

UNITED STATES PATENT OFFICE

2,294,535

WIRE DRAWING LUBRICANT

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No Drawing. Application July 26, 1940,
Serial No. 347,768

9 Claims. (Cl. 252—18)

This invention relates to the art of drawing wire, and is concerned more particularly with the provision of lubricant compositions adapted for use in that art.

In the past, wire to be reduced in cross-sectional area has been coated with a lubricant for the purposes, inter alia, of reducing the amount of power required for the draw and of improving the surface characteristics of the drawn wire. For this purpose there have been employed graphite, aluminum metal in the form of fine plates, and fatty acid soaps of, for example, sodium. In certain drawing technique it is common to associate lime with dry soap, the admixture being employed as a wire drawing lubricant composition.

The underlying function of a useful lubricant in this art appears to be this, that a readily deformable film, i. e., a film of comparatively low internal friction, is interposed between the die and the metal undergoing drawing. Employment of a lubricant has become even more important since the advent of drawing dies as hard as diamond or substantially so. Thus, the modern-day dies of tungsten carbide, tungsten carbide plus cobalt, and boron carbide, which have hardness of about that of diamond in addition to high strength (preventing rupture under considerable pressure or impact), do not, of themselves, lubricate,—that is to say, they do not attract films not readily detached from their surfaces. This makes all the more necessary the employment of lubricant films which cling to the metal surfaces and/or to the die with considerable adhesive force.

My researches on use of soaps as wire drawing lubricants have indicated that their effectiveness is in inverse proportion to their total molecular weights, while the amounts required to be used are directly proportional to their total molecular weights. Also they indicate that the replacement of the removable hydrogen of a fatty acid does not impair the attraction of the fatty acid to metal surfaces provided the base used to replace the hydrogen be not of very high molecular weight so as to impair to any considerable degree the relative amount of oxygen in the fatty acid soaps molecule. If, on the other hand, the fatty acid be of relatively low molecular weight, or if it contains in its constitution more than the normal content of oxygen, or oxygen plus halogen, or halogen, the attraction of that fatty acid compound for metal surfaces is greatly enhanced. Against the use of fatty acid compounds containing halogen, however, stands the possible disad-

vantage that decomposition of the compound with release of halogen acid may in some instances cause some corrosion of the wire carrying the compound in case the metal of the wire is susceptible to ready corrosion by small amounts of halogen acid.

I have found it preferable to employ, in wire drawing lubricant compositions, highly oxygenated compounds (hereinafter more specifically described) which have approximately equal attraction for metal surfaces (as compared with the halogen-containing compounds) and which are capable of reducing the draught power required to nearly that required merely for deformation of the metal. I have found, also, that the replaceable hydrogen, of my highly oxygenated saturated aliphatic acids of petroleum origin may be replaced by sodium, potassium, ammonium, calcium, magnesium, or other bases of these types, or by an organic radical such as an alcoholic, ketonic or alcohol-ketonic radical, the main requirement being that the amount of the lubricant and its effectiveness are proportional to the amount of oxygen contained in the soap molecule.

The wire drawing lubricant composition of the present invention, then, consists essentially of acid compounds, i. e., free acids or soaps thereof,—characterized by containing the radicals of saturated aliphatic carboxylic, hydroxy carboxylic, keto carboxylic, or hydroxy keto-carboxylic, acids derived from a petroleum hydrocarbon mixture by liquid-phase, controlled, partial oxidation of such petroleum hydrocarbon mixture in accordance with the oxidation procedures disclosed in my U. S. Patent No. 1,863,004. These soaps, or the free acids, may be employed in solution, or in the form of aqueous emulsions, or in dry form.

The principal distinction between my acid compounds and ordinarily employed soaps lies in the relative amount of oxygen per molecule of the respective compounds: (1) the average molecule of my acid compounds used is much smaller than the average molecule in present-day commercial soaps, and (2) there is more oxygen per molecule of my acid compounds due to the fact that many of the acids are hydroxy, polyhydroxy, keto, or hydroxyketo acids. Accordingly, this materially larger oxygen content makes possible the provision of a solution which, percentage for percentage, affords more oxygen and hence causes an enhanced tenacity of adhesion of oxygen-containing molecules to the metallic surface. Moreover, my acid compounds

are usually associated with alcohols, ketones and/or keto alcohols (i. e., conjoint products of the oxidation procedure whereby the acids or acid compounds were formed); these non-acidic oxygen-containing compounds have high attraction for metal surfaces and are, per se, good lubricants, and hence further enhance the oxygen content of my wire drawing lubricant compositions in proportion to their amount therein.

The soap of the present invention may be a salt of an alkali metal, e. g., sodium, potassium or ammonium or of an alkaline earth metal, e. g., calcium or magnesium or a metal salt such as that of aluminum. Instead of the metal, the replaceable hydrogen may be replaced by an organic oxygen-containing radical such, for instance, as an alcohol, alcohol-ketone, polyalcohol, or the like. The soap may be employed alone, or in admixture with an assistant therefor. Among operable assistants are: lime, $\text{Ca}(\text{OH})_2$; sulphur chloride; an organic chloride such as a chlorinated naphthalene (e. g., the chlorinated naphthalene which one manufacturer provides under the trade name "Halowax"), chlorinated paraffin, various benzol chlorides, hexachlorethane, and the like; phosphoric acid esters such, for instance, as tricresyl phosphate and triphenyl phosphate; and various fatty oils which have been chemically combined with sulphur or have been treated with sulphur chloride. Any or all of these "assistants" are benefited by admixture with my soaps, or free acids, aforesaid, as is established by the reduction in the power required for deforming and drawing metals as compared with the power required in the cases where the said "assistants" are used alone. Even the dry soaps with or without the presence of lime are forced into the throat of the die by the advancing wire and there act as lubricants, as when they are forced by the drag of the wire into the throat they become intimately associated with the metal surface and refuse to be squeezed out at the pressures required for deforming the wire.

The invention will be described in greater particularity with reference to the following illustrative examples:

Example 1

The acidic products of an oxidation reaction mixture derived from the oxidation of 124-126° M. P. paraffin wax were saponified with caustic soda, the saponification mixture was diluted with water to give a 25% soap solution, and the unsaponifiable material was removed. Fine copper wire was drawn through a bath of this solution, the wire being reduced in diameter by passage through a series of ten diamond dies from number 14 to number 40. Practically no wear of the dies was observable and the surface characteristics of the wire product were good. A comparative test using tallow soap solution, same percentage solids, showed appreciable wear on the dies, and surface striations on the wire.

Example 2

100# of 130 saponification equivalent Sharples wax oxidation product was mixed with 10# of dry hydrated lime in a heated mixer the whole being stirred so that a homogeneous high melting point mixture was arrived at. The temperature was maintained at about 125° C., the mixture finally becoming so stiff as to stop the mixer. This product was then removed and ground to a fine powder. This powder was then mixed very

intimately with an equal volume of lime hydrate and used as a drawing mixture. It was found that two more volumes of lime could be added to this mixture and it would still function perfectly. The volumes of lime hydrate are based upon the volume of my lime soap first made.

Example 3

A quantity of the soap product obtained as in Example 1 above was brought to boiling and to it there was added an aqueous solution of aluminum sulphate, care being taken to add the latter, by increments, until no further precipitation occurred. The resulting aluminum soap was drained free of adhering sodium sulphate solution, and was then washed with water, dried in an oven, and pulverized with an equal volume of dry slaked lime. The resulting fine dry powder gave excellent results when employed as a wire drawing lubricant in the drawing of iron and steel wires.

I claim:

1. A wire drawing lubricant composition consisting essentially of organic compounds characterized by containing the radicals of highly oxygenated saturated, aliphatic carboxylic acids derived from a petroleum hydrocarbon mixture by liquid-phase controlled partial oxidation, the carboxylic acids having average oxygen content at least as great as that of the hydroxy carboxylic acid form of said acids.

2. A wire drawing lubricant composition as defined in claim 1, in which the radicals of the highly oxygenated, saturated aliphatic carboxylic acids are combined with salt-forming radicals.

3. A wire drawing lubricant composition as defined in claim 1, characterized in that the acidic compounds are present in the form of soaps.

4. A wire drawing lubricant composition as defined in claim 1, characterized in that the acidic compounds are present in the form of soaps in aqueous dispersion.

5. A wire drawing lubricant composition as defined in claim 1, characterized in that the acidic compounds are present in the form of soaps in dry form.

6. A wire drawing lubricant composition as defined in claim 1, characterized in that the acidic compounds are present in the form of soaps in dry form in association with lime hydrate.

7. A wire drawing lubricant composition consisting essentially of a mixture of the aluminum salts of highly saturated aliphatic hydroxy carboxylic acids derived from a petroleum hydrocarbon mixture by liquid phase controlled partial oxidation, the carboxylic acids having an average oxygen content at least as great as that of the hydroxy carboxylic acid form of said acids.

8. A wire drawing lubricant composition consisting essentially of a mixture of the calcium salts of highly saturated aliphatic hydroxy carboxylic acids derived from a petroleum hydrocarbon mixture by liquid phase controlled partial oxidation, the carboxylic acids having an average oxygen content at least as great as that of the hydroxy carboxylic acid form of said acids.

9. A wire drawing lubricant composition consisting essentially of about equal amounts by volume of dry hydrated lime and a dry mixture of calcium salts of saturated aliphatic hydroxycarboxylic acids of mineral origin.

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