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CUTTING OIL COMPOSITION

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4 Claims. (Cl. 252—56)

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This invention relates to improved cutting oil compositions and it is particularly concerned with the production of relatively light cutting oils having improved lubricity and extreme pressure characteristics.

The use of cutting oils to carry off excess heat and to lessen friction created during metal working operations such as drilling, boring, milling and shaping is recognized as necessary to the commercial operation of such processes. Minimized friction and rapid heat removal are important to lessen wear on tools, to diminish the energy input required, to improve the finish of the shaped articles, to permit shaping articles to accurate dimension, and to permit the use of relatively high cutting speeds. The more viscous cutting oils which have viscosities of 100 SUV or more at 210° F. are satisfactory for many of these cutting operations. However, where excessive heat is generated, for example in the cutting of aluminum and brass and certain types of steels, the heat removal by more viscous oils may not be sufficiently rapid to permit the use of high cutting speeds and the production of satisfactory surfaces on the cut articles. On the other hand light mineral oils such as have been used heretofore, while they have high heat removal capacity, are less dense than the more viscous oils and their lubricity and extreme pressure characteristics are such that greater power input is required and greater tool wear results.

It is an object achieved by the present invention to provide cutting oil compositions having a light mineral oil base, which are highly mobile and have high heat removing capacity and which at the same time have good lubricity and extreme pressure characteristics. It is a further object achieved by the present invention to provide improved cutting oil compositions useful particularly in cutting operations on aluminum, brass and certain types of steels whereby there is obtained an improved finish on the cut products. It is also an object of this invention to provide improved cutting oil compositions useful as additives for the commercially available cutting oils, to improve their heat removal properties, their lubricity and extreme pressure characteristics whereby tool wear is lessened, energy consumption is diminished, improved finish and improved accuracy of dimensions are obtained, even at high cutting speeds.

We have found that by incorporating in a light non-viscous mineral oil a relatively small amount of a viscous mineral lubricating oil having a Saybolt Universal viscosity of at least about 100 at 210° F. and a small amount of an antioxidant adapted to prevent oxidational deterioration of mineral oils, and advantageously containing also a small percentage of a residue obtained from the solvent refining of distillate oils, a cutting oil composition having particularly advantageous properties for use in the cutting of aluminum, magnesium, brass, copper and other non-ferrous alloys and certain steels is obtained. We have found also that cutting oil compositions of this general type are particularly adapted for blending with heavier cutting oils of the types commercially available, with substantial improvement in the properties which recommend their use in the cutting of such metals.

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As a base oil for the cutting oil compositions of our invention, light mineral oils having viscosities and boiling ranges at least as high as those of kerosene and advantageously not greater than those of the very light lubricating oils such as mechanism oil, have been found most satisfactory. In general mineral oil fractions boiling above about 350° F. and having viscosities less than about 40 SUV at 100° F. have been found most useful. A particularly advantageous form of light oil is the product known as mineral seal oil, a typical example of which has an API gravity of 41.0, a flash point of about 260° F., a fire point of about 300° F., a viscosity at 100° F. of 38.7 SUV and a pour point of about +25° F. In compounding the cutting oil compositions of our invention these light oils are used in amounts corresponding to at least about 50 per cent by weight and advantageously in amounts corresponding to about 90 to 97.5 per cent by weight.

Various types of fixed fatty oils may be used in the cutting oil compositions of our invention. These oils are intended primarily to increase the oiliness or lubricity of the resultant composition and are customarily used in amounts corresponding to 0.5 to 15.0 per cent by weight. Lard oil is particularly satisfactory for this purpose. However, other animal oils such as tallow oil, neat's-foot oil, sperm oil, wool oil, whale oil and the like may be used. Also certain fish and vegetable oils may be used. The fish oils are generally less advantageous due to their offensive odor and the vegetable oils are likewise less advantageous because of their tendency to oxidize and form gum at the temperatures encountered in cutting operations. However, by the use of a sufficient amount of oxidation inhibitor this defect may be minimized and vegetable oils such as olive oil, rapeseed oil, corn oil and castor oil may be used.

The addition of the high viscosity petroleum lubricating oil to the cutting oil composition of our invention provides a film of lubricant on the worked metal surface which is relatively stable so that on very hot surfaces where the mineral seal oil or other light lubricating oil may be lost due to its high volatility, a lubricating film is maintained by the high viscosity petroleum oil present. A lubricating oil having a viscosity of about 150 SUV at 210° F. is most satisfactory but oils ranging in viscosity from about 100 to 200 SUV at 210° F. may be used. Typically 2 per cent of the highly viscous oil is used in the cutting oil compositions of our invention, but amounts between 1 and 20 per cent may be used with advantage.

The oxidation inhibitor used in the compositions of our invention increases the useful life of the cutting oil and decreases any tendency to thicken due to the formation of sludge or gum. Substantially any of the oxidation inhibitors heretofore used for the prevention of oxidational deterioration of petroleum oil compositions may be used, for example, the amino phenols, the alkylated phenols, the alkyl phosphites and the alkylated phenol phosphite and phosphate esters. The latter class, particularly the alkyl phenyl phosphite esters, are also effective in increasing the extreme pressure characteristics of mineral oil compositions to which they are added. For this reason we have found these compounds most advantageous for use in the cutting oil compositions of our invention. Typical compounds which have proved satisfactory are tri-(tertiary-amyl-phenyl)-phosphite, tri-butyl phosphite and similar compounds. The extreme pressure characteristics imparted by the addition of this class of phosphite oxidation inhibitors increase the polishing action obtainable with the cutting oil compositions of our invention and minimize the scuffing or tearing action on the metal. The antioxidants are advantageously incorporated in the cutting oil compositions in amounts from 0.03 to 5 per cent by weight.

By incorporating a small amount of each of the above components that is a fixed fatty oil, a relatively heavy lubricating oil and an oxidation inhibitor, particularly of the phosphite type, in a predominant amount of a mineral seal oil or other light mineral oil fraction cutting oil compositions having the desired properties can be obtained. We have found, however, that it is generally advantageous to incorporate also a relatively small amount of a residual material obtained by the solvent extraction of petroleum oil distillates. In the solvent refining of distillate petroleum oils, particularly for use as lubricating oils, extraction with furfural, nitrobenzene, sulfur dioxide, phenols and the like is often resorted to for the removal of certain undesired components, including polycyclic hydrocarbons and certain sulfur compounds. These extracted materials, when incorporated in the cutting oil compositions of our invention, are also effective to increase their extreme pressure characteristics. Furthermore, in view of the fact that the sulfur content in these compounds is closely combined, there is little or no tendency of the resulting cutting oils to cause tarnishing or discoloration of cut metal surfaces on which they are used. Solvent refining extracts obtained from distillate oils and having viscosities of 55 to 70 SUV at 210° F. have been found most useful. These distillate oil extracts, while advantageous in the compositions of our invention, are not essential components thereof,

but when used may be incorporated with advantage in amounts up to about 10.0 per cent by weight. A typical residual product of this type which has been found suitable for the compositions of our invention has the following properties:

API gravity		14.4
Flash point	°F.	365
Fire point	°F.	435
Viscosity at 100° F.	SUV.	1222
Viscosity at 210° F.	SUV.	61.8
Pour point	°F.	+5

Other extreme pressure agents may also be used in the compositions of our invention, such as sulfurized fatty oils or sulfurized mineral oil bases containing not only the chemically combined but also dissolved sulfur, or chlorinated organic compounds, and the like. However, for cutting oil compositions to be used in conjunction with readily tarnishable or readily discolored metal surfaces it is generally undesirable to use extreme pressure agents containing loosely combined or dissolved sulfur as such sulfur tends to mar the cut surfaces.

Various other components may be incorporated in the cutting oil compositions of our invention if desired, to improve other specific properties without deleteriously affecting the primary combination of properties of high capacity for heat removal, good lubricity and good extreme pressure characteristics, which characterize the cutting oil compositions of our invention. For example, wetting agents such as fatty acids and detergent sulfonates may be incorporated in the oil to improve its properties for wetting the metal surfaces with which it comes in contact. Also, if desired, essential oils such as pine oil, oil of citronella and the like, may be added to improve the odor.

The cutting oil compositions produced in accordance with the principles of this invention have in addition to their utility as cutting oils themselves, the valuable property of improving other and known cutting compositions when incorporated therein in substantial amounts. We have found that cutting oil compositions prepared in accordance with our invention act as energizers for the heavier cutting oil compositions. They have the property of increasing the penetration, wetting ability and cooling effect of such cutting oils. They are advantageously used in amounts corresponding to about 10 to 30 parts by weight on the mixture, although good results may also be obtained with greater or lesser amounts.

In the following specific example there are illustrated the results obtainable with the cutting oil compositions prepared in accordance with the present invention.

A cutting oil was made up having the following composition:

	Parts by weight
Mineral seal oil (kinematic viscosity about 2 to 4 centistokes at 100° F., +25° pour point)	95
Lard oil	2
Refined lubricating oil having a viscosity of 150 SUV at 210° F. and a pour point of +5	2
Naphthenic furfural extract of coastal distillate SUV 55 to 70 at 210° F., +5° F. pour point	1
Tri-(tertiary-amyl-phenyl)-phosphite	0.05
Oil of citronella (scenting agent)	0.01

The resulting composition had an API gravity of 39.6, a flash point of 270° F., a fire point of 305° F., a viscosity of 40.9 SUV at 100° F., and a pour point of +20° F.

This composition was employed in the tapping of aluminum castings in comparison with commerical cutting oil A, a soluble cutting oil used in an emulsion in water. In this cutting test 500 castings were tapped using each of the cutting oils. In the case of the castings using the commercial cutting oil emulsion, 25 castings were lost due to inadequate lubrication, while with the cutting oil compositions of the present invention no castings were lost from this cause. In other words, one casting out of every twenty was lost due to cracking or other damage caused by overheating or inadequate lubrication using the commercial cutting oil emulsion, while no castings were lost out of 500 processed using the composition of the present invention.

It was found in further tests that the speed of cutting aluminum could be increased 15 to 20 per cent without deleterious effect using the cutting oil of the present invention and the tool life could be lengthened up to 75 per cent. Also it was found in these tests that the cut aluminum surface had a high finish resembling that obtained in a polishing operation.

The cutting oil composition prepared according to the present invention was mixed in the proportion of 10 per cent with 90 per cent of commercial cutting oil B, which was a cutting oil containing about 3 per cent of sulfur and having a viscosity of about 100 SUV at 210° F. Comparative tests were then made between the results obtainable with this mixed cutting oil composition and with the original commercial cutting oil. In these tests it was found, on cast steel work, that 50 per cent more tool life and up to about 200 per cent increase in production could be obtained with the blended oil.

Another blend of oils was made using 30 parts of the cutting oil composition of the present invention and about 70 per cent of the commercial cutting oil B above shown. This blend when used in connection with the cutting of gears from Monel metal increased tool life by 250 per cent and reduced the cutting time 45 per cent over the results obtainable with the unblended cutting oil.

A third blended oil was prepared by mixing 15 parts of the cutting oil composition of the present invention with 85 parts of commercial cutting oil C, which had a viscosity of about 70 SUV at 210° F. and contained sulfurized lard oil and free and combined sulfur to a total of about 2 per cent. This blend when used in connection with the drilling of SAE–X4130 steel having a Rockwell C hardness of 38 to 40 increased the service of the drill 200 to 300 per cent.

Another blended cutting oil was prepared by mixing one part of the cutting oil composition above outlined with commercial cutting oil D, corresponding in composition to commercial cutting oil C above but having a slightly higher viscosity. When used in connection with the boring and reaming of 4150 steel this blend gave a 30 per cent increase in tool life.

While this invention has been described herein with respect to certain specific embodiments hereof, it is to be understood that the invention is not limited to the details of such embodiments except as hereinafter defined in the appended claims.

What we claim is:

1. An improved cutting oil composition comprising at least about 50.0 per cent by weight of a light mineral oil boiling above about 350° F. and having a viscosity not greater than about 40 SUV at 100° F., from about 1.0 to about 20.0 per cent by weight of a mineral oil having a viscosity between about 100 and about 200 SUV at 210° F., from about 0.5 to about 15.0 per cent by weight of a fixed fatty oil, from about 0.03 to about 5.0 per cent by weight of a petroleum oil anti-oxidant, and up to about 10.0 per cent by weight of the residue which remains after removal of the solvent from the extract obtained by extracting a petroleum distillate oil with a solvent capable of removing polycyclic hydrocarbons and sulfur compounds from petroleum distillate oils, said residue having a viscosity between about 55 and about 70 SUV at 210° F.

2. An improved cutting oil composition comprising at least about 5.0 per cent by weight of a light mineral oil boiling above about 350° F. and having a viscosity not greater than about 40 SUV at 100° F., from about 1.0 to about 20.0 per cent by weight of a mineral oil having a viscosity between about 100 and about 200 SUV at 210° F., from about 0.5 to about 15.0 per cent by weight of lard oil, from about 0.03 to about 5.0 per cent by weight of a petroleum oil anti-oxidant, and up to about 10.0 per cent by weight of the residue which remains after removal of the solvent from the extract obtained by extracting a petroleum distillate oil with a solvent capable of removing polycyclic hydrocarbons and sulfur compounds from petroleum distillate oils, said residue having a viscosity between about 55 and about 70 SUV at 210° F.

3. An improved cutting oil composition comprising at least about 50.0 per cent by weight of a light mineral oil boiling above about 350° F. and having a viscosity not greater than about 40 SUV at 100° F., from about 1.0 to about 20.0 per cent by weight of a mineral oil having a viscosity between about 100 and about 200 SUV at 210° F., from about 0.5 to about 15.0 per cent by weight of lard oil, from about 0.03 to about 5.0 per cent by weight of tri-(tertiary-amyl-phenyl)-phosphite, and up to about 10.0 per cent by weight of the residue which remains after removal of the solvent from the extract obtained by extracting a petroleum distillate oil with a solvent capable of removing polycyclic hydrocarbons and sulfur compounds from petroleum distillate oils, said residue having a viscosity between about 55 and about 70 SUV at 210° F.

4. An improved cutting oil composition comprising at least about 50.0 per cent by weight of a light mineral oil boiling above about 350° F. and having a viscosity not greater than about 40 SUV at 100° F., from about 1.0 to about 20.0 per cent by weight of a mineral oil having a viscosity between about 100 and about 200 SUV at 210° F., from about 0.5 to about 15.0 per cent by weight of lard oil, from about 0.03 to about 5.0 per cent by weight of tri-(tertiary-amyl-phenyl)-phosphite, and about 1.0 per cent by weight of the residue which remains after removal of the furfural from the extract obtained by extracting a petroleum distillate oil with furfural, said residue having a viscosity between about 55 and about 70 SUV at 210° F.

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Certificate of Correction

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Column 6, line 21, claim 2, for "5.0 per cent" read *50.C per cent*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of March, A. D. 1947.

[SEAL]

LESLIE FRAZER,
First Assistant Commissioner of Patents.