypoid gearsets for the differentials of automobiles and other vehicles, this process produces gears having excellent noise properties. In a comparative test involving over 80,000 gearsets, 92.3% of the hypoid gearsets lapped by the process of this invention had satisfactory noise ratings as compared with 89.3% of gearsets lapped with an oil base lapping composition using a similar process.

Lapping compositions used in the process of this invention are pumpable liquids and are particularly useful in lapping operations where continuous application of lapping composition is required or beneficial. For this purpose, these compositions preferably have a viscosity of about 100 to 1000 centipoises at 25° C. measured with a Brookfield viscometer using a number 3 spindle rotating at 60 r.p.m. High heat capacity and coeffcient of heat conductivity imparted to these compositions by the aqueous base provide lapping temperatures cooler than similar oil base compositions.

Most of the gear lapping machines designed to use oil base lapping compounds can be adapted to use the process and composition of this invention by simply replacing the oil base compound with the aqueous base compositions of this invention and making any adjustments necessitated by a change in lapping composition viscosity, if any. Machine Models 17, 19 and 503 produced by Gleason Works, Rochester, N.Y., for lapping hypoid gearsets are readily adaptable to the use of the process of this invention in which composition is continuously applied during the lapping operation.

Hypoid gears are ordinarily lapped at either 625 or 1250 pinion gear revolutions per minute in these Gleason machines using the process of this invention. The gears are mounted in meshing relationship with each other, and a load is applied to the gear teeth by driving the pinion gear and braking the ring gear with a torque of about 40 to 90 inch pounds depending primarily on the size of the gearset. Lapping motion is imparted to the composition by relative movement of the meshing gear teeth. Each gearset is rotated for about 6 minutes under this load resulting in removal of about 2.5 to 4 grams of metal from an average-size passenger car set.

Typical thickeners for the lapping compositions used in this invention include polysaccharide gums such as xanthan gum, gum tragacanth and gum arabic; gelatin; starch; sodium or potassium salts of fatty acids such as oleic acid; clays such as bentonite; salts of sulfonated polymers of alkenyl aromatic compounds; and mixtures of these. The phrase "thickened aqueous base" is used in this application to define aqueous bases comprising thickeners dissolved or mixed therein to increase the viscosity.

In these lapping compositions the most desirable thickener is xanthan gum, a polysaccharide gum derived from *Xanthomonas campestris,* commercially available under the trade name "Kelzan" from Kelco Company, Chicago. The term "polysaccharide gum" is used in this application to define polysaccharides which have been partially oxidized and are therefore soluble in water. Lapping compositions comprising xanthan gum are particularly stable over a wide range of temperature, pH and metal-ion concentration and are extremely desirable where relatively continuous lapping of gearsets by the process of this invention is being conducted. A small amount of thickener, usually less than one weight percent based on the total weight of the lapping composition, is sufficient to provide bases having adequate suspending ability although greater proportions can be used.

Abrasives useful in this invention include materials such as silicon carbide, boron carbide, diamond powder, aluminum oxide, silicon dioxide, ferric oxide, powdered glass, powdered mica, zirconinum silicate, quartz and emery flour. Recovery of the more expensive abrasives from the washing solutions by processes simplified because of the aqueous nature of the lapping composition renders the use of such abrasives economically feasible in the process of this invention. Particle size of abrasives in the process of this invention is preferably from about 180 to less than 300 mesh for good stability. Silicon carbide abrasives having a starting particle size of about 240 mesh are preferred for lapping hypoid gearsets for rear axles using the process of this invention because of good stability and excellent rear axle noise characteristics.

Thickened aqueous bases for the lapping compositions of this invention can suspend over 50% by weight of particulate abrasive. Suspending 50% by weight of silicon carbide having a particle size of about 240 mesh in these aqueous bases increases the viscosity by about 150 centipoises at 25° C. measured with a Brookfield viscometer using a number 3 spindle rotating at 60 r.p.m. Storage or

nonuse of these lapping compositions for several days sometimes allows the abrasive particles to settle. When this occurs, resuspension is accomplished by an ordinary agitation.

Typical emulsifiable oils useful in the compositions of this invention are the sulfonated paraffin or petroleum oils. The phrase "emulsifiable oil" is used in this application to define oils capable of forming suspensions of fine oil particles in water and includes what are commonly known as soluble oils. These emulsifiable oils decrease the tendency of the lapping compositions used in this invention to corrode ferrous parts and to change viscosity by water evaporation. A minimum of about 10% by weight of emulsifiable oil based on the weight of the aqueous phase is desirable when lapping hypoid gearsets.

If desired, small amounts of preservatives such as formaldehyde and rust preventatives such as sodium mercaptobenzothiazole can be added to the compositions used in this lapping process.

Lapping compositions of this invention are prepared by slowly mixing a suitable thickener with water; stirring in an emulsifiable oil and other corrosion inhibitors and preservatives, if desired; adjusting the viscosity with water; and stirring in the abrasive. Heating the water provides more rapid dissolution of thickener.

The lapping compositions of this invention generally are non-Newtonian fluids. To specify the viscosity of non-Newtonian fluids it is necessary to include the rate of shear at which the viscosity value is measured. Specifying the spindle number and its revolutions per minute used in the Brookfield viscometer measuring the viscosity identifies the rate of shear. Brookfield viscometers are manufactured by the Brookfield Engineering Laboratories, Inc., Stoughton, Mass.

EXAMPLE

About 80 gallons of hot water is added to a tank equipped with a stirrer. Xanthan gum thickener (2.86 lbs.) is slowly added to this water with stirring over a five-minute period. Using a sifter, 11.45 lbs. of bentonite clay is stirred into the solution. This addition is followed by separately stirring in 4.3 lbs. of sodium mercaptobenzothiazole, 3.4 lbs. of formaldehyde and 74.7 lbs. of emulsifiable oil. The resulting base is stirred for about two hours until all components are thoroughly blended resulting in a viscosity of about 300 centipoises measured with a Brookfield viscometer at 25° C. using a number 3 spindle rotating at 60 r.p.m.

About 650 lbs. of silicon carbide abrasive having a particle size of about 240 mesh is suspended in this base by slowly adding the abrasive with stirring over a two-hour period. After the addition, stirring is continued for two more hours. Water is added to adjust the Brookfield viscosity to about 400 centipoises.

Lapping sets of rear axle hypoid gears while mounted in meshing relationship and by driving the pinion gear and braking the ring gear, using continuous application of this composition, produced gears having excellent noise properties. With periodic additions of water and composition, lapping was continued for over a month with no decrease in lapping efficiency. Lapping composition is removed from lapped gearsets by passing them through a water base alkaline cleaner bath followed by a drying operation.

What is claimed is:

1. A relatively non-evaporating aqueous base lapping composition consisting essentially of a suspension of particulate abrasive and emulsified oil in a xanthan gum thickened aqueous medium, said suspension having a viscosity of about 100 to 1000 centipoises measured with a Brookfield viscometer at 25° C. using a number 3 spindle rotating at 60 r.p.m.

2. The composition of claim **1** in which the suspension contains at least about 10% by weight of emulsifiable oil.

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U.S. Cl. X.R.

51—301, 304, 306