United States Patent Office

3,498,920

Patented Mar. 3, 1970

3,498,920

COMPOSITIONS OF LIQUID PARAFFINS CONTAINING MIXTURES OF ALKYL-SUBSTITUTED POLYNUCLEAR AROMATIC HYDROCARBONS AS SWELLING AGENTS

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No Drawing. Continuation-in-part of application Ser. No. 385,799, July 28, 1964. This application Oct. 16, 1968, Ser. No. 768,174

Int. Cl. C09k 3/00, 3/02; C10m 1/16

U.S. Cl. 252—72 2 Claims

ABSTRACT OF THE DISCLOSURE

Compositions comprising liquid paraffins containing a small amount, sufficient to act as a swelling agent, of a mixture of alkyl-substituted polynuclear aromatic hydrocarbons comprising alkyl naphthalenes, acenaphthylenes, phenanthrenes and pyrenes.

CROSS REFERENCE TO RELATED APPLICATIONS

Continuation-in-part of application Ser. No. 385,799, filed July 28, 1964, now abandoned.

BACKGROUND OF THE INVENTION

Field of the invention

This invention, which is a continuation-in-part of our copending application Ser. No. 385,799, filed July 28, 1964, relates to liquid hydrocarbon compositions, particularly suitable for use as hydraulic or lubricating oils, having improved rubber-swell characteristics. More particularly, in this aspect, the invention relates to hydraulic or lubricating oils having the aforementioned improved rubber-swell characteristics, in which these desirable properties of the oil are retained during its use.

Description of the prior art

Prior to the present invention, oils employed for hydraulic or lubricating purposes, under conditions in which the oil is being retained within a sealed area, have been comprised of predominantly naphthenic hydrocarbons, in preference to paraffinic hydrocarbons, inasmuch as it was found that the use of paraffinic oils, in many systems, resulted in loss of lubricant which occurred largely past seals and packings. The use of naphthenic oils, on the other hand, was found to result in minimizing such leakage; whereas the use of paraffinic oils, apart from the leakage problem, is highly attractive, inasmuch as the paraffinic oils are more stable to deterioration by oxidation, afford better wear protection, and, in many instances, possess better viscosity indexes. It has been found, however, that the paraffinic oils do not possess the ability to swell seals and packings, to result in a tighter closure and thus minimize leakage in the system. Hence, the ability to employ paraffinic hydrocarbon oils in hydraulic or lubricating

systems, which will not result in leakage past seals or packings, is highly desirable from a practical standpoint.

SUMMARY OF THE INVENTION

In accordance with the present invention, it has now been found that improved liquid paraffinic hydrocarbons, suitable for use as hydraulic or lubricating oils and possessing the aforementioned advantages of oxidation stability, improved wear protection and high viscosity indexes, can be provided without the aforementioned disadvantages of leakage past seals and packing, by incorporating in such oils small quantities of a mixture of alkyl-substituted polynuclear aromatic hydrocarbons, as swelling agents, as more fully hereinafter described. In this respect, it has been found that the use of even small quantities of the aforementioned aromatic hydrocarbons causes rubber or packings in enclosed systems to swell, thereby making for a tighter closure and minimizing, or completely avoiding leakage. In this manner, all of the advantages of paraffinic hydrocarbons over naphthenic hydrocarbons are realized, without encountering the aforementioned leakage problems.

More specifically, in accordance with the present invention, the lubricating oil vehicle may comprise any liquid paraffinic hydrocarbon, or liquid hydrocarbons which are predominantly paraffinic in character. Thus, for example, the lubricating oil may comprise, in a preferred form, a liquid paraffinic petroleum hydrocarbon, or liquid petroleum hydrocarbons which are predominantly paraffinic in character. This paraffinic lubricating oil may, therefore, comprise any of the conventional paraffinic hydrocarbon oils of lubricating viscosity, and may include mineral or synthetic lubricating oils. The mineral lubricating oils, which are preferred as the lubricating vehicle, may be of any suitable lubricating viscosity, ranging from about 45 SUS at 100° F. to about 2000 SUS at 100° F. These oils may have viscosity indexes varying from about 70 to about 100 or higher. Viscosity indexes from about 75 to about 100 are preferred. The average molecular weights of these oils preferably range from about 250 to about 800.

The alkyl-substituted polynuclear aromatic hydrocarbons employed in combination with the aforementioned paraffinic hydrocarbons, as swelling agents, are present in the form of a mixture of alkyl-substituted polynuclear aromatic hydrocarbons comprising, by weight, from about 15 to about 25 percent alkyl naphthalenes, from about 15 to about 30 percent acenaphthylenes, from about 35 to about 55 percent phenanthrenes and from about 1 to about 5 percent pyrenes. In general, such mixtures have a boiling point of at least about 400° F. and usually a boiling point from about 400° F. to about 1000° F. Most preferred are mixtures of the aforementioned components which have boiling points from about 480° F. to about 1000° F. A more detailed description of these alkyl-substituted polynuclear aromatic hydrocarbons is disclosed in U.S. Patent 3,062,771, issued Nov. 6, 1962, and such disclosure is incorporated herein by reference. In general, although it is desirable to employ a pure alkyl-sub-

stituted polynuclear aromatic hydrocarbon oil in combination with the aforementioned paraffinic oil vehicle, it is extremely difficult, from a commercial standpoint, to produce a substantially pure product. However, the use of thermal or catalytic processes results in the build-up of the aromatic fractions and a cracking of the paraffinic fractions, which, therefore, makes it possible to produce a highly aromatic material which can be used either in its entirety in the aforementioned boiling point range, or in any desired intermediate cuts. Analysis for the paraffinic content of the commercially produced aromatic oils by adsorption on silica gel shows that they contain no more than about 8 percent paraffins by volume. The aromatics content, on the other hand, is at least about 90 percent, by volume.

Insofar as the quantity of the alkyl-substituted polynuclear aromatic hydrocarbons, which is employed in combination with the base liquid paraffinic hydrocarbon, is concerned, even small quantities of the aromatic hydrocarbons are effective; however, compositions are preferred which comprise liquid paraffinic hydrocarbons containing from about 5 percent to about 20 percent, by volume, of the alkyl-substituted polynuclear aromatic hydrocarbons. It should also be noted that the liquid paraffinic hydrocarbon compositions of the present invention may contain, in addition to the aforementioned alkyl-substituted polynuclear aromatic hydrocarbons, minor amounts of other additive materials such as anti-wear, anti-oxidation, or anti-corrosion agents, if so desired.

The chemical and physical properties of a typical mixture of alkyl-substituted polynuclear aromatic hydrocarbons, which may be employed in the novel compositions of the present invention are illustrated by the following Table I:

TABLE I

	Wt. percent
Paraffins	2.2
1-ring naphthenes	0.5
2-ring naphthenes	0.3
3-ring naphthenes	0.3
4-ring naphthenes	0.3
5-ring naphthenes	0.2
Alkyl benzenes	6.0
Alkyl naphthalenes	20.9
Acenaphthylenes, including acenaphthenes	23.2
Phenanthrenes, including cyclanophenanthrenes	44.1
Pyrenes	2.0
	100.0

Specific gravity	1.0458
Flash pt., ° F.	320
Pour pt., ° F.	−20
Color	2.0
Viscosity at 100° F., SUS	53
Distillation range, ° F.	525–700
Mixed aniline cloud pt., ° F.	65
Silica gel analysis (aromatics) ——percent——	95

DESCRIPTION OF SPECIFIC EMBODIMENTS

The following examples will serve to illustrate the efficacy of the novel and improved compositions of the present invention, containing the aforementioned alkyl-substituted polynuclear aromatic hydrocarbons in minor proportions. In these examples, as more fully hereinafter discussed, the alkyl-substituted polynuclear aromatic hydrocarbons are designated as "aromatic oil additive" for simplicity. The properties of the aromatic oil additive employed in these examples are indicated in Table I.

In Examples 1 through 5 of the following Table II, are shown the improved rubber swell properties obtained by the addition of the aforementioned aromatic oil additive of Table I, to a 200 SUS paraffinic hydrocarbon oil with respect to a nitrile rubber, tested in accordance with a standard test ASTM D571–59T using a temperature of 250° F. and an immersion period of 70 hours.

TABLE II

	Percent 200 SUS paraffin/ percent aromatic oil additive	Percent rubber swell
Example 1	100/0	−1.1
Example 2	94/6	+5.3
Example 3	92/8	+6.6
Example 4	91/9	+8.3
Example 5	90/10	+9.3

From the data in Table II, it will be noted that the aromatic oil additives of the present invention are markedly effective in achieving the desired degree of rubber swell when used in combination with liquid paraffinic hydrocarbons.

In another series of preferred formulations, three types of the improved liquid paraffinic hydrocarbons of the present invention, containing the aforementioned aromatic oil additive, described in Table I (supra), were tested for their efficacy as hydraulic oils on a comparative basis with conventional commercially available paraffinic oils, in which the aforementioned aromatic oil additive was not present. The compositions of the aforementioned hydraulic oils which were subjected to comparative tests, are shown in Examples 6, 7, and 8 of the following Table III, in which the various components are expressed in percent by volume.

TABLE III

	Ex. 6	Ex. 7	Ex. 8
100 SUS solvent paraffin	8.00		
200 SUS solvent paraffin	82.35	82.35	44.35
125 SUS solvent bright		7.00	45.00
Aromatic oil additive of Table I	9.00	10.00	10.00
Anti-wear additive [1]	0.60	0.60	0.60
Anti-rust additive [2]	0.05	0.05	0.05

[1] A zinc dialkyldithiophosphate.
[2] An amine derivative of an alkenyl substituted succinic acid.

The characteristics and specifications of the hydraulic oil formulations of Examples 6, 7, and 8, are shown in the following Table IV.

TABLE IV

	Ex. 6	Ex. 7	Ex. 8
Gravity, ° API	26.8	26.6	25.9
Pour, ° F. (max.)	20	20	25
Flash, ° F. (min.)	360	360	360
Viscosity at 100 ° F. SUS	145/155	190/210	290/310
Viscosity at 210° F. SUS	43	45	52
Viscosity Index	92	97	100
Color (max.)	2	3	5
Aniline Point, ° F.	195	200	210
Rust Test (ASTM D665-60)	Pass	Pass	Pass
Neutralization No.	1.2	1.2	1.2

In the following Table V, are shown the performance properties of the improved liquid paraffinic hydrocarbon oils containing the aforementioned alkyl-substituted polynuclear aromatic hydrocarbons, as swelling agents, and as represented by the formulation of Examples 6, 7, and 8 of Table III, compared with conventional commercially available oils, in which the aforementioned aromatic oil

additives were not present, and in which there was a large proportion of naphthenic hydrocarbons.

TABLE V

	150 SUS conventional oil	200 SUS conventional oil	Oil of Ex. 6	Oil of Ex. 7	Oil of Ex. 8
Viscosity Index	63	71	92	97	100
Rubber swell percent vol. increase (D-471; 70 hrs.; 250° F.):					
Rubber A	9.7	9.6	8.1	8.6	8.3
Rubber B	16.5	16.8	15.2	16.3	16.4
Rubber C	2.5	2.0	1.7	2.5	2.5
B-10 Oxidation Test [1] (40 hrs.; 260° F.):					
Percent kinematic viscosity increase at 100° F	54.7	49.1	14.2	11.7	12.6
Neutralization number increase	4.3	3.9	0.2	0.8	1.1
Deposits	[3]	[3]	0	0	0
Hydraulic service test [2] (150 hrs.; 1,000 p.s.i., 175° F.):					
Ring wt. loss, mg	164.4		2.4		
Vane wt. loss, mg	64.2		0.9		
Total wt. loss, mg	228.6		3.3		
Emulsion test at 130° F			[4]	[4]	[4]

[1] Described in ASTM Standards on Petroleum Products and Lubricants, 1956 Edition, pp. 940-943.
[2] Wear of a Vickers V-104-E pump is measured after running at the stated conditions pumping 3 gallons of oil around a closed circuit consisting of a reservoir, cooler, filter, pump, relief valve, flowmeter, and instruments.
[3] Moderate-heavy.
[4] Less than 3 cc. emulsion after 30 minutes.

From the foregoing pertinent data, the marked superiority of the improved liquid paraffinic hydrocarbons of the present invention containing alkyl-substituted polynuclear aromatic hydrocarbons, as swelling agents, will become apparent when compared with conventional commercially available oils containing a large proportion of naphthenic hydrocarbons in which the aforementioned aromatic oil additives are not present. More specifically, the improved liquid paraffinic hydrocarbons are markedly superior with respect to viscosity index, oxidation stability and wear protection, yet their rubber-swell properties are about the same as the aforementioned conventional oils.

Although the present invention has been described with preferred embodiments, it will be understood that various modifications and adaptations thereof may be resorted to without departing from the spirit and scope of the invention, as those skilled in the art will readily appreciate.

We claim:

1. A liquid paraffinic hydrocarbon composition having a viscosity from about 45 SUS to about 2000 SUS at 100° F. containing at least about 5 percent by volume of a swelling agent, boiling from about 525° F. to about 700° F., consisting of a mixture of alkyl-substituted polynuclear aromatic hydrocarbons comprising, by weight: from about 15 to about 25 percent alkyl naphthalenes; from about 15 to about 30 percent acenaphthalenes; from about 35 to about 55 percent phenanthrenes; from about 1 to about 5 percent pyrens; 1- to 5-ring naphthalenes; and alkyl benzenes.

2. A composition as defined in claim **1** wherein said swelling agent is present in an amount from about 5 to about 20 percent by volume.

References Cited

UNITED STATES PATENTS

2,816,867 3/1955 Moore et al.

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U.S. Cl. X.R.

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