

1

3,423,315

PIPE THREAD LUBRICANT

Paul R. McCarthy, Allison Park, and Thomas R. Orem,
Pittsburgh, Pa., assignors to Gulf Research & Develop-
ment Company, Pittsburgh, Pa., a corporation of
Delaware

No Drawing. Filed May 4, 1967, Ser. No. 636,031
U.S. Cl. 252-19 13 Claims
Int. Cl. C10m 5/06

ABSTRACT OF THE DISCLOSURE

A water-washable pipe thread lubricant which is particularly useful in lubricating pipe joints of drill strings in hydraulic jet oil-well drilling consists of a mixture of

- (1) an alkali metal or alkaline earth metal soap lubricating base of grease consistency, e.g., calcium or lithium base grease;
- (2) a solid lubricant powder, e.g., powdered lead and/or graphite; and
- (3) a soluble oil base consisting of a mixture of
 - (a) an alkali metal soap of a resin acid, e.g., potassium resinate;
 - (b) an alkali metal salt of a petroleum sulfonic acid, e.g., sodium petroleum sulfonate; and
 - (c) a coupling agent, e.g., diethylene glycol and/or diethylene glycol monobutyl ether.

This invention relates to a pipe thread lubricating composition and more particularly to a water-washable lubricant useful in lubricating drill stem joints.

In a newly developed drilling method, a jet bit is connected to the lower end of a rotating drill string. The jet bit is provided with a plurality of nozzles through which an abrasive-laden liquid, as distinguished from the usual drilling mud, is discharged at a velocity of at least about 500 feet per second. After being discharged from the nozzles at the bottom of the borehole, the abrasive-laden liquid together with cuttings from the well circulates up through the annulus in the well between the drill string and the wall of the borehole. The abrasive-laden liquid which also contains cuttings from the well upon reaching the surface is treated to remove undesired particles and is restored to its approximate original make-up.

When the drill string is removed from the well for servicing the bit or for other reasons, it is necessary to clean, remove and keep all foreign particles from the threads of the pipe joints in preparation for relubrication and reassembly of the string for re-entry into the well. Cleaning of the pipe threads is particularly important when using an abrasive-laden drilling liquid. If the abrasive-laden liquid adheres to the pipe threads during make-up of the drill string, seizure, galling and stripping of the pipe threads frequently occurs.

In the past when using a conventional drill bit with the usual drilling muds, a water-insoluble pipe thread lubricant was employed. Such water-insoluble lubricants gave satisfactory lubrication, prevented galling and seizure, were easily applied and effected a good seal between joints. Unfortunately, the use of a water-insoluble pipe thread lubricant to lubricate the joints of a drill string employed in the newly developed hydraulic jet drilling method wherein an abrasive-laden drilling liquid is utilized has not been entirely satisfactory. The abrasive materials including sand and ferrous abrasives such as iron or steel in the form of chips, shot or granular grit, readily adhere to the pipe thread lubricant when the joints are uncoupled. Inasmuch as the abrasive material is not easily removed from the pipe thread lubricant, it is necessary to remove the lubricant and abrasive from the pipe thread. While

2

water-insoluble lubricants can be removed from pipe threads with solvents such as petroleum naphtha, chlorinated hydrocarbons, and the like, the use of solvents presents handling and application problems and is economically undesirable. While some water-soluble lubricants have been developed which can be readily removed by directing a stream of water on the pipe threads lubricated therewith, the prior lubricants have not effectively prevented seizure and galling of the pipe threads.

We have discovered that a lubricant which is easily applied to pipe threads and, when desired, is easily removable therefrom by water while effectively preventing seizure and galling of the pipe threads can be obtained by incorporating a solid lubricant powder and a soluble oil base into a metal soap lubricating base. Thus, in accordance with the invention, there is obtained an improved water-washable pipe thread lubricating composition comprising a uniform blend of a metal soap lubricating base, a solid lubricant powder and a soluble oil base.

The metal soap lubricating base in the composition of the present invention is a composition having the consistency of a grease comprising a dispersion of a metal soap of a fatty acid in a mineral lubricating oil. Inasmuch as the metal soap lubricating base which we employ is a composition having the consistency of a grease, we can prepare the metal soap lubricating base according to known grease-making procedures. For example, fats and/or fatty acids together with the desired metal hydroxide can be charged to an atmospheric or pressure type vessel and intimately mixed at a temperature below 200° F. After thorough intermixture, the temperature is raised to between 330°-410° F. to effect saponification. After complete dehydration of the soap base, the soap is admixed with mineral oil while cooling to a temperature within the range of 150°-250° F. If desired, lubricant additives can be added to the cooled grease composition. The product is finally adjusted to the desired consistency and milled.

Instead of preparing the metal soap lubricating base, we can start with a previously prepared grease composition if it is either an alkali metal or alkaline earth metal grease composition. However, it may be necessary to incorporate a viscosity reducing oil into the composition to obtain a composition having the desired consistency. When a viscosity reducing oil is employed, we preferably use a light mineral oil for this purpose. In some grease compositions, the nature of the saponification is such that glycerine is liberated and some of it remains in the lubricating grease. Its presence in the final pipe thread lubricant is advantageous. Glycerine is a hygroscopic material which prevents drying and caking of the ultimate composition. For this reason, if glycerine is not liberated in the grease-making process, we frequently find it desirable in making pipe thread lubricants to add a hygroscopic agent, such as glycerine or glycol, in order to prevent caking or drying. The metal soap lubricating base comprises 15 to about 25 percent by weight of the pipe thread lubricant.

The mineral oil used in preparing the metal soap lubricating base may be any of the hydrocarbon oils of lubricating grade customarily used in compounding greases. The oil may be a refined or semi-refined paraffinic, naphthenic-, or asphalt-base oil having a viscosity of about 50 to about 4000 SUS at 100° F. If desired, a blend of oils of suitable viscosity may be employed instead of a single oil, by means of which any desired viscosity within the range of 50 to 4000 SUS at 100° F., may be secured. The viscosity of the oil has little effect on the penetration value of the ultimate pipe thread lubricant but more viscous oils produce compositions having greater stickiness and adhesive properties than do the lighter oils. The oil content of the metal soap lubricating base comprises about

80 to about 99 percent by weight of the metal soap lubricating base.

The metal soap of a fatty acid which is employed in forming the metal soap lubricating base is preferably an alkali metal or alkaline earth metal soap of a fatty acid having between 12 and 32 carbon atoms in the molecule. Examples of suitable metals which can be used in forming the soap are sodium, potassium, lithium, barium, calcium and strontium. The fatty acid used in preparing the soap may be either a saturated or an unsaturated acid. Examples of these acids are lauric, dodecylenic, myristic, palmitic, palmitoleic, stearic, oleic, linoleic, arachidic, behenic, erucic, carnaubic, cerotic, melissic and psyllaic. We can use the soap of either a substantially pure fatty acid or mixtures of fatty acids such as those obtained from various fatty oils and fats such as cottonseed oil, rapeseed oil, animal oils, fish oils, lard, tallow, etc. The saturated fatty acids such as those obtained from hydrogenated oils of vegetable, animal and marine extraction can also be used. The metal soap content of the metal soap lubricating base comprises about 1 to about 20 percent by weight of the metal soap lubricating base.

The solid lubricant powder which we use is a lubricating metal powder which can be used alone or in combination with another solid lubricant. Thus, we may use powdered zinc, copper, lead, aluminum, molybdenum sulfide, or graphite, or mixtures of these. The preferred composition is one which contains one or more of the metal powders such as lead powder in combination with graphite. The powder used is in finely divided form. The lubricating powder is employed in amounts of about 50 to about 80 percent by weight of the total pipe thread lubricating composition.

The soluble oil base employed in accordance with the invention is capable of forming stable emulsions with water. The soluble oil base comprises an alkali metal soap of a resin acid, an alkali metal salt of a petroleum sulfonic acid and a coupling agent. The soluble oil base comprises about 3 to about 10 percent by weight of the pipe thread lubricant, preferred amounts being within the range of about 5 to about 7 percent by weight. Suitable soluble oil bases which can be used in the composition of the invention are described in U.S. Patent No. 2,913,410 which issued on Nov. 17, 1959 to Earl E. Fisher. As described in said patent, a soluble oil base is obtained by blending a resin acid soap such as the potassium soap of rosin, a sodium or potassium petroleum sulfonate having a molecular weight of about 420 to about 440 and a coupling agent.

The resin acids which are used in preparing the resinsates of sodium and potassium are monocarboxylic acids of alkylated hydrophenanthrene nuclei. Resin acids can be classified in two groups, the abietic type and the pimaric type. They include abietic acid, levopimaric acid, neoabietic acid, dehydroabietic acid, dihydroabietic acid, tetrahydroabietic acid, dextropimaric acid and isodextropimaric acid.

Natural or synthetic sources of resin acids can be used for preparing the resinate soaps. A suitable natural source is rosin. Rosin is a solid resinous material obtained from the oleoresin or stump wood of pine trees. It contains chiefly resin acids and smaller amounts of non-acidic material. Another natural source of resin acids is tall oil, a natural mixture of resin acids related to abietic acid and of fatty acids related to oleic acid, together with non-acidic bodies, which is obtained by acidifying the black liquor skimmings of the alkaline paper pulp industry. Although these natural mixtures of resin acids are preferred, particularly because of their cheapness, the resin acid soaps for the compositions of the invention can be prepared from synthetic or purified resin acids of a single type or from mixtures of such acids.

The petroleum sulfonates which are used in the soluble oil base can be prepared by sulfonating a mineral oil of a boiling range which will produce sulfonic acids within

the desired average molecular weight range. Neither the petroleum sulfonate per se nor its method of preparation constitutes any portion of the invention. It is preferred, however, that the petroleum sulfonic acids from which the sulfonates are prepared have an average molecular weight within the range of about 420 to 440. In producing the petroleum sulfonate, the mineral oil is treated with a sulfonating agent such as concentrated sulfuric acid, oleum or sulfur trioxide to produce mahogany acids or oil-soluble petroleum sulfonic acids. The sulfonic acids are neutralized with the hydroxides of sodium or potassium to form the corresponding petroleum sulfonates.

The proportions of the components in the soluble oil base can vary over wide ranges. In general, the soluble oil base comprises about 20 to about 50 weight percent resin acid salts; about 45 to about 75 percent petroleum sulfonate; and about 0.5 to about 5 weight percent of a coupling agent such as diethylene glycol, diethylene glycol monobutyl ether, and the like. The exact amount of coupling agent is sufficient to adjust the emulsifiability of the resin-sulfonate mixture to a maximum. A small amount of water usually not exceeding about 5 weight percent may also be employed in the soluble oil base.

While the pipe-thread lubricating compositions prepared according to this invention are satisfactory with respect to extreme pressure characteristics, it may be desirable to employ a small amount of an extreme pressure agent or mixture of such agents to further enhance the extreme pressure characteristics of the lubricant. When the extreme pressure agent is employed, it can be added to the composition at any stage of its preparation. For example, the extreme pressure agent can be incorporated into the metal soap lubricating base or it can be incorporated in the soluble oil base. Alternatively, the extreme pressure agent can be blended into the pipe thread lubricant simultaneously with the blending of the metal soap lubricating base, soluble oil base and solid lubricant powder. Examples of some of the extreme pressure agents which can be used alone or in combination in compositions of the invention are sublimed blue lead, sulfur, sulfurized sperm oil, chlorinated oils and waxes, hexachloroethane, chlorinated naphthalene and lard oil treated with sulfur chloride. A metal soap of an acid selected from the group consisting of naphthenic acids and fatty acids having between 12 and 32 carbon atoms in the molecule can also be used. Examples of suitable metal soaps are lead naphthenate, lead laurate, lead stearate, lead oleate and lead psyllate. When an extreme pressure agent is desired, it is employed in an amount between about 1 and about 5 percent by weight based on the weight of the pipe thread lubricating composition. In any case, when an extreme pressure agent is used, it is added in an amount sufficient to improve the extreme pressure characteristics of the lubricant.

Other additives may also be incorporated in the pipe thread lubricant to improve other specific properties. Thus, rust inhibitors, oxidation inhibitors, hygroscopic agents, fillers, anti-bleeding agents, etc., may be added to obtain other desired properties.

In practicing the present invention, various methods may be used in compounding and blending the metal soap lubricating base with the soluble oil base and with the solid lubricant powder. Likewise, the viscosity or consistency of the final pipe thread lubricant may be adjusted by varying the ratio of the particular components or by adding a viscosity reducing diluent oil at any desired stage of processing. When it is desired to adjust the viscosity by means of such a diluent oil, we usually employ a light paraffin oil for this purpose.

According to one embodiment, the metal soap lubricating base and the soluble oil base are separately prepared. Thereafter, the soluble oil base and the solid lubricant powder are added to the vessel containing the metal soap lubricating base. The contents of the vessel are then thoroughly mixed. Conventional additives can

be incorporated in the lubricant at this point if desired. The product may be adjusted to the desired consistency and milled.

According to another embodiment, the metal soap lubricating base while hot and fluid is removed from the grease kettle, screened if necessary, and then mixed and blended with the other ingredients in a suitable vessel equipped with blades or other agitating means. In this embodiment, the metal soap lubricating base is usually brought to a workable consistency by adding a light paraffin diluent oil after which the solid lubricant powder is added and admixed. The soluble oil base is added and blended with the metal soap lubricating base and solid lubricant powder. If necessary, the viscosity of the blend thus obtained can be further reduced by the addition of a further amount of light paraffin diluent oil.

In preparing Compositions A to D shown in Table I, the metal soap lubricating base is a lithium soap grease, the soap content of which is about 3.2 percent by weight of the lubricating base. The lithium soap grease also contains 4.5 percent by weight of sulfurized sperm oil, 2.5 percent by weight of a lead soap and 1 percent by weight of sublimed blue lead.

The sulfurized sperm oil employed in the lithium soap grease is well-known in the art. Its preparation and properties are disclosed in U.S. Patent No. 2,179,066 to H. G. Smith. Sulfurized sperm oil advantageously has a sulfur content of about 8 to about 14 percent by weight. Inspection data for the sulfurized sperm oil used in the illustrative compositions are as follows:

Gravity, °API	13.0
Sp. gr., 60°/60° F.	0.979
Viscosity, SUS:	
At 100° F.	2975
At 210° F.	244
Flash point, OC, ° F.	465
Pour point, ° F.	+60
Color, ASTM D1500	8.0
Sulfur, ASTM D129, percent	11.5
Water by distillation, percent	<0.10
Neutralization value, ASTM D664:	
Total acid No.	3.7
Ash, ASTM D482, percent	0.012

The lead soap employed in the lithium soap grease is a fatty acid soap having the following typical properties:

Sp. gr., 60°/60° F., ASTM D1298	1.212
Viscosity, Furol, sec., 210° F.	645
Flash point, OC, ° F.	325
Fire point, OC, ° F.	385
Pour point, ° F.	+100
Color, ASTM D155	6.5
Lead as PbO, percent	32.5

The sublimed blue lead employed in the lithium soap grease is a basic sulfate of lead which is obtained upon the roasting of galena lead sulfide ore. This ore is about 80 percent lead and 11 percent sulfur combined as lead sulfide, the balance of the ore being zinc sulfide and other constituents. In obtaining sublimed blue lead, the ore is mixed with bituminous coal and slag and thus charged into a furnace. The furnace is designed and operated to produce fumes that escape from the molten charge. The fumes are filtered and the solid parts are retained. This retained, powder-like material is sublimed blue lead which has the following typical analysis.

	Percent by wt.
PbSO ₄	45-55
PbO	30-40
PbS	Not over 12
PbSO ₃	Not over 5
ZnO	Not over 5
Carbon	Not over 5

Typical properties of the lithium soap grease containing the sulfurized sperm oil, lead soap and sublimed blue lead are as follows:

Sp. gr., 60°/60° F.	1.007
Dropping point, ° F.	295
Penetration, ASTM D217	
77° F., 150 grams, 5 seconds:	
Unworked	400
Worked, 60 strokes	370
10,000 strokes	385
Sulfur, percent	0.61
Soap content	3.2

In preparing Compositions A to D, the lithium soap grease was admixed with an equal part by weight of a viscosity-reducing oil comprising a 100 SUS at 100° F. Texas oil. The viscosity-reduced lithium soap grease was then blended with the soluble oil base and with the solid lubricant powder, i.e., powdered lead and graphite. Prior to its introduction into the mixing vessel, the soluble oil base had been prepared by blending 23.6 parts by weight of a resin acid soap component, 72.5 parts by weight of a sodium petroleum sulfonate component, 2.9 parts by weight of diethylene glycol and 1.0 part by weight of diethylene glycol monobutyl ether.

The resin acid soap component of the soluble oil base was a material known commercially as "Dresinate 91" which consists of the potassium soap of a pale wood rosin (86 to 89 weight percent) and water (11 to 14 weight percent). The resin soap contained only resin acid salts. Inspection data for "Dresinate 91" are as follows:

Sp. gr., 60°/60° F.	1.053
Viscosity, Furol, sec., 122° F.	345.5
Pour Point, ° F.	+15
Color, ASTM union	3.75
Water by distillation, percent	13.3
Neutralization value, ASTM D974:	
Total acid No.	15.0
Saponification No., ASTM D94	16.5
pH value	9.2
Sulfonated residue, percent	10.1

The petroleum sulfonate component of the soluble oil base was "Petronate L" which contains 62 to 63 percent by weight sodium petroleum sulfonate, the acids of which have an average molecular weight of 433; 1.0 percent by weight of sodium carboxylate; 4 to 5 percent by weight of water; and the balance mineral oil. Inspection data for this petroleum sulfonate component are as follows:

Gravity, ° A.P.I.	8.5
Sp. gr., 60°/60° F.	1.011
Viscosity, Kin., cps. at 210° F.	261
Viscosity, Furol, sec., 122° F.	2604
Pour Point, ° F.	+80
Color, ASTM D1500	5.0
Sulfur, ASTM D129, percent	4.5
Water by distillation, percent	4.7
Neutralization value, ASTM D974:	
Total acid No.	0.21
pH value	9.5
Sulfated ash, ASTM D874, percent	10.4

The coupling agents, diethylene glycol monobutyl ether and diethylene glycol, employed in the oil soluble base are well-known commercial materials. These materials per se and their method of preparation constitutes no portion of the invention.

The powdered lead employed in the illustrative compositions is free from oil, grease, grit and other abrasives. It contains at least 95 percent by weight of free metallic

lead and not more than 5 percent by weight of lead oxide. Typical properties of the powdered lead are as follows—

Apparent density: lb./cu. ft.:	
ASTM B329 -----	328
Sieve analysis, ASTM B214, percent:	
On 100 mesh -----	0.1
Through 325 mesh -----	55.1
Spectrographic analysis, percent:	
Copper -----	0.03
Lead -----	99.68
Magnesium -----	0.07
Silver -----	0.03

The graphite employed in the illustrative compositions is amorphous graphite that is free from powdered coal, lamp black, carbon black, oil, grease, grit and other abrasives. Typical properties of the graphite are as follows—

It will be noted from the data in Table I that those compositions which contain from 3 to about 6 percent by weight of soluble oil base (Compositions C and D) were easily removed in the water-wash test. These compositions were easily applied to pipe threads and effectively prevented seizure and galling of the threads. In addition to being easy to apply to and easy to remove from pipe threads, Composition D also had good extreme pressure characteristics as evidenced by a Falex seizure load of 4000 pounds.

Other compositions within the scope of the invention, Compositions F, H and J, are illustrated in Table II. In preparing Compositions E and F, the metal soap lubricating base is a calcium soap grease. In compositions G and H, the metal soap lubricating base is a lithium soap grease. In Compositions I and J, the metal soap lubricating base is a barium soap grease. The make-up and properties of the comparative compositions are shown in Table II.

TABLE II

Make-up, Percent By Weight	E	F	G	H	I	J
Metal soap lubricating base -----	(22.70)	(17.00)	(22.70)	(17.00)	(22.70)	(17.00)
500 SUS at 100° F. Texas oil -----	12.12	9.08	20.87	15.63		
150 SUS at 210° F. Mid-Continent Bright Stock -----			9.95	7.45		
300 SUS at 100° F. Texas oil -----	20.80	13.89				
Lithium soap of tallow -----			0.07	0.05		
Lithium soap of hydrogenated castor oil -----			0.56	0.42		
Calcium soap of tallow -----	1.72	2.82				
Barium soap of tallow -----					1.53	1.13
Barium acetate -----					0.15	0.12
Glycerine -----	0.18	0.29			0.15	0.12
Solid Lubricant Powder -----	(77.30)	(77.30)	(77.30)	(77.30)	(77.30)	(77.30)
Powdered lead -----	75.00	75.00	75.00	75.00	75.00	75.00
Graphite -----	2.30	2.30	2.30	2.30	2.30	2.30
Soluble oil base -----		(5.70)		(5.70)		(5.70)
Sodium petroleum sulfonate ("Petronate L") -----		4.10		4.10		4.10
Potassium resinate soap ("Dresinate 91") -----		1.37		1.37		1.37
Diethylene glycol -----		0.17		0.17		0.17
Diethylene glycol monobutyl ether -----		0.06		0.06		0.06
Inspection:						
Penetration, Unworked -----	370	366	362	381	351	362
Water Wash-off, 2 gal. water/min. over 3½ x 1¼" panel coated with ½" lubricant, time in minutes. -----	5+	0.7	5+	0.5	5+	0.7
Falex seizure, lbs. -----	4,250			4,000		4,250

Sieve analysis, ASTM B214, percent:	
On 80 mesh -----	<0.1
On 100 mesh -----	0.51
On 200 mesh -----	14.5
Through 325 mesh -----	62.9
Ash, ASTM D1553, percent -----	32.3

In order to illustrate the ease with which lubricating compositions of the invention, Compositions C and D, can be removed from metal surfaces by water, metal panels measuring 3½" x 1¼" were coated with ½" of test lubricant. The coated panels were then sprayed with water at a rate of 2 gallons per minute. The time required to remove the lubricant was noted and recorded. The speed with which the lubricant is removed is indicative of the ease with which lubricating compositions of the invention can be removed from pipe threads. The make-up and properties of comparative compositions are shown in Table I.

TABLE I

Make-up, Percent By Weight	A	B	C	D
Metal soap lubricating base -----	(20.88)	(19.88)	(17.88)	(15.65)
500 SUS at 100° F. Texas oil -----	4.34	4.74	4.34	3.70
150 SUS at 210° F. Mid-Continent Bright Stock -----	4.04	3.84	3.44	3.02
100 SUS at 100° F. Texas oil -----	11.16	10.56	9.36	8.36
Lithium soap of tallow -----	0.07	0.07	0.07	0.06
Lithium soap of hydrogenated castor oil -----	0.67	0.67	0.67	0.51
Solid lubricant powder -----	(77.30)	(77.30)	(77.30)	(77.30)
Powdered lead -----	75.00	75.00	75.00	75.00
Graphite -----	2.30	2.30	2.30	2.30
Soluble oil base -----		(1.00)	(3.00)	(5.70)
Sodium petroleum sulfonate ("Petronate L") -----		0.72	2.16	4.10
Potassium resinate soap ("Dresinate 91") -----		0.24	0.72	1.37
Diethylene glycol -----		0.03	0.03	0.17
Diethylene glycol monobutyl ether -----		0.01	0.03	0.06
Extreme pressure agent -----	(1.82)	(1.82)	(1.82)	(1.35)
Sulfurized sperm oil -----	1.02	1.02	1.02	0.76
Lead oleate -----	0.57	0.57	0.57	0.42
Sublimed blue lead -----	0.23	0.23	0.23	0.17
Inspection:				
Penetration, Unworked -----	358	366	358	367
Water Wash-off, 2 gal. water/min. over 3½ x 1¼" panel coated with ½" lubricant, time in minutes. -----	5+	5+	1	0.3
Falex seizure, lbs. -----				4,000

It will be noted from the data in Table II that those compositions which contain the soluble oil base were easily removed in the water-wash test. These compositions were easily applied to pipe threads and effectively prevented seizure and galling of the threads. In addition to being easy to apply to and easy to remove from pipe threads, Compositions F, H and J, notwithstanding the absence of extreme pressure additives, show good extreme pressure characteristics as evidenced by Falex seizure loads of 4000 pounds and higher.

While our invention has been described with reference to various specific examples and embodiments it will be understood that the invention is not limited to such examples and embodiments and may be variously practiced within the scope of the claims hereinafter made.

We claim:

1. A pipe thread lubricating composition comprising a uniform blend of

(1) about 15 to about 25 percent by weight of a metal soap lubricating base comprising a dispersion in a mineral lubricating oil of a sufficient amount to thicken the lubricating oil to a grease consistency of a metal soap of a fatty acid having between 12 and 32 carbon atoms in the molecule, said metal being selected from the group consisting of alkali metals and alkaline earth metals;

(2) about 50 to about 80 percent by weight of a solid lubricant powder; and

(3) about 3 to about 10 percent by weight of a soluble oil base comprising:

(a) about 20 to about 50 percent by weight of an alkali metal soap of a resin acid;

(b) about 45 to about 75 percent by weight of an alkali metal salt of a petroleum sulfonic acid having a molecular weight of about 420 to about 440; and

(c) about 0.5 to about 5 percent by weight of a coupling agent.

2. The lubricating composition of claim 1 which also contains an extreme pressure agent in an amount sufficient to improve the extreme pressure characteristics of the lubricant.

3. The lubricating composition of claim 1 wherein the metal soap of a fatty acid is a lithium soap.

4. The lubricating composition of claim 1 wherein the metal soap of a fatty acid is a calcium soap.

5. The lubricating composition of claim 1 wherein the metal soap of a fatty acid is a barium soap.

6. A pipe thread lubricating composition comprising a uniform blend of

(1) about 15 to about 25 percent by weight of a metal soap lubricating base comprising a dispersion in a mineral lubricating oil of a sufficient amount to thicken the lubricating oil to a grease consistency of a lithium soap of a fatty acid having between 12 and 32 carbon atoms in the molecule;

(2) about 50 to about 80 percent by weight of a solid lubricant powder; and

(3) about 3 to about 10 percent by weight of a soluble oil base comprising:

(a) about 20 to about 50 percent by weight of a potassium soap of a resin acid;

(b) about 45 to about 75 percent by weight of a sodium salt of a petroleum sulfonic acid having a molecular weight of about 420 to about 440; and

(c) about 0.5 to about 5 percent by weight of a coupling agent.

7. The lubricating composition of claim 6 which also contains an extreme pressure agent in an amount sufficient to improve the extreme pressure characteristics of the lubricant.

8. A pipe thread lubricating composition comprising a uniform blend of

(1) about 15 to about 25 percent by weight of a metal soap lubricating base comprising a dispersion in a mineral lubricating oil of a sufficient amount to thicken the lubricating oil to a grease consistency of a lithium soap of a fatty acid having between 12 and 32 carbon atoms in the molecule;

(2) about 50 to about 80 percent by weight of a mixture of powdered lead and graphite; and

(3) about 3 to about 10 percent by weight of a soluble oil base comprising:

(a) about 20 to about 50 percent by weight of a potassium soap of a resin acid;

(b) about 45 to about 75 percent by weight of a sodium salt of a petroleum sulfonic acid having a molecular weight of about 420 to about 440; and

(c) about 0.5 to about 5 percent by weight of a mixture of diethylene glycol and diethylene glycol monobutyl ether.

9. The lubricating composition of claim 8 which also contains about 1 to about 5 percent by weight of a mixture of sulfurized sperm oil, lead oleate and sublimed blue lead.

10. A pipe thread lubricating composition comprising a uniform blend of

(1) about 15 to about 25 percent by weight of a metal soap lubricating base comprising a dispersion in a mineral lubricating oil of a sufficient amount to thicken the lubricating oil to a grease consistency of a calcium soap of a fatty acid having between 12 and 32 carbon atoms in the molecule;

(2) about 50 to about 80 percent by weight of a mixture of powdered lead and graphite; and

(3) about 3 to about 10 percent by weight of a soluble oil base comprising:

(a) about 20 to about 50 percent by weight of a potassium soap of a resin acid;

(b) about 45 to about 75 percent by weight of a sodium salt of a petroleum sulfonic acid having a molecular weight of about 420 to about 440; and

(c) about 0.5 to about 5 percent by weight of a mixture of diethylene glycol and diethylene glycol monobutyl ether.

11. A pipe thread lubricating composition comprising a uniform blend of

(1) about 15 to about 25 percent by weight of a metal soap lubricating base comprising a dispersion in a mineral lubricating oil of a sufficient amount to thicken the lubricating oil to a grease consistency of a barium soap of a fatty acid having between 12 and 32 carbon atoms in the molecule;

(2) about 50 to about 80 percent by weight of a mixture of powdered lead and graphite; and

(3) about 3 to about 10 percent by weight of a soluble oil base comprising:

(a) about 20 to about 50 percent by weight of a potassium soap of a resin acid;

(b) about 45 to about 75 percent by weight of a sodium salt of a petroleum sulfonic acid having a molecular weight of about 420 to about 440; and

(c) about 0.5 to about 5 percent by weight of a mixture of diethylene glycol and diethylene glycol monobutyl ether.

12. A pipe thread lubricant having substantially the following approximate composition:

	Percent by weight
Metal soap lubricating base:	
Mineral lubricating oil.....	80 to 99...
Lithium soap of a fatty acid having between 12 and 32 carbon atoms in the molecule.....	1 to 20...
Solid lubricant powder.....	50 to 80.
Soluble oil base:	
Resin acid soap component:	
Potassium soap of pale wood rosin.....	86 to 89...
Water.....	11 to 14...
Sodium petroleum sulfonate component:	
Sodium salt of petroleum sulfonic acids having a molecular weight of about 420 to 440.....	62 to 63...
Sodium carboxylate.....	1.....
Water.....	4 to 5...
Mineral oil.....	31 to 33...
Coupling agent.....	0.5 to 5...
Extreme pressure agent.....	1 to 5.

13. A pipe thread lubricant having substantially the following approximate composition:

	Percent by weight
500 SUS at 100° F., Texas oil	3.7
150 SUS at 210° F., Mid-Continent bright stock	3.02
100 SUS at 100° F., Texas oil	8.36
Lithium soap of tallow	0.06
Lithium soap of hydrogenated castor oil	0.51
Powdered lead	75.0
Graphite	2.3
Resin acid soap consisting essentially of 86 to 89 percent by weight of potassium soap of pale wood rosin and the balance water	1.37
Sodium petroleum sulfonate consisting essentially of 62 to 63 percent by weight of sodium petroleum sulfonate the acids of which have an average molecular weight of about 420 to 440, about 1 percent by weight of sodium carboxylate, about 4 to 5 percent by weight of water and the balance mineral oil	4.1

Percent by weight

Diethylene glycol	0.17
Diethylene glycol monobutyl ether	0.06
Sulfurized sperm oil	0.76
Lead oleate	0.42
Sublimed blue lead	0.17

References Cited

UNITED STATES PATENTS

2,543,741	2/1951	Zweifel	252—19
2,913,410	11/1959	Fisher	252—33.2

DANIEL E. WYMAN, *Primary Examiner*.

15 I. VAUGHN, *Assistant Examiner*.

U.S. Cl. X.R.

252—26, 25

20