

## UNITED STATES PATENT OFFICE

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## DRIVING JOURNAL COMPOUNDS

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This invention relates to lubricants of the driving journal compound type and particularly to such lubricants in which all or a large part of the soap content consists of soda soaps of certain low molecular weight fatty acids together with soda soaps of certain high molecular weight fatty acids, avoiding insofar as conveniently possible soda soaps of fatty acids of conventional molecular weight.

Lubricants of the driving journal compound type consist wholly or largely of soda soap and lubricating oil, the soda soap comprising from about 35% to about 55% and preferably from about 40% to about 50% of the product. The soap content of such products should be made from fatty acids rather than fats, i. e. should be substantially glycerine free and should also be substantially anhydrous although a trace of water can be and usually is present.

In the past, lubricants of the driving journal compound type have commonly been made using soda soaps of fatty acid materials consisting largely of fatty acids having 16 to 18 carbon atoms per molecule, namely palmitic acid ( $C_{16}H_{33}COOH$ ) and stearic acid ( $C_{17}H_{35}COOH$ ), although higher molecular weight fatty acids having 20 or 22 carbon atoms per molecule have likewise been used. We have found that greatly superior results can be obtained by the use of substantial amounts of soaps of fatty acids containing from 10 to 14 carbon atoms per molecule together with substantial amounts of soaps of fatty acids containing at least 20 carbon atoms per molecule.

So far as the resulting driving journal compound type of lubricant is concerned, we have found that the various types of saturated fatty acids can be divided into three groups; namely, the low molecular weight group consisting of fatty acids having from 10 to 14 carbon atoms per molecule, the conventional molecular weight group consisting of fatty acids having 16 and 18 carbon atoms per molecule and the high molecular weight group consisting of fatty acids having from 20 to 24 or even more carbon atoms per molecule.

For our purposes the preferred member of the low molecular group is lauric acid ( $C_{12}H_{25}COOH$ ), but myristic acid ( $C_{14}H_{27}COOH$ ) is also unusually good and capric acid ( $C_{10}H_{21}COOH$ ) can likewise be used to advantage. The 11 and 13 carbon atom saturated fatty acids ( $C_{10}H_{21}COOH$  and  $C_{12}H_{25}COOH$ ), while not found in nature in significant amounts, would no doubt share the advantages of the above materials.

The prominent members of the group of fatty acids having conventional molecular weight are palmitic acid ( $C_{16}H_{33}COOH$ ) and stearic acid ( $C_{17}H_{35}COOH$ ).

Two important members of the group of fatty acids having high molecular weight are arachidic acid ( $C_{19}H_{39}COOH$ ) and behenic acid ( $C_{21}H_{43}COOH$ ).

It is an object of our invention to provide new and improved lubricants of the driving journal compound type and methods of manufacture therefor. Another object of our invention is to provide lubricants of the driving journal compound type having good body and toughness and also high plasticity at room temperature coupled with very high softening times at elevated temperatures. A further object of our invention is to provide lubricants of the driving journal compound type having improved pressing characteristics. Another object of our invention is to provide a method of making lubricants of the driving journal compound type under steam kettle conditions which have properties even more advantageous than those of products which could be made heretofore only under the more drastic conditions of the fire kettle technique. Other and more detailed objects, advantages and uses of our invention will become apparent as the description thereof proceeds.

It is highly desirable that a lubricant of the driving journal compound type be plastic at ordinary temperatures so that it can be pressed into sticks or blocks and so that the formed lubricant will not break under conditions of use. At the same time it is very desirable that such lubricants retain their body at elevated temperatures so that they will continue to resist flow under low pressures. Otherwise these lubricants do not retain their form during use and are consumed too rapidly.

We find that these properties can be combined to a most unusual degree by the use of low molecular weight saturated fatty acids having from 10 to 14 carbon atoms per molecule together with high molecular weight saturated fatty acids having from 20 to 24 or more carbon atoms per molecule. Fatty acids of both of these two groups can be made in a fairly high degree of purity by the fractional distillation of fatty acids obtained by the hydrolysis, and if necessary hydrogenation, of naturally-occurring fats.

In order to meet the required specifications and desirable characteristics of lubricants of the driving journal type, it is necessary to obtain a variety of properties which include structure, pressability, toughness, absence of crumbliness and favorable hardness or penetration characteristics at normal or elevated temperatures. The latter characteristic is best measured in terms of softening time which is a most important property.

Softening time is an index of quality from the service standpoint and is measured by a test in which a cylinder of driving journal compound

1/2 inch in diameter and about 5/8 inch long is heated on an oil or mercury bath to the desired test temperature while subjected to the weight of an 85 gram cylinder which provides a pressure on the driving journal compound comparable to the pressure to which the compound is subjected in actual operation when it is forced by a spring against a hot bearing. Softening time is defined as the time required to flatten the test cylinder 1/4 inch under these conditions.

In many respects palmitic acid yields a driving journal compound of highly desirable qualities. One particular quality which it gives is a very good structure. It likewise yields a driving journal compound which is readily pressable and which can readily be worked. On the other hand, under high temperature conditions such products have undesirably low softening times. In other words, such products tend to become extremely soft at temperatures to which they are normally subjected during use. Stearic acid and acids of higher molecular weight show some slight improvement in softening time and toughness of the driving journal compounds produced by their use but such compounds are extremely crumbly and definitely undesirable from this standpoint. Moreover, their softening times and pressing qualities leave much to be desired.

Turning to fatty acids of molecular weight less than that of palmitic, the driving journal compound produced has the desired smoothness, denseness and pressability and the softening time increases markedly as the length of the carbon chain decreases. On the other hand, such driving journal compounds have the undesirable property of losing body too rapidly when worked.

We have found that a driving journal compound which has structure, pressability, toughness and workability at least equal to that of palmitic acid, which has a softening time much higher than that of prior art products—in fact practically infinite softening time under normal conditions of use—and which does not lose body to an undesirable extent when worked can be made by using a substantial amount of fatty acids of low molecular weight together with a substantial amount of fatty acids of high molecular weight, eliminating (to the extent conveniently possible) the fatty acids of conventional molecular weight.

As an example of this type of product the following is a highly desirable lubricant of the driving journal compound type:

|                                 | Per cent |
|---------------------------------|----------|
| Sodium laurate                  | 25       |
| Sodium arachidate               | 20       |
| 530° F. flash steam refined oil | 45       |
| Heavy black oil                 | 10       |

In a product of this type either the sodium laurate or the sodium arachidate can be varied within the range from about 5% to about 95% of the total soap, or, speaking more generally, the total soap can be made up of:

|                                              | Per cent |
|----------------------------------------------|----------|
| C <sub>10</sub> to C <sub>14</sub> compounds | 5 to 95  |
| C <sub>20</sub> to C <sub>24</sub> compounds | 5 to 95  |

the products of intermediate molecular weight being substantially absent.

However, it is not imperative that the conventional stearic and palmitic acids be completely avoided and the soap can contain up to 50% of compounds of more than 14 and less than 20 carbon atoms as well as at least 5% each of C<sub>10</sub> to C<sub>14</sub> compounds and C<sub>20</sub> to C<sub>24</sub> compounds, the two to-

gether being at least 50% of the total. Preferably the soap has the following composition:

|                                              | Per cent |
|----------------------------------------------|----------|
| C <sub>10</sub> to C <sub>14</sub> compounds | 10 to 90 |
| C <sub>16</sub> to C <sub>18</sub> compounds | 0 to 30  |
| C <sub>20</sub> to C <sub>24</sub> compounds | 10 to 90 |

the C<sub>10</sub> to C<sub>14</sub> and C<sub>20</sub> to C<sub>24</sub> compounds together constituting at least 70% of the total soap.

As an example of a product of this type, a driving journal compound was made up using:

|                                 | Per cent |
|---------------------------------|----------|
| Soda soap                       | 45       |
| 530° F. flash steam refined oil | 45       |
| Heavy black oil                 | 10       |

in which the soap was made from 40% commercial lauric acid and 60% Armour No. 4 hydrogenated fatty acids, the latter being a high molecular weight commercial fatty acid containing some palmitic and stearic acids but mostly C<sub>20</sub> and C<sub>22</sub> compounds. The composition of the mixed fatty acid was:

|                                                                  | Per cent |
|------------------------------------------------------------------|----------|
| C <sub>12</sub> (lauric acid)                                    | 40       |
| C <sub>16</sub> and C <sub>18</sub> (palmitic and stearic acids) | 18       |
| C <sub>20</sub> and C <sub>22</sub> compounds                    | 42       |

The driving journal compound made from this mixed fatty acid under steam kettle conditions was unusually smooth having none of the crumbliness caused by stearic acid. Because of the relatively high proportion of C<sub>20</sub> and C<sub>22</sub> fatty acids the grease offered considerable resistance to working down. Lauric acid provided excellent pressability. The grease had an infinite softening time at 260° F., i. e., no perceptible deformation of the test cylinder took place after 2000 seconds. Had stearic acid been used to provide toughness or palmitic acid to provide pressability and good structure the softening time would have been very low and the other properties would have been much less satisfactory.

Almost any reasonable test can be met by proper selection of the amounts of high and low molecular weight acids.

Lubricants in accordance with our invention can be made in accordance with any of the procedures known in the art by merely substituting the fatty acids above described for those heretofore used. However, these low molecular weight fatty acids can be used particularly advantageously in a steam kettle type of operation as contrasted with fire kettle technique and white fatty acids heretofore used give low softening time products when steam kettles are used this is not true when low molecular weight fatty acids are used.

In the steam kettle technique the soap is formed in at least a portion of the oil at a temperature of from about 260° F. to about 300° F. and the remainder of the oil, if any, is then graded in. In no case should the grease be heated above 330° F.

While we have described our invention in connection with certain preferred embodiments thereof, it is to be understood that these are by way of illustration and not by way of limitation and we do not mean to be bound thereby but only to the scope of the appended claims.

We claim:

1. A lubricant of the driving journal compound type comprising as its major constituents soda soap and lubricating oil, said soda soap being made up to the extent of at least 5% of compounds having from 10 to 14 carbon atoms per molecule and to the extent of at least 5% of compounds having at least 20 carbon atoms per molecule.

2. A lubricant of the driving journal compound type comprising as its major constituents soda soap and lubricating oil in which said soda soap is made up predominantly of a substantial amount of at least one compound having from 10 to 14 carbon atoms per molecule and a substantial amount of at least one compound having at least 20 carbon atoms per molecule.

3. A lubricant according to claim 2 in which said compound having from 10 to 14 carbon atoms per molecule is sodium laurate.

4. A lubricant of the driving journal compound type comprising as its major constituents soda soap and lubricating oil in approximately equal quantities, said soda soap having the following composition:

|                                                   | Percent  |
|---------------------------------------------------|----------|
| C <sub>10</sub> to C <sub>14</sub> compounds..... | 10 to 90 |
| C <sub>16</sub> to C <sub>18</sub> compounds..... | 0 to 30  |
| C <sub>20</sub> to C <sub>24</sub> compounds..... | 10 to 90 |

5. In a substantially anhydrous lubricant containing from about 35% to about 55% soda soap, at least the bulk of the remainder being lubricating oil, the improvement which consists in using soda soap of which not more than 50% is made up of compounds having 16 to 18 carbon atoms per molecule, the remainder being made up of soaps of low molecular weight fatty acids having 10 to 14 carbon atoms per molecule, and soaps of higher molecular weight fatty acids having at least 20 carbon atoms per molecule, both said soaps of lower and higher molecular weight fatty acids being present in substantial proportions.

6. A substantially anhydrous lubricant of the driving journal compound type made up largely of soda soap and lubricating oil, said soda soap being substantially free of unsaturated compounds and containing not more than minor proportions of sodium palmitate and sodium stearate, the remainder of said soda soap being made up

of compounds having from 10 to 14 carbon atoms per molecule and from 20 to 24 carbon atoms per molecule, each in substantial proportions.

7. In the manufacture of a lubricant of the driving journal compound type, the step which comprises saponifying with caustic soda a fatty acid material rich in compounds having from 10 to 14 carbon atoms per molecule and rich in compounds having from 20 to 24 carbon atoms per molecule to give a soda soap having the following composition:

|                                                   | Percent  |
|---------------------------------------------------|----------|
| C <sub>10</sub> to C <sub>14</sub> compounds..... | 10 to 90 |
| C <sub>16</sub> to C <sub>18</sub> compounds..... | 0 to 30  |
| C <sub>20</sub> to C <sub>24</sub> compounds..... | 10 to 90 |

8. In the steam kettle manufacture of a lubricant of the driving journal compound type the step which comprises saponifying with caustic soda a fatty acid material containing a substantial quantity of at least one compound having from 10 to 14 carbon atoms per molecule and a fatty acid material containing a substantial quantity of at least one compound having from 20 to 24 carbon atoms per molecule.

9. In the manufacture of a lubricant of the driving journal compound type the step which comprises saponifying with caustic soda fatty acids in at least a portion of the lubricating oil at a temperature from about 260° F. to about 300° F., said fatty acids being rich in low molecular weight compounds and in high molecular weight compounds to give a soda soap containing a substantial quantity of at least one compound having from 10 to 14 carbon atoms and a substantial quantity of at least one compound containing from 20 to 24 carbon atoms, said low and high molecular weight soaps constituting at least 50% of the total soap.

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