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DRIVING JOURNAL COMPOUND

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9 Claims. (Cl. 87-9)

This invention relates to a hard high melting point lubricant of the type used by railroads for the lubrication of driving journals. This so-called "driving journal compound" usually consists largely of a soda soap and a heavy viscous mineral oil. In some cases certain additional minor constituents may be present.

The object of my invention is to produce an improved lubricant of this type which will permit lower lubricant consumption, lower bearing temperature, etc. Detailed objects will become apparent as the description proceeds.

Driving journal compounds are applied in cast or molded form in cellars beneath the locomotive driving axles, and are held there by perforated plate retarders which are shaped to conform to the configuration of the journal. The lubricant and plate are pressed snugly against the axle by means of springs. The bearing pressures on the journals are from 50 to 350 pounds per square inch of projected bearing area. The reversed thrust on the journals and the end-play and jolting of the trucks around curves and over frogs tend to rupture the lubricating film between the journal and the bearing. These factors along with the ever-present possibility of mechanical defects in the fit of the axles, crown brasses, and plates make the problem of correct lubrication extremely difficult.

A lubricant of this type must have proper structural characteristics so that it will feed uniformly through the plate to prevent the development of local hot spots and so that it will feed out fast enough to reduce the ill effects caused by high spots on the plate or journal; in other words it must take care of all but the most glaring mechanical deficiencies. On the other hand it must not feed too rapidly for three reasons: (1) high consumption makes for high labor costs in re-filling cellars; (2) high consumption ultimately results in too thin a lubricant cake and the danger of a hot box; and (3) high consumption means high lubricant costs. The second important requirement is that the driving journal compound should be of such a nature as to hold the journal to a minimum temperature rise when the locomotive is under full load and speed.

It has been found that the use of sodium soaps is highly important in this type of lubricant since they give the desired hard fibrous structure which is required. Calcium soaps, aluminum soaps, etc., are not satisfactory for use without sodium soaps. The proper selection of the fatty acid portion of the soap molecule is likewise of the

highest importance and it is with this feature that the present invention is concerned.

It was formerly customary to make these soaps from various types of commercial fatty acids and in particular from commercial "stearic acid" which was found to be more nearly satisfactory than other materials tried. However, the use of commercial "stearic acid" in the manufacture of soaps to be used in these driving journal compounds was by no means entirely satisfactory. If the soap content was kept fairly low the consumption of grease by the journal became inordinately high. On the other hand, when the soap content was raised to remedy this difficulty, much trouble was encountered from bearing failures, carbonization, etc.

It was found that a superior driving journal compound could be made by the use of certain hydrogenated fatty acids made from sources of unsaturated fatty acids containing largely acids of 18 or more carbon atoms to the molecule. These hydrogenated fatty acids contained a large portion of the chemical individual known as stearic acid. Thus, a typical hydrogenated fatty acid of this type may contain over 70% of stearic acid, from 7 to 8% of acids having 20 or 22 carbon atoms per molecule, about 10% of palmitic acid (16 carbon atoms per molecule) and from 12 to 15% of unsaturated acids. Driving journal compounds made from hydrogenated fatty acids of this type were found to be highly superior to those made from commercial "stearic acid".

A commercial "stearic acid" may contain as much as 40 to 60% of palmitic acid and as little as 35 to 40% of true stearic acid. The palmitic acid in commercial "stearic acid" is not removed by repeated pressings or by the other conventional methods of refining. Thus double or triple pressed "stearic acid" is usually thought to be highly pure and is in fact practically free from oleic acid and other low melting point material but still contains very large quantities of palmitic acid. The ratio of palmitic acid to true stearic acid is not materially reduced by the repeated pressing since the palmitic acid and stearic acid tend to form a mixture which is probably an eutectic.

The ratio of palmitic acid to stearic acid in commercial "stearic acid" is approximately constant for commercial "stearic acid" from all known natural sources.

The presence of palmitic acid in commercial "stearic acid" was thought to be the reason for its inferiority over the hydrogenated fatty acids since the latter differ from commercial "stearic acid"

largely in their much lower palmitic acid content. I have discovered, however, that palmitic acid is by no means objectionable per se but is objectionable only in its admixture with large proportions of stearic acid.

Thus, either stearic acid relatively free from palmitic acid (i. e. hydrogenated fatty acid) or palmitic acid relatively free from stearic acid, is far superior to the mixture known commercially as "stearic acid". I find, moreover, that the relatively pure palmitic acid is not only highly superior to the commercial "stearic acid" but is also definitely superior to the hydrogenated fatty acids for the manufacture of driving journal compounds.

This superiority of driving journal compounds made from soda soaps of palmitic acid includes both of the important considerations mentioned in the introductory paragraphs of this specification. In other words, the consumption of driving journal compound by the bearing under given test conditions is lower and the temperature rise in the bearing is also lower for a given soap content. A bearing using a driving journal compound containing a palmitic acid soap will run cooler and at the same time consume less lubricant than a bearing running under identical conditions using a driving journal compound containing soap made either from commercial "stearic acid" or from the relatively pure stearic acid known as hydrogenated fatty acids. Thus, in a bearing test using driving journal compounds containing 48.5% of various soaps and being otherwise identical, the bearing consumed 10 grams of a compound containing soap made from Baker's technical palmitic acid, while under identical conditions and during the identical period it consumed 15 grams of a compound made from sodium soaps of hydrogenated fatty acids. A compound made from a 50:50 mixture of the soaps of the two preceding examples gave a consumption of 80 grams. The corresponding consumption for a compound made from a sodium soap of commercial "stearic acid" is about 60 grams.

Other compositions were also made from a commercial mixture containing about 75% palmitic acid and 25% oleic acid and these compositions were tested in a standard bearing under standardized load, speed and time conditions to determine bearing temperatures. The average maximum temperature to which the bearing rose during the test was noted. When the temperature rose to 325° the journal was stopped, the bearing was permitted to cool to 260° F. and the test was then continued. The following table shows results under identical conditions for a series of driving journal compounds using soaps of hydrogenated fatty acids on the one hand and of a relatively pure palmitic acid on the other hand, the compounds being otherwise identical.

Maximum bearing temperature

Hydrogenated fatty acids		Palmitic acid (75% pure)	
Soap %	Temp. °F.	Soap %	Temp. °F.
48.5	325 (3 stops)	48.6	325 (1 stop)
45.0	325 (1 stop)	44.7	298
42.0	293	41.1	266
40.0	280	36.3	261
37.5	285		

It is apparent from this table that compounds

made from palmitic acids give lower bearing temperatures for a given soap content. In the case of the highest soap contents this is apparent from the increased number of stops during the fixed test period necessary to cool the bearing when using a compound made from the soaps of hydrogenated fatty acids.

Driving journal compounds in accordance with my invention may vary considerably in composition. The soap content is the most important factor and this may vary from 30 to 55%. I prefer, however, to confine the range to approximately 35 to 45%. Both the consumption of the lubricant by the bearing and the temperature to which the bearing rises are increased as the soap content of the lubricant is increased and it is therefore desirable to avoid using too much soap. The consumption curve appears to take a sharp rise at about 42% soap and I therefore prefer to keep under this figure. The 42% figure is subject to variation either up or down with slight variations in the nature of the soap stock and with other variables. The soap content must not be too low or the driving journal compound loses its desired hard fibrous structure and becomes too soft. Furthermore, if the soap content is progressively lowered a point is reached at which the consumption begins to rise as it does in the case of too high a soap content.

I may also use a small amount of pure fat or fat containing some free fatty acid in my compound. The quantity may be from 1 to 10% and preferably from 3 to 7%. Lard oil is highly suitable. This ingredient of my composition can, however, be entirely eliminated, but when this is done it is desirable to increase the soap content by 1 or 2%. My driving journal compounds will also usually contain a very small amount of water which tends to give the desired fibrous structure. The water content should, however, be less than 1% and usually less than 0.1%. The remainder of my compound is made up of oil. Any kind of heavy viscous lubricating oil is suitable but I find it best to use some type of residual oil, such as steam-refined oil. I also find it advantageous to include a small amount of a heavy black oil such as is produced from Wyoming crudes. This may be present in quantities of from 1 to 50% of the total oil but preferably from about 5 to 20% of the total oil. Various other materials, for instance fillers, such as graphite, asbestos, mica, etc., can be used and if used they are in addition to the constituents already mentioned and are not to be considered in calculating the amounts of the main constituents. The use of such materials is not recommended in ordinary cases.

A typical example of a composition according to my invention is as follows:

	Percent
Sodium palmitate (technical grade)	40
No. 1 lard oil	2.5
Heavy black oil	8
Steam refined oil (530° F. flash)	49.5
Total	100

Driving journal compounds in accordance with my invention can be made by various methods. In a preferred method the fatty acid is melted in the heavy mineral oil at 220-325° F. in a steam kettle equipped with a mixer. Sodium hydroxide is then added thereto in the form of an aqueous solution, for example 48% strength, with constant stirring until complete neutralization has been effected and the batch has become heavy and

dry. The acidity or alkalinity of the batch is then determined and more acid or alkali is added to bring the mixture to approximate neutrality, the acidity or alkalinity being equivalent to about

5 -.02 to +.02% sodium hydroxide. The lard oil is next added and worked in with stirring at a temperature below the melting point of the grease. If the temperature is raised too high and the grease is melted, the proper fibrous structure may be obtained by a gentle stirring of the compound as its temperature is diminished, about 10 .03 or .04% of water being added if necessary to replace the water which has been driven out. It is preferable, however, to avoid this overheating.

15 The driving journal compound may suitably be finished at a temperature 40 or 50° F. below the neutralization temperature.

The temperature conditions, speed of stirring, etc., have a considerable effect on the fiber structure and other qualities of the driving journal compound and must be adjusted by experiment to give the results required in any particular case. Another expedient which generally improves the fiber structure is to add the sodium hydroxide in 25 two batches, first neutralizing about two thirds of the fatty acid and after this reaction is completed neutralizing the remaining one third.

It is highly important that the soaps used in making my compounds be made from fatty acids 30 rather than from fats. Greases made from fats are usually very unsatisfactory. This appears to be due in part to the fact that glycerine is an undesirable constituent in my compounds although a compound made from fatty acids and containing the stoichiometrically equivalent amount of glycerine is superior to an otherwise similar grease made from fats.

35 The palmitic acids used in making my compounds may come from any desired natural source. One good source is fatty acids from palm oil which can be separated by efficient fractional distillation, preferably under vacuum, to produce a fraction containing a high concentration of the chemical compound palmitic acid.

40 I strongly prefer to use soaps containing at least 65% and preferably at least 70% of the chemical compound sodium palmitate. Progressively higher contents of sodium palmitate, e. g. 80%, 90% and 95%, are increasingly desirable. 50 Another important factor is to keep the sodium stearate content down since sodium oleate and other soaps appear to be far less detrimental than sodium stearate. It is highly important that the content of the latter be kept under 15% and preferably under 10%.

55 The percentages given in this specification are expressed in terms of weight.

It can generally be said that driving journal compounds in accordance with my invention contain shorter and thinner fibers than those of the prior art.

While I have described my invention in connection with certain specific embodiments and in connection with certain theories, it is to be understood that these are by way of illustration only and not by way of limitation.

I claim:

1. A hard high melting point driving journal compound consisting largely of soda soap and a heavy viscous mineral oil, each present in large proportion, said soda soap containing at least about 70% sodium palmitate.

2. A hard high melting point driving journal compound consisting largely of soda soap and a heavy viscous mineral oil, each present in large

proportion, said soda soap containing at least about 65% sodium palmitate and not more than about 15% sodium stearate.

3. A hard high melting point driving journal compound consisting largely of soda soap and a heavy viscous mineral oil, each present in large proportion, said soda soap containing at least about 70% sodium palmitate and not more than about 15% sodium stearate.

4. A driving journal compound comprising the following constituents in substantially the following percentages by weight:

	Percent
Soda soap-----	30-55
Heavy viscous mineral oil-----	34-70 15
Free fat and fatty acid-----	0-10
Water-----	0-1

said soda soap containing at least about 70% sodium palmitate.

5. A substantially glycerine free driving journal compound comprising the following constituents in substantially the following percentages by weight:

	Percent 25
Soda soap-----	30-55
Heavy viscous mineral oil-----	34-70
Free fat and fatty acid-----	0-10
Water-----	0-1

said soda soap containing at least about 65% sodium palmitate and not more than about 15% sodium stearate.

6. A driving journal compound comprising the following constituents in substantially the following percentages by weight:

	Percent
Soda soap-----	35-45
Heavy viscous mineral oil-----	48-62
Free fat and fatty acid-----	3-7
Water-----	0-0.1 40

said soda soap containing at least about 70% sodium palmitate.

7. A driving journal compound comprising the following constituents in substantially the following percentages by weight:

	Percent
Soda soap-----	35-45
Heavy viscous mineral oil-----	48-62

said soda soap containing at least about 70% sodium palmitate.

8. A substantially glycerine free driving journal compound comprising the following constituents in substantially the following percentages by weight:

	Percent
Soda soap-----	35-45
Heavy viscous mineral oil-----	48-62

said soda soap containing at least about 70% sodium palmitate and not more than about 10% sodium stearate.

9. A driving journal compound having substantially the following weight composition:

	Percent 65
Soda soap-----	40
Steam refined oil-----	49
Heavy black oil-----	8
Lard oil-----	2.5
Water-----	0-0.1 70

said soda soap containing at least about 65% sodium palmitate and not more than about 15% sodium stearate.

CERTIFICATE OF CORRECTION.

Patent No. 2,086,870.

July 13, 1937.

WILLIAM P. HILLIKER,

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 67, claim 9, in the table, for the numeral "49" read 49.5; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of September, A. D. 1937.

Henry Van Arsdale

(Seal)

Acting Commissioner of Patents.