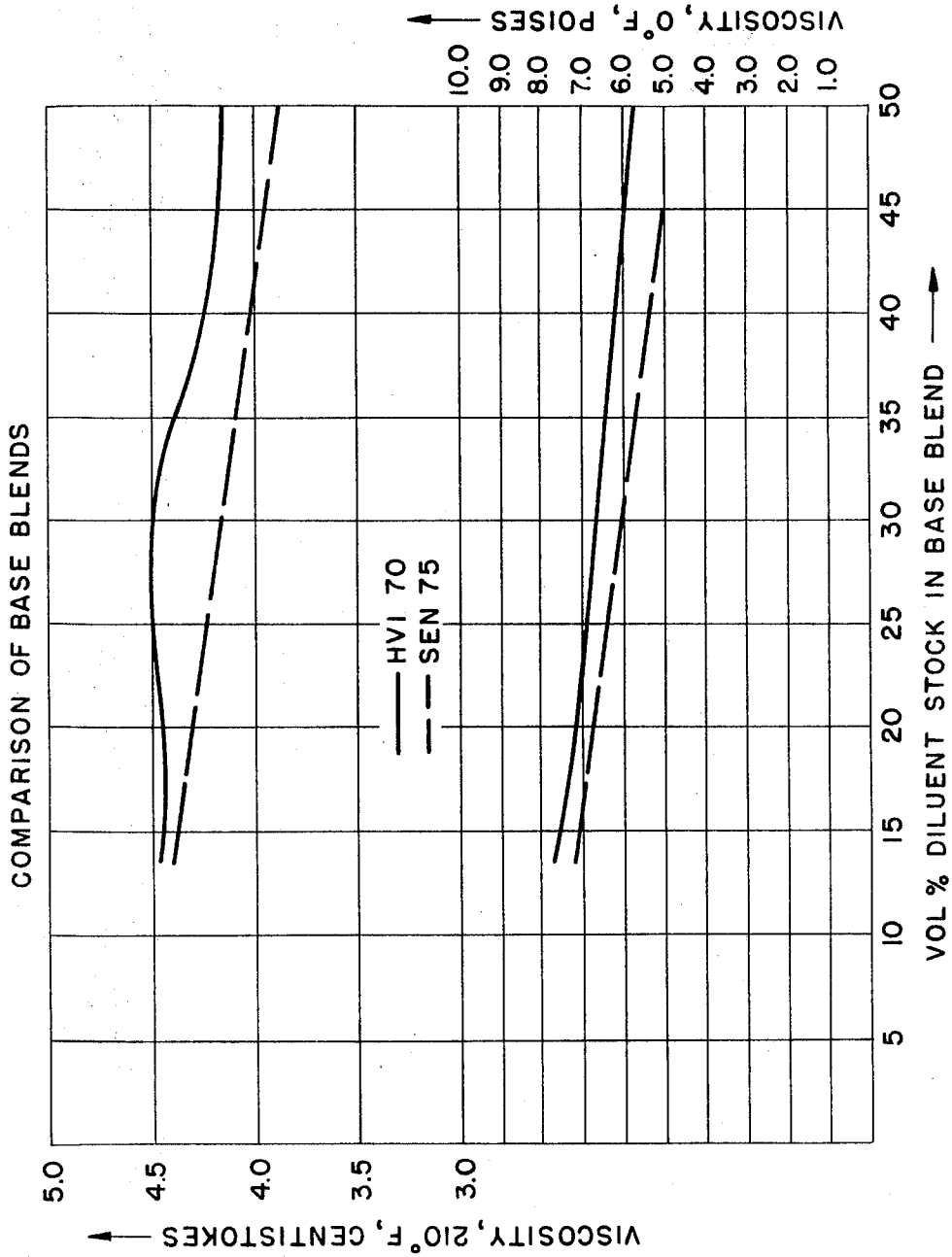
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BASE OIL STOCK FOR FIVE-GRADE LUBRICANT FOR INTERNAL COMBUSTION ENGINES

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INVENTORS
RICHARD D. SCHIEMAN
RICHARD L. RIEDEL
BY John F. Jones
ATTORNEY

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BASE OIL STOCK FOR FIVE-GRADE LUBRICANT FOR INTERNAL COMBUSTION ENGINES

Richard L. Riedel, Bay Village, and Richard D. Schieman, Avon Lake, Ohio, assignors to The Standard Oil Company, Cleveland, Ohio

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ABSTRACT OF THE DISCLOSURE

A blended motor oil base stock for gasoline internal combustion engines is provided which is usable the year round despite extreme climatic conditions. The base oil is formulated to meet specifications for a SAE 10W50 five-grade motor oil when suitable additives are incorporated therein. The motor oil comprises a blend of two neutral oils and a dewaxed catalytically cracked cycle oil.

BACKGROUND OF THE INVENTION

Lubricating oils for internal combustion engines have a single main function, namely to provide adequate lubrication for the engine, thus permitting a minimal amount of wear, despite the fact that the engine operating temperatures may range from well below 0° F. on a winter morning to well above 400° F. at the walls of the cylinders in the combustion zone. To perform this function of lubrication acceptably, the oil must have thermal stability, wear stability, shear stability, a resistance to being broken down into harmful deposits which show up as "varnish" within the engine, and be very sparingly consumed by the engine. Oils derived from petroleum have been used extensively for lubricating oils. Especially useful are the solvent extracted neutral (referred to as SEN) oils which are particularly popular when modified with various additives, depending upon the final viscosity and performance requirements of the oil under conditions of use.

Typical SEN oils that are available in a petroleum refinery are SEN 75, SEN 100, and SEN 300 oils, the latter two being more or less standard. It should be noted that sometimes a stock labeled SEN 100 may vary from 95 to 105, depending upon which refinery it comes from; and similarly, a stock labeled SEN 300 may vary between 295 and 305. In other words, normal SEN 100 and 300 stocks have a range of ±5 SSU. In the instant application, reference is made to nominal SEN 100 and 300 oils that are generally ±2 SSU.

It is well-known that the demands made by an internal combustion engine on the lubricating oils used therein are extremely high. More recently, a market has developed for specialty multi-grade oils which, besides having all the characteristics desired in a superior motor oil, at the same time have the unique property of being usable throughout the year regardless of climatic conditions or severity of usage. In particular, even when the oil is used in a very northerly location where winter temperatures plunge to well below 0° F., it is required that the oil be relatively fluid to permit good lubrication of the engine and, as the temperature of the engine increases to operating temperatures, that the oil exhibit the lubricity and stability of a much heavier weight oil, protecting the engine under severe and harsh treatment. Another important criterion for a high performance motor oil is that it should have low consumption in an engine, especially when pollution caused by automobile emissions is of particular concern.

It is well-known that additives are used containing particular organic compounds which serve to enhance certain characteristics desired in multi-grade oils. However, it is important to note that, when a five-grade 10W50 oil is desired, unless the proper base oil mixture is formulated, the addition of additives will not impart to the finished oil the marketable characteristics referred to hereinabove.

The instant invention had its genesis in the need for a five-grade SAE 10W50 oil which would simultaneously meet the specifications for a SAE 10W and a SAE 50W motor oil. The specifications for these two grades are set forth as follows:

	SAE 10W	SAE 50W
Viscosity at 210° F.:		
Min. (cs.)	No req	
Max. (cs.)	No req	
Min. (SUS) [1]	No req	85.0
Max. (SUS)	No req	110.0.
Viscosity at 0° F.:		
Min. (cs.)		No req.
Max. (cs.)		No req.
Min. (SUS)	6,000 [2]	No req.
Max. (SUS)	<12,000	No req.
V.I., min	No req	No req.
Pour point,° F. max	No req	No req.
Stable pour point,° F. max	No req	No req.
Flash point,° F. min	No req	No req.

[1] The viscosity of SAE crankcase oils shall not be less than 39 SUS at 210° F.
[2] Minimum viscosity at 0° F. may be waived provided viscosity is not below 40 SUS at 210° F.

It was decided to attempt to formulate a finished oil which would have specifications in the middle of the established ranges set forth hereinabove. Such an oil would have the following specifications:

Viscosity at 210° F.—18.7 centistokes
Viscosity at 0° F.—15 poises, max.
Pour——20° F.
Flash—375° F.

It was apparent that no known blend of refined petroleum-based oils could possibly meet these specifications, without the use of additives, and there was some question as to whether a blend could be formulated which, even with additives, could do so.

The selection of additives was limited to those which were commercially available. Two additives were chosen to be used together; one was a viscosity index improver and pour point depressant, the other was a multi-functional additive which is also a detergent-dispersant. A representative additive of the former type typically has a specific gravity of about 0.9, viscosity at 210° F. about 8,000 SSU, and viscosity at 100° F. of about 75,000 SSU with a pour point of 20° F. A representative additive of the latter type typically has a specific gravity of 0.94, viscosity at 210° F. of 170 SSU, contains minor quantities of boron, manganese, nitrogen, phosphorus, sulfur and zinc, and chemically is an ashless succinimide containing zinc dithiophosphate. The choice of these two additives determined the minimum specifications the base blend would have to meet if it was to stand a chance of making the finished oil standards.

Most refineries are designed to make SEN oils of some specific, more or less standard, types. Such generally available SEN oils are the 75, 100 and 300 oils.

It was quickly apparent that, even with the highest viscosity index (VI) mixture of SEN 100 and SEN 300 oils, the low temperature viscosity was too high. When the additives were added, the finished oil failed to meet the mean SAE 10W50 specifications. Thus it became necessary to introduce a third component, preferably one which would lower the low temperature viscosity without lowering the 210° F. viscosity substantially.

It was unexpectedly discovered that a dewaxed oil product (referred to herein as HVI 80) obtained from a

dearomatized catalytically cracked stock lent itself uniquely to being combined with selected SEN oils to yield a base blend with all the desired characteristics, which base blend could be used with an additive package to yield the finished five-grade SAE 10W50 oil. The HVI 80 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 HVI 80 oil used in the instant invention. 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 instant application is concerned mainly with the blending of selected conventional SEN oils in a very narrow range of ratios with a particular quantity of substantially aromatics-free and wax-free catalytically cracked stock into a three-component blend with surprising physical specifications which permit the blend to coact with known additives so that the final blended mixture performs as a SAE 10W50 five-grade oil with measured properties which fall within approved SAE specifications.

SUMMARY OF THE INVENTION

It is an object of the instant invention to provide a base oil which is a blend of selected solvent extracted neutral oils having viscosities of about 100 SSU and 300 SSU measured at 100° F. (referred to herein as SEN 100 and SEN 300 oils) and a dewaxed and dearomatized catalytically cracked stock having a viscosity of about 80 SSU at 100° F., within specific relatively narrow ranges to yield a blend composition which unexpectedly imparts highly desirable characteristics to the blend.

It is another object of the instant invention to provide a blended mixture of two SEN oils having relatively low viscosity indices of about 90 to 100 and a substantially dearomatized and dewaxed catalytically cracked oil having a relatively high viscosity index of from 103 to 106 to yield a blend with a viscosity index of 101.

It is still another object of the instant invention to provide a base oil which is a mixture of three oils, two of which are SEN oils in a relatively constant proportion, and the third being a catalytically cracked dearomatized and dewaxed stock, in the range of 23 percent to 40 percent by volume of the mixture, which has the unique property of lowering the 0° F. viscosity but unexpectedly has a negligible effect on the 210° F. viscosity of the mixture within said range.

It is a further object of the instant invention to provide a three-component mixture of oils, two components being SEN oils, the ratio of one to the other being set by criteria of performance for a superior motor oil, and the third component being a catalytically cracked oil stock which has the unique property of increasing the ratio of the change in 0° F. viscosity to that of 210° F. viscosity to a very large number in excess of 5,000.

It is yet another object of the instant invention to provide a blend of three common refinery oil stocks in a particular narrow range of proportions to yield a novel composition which unexpectedly provides a base blend which when used in conjunction with known multi-functional dispersant detergent additives and known viscosity index improvers and pour point depressants is peculiarly suited to the formulation of a five-grade SAE 10W50 motor oil and is characterized by excellent thermal and wear stability and by very low oil consumption in internal combustion engines.

PREFERRED EMBODIMENT OF THE INVENTION

The preferred ratio of SEN 100 to SEN 300 oil stocks is in the range from about 3.60 to about 3.72, the lower end being preferred. This ratio was set by the highest VI obtainable for the mixture, and several considerations, chief of which were thermal stability of the mixture, low oil consumption because of controlled volatility, high wear stability, and good deposit control.

The optimum ratio for the SEN 100 to SEN 300 oils was 52.3 parts to 14.4 parts by weight. This ratio was used to make up the three-component base blend using as the third component, first, SEN 75 oil and then HVI 80 oil. Pertinent properties of SEN 75 and HVI 80 oils are set forth in Table I hereinbelow:

TABLE I.—COMPARISON OF LOW VISCOSITY STOCKS

Stock	HVI 80	SEN 75
Gravity,° API	33.8	34.5
Pour point,° F	0	0
Flash point,° F	370	360
Viscosity at 100° F., SSU	88.3	76.1
Viscosity at 210° F., SSU	38.5	37.2
Viscosity index	103	105
Processing history	(1)	(2)

[1] Cat. cracking distillation solvent extraction dewax clay contact.
[2] Distillation solvent extraction dewax hydro treat.

The choice of the SEN 75 stock was predicated upon the fact that its viscosity index was closest to that of HVI 80 stock, and upon the fact that it had the lowest acceptable flash point (360° F.) for a light stock. In addition, the SEN 75 oil had the benefit of (for comparison purposes) a lower viscosity of 0° F. than that of HVI 80 and about a comparable viscosity at 210° F. Properties of the two base three-component blends are set forth in Table II. It is important to note that the blended stock must meet certain viscosity criteria, which are determined by the ability of the three-component blend to meet the specifications of the five-grade finished oil after the additives are added. The base three-component blend must meet a viscosity at 210° F. in the range from 4.32 to 4.43 centistokes and a viscosity at 0° F. not to exceed 7.4 poises. The difficulty of meeting these criteria can be gauged from the fact that the viscosity of a two-component blend consisting of SEN 100 and SEN 300 oils in the ratio of 3.63 is 4.63 centistokes at 210° F. and 8.7 poises at 0° F.

TABLE II.—COMPARISON OF BLEND CHARACTERISTICS

Composition wt. percent:										
SEN 100	68.0	63.0	42.3	47.3	39.5	68.0	63.0	52.3	47.3	39.5
SEN 300	18.7	17.0	14.4	12.7	10.8	18.7	17.0	14.4	12.7	10.8
HVI 80	13.3	20.0	33.3	40.0	49.7					
SEN 75 Neutral						13.3	20.0	33.3	40.0	49.7
Ratio SEN 100:SEN 300	3.63	3.71	3.63	3.72	3.66					
Viscosity, 210° F., SSU	40.93	40.84	40.87	40.22	39.9	40.68	40.35	39.84	39.51	39.05
Viscosity, 210° F., cs	4.47	4.44	4.45	4.25	4.15	4.39	4.29	4.13	4.03	3.88
Viscosity, ° F., poises	7.7	7.2	6.5	6.2	5.7	7.1	6.8	5.8	>5.5	>5.5

The effect of the third component, which might be regarded as a diluent, is set forth in the figure. It will be noted that the plot of the viscosities at 210° F. and 0° F. of the base blend with SEN 75 oil as diluent is predictably straight, indicating a normally expectable gradient. In contrast, it will be noted that the blend with HVI 80 as diluent exhibits a peculiar flattening out in a particular range of the viscosity curve at 210° F. The significance of this anomalous behavior is that a substantial amount of HVI 80 may be added as a diluent without lowering the 210° F. viscosity significantly, at the same time lowering the 0° F. viscosity markedly. Thus, mixtures of the blend containing from 18.6 percent to 40 percent HVI 80

oil meet the 210° F. viscosity, while mixtures containing more than 23 percent meet the 0° F. specification. In other words, mixtures of the three-component blend containing from 23 percent to 40 percent HVI 80 stock are able to meet both the 210° F. viscosity and the 0° F. viscosity. In contrast, the only mixtures containing SEN 75 oil which meet both the 210° F. and 0° F. viscosities are those containing from 17 percent to 18.4 percent SEN 75—an extremely narrow range. Moreover, the volatility of the blend containing only SEN stocks was unacceptably high. Other oils were tried as likely substituents for the third component, particularly those derived from highly naphthenic Coastal crudes which are characterized by very low pour points. In each case, the same problem arose, namely that both 0° F. and 210° F. viscosity specifications could not be met simultaneously, regardless of the quantity of diluent used.

The crux of the instant invention is linked to the discovery that HVI 80 stock unexpectedly exhibits a peculiar flattening of the viscosity curve for the blend at 210° F., presumably as a result of its unusual processing history, and because of this peculiarity it permits a relatively wide choice of the quantity of diluent to be used to make a five-grade SAE 10W50 finished oil after the incorporation of known additives.

The difference in the effect of the addition of the catalytically cracked oil stock to make this blend is reflected in another manner, namely in the behavior of the ratio of the change of 0° F. viscosity to the change in 210° F. viscosity as concentration of the oil stock in the blend increases or decreases. Ideally, one would hope that the change in viscosity at 210° F. is 0, and that the change of 0° F. viscosity due to addition of the lighter stock would be very large so that the ratio would be a number approaching infinity. It will be immediately apparent that, if the changes in viscosities at both temperatures are approximately the same, the ratio will be close to 1.

Because of the unique viscosity properties exhibited by HVI 80, the 0° F. viscosity of the finished blend can be reduced to a minimum with a far lower concentration of light stock than would otherwise have been possible, which in turn permits the preservation of important characteristics for the oil such as low consumption and low break-down due to shear.

The following recipe is illustrative of a typical 30,000 gallon batch of finished multi-grade SAE 10W50 oil.

In a tank fitted with a continuous stirrer, mix 4,050 gallons SEN 100 and 3,150 gallons SEN 300 oils with continuous agitation at 140° F. In a separate tank mix, at 140° F. with continuous stirring, 3,750 gallons SEN 100 oil with an equal portion of Lubrizol 3125 additive, an acrylate copolymer additive which acts as a viscosity index improver and four point depressant. In another tank, mix 3,900 gallons SEN 100 oil with an equal portion of Amoco 5800, a multi-functional detergent-dispersant additive comprising an ashless succinimide containing zinc dithiophosphate. In still another tank, mix at 140° F. with continuous stirring the preceding two additives blended with SEN 100 oil. Add to the mix 7,500 gallons HVI 80. Finally, add the mixture of HVI 80 along with the additives and the SEN 100 oil to the SEN 100 and SEN 300 mixture prepared initially, and mix at 140° F. with continuous stirring. The final mixture is a five-grade SAE 10W50 oil with specifications set forth hereinabove.

We claim:

1. A five-grade SAE 10W50 motor oil with excellent thermal and wear stability having a pour point of less than —20° F., a measured viscosity at 0° F. not to exceed 15 poises, a viscosity at 210° F. within the range from

85 SSU to 110 SSU and a flash point of about 375° F. comprising a base blend of three petroleum derived oil stocks, two of said oil stocks being solvent extracted neutral oils having viscosities at 100° F. of about 100 SSU and 300 SSU present in a ratio of from about 3.63 to about 3.77 parts 100 SSU stock to 300 SSU stock, and a dewaxed oil product obtained from an essentially aromatics-free catalytically cracked oil stock having about a 0° F. pour point, a flash point of 380° F. to 400° F., a gravity (API) within the range from about 33 to about 35, boiling within the range 600° F. to 800° F., and a viscosity at 100° F. in the range from 77 SSU to 87 SSU and a viscosity index in the range from 103 to 106, present in said motor oil in the range from about 23 percent to 40 percent by volume.

2. A five-grade SAE 10W50 motor oil with excellent thermal and wear stability having a pour point of less than —20° F., a measured viscosity at 0° F. not to exceed 15 poises, a viscosity at 210° F. within the range from 85 SSU to 110 SSU and a flash point of about 375° F. consisting essentially of a multi-functional detergent-dispersant additive, a viscosity index improver, and a base blend of three petroleum derived oil stocks, two of said oil stocks being solvent extracted neutral oils having viscosities at 100° F. of about 100 SSU and 300 SSU present in a ratio of from about 3.63 to about 3.77 parts 100 SSU stock to 300 SSU stock, and a dewaxed oil product obtained from an essentially aromatics-free catalytically cracked oil stock having about a 0° F. pour point, a flash point of 380° F. to 400° F., a gravity (API) within the range from about 33 to 35, boiling within the range 500° F. to 800° F., and a viscosity at 100° F. in the range from 75 SSU to 90 SSU and a viscosity index in the range from 103 to 106, present in said motor oil in the range from about 23 percent to 40 percent by volume.

3. A blended base oil mixture useful as the main constituent for a motor oil lubricant in internal combustion engines, said blended mixture being peculiarly adapted for use with an additive package which permits the finished oil to have measured properties consistent with the specifications set forth for a five-grade SAE 10W50 oil, said blended base oil consisting essentially of a mixture of solvent extracted neutral oils of about 100 SSU and 300 SSU viscosity at 100° F., in a ratio of SEN 100 to SEN 300 from about 3.63 to about 3.72, and a dewaxed oil product obtained from an essentially aromatics-free catalytically cracked oil stock, said catalytically cracked oil stock being present in the range from about 30 parts to 35 parts to 100 parts by weight blended base oil mixture.

4. The blended base oil mixture of claim 3 wherein the ratio of SEN 100:SEN 300:HVI 80 oils is about

52.3:14.4:33.3

5. The composition of claim 2 wherein said multi-functional detergent additive is an ashless succinimide containing zinc dithiophosphate and said viscosity index improver is an acrylate copolymer.

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HERBERT LEVINE, Primary Examiner

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