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EMULSIFIABLE METAL-WORKING
LUBRICANT

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The present invention relates to an emulsifiable metal working lubricant and, particularly, to a lubricating composition designed to facilitate the cold working of metal, particularly ferrous metals, although other metals may be worked with the assistance of such composition. The invention pertains also to a process of metal working involving a new principle of lubrication.

(1) The present invention is based upon the discovery of unexpected merit in the use of a complex emulsion which has a combination of both oil-in-water and water-in-oil emulsions. As is well-known in the art, it is considered desirable to use lubricants for metal working which have greater "oiliness" than simple mineral oils. Because of the cooling effects of the water component, the use of aqueous emulsions for metal working is very widespread and almost universal. The emulsion type lubricants of the prior art have generally been simple emulsions of varying degrees of stability of the oil-in-water type. While they have improved metal working operations, they have not been as effective as desired. There is an important need for a metal working lubricant which facilitates the rolling, drawing or other deformation of metal with reduced power and which also permits a greater reduction or deformation of such metal for each passage through the rollers, drawing dies, or the like.

It has been discovered, according to the present invention, that an emulsifiable composition of the complex type mentioned above may be prepared by adding to a suitable hydrocarbon or mineral oil a substantial proportion of fatty material, plus at least two different emulsifiers, one of the type producing oil-in-water, the other of the type producing water-in-oil emulsions. Fatty acids, rosin acids, fatty oils and the corresponding alcohols and mixtures thereof have all been found highly satisfactory. Oleic acid, sperm oil, tall oil and soyabean oils have also been tested and all have been found effective.

(2) In commercial practice, other factors aside from the novelty of the invention have been considered. When expense, availability, odor, stability and staining characteristics are taken into account, lard oil is found to be the preferable fatty component at the present time. The other materials mentioned above are almost as satisfactory in most instances.

(3) For the oil-in-water emulsifier, it is preferred to use combinations of at least two different surface active materials of the non-ionic complex ester and ester-ether type as repre-

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sented by the sorbitan-esters of common fatty acids, aromatic polyglycol ethers and polyoxyethylene sorbitol fatty acid esters. However, a single emulsifying agent may sometimes be used.

5 The commercial partial esters sold by Atlas Powder Company under trade names "Spans" and "Tweens" are quite satisfactory, but other similar products may be used. These preferably are used in conjunction with a monovalent metal sulfonate of the oil-soluble type. In some cases the sulfonate may be omitted. When used, sulfonates derived from mineral oils by drastic treatment with strong sulfuric acid are preferred, but other types may be used. The preferred sulfonates are those prepared by neutralizing petroleum derived sulfonic acids of molecular weight of at least 350. The alkali metal sulfonates, specifically sodium petroleum sulfonates of molecular weights of 350-650, are preferred.

10 (4) As a water-in-oil emulsifier, a polyvalent metal soap of fatty oil or fatty acid having from about 10 to 24 carbon atoms per molecule is preferred. The alkaline earth metals are specifically preferred, i. e., calcium, barium, and strontium soaps, though others such as aluminum may be used. Polyvalent metal sulfonates, such as calcium petroleum sulfonates of sufficiently high molecular weight to be oil-soluble may also be used. Molecular weights, based on sulfonic acids of at least 350 and preferably higher, up to 650, are preferred. Since calcium soaps are inexpensive, readily available, easily prepared, calcium is the preferred metal; because of their greater solubility in mineral oils, the oleate and sulfonate soaps are preferred. Non-ionic emulsifiers of the type producing water-in-oil emulsion, e. g., pentaerythritol monooleate, have been found equally effective.

15 (5) Particularly effective compositions are made of a relatively light mineral base lubricating oil, of about 50 to 100 S. S. U. at 100° F., containing about 10 to 20% by weight, based on the total composition, of lard oil, about 3 to 10% of partial fatty acid ester of polyhydric alcohol, e. g., a combination of "Span 80" and "Tween 81," 0 to 4% of sodium petroleum sulfonate of molecular weight between 375 and 550, and 0.5 to 2% of oil-soluble calcium soap, e. g., calcium oleate.

20 The proportions of the various ingredients mentioned above may be varied quite widely. The mineral oil itself may vary from a very light to a very viscous consistency, e. g., as low as about 45 S. S. U. at 100° F. to as much as 200 S. S. U. at 210° F. Because of its improved

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cleaning characteristics following rolling, of sheet metals, for example, the preferred viscosity is approximately 60 S. S. U. at 100° F. or between 50 and 100 S. S. U. at this temperature. The total quantity of emulsifiers will ordinarily not exceed 25% and ordinarily will range from about 5 to about 12% total. The quantities of soaps used are low, usually not exceeding about 3%, because it is not desirable to use so much soap that the oil is thickened to a grease consistency. Soap proportions used to produce the water-in-oil phase are preferably between 0.3 and 3.0% by weight of the total composition. The quantities of fatty oil, rosin or fatty acids may be as little as 2% and up to about 50% by weight of the total composition. Proportions of 10 to 20% ordinarily are preferable.

In general, the composition which is to be emulsified before use comprises, broadly, proportions ranging from 25 to 90 parts by weight of the mineral base oil, 2 to 50 parts by weight of fatty oils, glycerides or higher alcohols (e. g. sperm oil), fatty or rosin acids, or mixtures of these, 2 to 25 parts of the oil-in-water emulsifiers and 0.5 to 3 parts of polyvalent metal soaps or other water-in-oil emulsifiers. The parts by weight just indicated may also represent the percent composition by weight of the finished product.

A particularly suitable product which has been tested and serves as a specific example consists of a mineral base oil of about 60 S. S. U. viscosity at 100° F. containing 15% by weight, based on the total composition, of lard oil, 4% by weight of polyoxyethylene sorbitan monooleate ("Tween 81"), 1% by weight of sorbitan monooleate ("Span 80"), 2% of the oil-soluble sodium salt of petroleum sulfonic acids of molecular weight between 400 and 500 and 1% of calcium oleate. This product displays outstanding adhesiveness to metal in the presence of water, not being too readily washed off by the cooling water of plate rolling mills. Plant tests have shown an improved reduction per pass for the rolling of sheet steel for tin plate along with a more acceptable elongation and grain structure of the metal. It is particularly applicable to the cold rolling of steel and also to the drawing of copper, brass and aluminum wire and tubing.

The composition described in the preceding

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paragraph has been tested with excellent results on a reversing type 4-high, 36 inch plate mill and also on a continuous 5-stand plate mill of standard commercial design. Appreciable increases in reduction per pass are noted when the complex emulsion is applied as a surface layer on the metal subjected to the deforming forces.

What is claimed is:

1. A composition consisting essentially of mineral base lubricating oil containing 5 to 40% by weight, based on the total composition, of lard oil, 3 to 25% of a combination of at least two different oil-in-water emulsifiers one of which is an alkali metal petroleum sulfonate of molecular weight within the range of 350 to 650 and the other is a long chain fatty acid ester of a polyhydric alcohol, and about 0.3 to 3% of calcium soap of fatty acids of the C₁₀ to C₂₄ range.

2. A composition consisting essentially of mineral base lubricating oil containing about 15% by weight of lard oil, based on the total composition, about 5% of non-ionic partial long chain fatty acid esters of polyhydric alcohol emulsifiers, about 2% of oil-soluble sodium petroleum sulfonates and about 1% of calcium soap of C₁₄ to C₂₂ fatty acids.

3. The process of working metal which comprises applying a deforming force thereto in the presence of a surface layer of a complex oil-in-water and water-in-oil emulsion of the following oil composition:

Mineral lubricating oil—65 to 84.7% by weight,
Lard oil—10 to 20%,

Emulsifier consisting of a combination of oil soluble sodium petroleum sulfonate and a long chain fatty acid monoester of a polyhydric alcohol—5 to 12%,

Calcium soap of C₁₀ to C₂₄ fatty acid—0.3 to 3%.

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