This application is a continuation-in-part of my application Ser. No. 157,291 filed Nov. 7, 1961, and now abandoned.

This invention relates to a non-corrosive, lubricating composition, having good cooling properties and to the process of lubricating and cooling metal parts which are subjected to high frictional loads with a minimum of corrosion of the metal parts. The invention is concerned with both water-soluble and oil-soluble lubricating and cooling compositions which are non-corrosive.

Lubricating aqueous solutions such as applied in the metallurgical industry is ordinarily accomplished by the addition of strong organic bases such as aminoaecohols or polyalcohols or polyoxy glycols. The alkalinity of the aminoaecohols make them irritant for human skin and corrosive for most of the metals, whereas the polyalcohols and polyoxy glycols are particularly corrosive with respect to ferrous metals. Thus, high proportions of corrosion inhibitors are usually added to such lubricating solutions without completely avoiding the risk of corrosion.

Among the objects of the invention is to provide aqueous lubricants which have a pH that can be regulated between the values of 7 and 9 so as to provide an aqueous lubricating composition with a pH adjusted to the properties best suited for the metal or metals to be lubricated.

One phase of the invention is based on the discovery that the aminoaecohol salts of certain acids are possessed with high lubricating properties and when mixed with water have much higher cooling properties than the conventional aqueous lubricants such as the aqueous solutions of water soluble oils, aminoaecohols (including the ethanamines), or the polyalcohols or polyoxy glycols. Another phase of the invention is based on the discovery that compositions containing said aminoaecohol salts of said certain acids can have the pH of the composition adjusted by varying the proportions of the acid or base and that when the pH of such composition is adjusted to produce the least corrosion toward a particular metal with which it is to be used, the resultant composition also usually has the most favorable lubrication properties for that particular metal. Certain of these salt compositions also have the property of promoting the cutting or grinding of metals.

It has further been found that the cooling, lubricating and cutting advantages of these amine salts of acids can be extended to the oil lubricating compositions by making the salts from oil soluble amines whereby oil soluble salts are obtained which are especially suitable for addition to oils to be employed in extreme pressure applications. Going still another step further, it has been found that said water soluble salts can be emulsified in such oils with the aid of emulsifying agents to improve the properties of the oil.

Among still further objects of the invention, therefore, is to provide oil compositions having improved cooling, cutting, lubricating and anti-corrosive properties.

It is emphasized that the additives of this invention, either water, or oil soluble, or emulsified, are not ordinary lubricants but efficacious antifriction, cutting, extreme pressure cutting, cooling and anti-corrosive additives increasing in very high proportions these properties in mineral oils and providing for comparable properties to their aqueous solutions or emulsions. Even in solution in oils, for the oil soluble ones, they increase the heat conductibility of said oils and thus their cooling power. These special properties communicated by said additives either to water or to oils or to aqueous emulsions of oil in water have been successfully tested by industrial experiments in lubricating and tooling. These tests have shown improvements in the life of the tools, the possibility of increasing the speed of the work, the facility for the workmen to complete the work and the quality of the work itself. Practically, the average increase of the duration of tools for a given type of work is between 20% and 50% depending somewhat on the type of work and the metal toolled.

Another object of the invention therefore is to provide an oil soluble or water soluble or emulsifiable additive for a lubricating composition which improves the cooling, cutting, lubricating and/or anti-corrosive properties of the liquid to which it is added.

The objects of the invention are attained by preparing a salt by reacting acid selected from the group consisting of oxygenated inorganic polybasic acids, polybasic organic carboxylic acids or organic acid-alcohol combinations with an alkaline amino compound selected from the group consisting of aliphatic amines and polyamines, aliphatic amino ethers, aminoaecohols, polyalcohol, and condensation products of alkyl amines and polyamines with epoxides in the presence of solvents for the ingredients and adjusting the pH of the salt or reaction mass to a value of 7-9 by regulating the amount of basic amino compound added. Since the acids are bifunctional, the resultant compounds are still salts although all of the acidic hydrogens may not be replaced by an amido radical.

The oxygenated inorganic acids, polybasic acids include boric and chromic acids, chromic acid anhydride, the phosphoric acid including the ortho, pyro, meta- and polyphosphoric acids as well as the thio- and dithio phosphoric acids. The dibasic organic acids include oxalic, tartaric, adipic, suberic, sebacic, and citric acids; the acid chlorides include laetic, tartaric and citric acids, the last two being both dibasic and acid chloride compounds.

Depending on whether the final mix is to be oil soluble or water soluble or both oil and water soluble, the amino compounds are selected from water soluble or oil soluble compounds. The water soluble alkaline amines and aminoaecohols include the mono, di, and triethanolamine, the mono, di, and trisopropanol amine, ethylene diamine, diethylethylene diamine, dipropylene diamine, morpholine, morpholine derivatives in which one or more hydrogens are replaced by alkyl or alkoxy groups. Rings compounds such as morpholine, which contain saturated carbon atoms are considered as aliphatic compounds.

The oil soluble amino compounds include those amino compounds as defined above which in addition include at least one alkyl radical of 8-24 carbon atoms.

Amino compounds which produce reaction products having both oil and water solubility are organic surface active bases which result from the condensation of epoxides with fatty amines, polyamines and alkylaminopropylamines which contain 8-24 carbon atoms in the alkyl radical. When these amino compounds are combined with alicyclic acid, they may be added in a quantity so as to effect only part of the neutralization of the acid, a portion of the neutralization being effected by inorganic bases or other amino compounds and during the process the reaction temperature is preferably kept below 30° C. in order to avoid secondary reactions due to the oxidizing power of chromic acid.

The lubricating and cooling powers of the water soluble products remain considerable even at dilutions down to about 1% of the salt in water. As the products are diluted with water the pH value thereof decreases slightly.
important feature of the invention is the ability to adjust the pH of the salt mix or solution thereof to the best anti-corrosive value for the metal with which it is to be used. When formic metals, lubricating fluids and cooling solutions having a pH of 7.5 to 8.4 or 8.8 are very satisfactory, for use with copper a pH value of about 7-7.5 is very satisfactory. For use with aluminum and zinc surfaces, a pH of 7 to 7.8 is very satisfactory. All of these values can vary somewhat when alloys of the various metals are to be lubricated.

In addition to being useful as cooling and lubricating fluids in cutting and drilling operations, the water solutions of the salts are satisfactory as lubricants in hydraulic transmissions where fire hazards exist, as in mines.

Optional additions for the compositions include corrosion inhibitors, chelating agents to bond calcium and heavy metal salts present in diluting water, antiseptic and fungicide compounds, anti-foaming agents, emulsifying agents for emulsifying oils in aqueous solutions of the salts, etc. The corrosion inhibitors may be desirable in some cases even when the pH of the lubricating liquid has been adjusted to the most desirable value. Inorganic inhibitors such as alkali metal nitrates may be added, although with some risk of precipitation thereof in winter, or conventional water soluble organic inhibitors may be added. Chelating agents to prevent precipitation of calcium and heavy metal salts are the well known ethylenediamine tetracetic acid (EDTA) compounds and similar compounds. The fungicides are particularly advisable additions when orthophosphoric acid is the acid employed.

Certain of the acids and amino compounds employed in the formation of the salts have advantages over other acids for particular lubricating uses. Thus, the property of chromic acid salts of the amines as corrosion inhibitors for ferrous metal when added to corrosive aqueous liquids containing oxygen, hydrogen sulfide and carbon dioxide, has already been disclosed in Viles U.S. Patent No. 2,607,744. According to the said patent, stoichiometric proportions of the amines are reacted with the chromic acid compound so as to completely neutralize the chromic acid whereas according to the present invention sufficient alkali reacting compounds are added to provide a pH in the range of 7-9 and to provide the best pH within said range for maximizing the anti-corrosive properties with respect to the metal with which the salt is to be employed. It has also been found that the chromic acid reaction products are especially desirable in providing exceptional cutting properties in addition to the lubricating properties thereof.

Where lubrication and cutting are more important than anti-corrosive properties, amino alcohols and polyaminoalcohols are preferred as the amino compounds to form the salts, but where cooling is a more important consideration, the amines and polyamines are preferred. Exceptionally high lubricating products are obtainable without any chromic acid addition when a substantial portion of amino morpholine and when the acid is citric, boric or adipic acid.

The chromic acid salts have a disadvantage in that in storage many such compounds tend to darken. To minimize this tendency it has been found that it is desirable to react the chromic acid partly with a cyclic saturated amine such as cyclohexylamine or dicyclohexyl amine, partly with an amino alcohol (the mono-, di-, or triethanolamine or corresponding isopropanol amines), and also partly with an alkali metal or alkali earth base such as sodium, potassium or lithium hydroxide in the proportions of 40-60% of the inorganic base, 5-20% of the cyclic saturated amine, the remainder being the amino alcohol.

When it comes to stability in hard or calcium containing waters, the compounds formed with the meta-, pyro- or polyphosphoric acids have advantages in that such compounds act as sequestering agents for calcium, etc. without requiring the additions of EDTA. Such higher phosphoric acids have the advantage over orthophosphoric acid in not forming fermentable salts thereby requiring no additional fungicide, and in producing non-foaming salts.

When using amino-tannic anti-emulsifying agents may be employed for emulsifying oils into aqueous solutions of the salts of the invention. In some cases the salt itself acts as an emulsifying agent as in the case where oxyethyl fatty amines and polyamines are employed as the alkaline reactant in the salt.

I will now illustrate the invention with examples of application of my process and of the products obtained thereby.

EXAMPLE 1

35 kilograms of citric acid are dissolved in 575 kilograms of water. Then, there are added progressively, while agitating, 170 kilograms of triethanolamine so as to obtain for the solution a maximum pH of 8.4. Aqueous dilutions of this solution have a pH between 8.4 and 7.7 according to the dilution, the pH decreases with the dilution. There is thus obtained a concentrated aqueous solution having very high antifriction power and which is non-corrosive against ferrous metals, copper and its alloys and aluminum. For use as a lubricant the concentrate can be diluted with water, for instance at 2.5-3% by weight of the concentrated solution, and be employed in grinding, the dilute solution having very slight corrosive effects on the metals. Conventional corrosion inhibitors may be added for additional protection. For instance there could be dissolved in the concentrated aqueous lubricating solution set forth above, 225 kilograms of crystallized commercial sodium nitrite which protects ferrous metal against any risk of corrosion. But such protection might completely prevent corrosion against metals other than ferrous on account of the alkalinity given to the aqueous solutions by the sodium nitrite dissolved therein. On the other hand, substantially complete protection against corrosion may be obtained by adding to the concentrated lubricating aqueous solution of triethanolamine citrate of the present example which has been regulated so as to minimize corrosiveness against all metals, 25 to 50% by weight of an aqueous solution of anti-corrosive chromic acid compound made according to Examples 12-15, or by adding 1 to 3% of same solution to the dilution solutions of the triethanolamine citrate lubricant of the present example. This association of two lubricating additives according to the invention provide anti-corrosive, lubricating aqueous solutions possessed with very high antifriction, cutting and anti-corrosive properties. Experiments on milling machines have shown that such diluted solutions neither the steel nor the copper parts of the magnetic plates of such machines, nor the bronze of the valves, nor the aluminum name plates where the characteristics of the machines are printed, show the slightest corrosion after very long exposure time. Thus it appears that such lubricants secure complete safety in all respects.

EXAMPLE 2

In Example 1, 25 to 100% of the triethanolamine is replaced by morpholine or an alkyl substituted morpholine. There are obtained aqueous lubricants which can be diluted down to 5% in water without loss of corrosion when no addition of any corrosion inhibitor or of an anti-corrosive lubricating additive is made to them, especially when the pH is within the limits between 7 and 9.

EXAMPLE 3

In Example 1, citric acid is replaced by lactic acid in proportion for obtaining the same range of pH for the aqueous lubricating solutions. Thus 60 kilograms of aqueous lactic acid at 50% concentration by weight are combined with 70 kilograms of triethanolamine in 570 kilograms of water so as to obtain a maximum pH of 8.4 for the concentrated aqueous solution obtained. On dilution with water, the pH remains between 8.4
and 7.7. The properties of the aqueous lubricating solutions thus obtained are similar to those of the lubricating solutions of Example 1. They may also be combined with the anti-corrosive chronic acid salt lubricants made according to Example 12. Part of the total proportion of triethanolamine may also be replaced by morpholine or a substituted morpholine as stated in Example 2. By adding additional lactic acid the pH of the solutions may be reduced to about 7 for use in connection with the tooling of copper.

EXAMPLE 4
Tartaric acid is neutralized in presence of water with triethanolamine as is done in the above examples with citric and lactic acids. When lubricating and cooling or cutting ferrous metals is contemplated, the pH of the diluted solutions is between 8 and 8.8. When the metal is copper, aluminum or zinc the proportions of acid and base combined are modified in order to obtain a pH of between 7 and 7.5 for lubricating solutions. The same addition of anti-corrosive compounds of Examples 12–15 or substitution of morpholine instead of triethanolamine as set forth in Examples 2 and 3 may also be effected for same purposes.

EXAMPLE 5
35 kilograms of boric acid in powder form are kneaded with water and neutralized in presence of a total amount of 780 kilograms of water with 65 kilograms of triethanolamine in order to obtain a pH between 7.7 and 8.4. There is obtained an excellent aqueous lubricant having high antifriction and cooling properties and which is non-corrosive against ferrous metals. For tooling of copper or other metals corroible by alkaline solutions the proportion of triethanolamine is preferably reduced so as to obtain a pH between 7 and 7.5 after dilution with water. Lubricants according to Examples 12–15 may also be incorporated as anti-corrosive and cutting additives to the lubricants of the present example.

EXAMPLE 6
To 50 kilograms of adipic acid in powder form mixed with 300 kilograms of water, there are added 135 kilograms of triethanolamine while heating at 40°–50° C. There is obtained a viscous aqueous lubricating solution having a pH of about 8 and a very high lubricating power. This pH may be regulated in accordance with the properties of the metal to be lubricated by varying the proportions of the acid and base. In order to avoid foam when agitating the solutions, small proportions between 0.05% and 0.15% of an anti-foaming silicone oil or emulsion of the same in water are added. If the solution is to be very diluted in water, there is added to the lubricants of the present example, a lubricant according to Examples 12–15, as in Example 1.

EXAMPLE 7
In Example 6, adipic acid is replaced by the equimolecular amount of sebacic or suberic acid for obtaining aqueous solutions having besides lubricating properties, wetting and detergent properties which are useful in milling and grinding. Combination of these lubricants with lubricants according to Examples 12–15 may also be effected.

EXAMPLE 8
In Example 6, adipic acid is replaced by the equimolecular amount of oxalic acid to provide a lubricant having high cooling power and of which the pH is adaptable to the metal to be lubricated. Combination of this lubricant with lubricants according to Examples 12–15 may also be effected, especially when it is to be used in the form of very diluted solutions.

EXAMPLE 9
Diethylene triamine in aqueous solution at 15% by weight is neutralized by one of the acids stated in the previous examples, up to a pH of 8.2. There are obtained lubricating solutions usable as they are obtained or at suitable dilution with water, for cooling and hydraulic transmissions.

EXAMPLE 10
In Examples 1 to 8, triethanolamine is replaced partly or wholly, either for reasons of economy, or availability or solubility in water of the salts of the different acids stated, by one of the following amino compounds; ethylene diamine, diethylene triamine, dipropylene triamine, mono- or diethanolamine, mono-, di- or trisopropanolamine.

EXAMPLE 11
28 kilograms of triethanolamine diluted with 100 kilograms of water are neutralized with about 4 kilograms of orthophosphoric acid in order to obtain for the aqueous solutions a pH between 8.5 and 8.8. The aqueous solution obtained constitutes an excellent lubricant for tooling of ferrous metals. This composition, however, has certain drawbacks as follows: (1) its dilutions with natural waters may impart a turbid aspect and form a very light precipitate (which may be again dispersed by agitation) so that, when in use, the lubricant does not keep its transparency, (2) at diluted concentrations of between 3 and 5% by weight in water, the noncorrosiveness of the diluted solutions against ferrous metals is not perfect and the addition of sodium nitrite to the concentrated lubricant in proportion so as to obtain anticrosive dilutions results in the crystallization of the lubricant in winter, (3) there are readily developed, on the surface of these lubricants, when not agitated, especially above a temperature of 20° C., fermenting layers which tend to adulterate the properties of the lubricant and which are besides very undesirable for reasons of salubrity; (4) the aqueous solutions tend to foam when agitated. The instability in presence of natural waters may be corrected for instance by adding EDTA in proportion of 0.5 to 2% according to the hardness of the water or more simply with 2% of a water soluble pyrophosphate or polyphosphate. But, a much better solution is given to the problem of obtaining stable transparent aqueous lubricants with amine or aminoaocohols salts of phosphoric acids, by employing phosphoric acid other than the orthophosphoric acid. According to the present process of the invention, orthophosphoric acid is heated for about 3 hours starting from about 200° C. up to 330° C. in a glass apparatus. The dehydration of orthophosphoric acid thus produced leads to polyphosphoric acids and especially to hexamolphosphoric acid which forms a crystalline paste after cooling. This acid is maintained free of humidity until reacted with the amino compound to prevent re-hydration. The acid is neutralized with an aqueous solution of triethanolamine up to the desired pH of 8.5–8.8 when utilization for ferrous metals is aimed at. By adding to an aqueous solution of 100 kilograms of triethanolamine in 100 kilograms of water 12 kilograms of the acid dehydration product obtained as above from orthophosphoric acid, the concentrated aqueous solution of the additive thus obtained does not precipitate when diluted with hard waters, does not crystallize in winter when adding sodium nitrite as a corrosion inhibitor and is no more subject to development of fermentations. Besides the aqueous solutions do not foam when agitated. Furthermore, the anti-friction properties of said solutions are much increased and these solutions have gained cutting properties which are shown by the results of the tests on test machines such as "four balls machine" for instance. In this example also, the proportion of the base may be de-
creased so as to obtain a pH of 7–7.5 for the aqueous solutions when tooling of non-ferrous metals is aimed at. Besides, the combination with lubricants according to Example 12 may also be expected especially when very diluted lubricating solutions are to be used and triethanolamine may be replaced partly or wholly by morpholine or a substituted morpholine or partly by mono or dicyclohexylamine.

**EXAMPLE 12**

30 kilograms of triethanolamine in solution in 60 kilograms of water are neutralized with 10 kilograms of an aqueous solution at 50% by weight of chromic acid, as to obtain a pH of about 8.2–8.5. The aqueous solution thus obtained as well as its dilutions with water show very high lubricating, extreme-pressure cutting and anticorrosive properties which are set forth by the following results obtained from experiments on a test machine of the "four ball" type.

<table>
<thead>
<tr>
<th>Lubricant</th>
<th>Dilution by wt. in water used for test, percent</th>
<th>Print Dimension for 1” ball, mm.</th>
<th>Welding load, kg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water, 60 kg; Triethanolamine, 30 kg; Chromic acid, 9 kg</td>
<td>30%</td>
<td>0.5</td>
<td>480</td>
</tr>
<tr>
<td>Dry extract, 40%</td>
<td>8%</td>
<td>2</td>
<td>380</td>
</tr>
<tr>
<td>Non extreme-pressure cutting oil of commerce</td>
<td>Pure</td>
<td>8</td>
<td>140</td>
</tr>
<tr>
<td>Extreme-pressure cutting oil of commerce</td>
<td>Pure</td>
<td>1.5</td>
<td>280</td>
</tr>
</tbody>
</table>

The above results emphasize the extraordinary high pressure lubricating and cutting properties with regard to steel of aminoaolcohol contains aqueous solutions, as discovered by the inventor.

It is apparent from these results that the aqueous solution at 35% of dry additive in water has higher extreme-pressure lubricating properties than the pure extreme-pressure lubricating and cutting oil of the commerce. Other tests effected with test lathes and drilling machines show the similar, very high cutting properties of the additives which include the reaction product of triethanolamine and chromic acid of this example. The same properties are still found when triethanolamine is replaced by other water soluble amino alcohols such as mono or diethanolamine and mono, di, or triisopropanolamine, or even by amines and polyamines for instance ethylene diamine, diethylenetriamine or dipropylene triamine so that it is apparent these exceptional lubricating and cutting properties belong, more or less pronounced, to all water soluble additives which may be obtained from amines or polyamines and aminoaolcohols or polyaminolcohols, by combining them with chromic acid. In addition, the low temperature maintained with respect to the balls in the test machine or by the tools in industrial machine-tooling show that the lubricating and cutting properties are accompanied with a high cooling power especially when a small proportion (about 0.1 to 0.3%) of a wetting agent is added to the aqueous lubricating solutions, as for instance, an oxyethyl alky phenol or an oxyethyl amine. Furthermore, the anticorrosive properties of the aqueous lubricating solutions according to this example are extremely high. For example, in finishing metal products as by grinding, a dilution at 1% in water of the above described lubricant, containing 0.33% of additive (on a dry basis), when performed, will be capable of being used with a total security against corrosion, even on ferrous metals. The choice of the amino compound may still allow increasing the anticorrosive power of the additive. It is the case when employing a morpholine.

It goes without saying that the proportion of the acid and the base are, for the lubricants of this example, also adaptable to the properties of the metal to be contacted with the lubricant, especially as to the pH of the aqueous solution. For instance, ferrous metals permit the pH to be between 8 and 8.8 which also corresponds to a proportion of the acid and basic components combined in the additive giving the best lubricating and cutting power for hard metals, whereas for softer metals as copper, aluminum, or zinc which are easier lubricated and tolerated, the pH is preferably between 7 and 7.5. In the case of ferrous metals, when antifriiction is especially to be considered, an excess of aminoaolcohol, usually not exceeding 10% by weight may be desirable. The pH nevertheless is not increased above 9 on account of the "ionic buffering effect" of the compounds in aqueous solution.

**EXAMPLE 13**

In the same connection concerning increasing antifriction, a good solution consists in combining lubricants of the type described in Examples 1 to 10 and lubricants of the type of Example 12. The proportions of the two lubricants may be adapted to the application contemplated, to the dilution for use and to the anticorrosive power desired for this dilution. In general, the lubricants of Example 12 are combined with the lubricants of the Examples 1 to 10 in order to adapt the lubricating, cutting and anticorrosive properties of the combined lubricant, to the metal to be contacted with this lubricant and to the work to be effected.

**EXAMPLE 14**

The only inconvenience of the lubricating solutions according to Example 12 is that they darken progressively. This inconvenience, nevertheless, does not hinder their use for finishing works in tooling since they can be used very diluted in water and these dilutions, despite their color, remain transparent for a long time. However, these dilutions after long circulation in pumps and feeders of the machines and on the tools tend, after a few days or a few weeks, to become less transparent and to form a light deposit. It was thus very important to find means for stabilizing these solutions without changing their interesting properties as lubricants and coolants. One of the means tested was to add antioxidizing compounds to the lubricating solutions but this turned out to be a rather expensive and not very safe solution. According to the present example, stable aqueous lubricants are obtained from chromic acid by neutralizing said acid with more than one base, these bases having been determined after many experiments. Thus, instead of the composition for the additive described in Example 12, the composition resulting from the neutralization of the 50% by weight aqueous solution of chromic acid with 5 to 20% monooxycyclohexylamine or dioxycyclohexylamine and completing the neutralization with triethanolamine while diluting with water, whereupon a perfectly limpid (when cold), light yellow, aqueous solution is obtained which will not darken rapidly.

**EXAMPLE 15**

The process is conducted as in Example 12 except that three bases are added to neutralize the chromic acid, of which one is a strong inorganic base, for instance sodium, potassium, lithium, calcium, or barium hydroxide. Experiment has shown that one of the best additives for use in aqueous solution with the highest safety with regards to stability, without losing any of the very interesting properties possessed by the additive described at the beginning of Example 12, is obtained by neutralizing 80 kilograms of the 50% by weight aqueous solution of chromic acid in presence of 800 kilograms of water, first with 70 kilograms of 50% by weight aqueous solution of potassium hydroxide, then with 10 kilograms of monooxycyclohexylamine and finishing the neutralization with about 25 kilograms of triethanolamine, the exact amount of the latter depending on the pH desired (between 7 and 9) for the final aqueous solution with regards to the metal to be contacted with the lubricant and to the application contemplated. This solution is of a yellow
color not darker than a refined petroleum oil and darkens only when spoiled by use.

**EXAMPLE 16**

In Example 15, 25% of the potassium hydroxide aqueous solution is replaced by an equivalent amount of calcium hydroxide, the other bases remaining unchanged. The lubricating aqueous solution thus obtained is especially adapted to cutting of hard metals and alloys.

**EXAMPLE 17**

In Examples 12–15, 5% to 20% of chromic acid is replaced by polyethersphoric acid as obtained in Example 11. The lubricating aqueous solutions thus prepared have stabilities of duration.

**EXAMPLE 18**

To 60 kilograms of one of the concentrated aqueous lubricating solutions obtained according to Examples 1 to 10, there are mixed 40 kilograms of one of the concentrated aqueous lubricating solutions according to Examples 12–17. The pH being adapted to the metal to be toolled, the aqueous lubricant resulting from this mixing is adapted for use in high dilutions in water (between 1 and 3% by weight) for metal tooling without risk of corrosion.

**EXAMPLE 19**

The additives obtained according to Examples 12–15 may also be added to emulsifying compounds or compositions with a view to increasing their cutting power and giving them anticorrosive properties so that they can be used for preparing cutting anticorrosive emulsions of oil in water with applications in metal tooling or hydraulic transmissions. Especially are they useful as additives for non-ionic emulsifiers derived from epoxides by condensation with molecules such as fatty acids, fatty alcohols, alkyl phenols, fatty amines, alkylamino propyl amines derived from fatty acids, of which the corrosive power is well known and which give corrosive emulsions of oil in water. When combined with the additives of Examples 12–15 (especially those which comprise a morpholine) said emulsions gain high cutting properties and become anticorrosive. The proportion of additive to be added to the corrosive emulsion depends on the corrosive power of said emulsion and on the dilution of the soluble oil in water to form the emulsion. This proportion is determined by experiment.

**EXAMPLE 20**

A mixture of oil soluble non-ionic surface-active compounds resulting from the condensation of 3 to 10 molecules of ethylene oxide with alkylamino propylamines of which the alkyl radical has from 8 to 18 carbon atoms is neutralized with a 30% by weight aqueous solution of chromic acid up to the proportion for obtaining a pH of 7 to 9 for the aqueous solutions or emulsions and simultaneously suitable for the metal to be contacted with the aqueous lubricant or soluble oil aqueous emulsion prepared with this mixture of surface-active compounds. The anticorrosive surface-active lubricating additive thus obtained gives, with water, anticorrosive aqueous lubricating solutions. Dissolved in hydrocarbons, said additives provide anticorrosive soluble oils possessed with high cutting and cooling properties. With a view to stabilizing the additives of the present example, the neutralization of chromic acid may be effected partly with the oxyethyl amines and partly, as in Examples 13 and 14, with other bases, among which potassium or sodium hydroxide and mono or dicyclohexylamine.

**EXAMPLE 21**

90 kilograms of alkylamino propyl amines in which the alkyl radical has from 8 to 18 carbon atoms, or 90 kilograms of similar alkylamino propyl amine derived from olein, are dissolved in 160 kilograms of petroleum oil of medium viscosity, for instance spindle oil, or in the same amount of a synthetic hydrocarbon oil of a viscosity between 3° and 5° Engler at 50°C, and are neutralized while cooling and agitating with a 50% by weight aqueous solution of chromic acid. Then, the neutral product formed by saponification and heating up to 105°–110°C. There is thus obtained an additive of brown color having the appearance of a grease, which is soluble in oils and especially in hydrocarbon oils and which may be used as it is, as an anticorrosive, antiflaking and extreme-pressure lubricating grease. The oily solutions of this additive constitute lubricating oils possessed with high antifriction, high extreme-pressure cutting and high anticorrosive properties and are suitable for anticorrosive lubrication and extreme-pressure cutting without water. Such oily solutions show also a very high protective power against corrosion of any metal, either ferrous metals, copper and alloys, aluminium, zinc, magnesium etc., so that they may be used both as lubricating, cutting and protective oils, providing self-protection of lubricated or tool parts for long periods of time. For avoiding the dehydrating step, chromic anhydride may be added in lieu of aqueous chromic acid.

In this connection, the additives according to the present example may enter in more complex compositions in which there are added to the said additives water-repellent oil soluble salts of fatty acids, resinic acids, tall oil acids, naphthenic acids and of fatty amines, fatty polyamines, fatty alkylamino propyl amines; petroleum waxes, natural or synthetic resins; high elastomer polymers such as polybutenes of high molecular weight, lanolin, water insoluble sulfonates such as alkali earth sulfonates, and alkyl alcohols of which the alkyl radical has from 6 to 12 carbon atoms, drying oils, natural or from petroleum, in order to increase the water-repellent and waterproofing properties, the adherence to the metal, and resistance to elimination of the protective lubrication oil, or in other words to develop the physical anticorrosive properties of the oil by means of these complementary products and to associate them with the chemical and physico-chemical anticorrosive properties of the additive according to the present application. Also a portion of the alkylamino propyl amine may be replaced by other amines such as triethanol amine. Dissolved in mineral oil in proportion from 2 to 25% by weight according to the degree and to the duration of the protection desired, allows obtaining protective oils providing perfect protection for any corrodible metal either indoors or outdoors without shelter. Such protective oils have been submitted for tests to the Bureau Veritas and have shown (report No. R. 50.667–3 LB) higher protective power than the best protective oils known and taken as a reference.

**EXAMPLE 22**

In Example 21, to the fatty amine chromate or fatty alkylamino propyl amine chromate or to the compositions in which they are used, there is added a fatty amine or fatty alkylamino propyl amine thio-phosphate, or better dithiophosphate, in proportion of 10 to 100% by weight of the chromate. The water repelency of the oils in which the mixtures thus obtained are dissolved for obtaining lubricating, cutting and protective oils, is further increased.

**EXAMPLE 23**

Additives as in the foregoing examples are introduced as components in lubricating greases, coatings, paints, varnishes, for increasing their protective properties against corrosion of metals.

The features and principles underlying the invention described above in connection with specific exemplifications will suggest to those skilled in the art many other modifi- cations thereof. It is accordingly desired that the appended claims shall not be limited to any specific feature or details thereof.
I claim:

1. Process of lubricating, cutting and cooling metal parts while protecting said parts against corrosion consisting in bringing into contact with the metal parts to lubricate and cool the same and promote cutting thereof, a liquid selected from the group consisting of aqueous solutions and dispersions and oil solutions of at least one additive possessed of lubricating, cutting, cooling and anticorrosive properties adapted to said metal, said additive consisting essentially of chromic acid which is at least partially neutralized, said acid being at least partially neutralized with an amino base selected from the group consisting of water soluble amines and oil soluble fatty amines, said water soluble amines consisting essentially of a mixture of monocyclohexylamine and triethanol amine, said oil soluble fatty amines being selected from the group consisting of fatty alkylamines containing 8 to 24 carbon atoms in the alkyl group and alkyl-aminepropylamines containing 8 to 24 carbon atoms in the alkyl group, adjusting the proportion of acid and amine to provide a pH of 7 to 9 in the lubricating, cutting, cooling and anticorrosive solutions.

2. The process as claimed in claim 1 wherein the lubricating, cutting, cooling and anticorrosive liquid is an oil solution, and said base is selected from the group consisting of fatty alkylamines in which the alkyl group has 8-24 carbon atoms and alkylaminopropyl amines in which the alkyl group has 8-24 carbon atoms.

3. The process as claimed in claim 1, wherein the lubricating, cutting, cooling and anti-corrosive liquid is an aqueous solution, and said amine base is a mixture of monocyclohexylamine and triethanol amine whereby to provide high, extreme pressure cutting properties to said aqueous solution.

References Cited by the Examiner

UNITED STATES PATENTS

2,126,173 8/1938 Clapsadle et al. .... 252—389 X
2,371,866 3/1945 Barrett ............. 252—389 X
2,607,744 8/1952 Viles ................ 252—392
2,850,461 9/1958 Bloch et al. ........ 252—390 X
2,917,160 12/1959 Turinsky .......... 252—34 X
2,959,842 6/1960 Thompson .......... 252—34 X

DANIEL E. WYMAN, Primary Examiner.

C. F. DEES, Assistant Examiner.