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WIRE, ROD, AND SHEET METAL DRAWING LUBRICANT OF SYNTHETIC WAX, BORATE, AND ORGANIC BINDER

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This invention relates to lubricants, and more particularly to dry lubricants for use in the drawing of metal wire and rod stock and in the deep drawing of sheet metal stock.

In accordance with the present invention, a lubricating composition is proposed of which an aqueous solution thereof is applied to the wire or metal stock prior to the forming operation and caused or permitted to dry thereon and form on the metal stock a dry, homogeneous, adherent lubricating and protective film which, during the drawing or formation of the stock to the desired shape, supplies the necessary protection and lubrication to the stock and die surfaces. The composition of the present invention will be found to be of particular utility when forming metal stock which, due to its surface, requires a protective barrier film.

The new and improved lubricating compositions of the present invention, broadly stated, comprise the following ingredients combined together in cooperative relationship and in the proportions shown, the proportions being by dry weight:

	Range	Preferred
Component A:		
A synthetic wax having a melting point of at least about 95° C.	*Parts* about 10–40	*Parts* about 20
Component B:		
Metal borates, borate ores, mixtures thereof, or any of the above with colloidal clay, metal silicates, or metal carbonates	about 85–35	about 70
Component C:		
An inert, water-soluble organic lubricating binder	about 5–25	about 10

A composition containing the above-stated compounds and applied to the metal stock in the above-described manner will be found to possess a remarkable cooperative effect between the individual materials which results in a far superior lubricating effect during the metal forming operation.

Component A

This compound constituting one of the ingredients in the lubricating composition of the present invention has been identified as a synthetic wax possessing a high melting point on the order of about at least 95° C. The purpose of this ingredient is to cooperatively function with the remaining compounds to provide the desired protection and lubricity to the metal stock and the dies during the forming operation. It has been found that any synthetic wax possessing a melting point of at least 95° C. will perform in the

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desired manner. The melting point is of prime importance with respect to this material due to the fact that the lubricating composition is preferably applied in a water solution having a temperature of at least about 95° C. and if the melting point of the wax is low, the wax would be in a fluid state and merely float on the surface thus, upon drying, being in an uncombined state with respect to the remaining ingredients. Moreover, it has been found that the melting point is quite critical with respect to the overall lubricating characteristics of the blended composition. If the melting point is below the stated minimum limit the wax will melt too quickly thus providing no lubricity at the higher temperatures encountered during the forming operation. In other words, the melting point of the wax must be such that it will, in combination with the other ingredients, provide some lubrication at relatively all stages of the forming operation.

There are a wide variety of high melting point synthetic waxes readily available commercially which will be found suitable for use as Component A in the composition. One such class of materials is the complex nitrogen derivatives of the higher fatty acids and more particularly amides of higher fatty acid esters such as cetyl acetamide etc. The melting point range of the amides of fatty acid esters and particularly the aliphatic esters will be from between about 95° C. up to about 140° C. Commercially available materials coming within the meaning of this particular class are marketed by Glycol Products Company of Brooklyn, N. Y., under trade-marks of Acrawax, Acrawax C, and Acrawax C. T.

An additional material that is preferred also and one that is readily available is the wax manufactured by the National Oil Products Company of Harrison, N. J., under the trade-mark Napcowax.

Other and additional waxes found equally suitable for use as Component A in the composition of the present invention are the following materials, identification being had in the form of their trade names: I. G. Wax O (M. P. 101–106); I. G. Wax OP (M. P. 101–106); I. G. Wax Z (M. P. 100–102); glyceryl, glycol or polymerized ethylenic esters of acids derived from montan wax, i. e. Durocer (M. P. 120–127), Rezo Wax A (M. P. 107–112), Rezo Wax B (M. P. 95–100), Stroba Wax (M. P. 98–100), Abacer (M. P. 95–97); Santowax P (M. P. 200–215); Santowax PSA (M. P. 139–145).

Another class of materials also suitable for use as Component A are high molecular weight fatty

acid amides such as octanamide (M. P. 106); decanamide (M. P. 99); dodecanamide (M. P. 102); tetradecanamide (M. P. 103); hexadecanamide (M. P. 106); octadecanamide (M. P. 109); 25% hexadecanamide–75% octadecanamide (M. P. 100); etc.

While in the foregoing discussion of the illustrative materials suitable for use as Component A, reference has been had to the individual compounds. However, it will be found that a mixture of one or more waxes may be employed with satisfactory results. For example, Acrawax CT may be admixed with Napcowax and then blended into the completed composition to function as Component A. In the production of such mixtures extreme caution should be had to insure the melting point of the mixture being within the hereinbefore given range. Therefore, in the discussion hereinafter given, where reference is had to Component A or synthetic wax, such reference is to include both single materials as well as mixtures thereof.

Component B

The compounds suitable for use as Component B in the composition of the present invention may be generically identified as inorganic boron-containing compounds. Such materials have been specifically identified as metal borates, borate ores, mixtures thereof, or any of the foregoing admixed with colloidal clay, metal silicates or metal carbonates. These materials have been found to cooperatively function with the other ingredients of the composition to provide the necessary lubrication. These materials when present within the stated range are of particular value at the extremely high frictional heats encountered during the latter stages of the metal forming or drawing operation.

The metal borates may be any water-soluble or water-insoluble borate and may be used singularly or in an admixture as above indicated. The borate when used alone will be present in the composition in an amount ranging from between about 35–85 parts by weight, dry. Illustrative and non-limiting examples of suitable borates for use as Component B are borax, potassium borate, lithium borate, barium borate, magnesium borate, manganese borate, iron borate, copper borate, zinc borate, lead borate, aluminum borate, etc.

The borate ores are ordinarily water-insoluble, naturally occurring, complex metal borate mixtures, such mixtures being of sodium, calcium, magnesium, iron, manganese, and the like. The mixtures also contain various other impurities in the form of various silicates, carbonates, and oxides. The borates when employed in the form of the ore is preferably admixed with the other ingredients in a powdered state.

The borate ores are normally mined in California and Nevada and usually marketed in the naturally occurring state as obtained. Illustrative examples of commercially available ores are

Colemanite ($Ca_2B_6O_{11}\cdot 5H_2O$);
Ulexite ($Ca_2B_6O_{11}\cdot Na_2B_4O_7\cdot 16H_2O$);
Borocalcite ($CaH_2B_4O_8\cdot 3H_2O$);
Boracite ($Mg_7Cl_2B_{16}O_{30}$);
Laderellite ($(NH_4)_2(B_5O_8)_2\cdot 5H_2O$);
Pinnoite ($MgB_2O_4\cdot 3H_2O$);
Ascharite ($MgHBO_3$);
Kaliborate ($KMg_2B_{11}O_{19}\cdot 8H_2O$);
Razorite Gesterley Borate, etc.

As hereinbefore indicated, certain additional ingredients may be employed as a substitute for a portion of the borate or borate ore. For example, colloidal clay, in an amount ranging from between about a trace up to about 20 parts by dry weight, may be admixed with the borate or borate ore with a like omission of such borate or ore. Caution should be employed when using the clay since it tends to rapidly thicken the water solution in which the composition is applied to the stock and it should therefore be used sparingly.

Other ingredients that may be substituted also for a portion of the borate or the ore are water-soluble silicates and carbonates with certain additional properties being imparted to the composition. For example, an addition of a small amount on the order of about 1 to 5 parts by dry weight of the silicate or carbonate render the composition eutectic. Examples of suitable silicates and carbonates are the alkali and alkaline earth metal salts thereof.

In compounding such a mixture of borate materials as above discussed, many combinations of the various materials are possible. For example, the mixture may consist of two or more metal borates; two or more borate ores; one or more metal borates with one or more borate ores; metal borate and colloidal clay; borate ore and colloidal clay; metal borate and water-soluble silicate or carbonate; a borate ore and a water-soluble silicate or carbonate; metal borate; borate ore, and colloidal clay or a water-soluble silicate or carbonate; or any additional combinations of these materials in the manner above-indicated. In the blending of these mixtures, the amount to be employed of the substitute materials has been given as from a trace up to about 20 parts for the clay and from about 1 to 5 parts for the silicate and the carbonate. The amount of these mixtures to be employed as Component B in the composition must fall within the hereinbefore stated broad range of 35–85 parts.

Component C

The materials to be employed in the composition as Component C has hereinbefore been generically identified as an inert, water-soluble, organic lubricating binder. The purpose of these materials in the lubricating composition is to act as a binder and to also cooperatively function with the remainder of the ingredients to impart the desired lubricating during the forming operation. In order to impart these desired characteristics to the composition, the compounds to be employed as Component C, of necessity, must possess the following properties: (1) water-soluble in order that it may be carried in complete solution with the remaining ingredients; (2) inert with respect to other materials in the composition as well as the aqueous carrier in order that no objectionable materials will be precipitated onto the surface of the metal stock; (3) possess a melting point of at least 10° C. so that the material will be present when needed during the lubricating of the stock and die; (4) have an "initial distillation point" of at least 200° C. so that the compound will not "flash off" during the initial high frictional heat encountered in the drawing operation.

In summation, any compound possessing the above stated properties will be found suitable for use as Component C in the lubricating composition. Illustrative examples of suitable compounds are the polyhydric alcohols and the fatty acid esters thereof which possess the above-

stated properties and particularly the aliphatic polyhydric alcohols having less than four hydroxy groups and the fatty acid esters thereof; the following specific compounds illustrating suitable materials falling within these classes; glycerol, glyceryl monostearate, glyceryl oleate, polyethylene glycol (di- and tri-), polyethylene glycol oleate, propylene glycol, polyethylene glyco stearate, propylene glycol oleate, propylene glycol stearate, diglycol stearate, etc.

Other and additional materials satisfying the requirements of Component C are readily available commercially such as aliphatic amines, i. e. phenyldiethanolamine; ketones, i. e. phenylmethylpyrazolone; etc. Under these circumstances, no useful purpose is seen in providing a long list of compounds which are well-known and which possess the properties required for Component C.

Of the compounds suitable for use as Component C, a particular and preferred class of compounds are the aliphatic polyhydric alcohols having less than four hydroxy groups and the fatty acid esters thereof and which, additionally, are relatively solid and possess a melting point of at least from between about 40° up to about 70° C. Illustrative examples of these preferred compounds are polyethylene glycol (di- and tri-), polyethylene glycol oleate (di- and tri-), diglycol stearate, glyceryl monostearate, propylene glycol stearate, etc.

It should be particularly noted that Component C in the lubricating composition may be in the form of a mixture of one or more of the individual compounds, each of which would satisfy the hereinbefore stated requirements. For example, polyethylene glycol may be combined with polyethylene glycol oleate, glyceryl monostearate, glycerol, propylene glycol, propylene glycol oleate, glycerol distearate, etc. and the resulting mixture employed as Component C. Moreover, any of the foregoing may be mixed with one another in any desired ratio to produce a mixture suitable for use. When employing such a mixture, however, the total amount of the mixture must fall within the broad range hereinbefore given for Component C.

Additional component compounds

Under many circumstances, additional materials will be found desirable due to the particular stock used and the state of its surface. It has been found that under many circumstances it will be advantageous to add a small amount, i. e. about ½ to 5 parts, of a surface active agent. The surface active agent must be inert with respect to the water employed in forming a solution of the composition and must also possess the well-known properties of surface active agents. Illustrative and specific compounds which are known as surface active agents are dioctyl ester of sodium sulfosuccinic acid, sodium petroleum sulfonate, alkyl naphthalene sulfonates, dibutyl phenyl phenol sodium sulfonate, cetyl trimethyl ammonium bromide, sodium alkyl sulfates i. e. sodium lauryl sulfate, sodium octyl sulfate, etc., potassium lauryl sulfate, potassium octyl sulfate, amino fatty acid esters, polyoxyalkylene di-fatty acid esters, alkyl aryl sulfonates i. e. "Nacconol NR," etc. These specific compounds above given illustrate only a relatively few of the many compounds known as surface active agents and, in view of the wide recognition of such compounds no need to give a lengthy description of such compounds is believed necessary.

Having described in detail each of the component compounds constituting the lubricating composition of the present invention it therefore becomes convenient to present a number of specific and illustrative completed compositions, the parts being given by dry weight:

Example 1

	Parts
Cetyl acetamide	20
Borax	70
Polyethylene glycol	10

Example 2

	Parts
Acrawax (2), Acrawax C. T. (10), Lithium borate (65), Colloidal clay (3)	12
Glyceryl distearate	68
	20

Example 3

	Parts
Napcowax	35
Colemanite (41), Sodium silicate (1)	42
Glyceryl monostearate	22½
Sodium lauryl sulfate	½

Example 4

	Parts
Napcowax	12
Zinc borate	75
Polyethylene glycol oleate	13

Example 5

	Parts
Cetyl acetamide	19
Copper borate (60), Sodium carbonate (4)	70
Phenylmethylpyrazolone	8
Proprylnaphthalene sulfonate	3

Example 6

	Parts
Cetyl acetamide	40
Laderellite	35
Phenyldiethanolamine	25

Example 7

	Parts
Napcowax (10), Cetyl acetamide (25)	35
Ulexite	40
Glycerol	20
Sodium petroleum sulfonate	5

Example 8

	Parts
Tetradecanamide	20
Borocalcite	70
Polyethylene glycol oleate	10

Example 9

	Parts
I. G. Wax O	15
Boracite	60
Propylene glycol stearate	23
Dibutylphenylphenol sodium disulfonate	2

Example 10

	Parts
Rezo Wax A	35
Magnesium borate (45), Colloidal clay (3)	48
Propylene glycol	15

Example 11

	Parts
Durocer	10
Kaliborate	70
Phenylmethylpyrazolone	19
Potassium octyl sulfate	1

Example 12

	Parts
I. G. Wax C	15
Ulexite	80
Polyethylene glycol	5

Example 13

	Parts
Acrawax C. T	25
Borax (53), Sodium silicate (2)	55
Diglycol stearate	16
Sodium lauryl sulfate	4

Example 14

	Parts
Cetyl acetamide	22
Ascharite (43), Colloidal clay (15)	58
Polyethylene glycol oleate	20

Example 15

	Parts
Dodecanamide	18
Borax Kaliborate (40), Kaliborate (3)	43
Propylene glycol stearate	25

Example 16

	Parts
Rezo Wax B	33
Potassium borate (27), Borax (20)	47
Phenyldiethanolamine	17
Nacconol NR	3

Example 17

	Parts
Santowax P	38
Ascharite (20), Lithium borate (20)	40
Polyethylene glycol	22

Example 18

	Parts
Octanamide	12
Colemanite (40), Magnesium borate (40)	80
Phenylmethylpyrazolone	8

Example 19	*Parts*
Cetyl acetamide	15
Laderellite (30) / Ulexite (45)	75
Phenyldiethanolamine	10

Example 20	*Parts*
Abacer	25
Borocalcite (20) / Boracite (30) / Colloidal clay (10)	60
Polyethylene glycol	14
Butyl naphthalene sulfonate	1

Example 21	*Parts*
Santowax P (5) / Stroba Wax (25)	30
Borax (20) / Ascharite (18) / Sodium bicarbonate (5)	43
Propylene glycol stearate	25
Petroleum sulfonate	2

For applying the new and improved compositions of the present invention to the wire or metal stock prior to its formation thereof, an aqueous solution of the composition is made using a concentration of from about eight ounces per gallon of water to saturation, depending on the roughness of the surface of the stock and the severity of the draw. As the roughness and porosity of the stock increases, the concentration of the composition will likewise increase. For extremely rough and highly porous stock such as vitreous enamel stock, a saturated solution is deemed best. For extremely light draws, the concentration may be about eight ounces per gallon of water.

The aqueous solution as above prepared is ordinarily applied to the wire or metal stock by a simple, dipping operation with the temperature of the bath being at least about 90° C. and then permitted to dry thereon whereby there is formed on the surface of the stock a dry, homogeneous, self-adherent lubricating and protecting barrier film. The stock containing the film is then pressure shaped or drawn into the desired shape without any harmful effects to the dies or the surface of the metal stock. After the shaping operation, the formed article is then washed with hot water which completely removes any trace of the lubricants from the surface of the formed article. In other words, the formed article is ready to receive any subsequent operation, i. e. vitreous enameling, painting, electro-plating, etc. without any additional cleaning, washing, or pickling treatment.

It should be particularly noted that after the dry homogeneous film has been placed upon the stock in the above manner the forming operation does not have to be immediately started. In other words, the dry homogeneous film is imparted to the stock and the stock in this condition may then be stored for any period of time that is desired. This characteristic of the composition in maintaining its full degree of lubricity over an extended period of time is extremely advantageous since it permits the mill manufacturer to provide small metal fabricators with the desired metal stock already containing a lubricating film as well as a protective film. In this manner, the mill can finish the stock as it comes from the mill to impart the desired degree of surface finish and then coat the finished stock immediately in the manner above described and sell the stock in this condition. The fabricator then forms the stock to the desired shape and washes the film off leaving a shaped metal article requiring no additional surface finishing or cleaning. This permits the fabricator to dispense with the costly equipment heretofore required to finish the surface of the shaped metal article.

Having thus described our invention, we claim:

1. A coating material for admixture with water for coating a piece of unformed metal stock and the like and forming thereon a self-adherent, homogeneous, lubricating and protecting film comprising the following ingredients by weight, dry:

Component A:

	Parts
A synthetic wax having a melting point of at least about 95° C	10–40

Component B:

A boron containing material selected from the class consisting of metal borates, borate ores, mixtures of the foregoing, and any of the foregoing admixed with a minor amount of a material selected from the group consisting of colloidal clay, water-soluble silicates, and water-soluble carbonates	85–35

Component C:

A water-soluble organic lubricating binder which is inert with respect to other material in the composition and has a melting point of at least about 10° C. and an initial distillation point of at least about 200° C	5–25

2. A coating material in accordance with claim 1 wherein Component A is a nitrogeneous derivative of a higher fatty acid.

3. A coating material in accordance with claim 1 wherein Component A is an amide of an aliphatic ester of a higher fatty acid.

4. A coating material in accordance with claim 1 wherein Component A is cetyl acetamide.

5. A coating material in accordance with claim 1 wherein Component A is an aliphatic amide.

6. A coating material in accordance with claim 1 wherein Component A is an ester of a derivative of montan wax.

7. A coating material in accordance with claim 1 wherein Component B is a metal borate.

8. A coating material in accordance with claim 1 wherein Component B is an alkali metal borate.

9. A coating material in accordance with claim 1 wherein Component B is a water-insoluble metal borate.

10. A coating material in accordance with claim 1 wherein Component B is a water-soluble metal borate.

11. A coating material in accordance with claim 1 wherein Component C is an aliphatic polyhydric alcohol.

12. A coating material in accordance with claim 1 wherein Component C is an aliphatic polyhydric alcohol having less than four hydroxy groups.

13. A coating material in accordance with claim 1 wherein Component C is a fatty acid ester of an aliphatic polyhydric alcohol.

14. A coating material in accordance with claim 1 wherein Component C is a fatty acid ester of an aliphatic polyhydric alcohol having less than four hydroxy groups.

15. A liquid composition comprising a major amount of water and a minor amount of the composition set forth in claim 1.

16. A coating composition in accordance with claim 1 wherein Component A is a nitrogeneous derivative of a higher fatty acid; Component B is metal borates; and Component C is an aliphatic polyhydric alcohol selected from the group

consisting of aliphatic polyhydric alcohols having less than four hydroxy groups and the fatty acid esters thereof.

17. A coating material in accordance with claim 1 wherein the proportions of the component compounds are as follows:

	Parts
Component A	about 20
Component B	about 20
Component C	about 10

18. A coating material in accordance with claim 1 which has included therein about ½ to 5 parts of an inert surface active agent.

19. A coating material in accordance with claim 1 wherein Component B is a

	Parts
Metal Borate	85–30
Water-soluble carbonate	1– 5

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
Re. 23,184	Whitbeck	Dec. 20, 1949
2,126,128	Montgomery	Aug. 9, 1938
2,319,393	Epstein	May 18, 1943
2,334,076	Epstein	Nov. 9, 1943

OTHER REFERENCES

"Synthetic Organic Chemicals," Carbide and Carbon Chemicals Corporation, 12th ed., pub. July 1, 1945, p. 23, lines 16–22.