United States Patent [19]

Schieman

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[54] **FIVE-GRADE MOTOR OIL FOR INTERNAL COMBUSTION ENGINES**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 202,650, Nov. 26, 1971, abandoned.

[52] **U.S. Cl.** ..... **252/32.7 E,** 208/18, 208/19

[51] **Int. Cl.** **C10m 1/48**

[58] **Field of Search** ..... 208/18, 19; 252/32.7 E

[56] **References Cited**

UNITED STATES PATENTS

2,660,552	11/1953	Blanding	208/95
2,660,553	11/1953	Knox	208/20
3,219,666	11/1965	Norman et al.	252/51.5 A
3,595,967	7/1971	Riedel et al.	252/32.7 E X

OTHER PUBLICATIONS

Smalheer et al., "Lubricant Additives," 1967, pp. 2-8.

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[57] **ABSTRACT**

A five-grade motor oil composition for gasoline internal combustion engines having improved oil consumption and low-temperature cranking characteristics comprises a base oil blend of two solvent extracted neutral mineral oils and a dewaxed and dearomatized catalytically cracked mineral oil stock, in combination with suitable lube oil additives. The finished oil formulation meets the requirements for a SAE 5W-40 motor oil.

10 Claims, No Drawings

FIVE-GRADE MOTOR OIL FOR INTERNAL COMBUSTION ENGINES

This application is a continuation in part of U.S. Pat. Ser. No. 202,650 filed Nov. 26, 1971 and now abandoned.

This invention relates to a motor oil composition for gasoline internal combustion engines. More particularly this invention relates to a blended motor oil base stock that will provide adequate lubrication for internal combustion engines despite extreme climatic conditions.

Normally, lubricating oils must provide minimal wear in an engine under operating temperatures at the cylinder walls in the combustion zone ranging from well below 0°F. on a winter morning to well above 400°F. To perform this function satisfactorily, the oil must have thermal stability, shear stability and a resistance to breaking down into harmful deposits which show up as "varnish" within the engine. Another important criterion for motor oil performance is that it have low consumption in an engine, particularly because environmental pollution caused by automobile emissions is of concern.

A market has been developed for multi-grade motor oils which besides having all of the characteristics desired in a superior motor oil should provide adequate lubrication throughout the year regardless of climatic conditions or severity of usage.

It is therefor an object of this invention to provide a base oil for a motor oil formulation which comprises a unique blend of several refinery lubricating oil stocks in certain specific proportions which when used in conjunction with well known multi-functional dispersant-detergent additives, viscosity index improvers, and pour point depressants will be consumed at very low levels in the operation of the engine and will meet the required specifications for a five-grade SAE 5W–40 crankcase oil.

A serious problem generally associated with 5W grade motor oils is oil consumption. It has long been recognized that while 5W oils have excellent low temperature cranking properties, they usually are limited to use at ambient temperatures not exceeding 60°F. due to undesirable oil consumption characteristics. At the same time oils of 10W grade are usually restrictive to low temperature cranking characteristics and are not useful below 0°F., however they do not have the oil consumption problems above 60°F. associated with the 5W oils. No known blend of refined petroleum-base has previously been described which will meet the specifications required for a multi-grade 5W–40 motor oil having both satisfactory consumption properties and low-temperature cranking properties. It is therefor a further object of this invention to provide a base oil blend for a SAE 5W–40 oil which satisfies both of the above criteria.

The most preferred oils of the instant invention provide a finished 5W–40 motor oil wherein no more than 12 volume percent of the oil boils below 725°F., has a minimum 300°F. viscosity of 6.5 centistokes, a minimum 210°F. viscosity of 14.7 centistokes, a maximum 0°F. viscosity of 12 poises (cold crank simulator viscosity) and a maximum consumption rate in the engine of about 5.8 quarts/64 hours of oil as defined by the Sequence IIIC test (SAE-General Motors-6041).

In accordance with this invention, the base oil for the multi-grade motor oil comprises a specific blend of two selected solvent extracted neutral mineral oils, one having a viscosity of about 100 to about 150 SSU preferably about 140 SSU at 100°F., and the other having a viscosity of about 700 to about 800 SSU preferably about 750 SSU at 100°F., (hereinafter referred to as SEN 100–150 and SEN 700–800 respectively) and a second component which is dewaxed and dearomatized catalytically cracked mineral oil stock having an average viscosity of about 75 to about 90 SSU preferably about 85 SSU at 100°F. (herein referred to as HVI 75–90 oil).

Solvent extracted neutral oils are well-known standard mineral oil refinery stocks. The HVI 75–90 oil is an end product obtained by fractionating the effluent from a catalytic cracking zone in a tower, running off the bottoms from the tower into a catalyst separation zone where the catalyst fines are settled out, decanting the supernatant phase called cycle oil or decanted oil, and extracting the decanted oil with a solvent for the removal of aromatics. The extract phase containing the aromatics is removed, and the raffinate phase containing the paraffinic stock is led to a dewaxing zone where wax is separated, leaving a dewaxed oil product which is the feed stock for the HVI oil used. The HVI 75–90 oil is obtained by fractionally distilling this feedstock. A process for obtaining a wax composition from a catalytic cracking stock, leaving a dewaxed oil product, is described in U.S. Pat. No. 2,660,553.

The base oil of this invention comprises a carefully balanced mixture of the aforementioned refinery stocks so that a light component and a heavy component are formulated and are combined to fulfill the SAE 5W and the SAE 40 requirements of the multi-grade motor oil. The light component which fulfills the SAE–5W requirement of the motor oil comprises a blend of two fractions of the dewaxed, dearomatized, fractionated catalytically cracked stock, which has superior thermal stability as compared with solvent extracted neutral oils of comparable boiling range, and a unique ability to reduce the viscosity of 0°F. without decreasing the viscosity at 210°F. in the same ratio. The heavy component which fulfills the SAE–40 requirement is derived from a blend of the SEN 100–150 oil and the SEN 700–800 oil. The properties of typical mineral oil stocks blended to formulate the motor oil of this invention are given in Table I.

The high boiling range of the light component of this lubricating oil formulation is uniquely obtained by combining two fractions of the dewaxed, dearomatized, catalytically cracked stock in certain definite ratios which apparently azeotrope, thereby retaining the high boiling range while reducing viscosity. It is highly important that a minimum amount of this light component boil below 725°F. and that the 210°F. viscosity remain as high as possible in order to minimize the quality of the oil consumed by the engine. The trend in oil consumption by the engine as related to the amount of oil in the finished oil boiling below 725°F. is illustrated by the data given in Table II. These data show within limits of experimental error that oils containing substantially more than 25 volume percent of components boiling below 725°F. increase consumption above the tolerable limits. Preferred are light components where no more than 15 volume percent boil below 725°F.,

and most preferred are those light components where no more than 12 volume percent boil below 725°F.

In order for the light component of this base oil formulation to meet the consumption restriction and to fulfill the 5W requirement in the finished oil, the light component must have a minimum viscosity at 210°F. of about 3.2 centistokes, a maximum viscosity at 0°F. of about 5.9 poises, coupled with a restrictive boiling range of between about 650° to 800°F. with no more than about 25 percent by volume of the oil boiling below 725°F. The light component of the base oil of this invention is conveniently a blend of from about 5 to 18 percent by volume of an oil fraction of a dewaxed, dearomatized, catalytically cracked stock having a maximum of about 80 percent of the oil by volume boiling below 725°F., a 210°F. viscosity in the range of from about 2.8 to 2.9 centistokes, a 100°F. viscosity of from about 11.5 to 11.9 centistokes and a 0° F. viscosity of from about 2.2 to 2.9 poises, combined with from about 82 to 95 percent by volume of a dewaxed, dearomatized, catalytically cracked oil fraction having a maximum of 15 percent by volume of the oil boiling below 725°F., a 210°F. viscosity of from about 3.8 to 4.0 centistokes, a 100°F. viscosity of from about 18.7 to 19.0 centistokes and a 0°F. viscosity of from about 4.5 to 5.5 poises. Typical catalytically cracked oil fractions suitable for use in the light component of the base oil formulation are shown in Table I. The light component of the base oil could also be prepared from a single fraction.

The ratio of the two oil fractions that constitute the base oil may vary to some extent with the type of additive employed in the finished oil, since in instances where the additive contains a diluent oil, the volatility of the base oil must be adjusted in accordance with the volatility of the diluent oil employed.

The heavy component of the base oil in this invention in order to fulfill the SAE 40 requirement of the finished oil must have a 300°F. viscosity of at least 2.5 centistokes in order to provide sufficient hydrodynamic film strength at high temperatures, a minimum 210°F. viscosity of about 6.4 centistokes, a maximum 0°F. viscosity of about 20.0 poises and with little or no volume percent of the oil boiling below 725°F.

The heavy component having the above properties is obtainable by blending from about 70 to about 85 preferably 72 to 84 volume percent of a SEN 100–150 oil with from about 15 to about 30 preferably 16 to 28 volume percent of a SEN 700–800 oil, the properties of typical oils being given in Table I.

Although the requirements for a 5W–40 base oil can be essentially met with the oil blend comprising the light component of the present formulation, there is need for the heavy component to fulfill the 300°F. viscosity requirement essential for adequate film strength of the oil at high temperatures. Concomitantly, the heavy component should have properties which do not increase the 0°F. viscosity of the base oil formulation to above about 5.7 poises. Such an oil is obtained with the blend of a SEN 700–800 oil with a SEN 100–150 oil.

While a blend of the SEN 100 oil and the SEN 750 oil meet the viscometric requirements for the base oil at 0°F., minor problems associated with volatility occur with this particular formulation. However, the SEN 140 oil in the heavy component blend can be replaced with a SEN 100 oil provided the boiling range of the SEN 100 is restricted to within approximately 720° to 835°F. It is again apparent that the initial part of such an oil is closely restricted to the region of 725°F. Viscometrically such an oil must have a viscosity of from about 3.9 to 4.2 centistokes at 210°F. and a maximum viscosity of about 6.0 poises at 0°F.

To attain a base oil that meets the viscosity and volatility criteria for the finished five-grade motor oil, the light and heavy components are blended in amounts ranging from about 70 to 85 parts of the light component with from about 15 to 30 parts of the heavy component on a volume basis. A typical base oil would have a maximum of about 10 volume percent of the oil boiling below 725°F. with the following viscometric properties:

Minimum Viscosity at 300°F.	2.0 centistokes
Minimum Viscosity at 210°F.	4.0 centistokes
Maximum Viscosity at 0°F.	5.7 poises
Pour	0°F.
Flash	415°–420°F.

The additives to be added to the base oil formulation in order to obtain a finished crankcase oil with the proper SAE specification are those that are available commercially, such as the A.P.I. Service S.E.-type additives. In the instant formulation, two additives which are preferred to be combined with the base oil are a viscosity index improver and a multi-functional additive which is also a detergent-dispersant-inhibitor-type additive. A representative additive of the former type is polymethylmethacrylate which typically may have a specific gravity of about 0.9, a viscosity at 210°F. of about 4200 SSU, and viscosity at 100°F. of about 63,000 SSU with a pour point of +25°F. A representative additive of the latter type typically has a specific gravity of 0.95, a viscosity at 210°F. of 156 SSU and contains minor quantities of magnesium, nitrogen, phosphorus, sulfur and zinc. Chemically this additive contains zinc dialkyl dithiophosphate and calcium alkyl phenates as oxidation inhibitors, a succinimide as an ashless dispersant and magnesium sulfonate as a detergent.

A typical oil formulation falling within the limits specified hereinabove is illustrated by the following example:

EXAMPLE

In a tank maintained at 140°F. and fitted with a continuous stirrer were blended 1335 gallons of a viscosity index improver consisting of polymethylmethacrylate 19,110 gallons of a HVI 85 oil consisting of 12.9 volume percent of a fraction of a dewaxed dearomatized, catalytically cracked stock having a 210°F. viscosity of 2.85 centistokes and a 100°F. viscosity of 11.5 centistokes, and 87.1 volume percent of a fraction having a 210°F. viscosity of 3.89 centistokes and a 100°F. viscosity of 19.01 centistokes. In a separate tank at 140°F. were mixed, with continuous stirring, 3450 gallons of SEN 140 oil, 1320 gallons of SEN 750 oil, 1335 gallons of the above viscosity index improver and 3450 gallons of a detergent-dispersant-inhibitor additive comprising a mixture of a zinc dialkyl dithiophosphate, a calcium alkyl phenate, magnesium sulfonate and a succinimide. To this mixture were added the above blend of HVI 85 oil and viscosity index improver. The final oil blend fulfilled the necessary requirements for a five-grade SAE 5W–40 motor oil.

TABLE I

Properties of Typical Oil Components in Base Oil Formulation

	Dewaxed	Cat Cracked Stocks	SEN 100	SEN 140	SEN 750–800
Viscosity 300°F., Cs	<1.5	2.0	—	2.3	5.1
Viscosity 210°F., Cs	2.85	3.89	5.0	14.23	
Viscosity 100°F., Cs	11.5	19.01	21.75	30.37	160.0
Viscosity 0°F., poises	2.8	5.5	6.15	11.1	>100.0
Distillation 0°F., 760 mm*					
IBP	622	690	700	719	722
2	647	—	722	735	865
5	652	714	730	748	892
10	662	721	733	753	904
20	670	731	740	762	922
50	693	750	753	785	964
90	732	790	789	835	1035
95	747	812	808	860	1032
E.P.	770	816	818	880	—

*ASTM D-1160

TABLE II

Effect of <725°F. Component on Oil Consumption of Finished Oil

Oil Type	10W-40	10W	5W-40	5W-40	5W-40	5W-40
<725°F. Component, Vol.%*	0	17	34.5	20	12	9
Oil Consumption, Oz/Hr.	2.28	4.0	4.43	3.42	2.0	2.94

*ASTM D-1160

We claim:

1. A blended base oil composition for use in a five-grade SAE 5W–40 motor oil comprising a blend of the following mineral oil components:

component (A) which consists essentially of a mixture of

1. from about 70 to 85 parts by volume of a solvent extracted neutral oil of about 100–150 SSU viscosity at 100°F., and
2. from about 15 to 30 parts by volume of a solvent extracted neutral oil of about 700–800 SSU viscosity, at 100°F.,

said component (A) having a minimum viscosity at 300°F. of 2.5 centistokes, a minimum viscosity at 210°F. of 6.0 centistokes, a maximum viscosity at 0°F. of 20.0 poises, with little or none of the oil boiling below 725°F.; and

component (B) which consists essentially of HVI 75–90 dewaxed oil obtained from an essentially aromatic-free catalytically cracked stock said dewaxed oil having a minimum viscosity at 210°F. of 3.2 centistokes, a maximum viscosity at 0°F. of 5.9 poises and a maximum of 25 percent by volume of the dewaxed oil boiling below 725°F.,

and wherein component (B) comprises from about 70 to 85 percent by volume of the total base oil composition.

2. A blended base oil composition of claim **1** for use in a five-grade SAE 5W–40 motor oil comprising a blend of the following mineral oil components:

component (A) which consists essentially of a mixture of

1. from about 72 to 84 parts by volume of a solvent extracted neutral oil of about 140 SSU viscosity at 100°F., and
2. from about 16 to 28 parts by volume of a solvent extracted neutral oil of about 750 SSU viscosity, at 100°F.,

said component (A) having a minimum viscosity at 300°F. of 2.5 centistokes, a minimum viscosity at 210°F. of 6.0 centistokes, a maximum viscosity of 0°F. of 20.0 poises, with zero percent of the oil boiling below 725°F; and

component (B) which consists essentially of a blend of dewaxed oils obtained from an essentially aromatic-free catalytically cracked stock, said blend having a minimum viscosity of 210°F. of 3.2 centistokes, a maximum viscosity at 0°F. of 5,9 poises and a maximum of 15 percent by volume of the dewaxed oils boiling below 725°F.;

and wherein component (B) comprises from about 70 to 80 percent by volume of the total base oil composition.

3. The blended base oil composition of claim **1** wherein component (B) consists essentially of a blend of

1. from about 5 to 18 parts by volume of a fraction of a dewaxed, catalytically cracked stock having a viscosity at 210°F. of from about 2.8 to 2.9 centistokes, a maximum viscosity at 0°F. of 2.9 poises, and a maximum of 80 percent by volume of said oil fraction boiling below 725°F.; and
2. from about 82 to 95 parts by volume of a fraction from said catalytically cracked stock having a viscosity at 210°F. of from 3.8 to 4.0 centistokes, a maximum viscosity at 0°F. of 5.5 poises

and a maximum of 15 percent by volume of said oil fraction boiling below 725°F.

4. The blended base oil composition of claim **2** wherein the volume ratio of component (B) to component (A) is about 4 to 1.

5. In a five-grade SAE 5W–40 motor oil with excellent consumption properties and thermal and wear stability having a measured viscosity at 0°F. not to exceed 12.0 poises, a minimum viscosity at 210°F. of 14.7 centistokes, a minimum viscosity at 300°F. of about 6.5 centistokes, and wherein no more than 15 percent by volume of the oil boils below 725°F., comprising a multifunctional detergent-dispersant-inhibitor additive, a viscosity index improver and a base oil composition the improvement comprising using as a base oil a blend of the following mineral oil components:

component (A) which consists essentially of a mixture of

1. from about 70 to 85 parts by volume of a solvent extracted neutral oil of about 100–150 SSU viscosity at 100°F., and
2. from about 15 to 30 parts by volume of a solvent extracted neutral oil of about 700–800 SSU viscosity at 100°F.,

said component (A) having a minimum viscosity at 300°F. of 2.5 centistokes, a minimum viscosity at 210°F. of 6.0 centistokes, a maximum viscosity at 0°F. of 20.0 poises with little or none of the oil boiling below 725°F.; and

component (B) which consists essentially of HVI 75–90 dewaxed oil obtained from an essentially aromatic-free catalytically cracked stock, said dewaxed oil having a minimum viscosity at 210°F. of 3.2 centistokes, a maximum viscosity at 0°F. of 5.9 poises and a maximum of 25 percent by volume of the dewaxed oil boiling below 725°F.;

and wherein component (B) comprises from about 70 to 85 percent by volume of the total base oil composition.

6. The five-grade motor oil of claim **5** wherein no more than 12 percent by volume of the boil boils below 725°F. and component (A) consists essentially of

1. from 72 to 84 parts by volume of a solvent extracted neutral oil of about 140 SSU viscosity at 100°F., and
2. from about 16 to 28 parts by volume of a solvent extracted neutral oil of about 750 SSU viscosity at 100°F.,

with zero percent of the oil boiling below 725°F.; and component (B) which consists essentially of a blend of dewaxed oils obtained from an essentially aromatic-free catalytically cracked stock; said blend having a maximum of 15 percent by volume of the dewaxed oils boiling below 725°F.; wherein component (B) comprises 70 to 80 percent by volume of the total base oil composition.

7. The five-grade SAE 5W–40 motor oil composition of claim **4** wherein component (B) consists essentially of a blend of

1. from about 5 to 18 parts by volume of a fraction of a dewaxed, catalytically cracked stock having a viscosity at 210°F. of from about 2.8 to 2.9 centistokes, a maximum viscosity at 0°F. of 2.9 poises, and a maximum of 80 percent by volume of said oil fraction boiling below 725°F.; and
2. from about 82 to 95 parts by volume of a fraction from said catalytically cracked stock having a viscosity at 210°F. of from 3.8 to 4.0 centistokes, a maximum viscosity at 0°F. of 5.5 poises and a maximum of 15 percent by volume of said oil fraction boiling below 725°F.

8. The composition in claim **5** wherein said viscosity index improver is polymethylmethacrylate and said multifunctional detergent additive comprises a mixture of zinc dialkyl dithiophosphate, a calcium alkyl phenate, a succinimide and magnesium sulfonate.

9. An HVI 75–90 dewaxed oil having an average viscosity of 75 to about 90 SSU at 100°F. obtained from an essentially aromatic-free catalytically cracked stock, said dewaxed oil having a minimum viscosity at 210°F. of 3.2 centistokes, a maximum viscosity at 0°F. of 5.9 poises and a maximum of 25 percent by volume of the dewaxed oil boiling below 725°F.

10. The HVI 75–90 dewaxed oil of claim **9** wherein a maximum of 15 percent by volume of the dewaxed oil boils below 725°F.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,873,455
DATED : March 25, 1975
INVENTOR(S) : Richard D. Schieman

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, Table I, SEN 100, SEN 140, and SEN 750-800 should read as follows:

SEN 100	SEN 140	SEN 750-800
----	2.3	5.1
4.15	5.0	14.23
21.75	30.37	160.0
6.15	11.1	>100.0

Signed and Sealed this

Fifth Day of October 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

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