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CUTTING-OIL COMPOUND AND PROCESS OF MAKING THE SAME.

No Drawing.

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To all whom it may concern:

Be it known that I, FRED K. BEZZENBERGER, a citizen of the United States, residing at East Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in and Relating to Cutting-Oil Compounds and Processes of Making the Same, of which the following is a specification.

The invention relates to oil compounds for cooling metal-cutting tools, such compounds being commonly termed "cutting oils".

In machine tool practice the cutting oil is played in a stream upon the tool and the work and, by absorbing therefrom some of the heat generated by the cutting operation, serves to prevent undue over-heating of the tool. Some oils are not suitable for this purpose, those which are suitable and effective are distinguished from the others by their property of running to the hot point of the tool rather than away from it. This desirable and essential property is found most markedly in the animal oils, being particularly marked in the case of lard oil, while it is lacking in the mineral oils. However, mixtures of such animal oil with mineral oils retain this characteristic property of the animal oil and such mixtures, being cheaper than animal oils, such as lard oil, have been extensively used. It is known, too, that the above-mentioned property of animal cutting oils is enhanced by the presence of sulfur and sulfurized cutting oils have been extensively used. In so far as I am aware, however, all prior sulfurized cutting oils have been characterized by an exceedingly disagreeable odor and by a dark and more or less opaque color, both of which properties are obviously objectionable. Some of these sulfurized oils have also been unstable, the sulfur tending to settle out.

The present invention has for its chief object the production of a sulfurized cutting oil characterized by natural freedom from objectionable odors, a relatively high measure of clearness or transparency and chemical stability, as well as high effectiveness as a cooling medium.

In the production of sulfurized cutting oils, the combination of the sulfur with the oil is induced by the action of heat, accompanied usually by more or less stirring or

agitation. My investigations lead me to believe that the evil odors characterizing these cutting oils are due to the substitution of sulfur for hydrogen in the oil molecule with the resultant formation of hydrogen sulfide gas some of which is dissolved or occluded in the oil in such a way that it is practically impossible to eliminate it and its characteristic evil odor. Furthermore, the compounds resulting from the substitution of sulfur have frequently if not always been characterized by the dark and more or less opaque colors above referred to.

Now it has been known for upwards of a quarter of a century that it is possible by suitable heat treatment of unsaturated oils with sulfur to produce a chemical combination of the oil and sulfur without substantial substitution of sulfur for hydrogen of the oil molecule. There has been difference of opinion as to the possibility of theoretically complete prevention of such substitution but I have found that it can at least be prevented to such a high degree that the resulting liquid compound is substantially free from hydrogen peroxide and odor thereof. I regard this as satisfactory evidence that substantially none of the normal hydrogen atoms of the oil molecule is replaced by sulfur, and the gist of my invention consists in introducing chemically combined sulfur into a cutting oil compound of animal and mineral oils through the medium of an unsaturated oil with which the sulfur is chemically combined by addition. This I accomplish by the selection for sulfurization of a suitable unsaturated oil, the mixing therewith of sulfur in suitable proportions, heat treatment of the mixture capable of effecting addition of sulfur to the oil molecules substantially without substitution of sulfur for any of the hydrogen atoms of said molecule and, finally, the mixture of the resulting sulfurized oil with animal and mineral oils suitable to form the finished cutting oil compound.

In carrying out my invention, various unsaturated oils can be used, such as the drying or semi-drying oils. Among these are soy bean, linseed, china wood, corn, cottonseed and rapeseed oils. Other unsaturated oils which can be used include menhaden fish oil, lard oil, and neat's-foot oil. Theoretically, the amounts of sulfur which will combine with these oils are pro-

portional to their iodine numbers, and this index may help in selecting an oil. But there are other factors to consider, especially the price of the oil and its physical consistency in the sulfurized state. In addition, none of these oils are pure chemical substances and one should take into consideration the possibility of encountering deleterious side reactions in connection with the sulfurization. All things considered I have found corn oil and soy bean oil, especially the former, well suited to serve as a base for sulfurization.

As for the unsulfurized animal oil of the finished cutting oil compound, various ones can be used but I have found lard oil especially satisfactory. Any of the mineral oils heretofore used in cutting oils, or others suitable for the purpose, can be used. I prefer to use a mineral oil of the character of the lighter mineral lubricating oils, such as the oils known commercially as paraffin oils and neutral oils. As light an oil even as kerosene can be used but not as satisfactorily as the lighter lubricating oils referred to.

In order that my improved cutting oil compound and the preferred method of preparing it may be clearly understood I shall now describe in detail the preparation of a particular compound which I have found to be highly satisfactory.

To ninety (90) parts by weight of corn oil is added ten (10) parts by weight of sulfur in suitable form, as flowers of sulfur, and the mixture is heated in any suitable vessel, such as an iron kettle. The temperature is slowly raised, while stirring, to 140° C. and is maintained between 140° C. and 150° C. for two and one-half hours. The stirring need be continued only until the sulfur is dissolved which, with moderate stirring, usually requires about thirty minutes. The temperature is held, as stated, between 140° C. and 150° C. in order to complete the addition of the sulfur to the unsaturated points of the corn oil molecule. After the specified time, this addition is complete and the resulting product is a stable sulfurized oil or base free from objectionable odor and from sediment or cloudiness and has a heavy viscous consistency. The amount of sulfur used, namely ten (10) parts to ninety (90) parts of oil, is not sufficient to completely saturate the oil, the reaction not being carried to the point of complete saturation for reasons which will presently be explained.

To produce the finished cutting oil this sulfurized base is combined with a mixture of animal and mineral oils. As above indicated I have found lard oil especially satisfactory, and I prefer to mix one part of lard oil with from four to five parts of a suitable mineral oil such as above specified. To this

mixture is then added a suitable amount of the sulfurized base. I find that a uniform mixture of the constituents is facilitated by heating the lard oil and mineral oil separately, mixing them at 100° C. to 120° C. and then stirring in the sulfurized base which is preferably heated to about the same temperature. When the finished product is to be made at the time the base is prepared, the latter can simply be cooled to 100°.-120° C., preparatory to adding it to the lard oil and mineral oil mixture, and reheating thus avoided.

The ingredients of the finished cutting oil can be combined in various proportions with good results but I have secured especially satisfactory results with compositions within the following limits:

Base (sulfurizing), 10% to 25% (by weight); mineral oil, 75% to 60%; lard oil, 15%.

The sulfurized base of corn oil contains 10% sulfur and consequently the sulfur content in the cutting oil is from 1% to 2½%.

As stated above, the sulfurizing of the corn oil is not carried to the point of complete saturation. The principal reason for this is that as more and more sulfur is added to the unsaturated points of the corn oil molecule the oil takes on a heavier consistency which finally approaches a solid or semi-solid state in which, practically speaking, it would be immiscible with the animal and mineral oils to which it is to be added. A further advantage which flows from only partially saturating the corn oil is that it obviates danger of an excess of sulfur.

While a temperature range of 140° C.-150° C. is preferable in effecting the addition of sulfur to the sulfurized base, it should be understood that it is not impossible to employ temperatures beyond this range. A temperature as low as 125°, for example, can be employed with similar results except that the reaction occurs much more slowly and the cost of the operation is correspondingly increased. On the other hand, while addition reaction is speeded up as the temperature is raised, if the temperature is carried much above 150° C., there is a tendency for substitution reactions to occur with the production of undesirable odors and coloration. Thus while it may be possible to work within a range of say 125° C.-165° C., I prefer to carry out the sulfurization of the base oil within the temperature range of 140° C.-150° C., previously specified.

The sulfurized corn oil base which I produce is light in color and highly translucent, and it readily forms a uniform mixture with the other constituents of the finished cutting oil compound. Furthermore, the finished cutting oil is entirely free from disagreeable and objectionable qualities. It has a deep red, wine-like color free from cloudiness, has

no offensive odor and precipitates no free sulfur on standing. The oil also conforms to high standards as to freedom from gumming, corrosion of metals, etc., and is highly effective as a cooling agent.

While I have set forth, for purposes of explanation, the preferred composition of my improved cutting oil and the preferred procedure in producing it, it will be understood that there can be variation in both respects without departing from the invention, the scope of the invention being indicated by the appended claims.

What I claim is:

1. A cutting oil compound comprising animal oil, mineral oil and a sulfurized oil having a large proportion of the normally unsaturated points of its molecule saturated with sulfur and substantially none of the normal hydrogen atoms of its molecule replaced by sulfur.

2. A cutting oil compound comprising animal oil, mineral oil and an oil having normally unsaturated points of its molecule saturated with sulfur, the compound being substantially free from hydrogen sulfide and the odor thereof.

3. A cutting oil compound comprising animal oil, mineral oil and vegetable oil which has normally unsaturated points of its molecule saturated with sulfur, the compound being substantially free from hydrogen sulfide and the odor thereof.

4. A cutting oil compound comprising animal oil, mineral oil and corn oil which has normally unsaturated points of its molecule saturated with sulfur, the compound being substantially free from hydrogen sulfide and the odor thereof.

5. A cutting oil compound comprising approximately 15% animal oil, 60% to 75% mineral oil, and 25% to 10% oil having normally unsaturated points of its molecule saturated with sulfur, the compound being substantially free from hydrogen sulfide and the odor thereof.

6. The process of preparing cutting oil

compounds which comprises heating a mixture of unsaturated oil and sulfur to a temperature adapted to effect addition of sulfur to unsaturated points of the oil molecule without material substitution of sulfur for hydrogen atoms of the molecule, continuing such heating until the sulfur is substantially all combined with the oil, and mixing the resultant sulfurized oil with animal oil and mineral oil.

7. The process of preparing cutting oil compounds which comprises heating a mixture of unsaturated oil and sulfur to a temperature adapted to effect addition of sulfur to unsaturated points of the oil molecule without substitution of sulfur for hydrogen atoms of the molecule, the amount of sulfur used being insufficient to completely saturate the oil, continuing such heating until the sulfur is substantially all combined with the oil, and mixing the resultant sulfurized oil with animal oil and mineral oil.

8. The process of preparing cutting oil compounds which comprises heating a mixture of unsaturated oil and sulfur at a temperature at 125° C. to 165° C. to effect addition of sulfur to unsaturated points of the oil molecule, continuing such heating until the sulfur is substantially all combined with the oil by addition as stated, and mixing the resultant sulfurized oil with animal oil and mineral oil.

9. The process of preparing cutting oil compounds which comprises heating a mixture of corn oil and sulfur at a temperature of 140° C. to 150° C. to effect addition of the sulfur to unsaturated points of the corn oil molecule, continuing such heating until the sulfur is substantially all combined with the oil by addition as stated, and mixing the resultant sulfurized oil with animal oil and mineral oil.

In testimony whereof, I hereunto affix my signature.

FRED K. BEZZENBERGER.