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METAL WORKING COMPOSITIONS

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This invention relates to metal working compounds and more specifically to such compounds comprising finely divided particles of sulfur and finely divided particles of polytetrafluoroethylene dispersed in oils conventionally used in metal working processes.

Metal working compositions containing finely divided particles of elemental sulfur dispersed, or suspended, in oils normally used in metal working operations are well known and such compositions possess many functional and economical advantages. For example, mineral oils containing from 1–30% of sulfur suspended therein constitute well known cutting oils. The sulfur is not soluble in such oils but it may be readily suspended therein by an anti-settling agent such as a gelling, or suspending, agent. Suitable suspending agents include so-called castor wax, which is a hydrogenated castor oil, or low molecular monoesters of hydroxy stearic acid typified by the butyl ester of hydroxy stearic acid. It has been found, however, that such metal working compounds are not wholly satisfactory under severe metal working operations such as often experienced in metal stamping processes and especially in metal drawing processes.

It is a general object of this invention to provide novel and superior metal working compounds. It is another general object of the invention to provide improved metal working compounds which may be used effectively in a variety of metal working processes such as in cutting, stamping, drawing and tapping operations. It is a more particular object of the invention to provide metal drawing compounds of increased film strength so that such compounds can be used at higher extreme pressures. It is a special object of the invention to improve the anti-seize, anti-weld and anti-gelling properties of metal working compositions comprising suspensions of sulfur in lubricating and like oils. It is another special object of the invention to provide a modified metal working compound comprising a lubricating oil containing suspensions of finely divided sulfur which can be used in metal drawing operations at higher speeds and with a larger application of force than heretofore possible with kindred compositions. Other objects and features of the invention will become apparent from the more detailed description which follows.

Broadly conceived, the metal working compounds hereof comprise essentially finely divided particles of sulfur and finely divided particles of polytetrafluoroethylene (tetrafluoroethylene resins) dispersed in oils of the type heretofore used in metal working compounds. The dispersion, and the suspension, of the finely divided particles of polytetrafluoroethylene in the oil base does not present a particular problem for it may be dispersed therein in the same manner, and with the assistance of the same suspending agents as those heretofore used in suspending the finely divided sulfur in such oil bases.

It will be understood that a significant amount of polytetrafluoroethylene must be present in the metal working compounds relative to the amount of sulfur if the metal working compounds are to be importantly different from those containing sulfur alone. The amount of polytetrafluoroethylene should equal at least 2%, and usually equals 5 to 30%, of the weight of the sulfur. Typical metal working compounds of this invention would consist essentially of from 1–30% by weight of sulfur and from 0.2 to 30% by weight of polytetrafluoroethylene dispersed in sufficient mineral oil to make 100% by weight. As stated, the finely divided particles of sulfur and the finely divided particles of polytetrafluoroethylene can be dispersed and held in suspension in the oil base in the same manner as sulfur has heretofore been dispersed and held in suspension therein as by agitating the ingredients of the composition in the presence of 0.5–5% of a castor wax, or a hydroxy stearic acid ester, based on the weight of the oil used.

For economic reasons, it is advantageous to use the minimum amount of polyeterafluoroethylene. Thus even though 50%, and more, of polytetrafluoroethylene may be dispersed in many oil bases used in metal working compounds, one would not find it necessary to use more than the aforesaid 30% and customarily 10% or less, usually 1–5%, of the oil base is adequate in most metal working processes. Polytetrafluoroethylene is now readily available commercially as a fine granular powder which may be easily dispersed in a mineral oil or the like. Commercial polytetrafluoroethylene available from the E. I. du Pont de Nemours & Company of Wilmington, Delaware, under the trade name of Teflon 6 or 7 has proven quite satisfactory. Teflon 7, which is quite satisfactory for the purposes of this invention, is an ultra-fine granular powder with an apparent density of 200 g./l.

The following example, which is purely representative, will show one manner of preparing a metal working compound especially well adapted for use as a metal drawing compound.

EXAMPLE

In this example, a commercial cutting oil concentrate containing 15% of finely divided flowers of sulfur, 3–5% castor wax, as suspending agent, and the remainder 200 SUS mineral oil were used as a base material and the above mentioned Teflon 7 as the source of polytetrafluoroethylene.

In the preparation of the metal working compound, 500 g. of the cutting oil concentrate and 57.5 g. of the polytetrafluoroethylene were agitated until the fluoroethylene resin was dispersed in the mineral oil base containing the sulfur to form a paste. Then an additional 5020 g. of the cutting oil concentrate were added and agitation was continued until a homogeneous dispersion was obtained. The final stable dispersion consisted essentially of 14% sulfur, 1% polytetrafluoroethylene and 85% of the lubricating oil and dispersing agent.

The surprisingly superior properties of the metal working compounds of this invention, and other metal working compounds hereof prepared in the same way, may be readily appreciated by comparing them with the metal working compound mentioned above as the cutting oil concentrate as evaluated by the well-known Falex Test proposed to be standardized as ASTM D–2, Section V, Tech. K. Essentially the test measures the torque developed at a constant speed and the wear taking place on a steel journal when jaws bearing thereon are subjected to various jaw loads. In the instant test, the testing apparatus was first operated at a jaw load of 250 lbs. for three minutes and the torque noted in pounds. Thereafter, the load was increased by 250 lbs. every minute and the torque noted until seizure took place or wear was so heavy that the load could not be maintained.

In each of the metal working compounds tested, the oil base was a 200 SUS mineral oil and the dispersing agent was 3–5% castor wax. The variation was in the percentages of sulfur and polytetrafluoroethylene as set out in the tables below.

Table I

15% sulfur—Jaw load	0% Polytetrafluoroethylene—Torque
250	2-3
500	5-6
750	20-32

Seizure was evident while increasing load to 750 lbs.

Table II

14% sulfur—Jaw load	1% Polytetrafluoroethylene—Torque
250	6-15
500	34-35
750	44-41
1,000	47-46
1,250	47
1,500	48
1,750	48
2,000	48
2,250	49-48
2,500	49
2,750	50
3,000	50
3,250	51
3,500	51-52
3,750	53@ 3,700

Shear pin broke at 3700 lbs. while loading.

Table III

5% Sulfur—Jaw load	10% Polytetrafluoroethylene—Torque
250	3-15
500	27-28
750	35-34
1,000	36
1,250	36
1,500	37-36
1,750	37
2,000	37
2,250	38-37
2,500	38-37
2,750	38-37
3,000	39-37
3,250	39-35
3,500	40-36
3,750	40-37
4,000	40-42

Wear at 4000 lbs. was so heavy mechanical loader could not maintain load, which fell to 3900 lbs. by end of one minute.

It will be apparent from the foregoing tables that the objectives of this invention as set out above are obtained to a remarkable degree by the utilization of as little as 1% polytetrafluoroethylene in the metal working com-

pounds hereof. For instance, as shown in Table II, it will be seen that the metal working compound of the example, wherein 1% polytetrafluoroethylene replaces 1% sulfur, can be operated at about 5 times the extreme pressure of the metal working compound which does not contain the tetrafluoroethylene resin. Also Table III shows that only a small further advantage is obtained when two-thirds of the 15% of sulfur is replaced by the tetrafluoroethylene resin.

It will be understood that changes are not required as to the nature of the oil base or the sulfur component used in this invention although a lesser amount of sulfur is customarily required. As to the oil, the usual mineral, or petroleum, lubricating oils such as those having a viscosity of 100 to 1200 SUS are preferred for economic reasons. As to the sulfur component, flowers of sulfur, insoluble sulfur and other finely divided sulfurs of particle sizes known to be suitable in providing cutting oils and like metal working compounds are contemplated. While, as stated, as much as 30% of the total composition may be sulfur, a lesser amount is normally used in the presence of polytetrafluoroethylene. It will be understood, however, that an even more concentrated paste may be made but that a dilution of this concentrated paste would normally take place in use.

Likewise, the amount of dispersing agent is the same as that heretofore used. Customarily 0.5 to 1% of the weight of the oil base is sufficient when the concentrate is diluted for use but as much as 5% may be used in a concentrate.

While the example has related to the use of polytetrafluoroethylene, it will be understood that other polyfluoroethylene resins may be used to obtain some of the advantages of this invention while optimum advantages require that all of the hydrogen atoms of ethylene used in the production of the resin be replaced by fluorine, it is well known that certain of the advantages are obtained where other halogens such as chlorine substituents are present together with the fluorine substituents. Suitable fluoroethylene resins are also available from the chemical division of Minnesota Mining and Manufacturing Co. under the tradename Kel-F i.e. a polytrifluorochloroethylene resin. Fluoroethylene resins are also available from Union Carbide Chemicals Company.

Other oils heretofore used in metal working compounds obviously may be used in place of the mineral oils which are preferred for economic reasons. Such oils include animal and vegetable oils, in either natural or hydrogenated form, such as lard oil, cotton seed oil, rosin or rosin oils, turpentine, kerosene, sulfonated oils, or even carbon tetracholoride and soaps and graphite. Normally these vegetable and animal oils and the like are used advantageously in combination with the lubricating oils although under certain conditions, they may be used alone. At any rate, no special novelty is attributed to the oil base used in the compounds of this invention although such oils constitute an important ingredient in the composition.

It will be apparent that the present invention is not limited to the specific compounds or the materials and procedures disclosed in the body of the specification and the specific example for the disclosed materials and procedures will be suggestive of many others to those skilled in the art. Thus the invention extends to all equivalents which will occur to those skilled in the art upon consideration of the disclosure and the illustrative embodiments of the invention and the terms of the claim appended hereto.

What is claimed is:

A cutting oil comprising 1–30% by weight of finely divided particles of sulfur and 0.2–10% by weight of finely divided particles of a completely halogenated polyethylene resin selected from the group consisting of polytetrafluoroethylene resin and polytrifluorochloroethylene resin dispersed in a mineral oil base of 100–1200 SUS viscosity, said mineral oil being present in a major proportion and said resin being present in a quantity equaling about 5–30% of the weight of the sulfur.

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