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2,863,742

GASOLINE FUEL COMPOSITIONS

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No Drawing. Application October 4, 1954
Serial No. 460,238

5 Claims. (Cl. 44—58)

This invention relates to novel gasoline fuel compositions that are adapted to improve the operation of internal combustion engines under cool, humid atmospheric conditions. More particularly, the invention relates to gasoline fuel compositions that contain a small amount, sufficient to reduce the tendencies of the composition to cause engine stalling in an internal combustion engine, of a combination of a light lubricating oil and an amine salt of an organic phosphate, for example, an amine salt of a diester of an orthophosphoric acid.

When an internal combustion engine is operated under cool, humid atmospheric conditions, using a gasoline fuel having a relatively low 50 percent ASTM distillation point, engine stalling is apt to be encountered at idling speeds during the warm-up period, especially where engine idling occurs following a period of light load operation. Engine stalling under such conditions has been attributed to the partial or complete blocking of the narrow air passage that exists between the carburetor throat and the carburetor throttle valve during engine idling, by ice particles and/or solid hydrocarbon hydrates that deposit upon and adhere to the metal surfaces of the carburetor parts. Such icing of carburetor parts occurs as a result of the condensation of moisture from the air drawn into the carburetor and as a result of the solidification of such condensed moisture. The aforesaid condensation and solidification of moisture are caused by the refrigerating effect of rapidly evaporating gasoline. Accordingly, excessive engine stalling due to carburetor icing occurs as a practical matter only in the instance of gasolines containing a large proportion of relatively highly volatile components.

Excessive engine stalling is, of course, a source of annoyance owing to the resulting increased fuel consumption, battery wear and inconvenience of frequent restarting. It is therefore important that the inherent engine stalling characteristics of gasoline fuels be reduced substantially, where the 50 percent ASTM distillation point of such gasoline fuels is sufficiently low to cause a problem in this respect.

We have found that the stalling characteristics of gasoline fuel compositions that normally tend to promote engine stalling due to carburetor icing, i. e., one having a 50 percent ASTM distillation point of not more than 220° F., are markedly improved by the incorporation therein of a small amount of a mixture of a salt of a C₆-18 primary, aliphatic monoamine and a diester of o-phosphoric acid, where the ester substituents are C₃-10 alkyl groups, and about 0.25 to about 0.75 percent by volume of the composition of a light lubricating distillate oil having a viscosity at 100° F. of from about 50 to about 500 Saybolt Universal seconds. The present invention therefore includes gasoline compositions that have been improved in the above-described fashion, and also the method of operating internal combustion engines under cool, humid atmospheric conditions, using such improved gasoline compositions as the fuel.

Salts of the foregoing type are conveniently prepared

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by the neutralization of a diester of the particular phosphoric acid with approximately stoichiometric proportions of an amine of the class described herein. In most instances, it is advantageous that the pH of the reaction mixture be adjusted to substantially neutral, i. e., between about 5.5 and about 7.5, by controlling the amount of amine introduced into the reaction. In the case of amines that are very weak bases, however, a lower pH, for example of the order of 3.0 or 3.5 is satisfactory. The neutralization reaction normally takes place spontaneously, or substantially so, with the evolution of heat. It is preferable to maintain the reaction temperature below about 180° F., cooling the reaction mixture if necessary. In no case should the temperature of the reaction mixture be allowed to rise above about 200° F., if appreciable decomposition of the resulting salt is to be avoided. The preparation of typical salts, the use of which is included by this invention, is set forth in detail in U. S. Patent No. 2,387,537 to Smith and Cantrell.

Suitable salts for the purposes of this invention are formed by primary amines whose organic substituents can be aliphatic radicals, including saturated, unsaturated, cyclic, branched chain and straight chain radicals.

Thus, for example, the invention includes the use of oil-soluble organic phosphate salts of primary, straight or branched chain alkyl, alkenyl, and alkadienyl amines, and primary, cycloalkyl amines. Representative examples of such amines are octyl, dodecyl, octadecyl, octadecadienyl, cyclohexyl, cycloheptyl, and abietyl (rosin) amines, and the like. Commercial mixtures of amines, such as cocoamine, form highly satisfactory phosphate salts of the kind included by the invention. Cocoamine is a mixture of amines prepared from coconut oil fatty acids, and contains a predominant amount of n-dodecyl amine (lauryl amine), together with minor amounts of n-octyl, n-decyl; n-tetradecyl, n-hexadecyl, n-octadecyl, and n-octadecenyl amines. Another suitable commercial amine mixture is "tallow" amine, a mixture of C₁₄-18 n-alkyl and alkenyl amines derived from animal tallow fatty acids. Although salts of amines containing hydrocarbon substituents are preferred, salts of amines whose substituents contain elements such as oxygen, halogens, sulfur, nitrogen or phosphorus which do not adversely affect the oil-solubility or polarity of the salt or the combustion characteristics of the ultimate gasoline compositions can be used. An example of such substituted amines is ricinoleyl amine.

Amines which form a preferred class of organic phosphate salts included by the invention are cyclohexyl, n-hexyl, n-octyl, n-dodecyl, n-octadecyl, and n-octadecenyl amines.

Organic phosphates that form suitable amine salts for the purposes of this invention are diesters of phosphoric acids whose two ester substituents are hydrocarbon radicals containing 3 to 10 carbon atoms. Examples of such organic diesters of phosphoric acids are the dipropyl diisoamyl, didecyl didodecyl, isoamyl iso-octyl esters of o-phosphoric acid. Although salts of organic phosphates whose organic substituents are hydrocarbon radicals are preferred, salts of other organic phosphates whose organic substituents contain elements such as oxygen, chlorine, bromine, iodine, fluorine, nitrogen, sulfur and phosphorus which do not adversely affect the oil-solubility or polarity of the ultimate amine salt, or the combustion characteristics of the gasoline composition, can be used.

Within the preferred class of amine salts, the salts of organic phosphates whose two organic substituents are open-chain, saturated aliphatic hydrocarbon radicals, for example, amine salts of diisoamyl, di-n-octyl, di-n-decyl,

and 3-methylbutyl,2-ethylhexyl o-phosphates, are considered especially effective.

Specific examples of preferred salts included by the scope of this invention are the oil-soluble amine salts of n-octyl, n-dodecyl (lauryl), n-octadecyl (stearyl), n-octadecenyl (oleyl), n-octadecadienyl (linoleyl), and cyclohexyl amines, and di-n-propyl, di-n-butyl, di-n-amyl, diisooamyl, isoamyl isooctyl (3-methylbutyl,2-ethylhexyl), di-n-octyl, diisooctyl, di-n-decyl o-phosphates.

Other examples of suitable salts are the oil-soluble salts of n-hexyl, amine, and the diisooamyl and diisooctyl esters of o-phosphoric acid.

The amine salts of this invention are utilized in gasoline fuels, i. e., hydrocarbon mixtures boiling in the gasoline range, in concentrations that are sufficient, together with the quantity of lubricating oil employed in the composition, to reduce the engine stalling tendencies of the gasoline fuels, i. e., concentrations in excess of about 0.001 percent. The normally useful concentration range for the purposes of this invention is from about 0.001 to about 0.03 percent. Although greater concentrations can be employed to advantage in some instances, no additional benefits with respect to anti-stalling are achieved by the use of such greater concentrations. For most currently marketed commercial gasolines, from about 0.001 to about 0.01 weight percent, for example, 0.004, 0.005, 0.006 weight percent, of the salt, together with the lubricating oil component of the additive combination, is usually sufficient to achieve a satisfactory reduction in the engine stalling tendencies of the fuel.

The lubricating oil component of the anti-stalling combination is used in the gasoline compositions of this invention in amounts of from about 0.25 to about 0.75 percent by volume of the composition, e. g., 0.5 volume percent. This oil should be a light lubricating oil distillate, e. g., one having a viscosity at 100° F. of from about 50 to about 500 Saybolt Universal seconds, e. g., about 100 S. U. S. Although highly paraffinic lubricating distillates can be used, lubricating distillates obtained from Coastal or naphthenic type crude oils are preferred because of their superior solvent properties. The lubricating oils utilized in the compositions can be solvent-treated, acid-treated, or otherwise refined.

Preferably, the lubricating oil and amine salt of the herein disclosed combination are employed in the gasoline compositions of this invention in weight ratios of from about 20:1 to about 650:1. However, these proportions may be departed from substantially, without substantial reduction in anti-stalling properties, so long as the minimum effective concentrations of both components are equaled or exceeded. The total concentration of the anti-stalling combination in the gasoline compositions of this invention is usually between about 0.25 weight percent, and about 0.8 weight percent, of the composition. Insofar as anti-stalling benefits are concerned, the total concentration need not ordinarily exceed the upper limit mentioned.

With respect to the particular concentration ranges mentioned above, it will be appreciated that the optimum concentration of the anti-stalling combination can vary according to the specific amine salt used and according to the severity of the atmospheric conditions. With regard to the last mentioned factor, the problem of engine stalling due to carburetor icing resulting from the refrigeration of moisture condensed from the atmosphere by evaporating gasoline has been observed to be significant at atmospheric temperatures of between about 30° and 60° F., e. g., 35°, 40°, 45°, 50° F., and when the relative humidity is in excess of about 65 percent, e. g., 75, 85, 95, 99 percent. The optimum concentration of anti-stalling additive should be sufficient to effect a substantial reduction in the stalling tendencies of the fuel at the atmospheric conditions of temperature and humidity which are likely to be encountered in service.

The optimum concentration of the anti-stalling addi-

tive combination can also vary according to the particular gasoline involved, since the problem of engine stalling is a function of the 50 percent ASTM distillation point of the gasoline fuel. Greater concentrations of the additive combination are normally desirable with decreasing 50 percent distillation points.

Practically speaking, the problem of engine stalling due to carburetor icing during rapid evaporation of gasoline occurs only in connection with gasolines having a relatively low 50 percent ASTM distillation point of not greater than about 235° F. While occasional engine stalling may occur as a result of carburetor icing at severe atmospheric conditions of temperature and humidity with gasolines having somewhat higher 50 percent ASTM distillation points, experience has indicated that the problem does not assume significant magnitude except with gasolines of the character indicated. The problem of engine stalling due to carburetor icing is especially severe in connection with gasoline having a 50 percent ASTM distillation point of less than about 220° F. The invention is particularly useful in connection with such gasolines. The term "gasoline" is used herein in its conventional sense to include hydrocarbon mixtures having a 90 percent ASTM distillation point of not more than about 392° F. and a 10 percent ASTM distillation point of not more than about 140.

The anti-stalling additives included in the combination of this invention can be incorporated into gasoline compositions in any convenient manner. Thus, the respective components can be separately added to the gasoline compositions. If desired, the amine salts can be added in the form of concentrated solutions or dispersions in solvents such as mineral oil, gasoline, naphtha, Stoddard solvent, mineral spirits, benzene, heptane, kerosene or the like. If desired, the respective components of the anti-stalling combination can be incorporated in gasoline fuel compositions in admixture with each other, and/or in admixture with other gasoline improvement agents, such as antioxidants, anti-knock agents, ignition control additives, dehazing agents, anti-rust additives, dyes and the like.

The lubricating oils and amine salts included by this invention coact in gasoline fuel compositions of the kind described herein to reduce the engine stalling tendencies of the latter under cool, humid atmospheric conditions. Thus, the lubricating oil component functions in part to form a residual, protective coating on metal carburetor surfaces contacted by the gasoline fuel, thereby tending to prevent adherence of ice crystals to the critical carburetor parts.

The amine salts included by the invention are highly polar materials that possess exceptional metal-wetting and water displacing properties. Accordingly, these salts tend to orient themselves over the metal carburetor surfaces, and in this way tend to form a residual coating on said metal carburetor surfaces. Because of their polarity and surface active properties, these amine salts tend to plate, or coat surfaces, especially by displacement of moisture, which would not be wet by the oil alone. By virtue of their affinity for oil, these salts also increase the metal-wetting and spreading properties of the oil itself. By virtue of their strong polarity, the amine salts of this invention further are considered to function by orienting themselves about individual water particles, or ice crystals, thereby preventing formation of macro-crystals of ice which are capable of blocking the carburetor air passage and causing engine stalling.

Unlike their isopropyl alcohol counterpart in a widely publicized, commercial anti-stalling additive combination, the amine salts of this invention do not achieve an anti-stalling effect by functioning as freezing-point depressants. As a matter of fact, many of the amine salts of this invention are essentially water-immiscible. Because of their poor water-miscibility, the amine salts of this

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invention are less susceptible to water leaching than is isopropyl alcohol.

The oil and amine salt combinations of this invention further coact to provide improved valve stem and upper cylinder lubrication, as well as improved lubrication of fuel pump and carburetor parts. While lubricating oil alone functions in some degree to provide lubrication of the regions indicated, the use of the herein disclosed oil-soluble amine salts greatly improves the lubricating properties of the oil.

Although the amine salts of this invention are utilized as anti-stalling agents, they are additionally useful in that they impart valuable anti-rust properties to gasoline compositions when used in anti-stalling concentrations.

The gasoline compositions of this invention and their preparation are illustrated in detail by the following specific examples.

EXAMPLE I

A gasoline composition having excellent anti-stalling characteristics was prepared by incorporation in a suitable, oil-containing gasoline fuel composition, at ambient atmospheric temperature, of an 84 percent solution of the substantially neutral cocoamine (lauryl amine) salt of 3-methylbutyl,2-ethylhexyl o-phosphoric acid in a light mineral lubricating oil, in the ratio of about 12 pounds per 1000 barrels of gasoline (approximately 0.0044 weight percent, active component). A typical sample of the non-oil-containing base gasoline used had the following inspections:

Gravity, °API	68.0
Sp. gr. 60°/60° F	0.709
TEL: ML./gal	0.49
Heat of combustion B. t. u./lb. (net)	19,020
Vapor pressure, Reid, lb	6.8
Distillation, gasoline:	
Over point, °F	122
End, °F	290
10% evap. at, °F	145
40	172
50	180
90	220

The oil, a light Coastal type (Texas) lubricating distillate oil, was previously added to the base gasoline in the amount of 0.5 percent by volume (approximately 0.642 percent by weight) in order to form the oil-containing gasoline fuel composition. A typical sample of the lubricating distillate oil used in the composition had the following properties:

Gravity, °API	24.5
Lbs./gal., 60° F	7.55
Viscosity, SUV, sec.:	
70° F	235
100° F	106.0
130° F	63.9
210° F	38.3
Viscosity index	16
Flash, P-M, °F	315
Flash, OC, °F	320
Fire, OC, °F	355
Pour, °F	-60
Color, ASTM union	2.0
Carbon residue, Conradson: percent	0.02
Copper strip test, 212° F. 3 hr	0
Neutralization value ASTM D-974-51 T, total acid No	0.05

EXAMPLE II

Another suitable composition was prepared in the manner of the foregoing example by admixture of the cocoamine salt of 3-methylbutyl,2-ethylhexyl o-phos-

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phoric acid with a gasoline base fuel which had been inhibited against oxidation, and a typical sample of which had a 50 percent ASTM distillation point of about 210° F., a motor method octane number of 83, and a research octane number of 95, and a tetraethyl lead content of 3 ml. per gallon. The base gasoline also contained 0.5 percent by volume of the same light Coastal lubricating distillate oil of Example I. The cocoamine dialkyl o-phosphate (84 weight percent oil concentrate) in this composition is added to the base gasoline in the ratio of approximately 16 pounds per 1000 barrels (approximately 0.0055 percent, by weight active component).

EXAMPLE III

Another satisfactory composition in accordance with this invention is prepared in the manner set forth in the foregoing examples by admixture of 0.01 percent by weight of the composition of the substantially neutral cyclohexyl amine salt of 2-ethylhexyl,3-methylbutyl o-phosphoric acid with a gasoline fuel that has an ASTM 50 percent distillation point of 220° F. and a tetraethyl lead content of 3 cc. per gallon, and that contains 0.5 volume percent of a 100 S. U. S./100° F. (approximate) Coastal lubricating distillate.

EXAMPLE IV

Another satisfactory gasoline composition is prepared by admixture at ambient atmospheric temperature of approximately 0.01 percent by weight of the composition of the substantially neutral cocoamine salt of di-n-propyl o-phosphoric acid, with a base gasoline fuel composition having a lead content of 3 cc. tetraethyl lead per gallon and a 50 percent ASTM distillation point of 200° F., and containing 0.5 volume percent of a 100 S. U. S./100° F. (approximate) lubricating distillate oil obtained from a Coastal type crude.

EXAMPLE V

Another satisfactory gasoline composition is prepared substantially identically as indicated in Example IV, except that the substantially neutral cocoamine salt of di-n-decyl o-phosphoric acid is used as the anti-stalling agent.

The compositions described in the foregoing examples are illustrative only, and other oil-soluble amine organic phosphate salts disclosed herein can be substituted in the foregoing specific compositions in the same or equivalent concentrations with good results. For example, there can be used, in lieu of the salts of the foregoing examples, the amine salts of n-octyl, di-n-octyl, n-octadecyl, and n-octadecenyl amines, and the diisoamyl and diisooctyl esters.

An appreciable reduction in engine stalling due to carburetor icing is achieved by the use of the foregoing gasoline fuel compositions in internal combustion engines of the gasoline-powered, spark ignition type. For example, the composition described in Example I was burned in an internal combustion engine operated at cool, humid atmospheric conditions, and the number of engine stalls due to carburetor icing was markedly less for this composition than for the base gasoline alone.

EXAMPLE VI

According to the procedure followed, the fuel compositions to be tested were fed to a standard 216 cubic inch, six cylinder, overhead valve, Chevrolet engine, drawing air through a bed of approximately 2 inch chunks of cracked ice packed in a standard ASTM-CFR ice tower. The engine was equipped with a standard Carter Model W-1 Carburetor having a standard Power Glide type throttle damper. The carburetor and fuel system were insulated from the engine by means of a ¼ inch thick asbestos cement board shield, 10 inches in width, which extended the length of the manifold.

The conditions at which the engine was operated are set forth below:

Cooling water temperature, ° F.:	
In -----	75-80
Out -----	90-95
Crankcase oil temperature, ° F.-----	140-150
Carburetor air intake temperature, ° F.-----	39-41
Relative humidity, percent.-----	82-85

The operating cycle of the engine included, after temperature became stabilized, operation for five minutes at 1500 R. P. M. at 5 brake horsepower (B. H. P.) load. During this period the carburetor throttle plate becomes chilled and ice formations are allowed to build up. After this five-minute run, the throttle was closed to the preset position to allow 450 R. P. M. idle speed. If the engine idled satisfactorily for 30 seconds the fuel was considered non-stalling during that operating cycle.

The composition of Example I was also compared under the conditions of the foregoing test with the same base gasoline containing isopropyl alcohol as an anti-stalling agent, and with another composition consisting of the base gasoline plus 0.5 volume percent of a 100 S. U. S./100° F. (approximately) Coastal lubricating distillate oil and isopropyl alcohol. In order to facilitate comparison of the foregoing compositions, the minimum additive concentrations required to achieve an arbitrary, uniform performance standard with the above-described engine operating conditions were determined and compared. This arbitrary performance standard was regarded as being achieved when the fuel composition permitted five consecutive operating cycles as defined above without more than one engine stall.

In order to compare the stability of the fuel compositions to water leaching, various of the above compositions were also tested according to the foregoing engine operating procedure, after being washed with five volume percent of water.

The results of the tests of the foregoing compositions are set forth below. Also, to illustrate the nature of the problem involved in the present invention and to furnish a standard for comparison, the stalling tendencies of the base gasoline, which contained no anti-stalling agent, are indicated below.

Composition	Base Fuel		Engine Test, Stalls per Five Operating Cycles	
			Before Water Wash	After 5% Water Wash
1-----	Base Gasoline, 180° F. 50% ASTM Distillation Point (Example I Base Fuel).		5	
2-----	Base Gasoline plus 0.5 Volume Percent 100 S. U. S./100° F. Coastal Lubricating Distillate Oil.		3	
	Base Fuel	Additive	Anti-Icing Additive, Minimum Percent by Volume to Achieve Not More Than 1 Stall per 5 Operating Cycles	
3-----	Base Gasoline	Isopropyl Alcohol	1.25	1.75
4-----	Base Gasoline plus 0.5 Vol. Percent 100 S. U. S./100° F. Coastal Lubricating Oil.	Isopropyl Alcohol	0.25	
5 ¹ -----	Base Gasoline plus 0.5 Vol. Percent 100 S. U. S./100° F. Coastal Lubricating Distillate Oil.	Cocoamine Salt of 3-methylbutyl, 2-ethylhexyl o-phosphoric Acid.	0.004	0.010

¹ Example I composition.

The data in the foregoing table clearly indicates the undesirable stalling characteristics of the base gasoline, per se, and the same gasoline containing only oil (compositions 1 and 2 in the foregoing table). Comparison of the stalling characteristics of the uninhibited base gasoline with those for an uninhibited base gasoline having a 50 percent distillation point of 240° F. clearly illustrates the unique nature of the problem dealt with by this invention, since the latter will produce not more than one stall in five operating cycles of the kind described. Comparison of the stalling characteristics of the base fuel (composition 1) with the stalling characteristics of composition 5 indicates that a major reduction in the stalling tendencies of the base gasoline is obtained by the incorporation in the gasoline composition of small amounts of the herein disclosed combination of amine salts and light lubricating oil. Comparison of the minimum concentrations of anti-icing additive required to pass the arbitrary performance standard for compositions 3, 4 and 5 clearly indicates the superiority of the herein disclosed agents as compared with standard commercial anti-icing agents comprising isopropyl alcohol as an essential ingredient.

The data set forth in the foregoing Example VI clearly indicate the utility of the gasoline compositions of this invention. It is understood that the data thus set forth are illustrative only, and that other gasoline compositions herein disclosed can be substituted, with beneficial results for the specific embodiment described in the example above. For example, the compositions of foregoing Examples II to V, inclusive, can be used as fuels in internal combustion engines with beneficial results. In addition, other gasoline compositions included by the invention may be substituted for the foregoing specifically described compositions. For example, there can be used advantageously gasoline compositions having 50 percent ASTM distillation points of, for example 175° F., 190° F. and 200° F., containing a small amount of a light lubricating distillate oil, for example, 0.25, 0.5, 0.75 volume percent of, for example a 100 S. U. S./100° F. Coastal lubricating distillate, or a 200 S. U. S./100° F. Coastal lubricating distillate, and small amounts, for example, 0.002, 0.004, 0.006 and 0.01 weight percent of the oil-soluble amine salts of n-octyl, di-n-octyl, n-octadecyl and n-octadecenyl amines, and the diisooamyl, and diisooctyl esters of o-phosphoric acid.

In order to demonstrate the improved lubricating properties of the gasoline compositions of this invention a solution consisting of the lubricating distillate described in Example I and 1 percent by volume of the 84 percent concentrate of the cocoamine salt of 3-methylbutyl, 2-ethylhexyl o-phosphoric acid anti-stalling adjuvant described in Example I was made up and tested for lubricating properties. The above-described solution corresponds approximately to the residue remaining after evaporation of the volatile gasoline components of the gasoline composition described in Example I. The foregoing oil solution was compared with a similarly tested sample of the same oil which contained no amine salt. The test procedure utilized was a standard accelerated precision test commonly known as the "4-ball test."

Briefly, this test involves rotation at a preselected speed of a single steel ball in contact with three additional steel balls held immobile beneath the first ball in a clamp or cradle. The three immobile steel balls and the rotating single steel ball are forced into contact with each other under a preselected, vertically applied compression load. Sufficient test lubricant is poured into the test cup to cover the three lower balls to a fixed depth. The test is carried out by continuing the rotation of the single steel ball in contact with the three immobile steel balls for whatever period of time is satisfactory, usually one or two hours. During the test, the oil in the test cup is maintained at a predetermined temperature, the operable temperature range for the test apparatus normally

being considered from about 86° to about 465° F. At the conclusion of the test, wear is measured by examination of the cleaned surfaces of the three stationary test balls under a microscope, the two maximum right angle diameters of each wear scar being measured to the closest 0.01 mm., recorded, and averaged.

Load and torque arm force readings made during the wear test described above can be used to calculate the average coefficient of friction between the relatively moving surfaces.

For the purposes of this test, runs were made at two different compression loads and at two different temperatures, using both the amine salt-containing oil sample and the blank oil sample. The results of these test runs are set forth in the tables below, Table A containing the results obtained with the lighter loading and Table B containing the results with the heavier loading:

Table A

Description	Lubricating Oil, 100 SUS/100° F.		99% 100 SUS F./100° Lubricating Oil plus 1% Cocoamine salt of 3-Methylbutyl,2-ethylhexyl o-Phosphoric Acid (84% Solution)	
Inspection: Wear Test, 4-Ball:				
Spindle Speed, R. P. M.	1,800		1,800	
Lever Load, Kg.	5		5	
Duration of Test, Hrs.	1		1	
Temperature of Test—				
°C.	30	180	30	180
°F.	86	356	86	356
Oil Temperature Rise, °C.	8	0	8	0
Average Coefficient of Friction	0.0983	0.1080	0.1015	0.0873
Average Scar Diameter, Mm.	0.475	0.695	0.318	0.212
Mean Specific Pressure, p. s. i. × 10 ³	16.7	7.67	36.6	82.3

Table B

Description	Lubricating Oil, 100 SUS/100° F.		99% 100 SUS/100° F. Lubricating Oil plus 1% Cocoamine salt of 3-Methylbutyl,2-ethylhexyl o-Phosphoric Acid (84% Solution)	
Inspection: Wear Test, 4-Ball:				
Spindle Speed, R. P. M.	1,800		1,800	
Lever Load, Kg.	7.5		7.5	
Duration of Test, Hr.	1		1	
Temperature of Test—				
°C.	30	180	30	180
°F.	86	356	86	356
Oil Temperature Rise, °C.	9	0	9	0
Average Coefficient of Friction	0.1005	0.0976	0.1049	0.0551
Average Scar Diameter, Mm.	0.547	0.648	0.392	0.273
Mean Specific Pressure, p. s. i. × 10 ³	18.6	13.3	36.2	74.6

Comparison of the results obtained with the blank oil and the results obtained with the amine salt-containing oil sample in the foregoing tables clearly shows the increased load carrying capacity and wear reduction characteristics imparted to the oil by the amine salts included in the scope of this invention. Comparison of the average scar diameters in the 86° and 356° F. test runs for the oil that contained no additive establishes that wear due to friction increases with temperature. However, comparison of the results of the corresponding test runs for the oil that contained the amine salt establishes that greater protection is provided against wear at high tem-

peratures than at low temperatures, and that wear in either instance is less than that obtained with the ordinary lubricating oil. The above-indicated improvement in lubricating properties is important in that improved valve stem and upper cylinder lubrication are obtained by the use of gasoline compositions containing the anti-stalling combinations described herein. Of course, it is understood that the foregoing specific embodiment is illustrative only and that other amine salt adjuvants specifically described herein can be substituted for that in the composition described in connection with the tests above with beneficial results.

To the gasoline fuel compositions of the present invention there can be added one or more additional additive agents designed to improve one or more characteristics of the gasoline fuel. For example, antioxidants, antiknock agents, ignition control additives, other deicing agents, anti-rust agents, dyes, lead scavenging agents and the like can be added to the gasoline compositions of this invention, and the invention specifically includes gasoline compositions containing such additives.

Numerous additional embodiments of the invention will readily suggest themselves to those skilled in the art. Accordingly, we do not intend to be limited by the foregoing description, but rather only by the terms of the claims appended hereto.

We claim:

1. A gasoline fuel composition comprising a major amount of a hydrocarbon mixture boiling in the gasoline range, having a 50 percent ASTM distillation point of not greater than about 220° F., and tending to promote stalling of internal combustion engines, said hydrocarbon mixture having incorporated therein a small amount, sufficient to reduce the engine stalling tendencies of the composition, of a combination of about 0.001 to 0.03 percent by weight of a salt of a primary, aliphatic monoamine that contains 6 to 18 carbon atoms, and a dialkyl ester of o-phosphoric acid whose alkyl substituents each contain 3 to 10 carbon atoms, and about 0.25 to about 0.75 percent by volume of the composition of a light lubricating distillate oil having a viscosity at 100° F. of from about 50 to about 500 Saybolt Universal seconds.

2. The composition of claim 1, wherein said salt is the n-dodecyl amine salt of 3-methylbutyl,2-ethylhexyl o-phosphoric acid.

3. The composition of claim 1, wherein said salt is the cocoamine salt of 3-methylbutyl,2-ethylhexyl o-phosphoric acid.

4. A gasoline fuel composition comprising a major amount of a hydrocarbon mixture boiling in the gasoline range, having a 50 percent ASTM distillation point of not greater than about 220° F., and tending to promote stalling of internal combustion engines, said hydrocarbon mixture having incorporated therein (a) about 0.005 percent by weight of the composition of the cocoamine salt of 3-methylbutyl,2-ethylhexyl o-phosphoric acid, and (b) about 0.5 percent by volume of the composition of a Coastal lubricating distillate oil having a viscosity of about 100 Saybolt Universal seconds at 100° F.

5. A gasoline fuel composition comprising a major amount of a hydrocarbon mixture boiling in the gasoline range, having a 50 percent ASTM distillation point not greater than about 220° F. and normally tending to promote stalling of internal combustion engines, said hydrocarbon mixture having incorporated therein a small amount, sufficient to reduce the engine stalling tendencies of the composition, of a combination of about 0.001 to 0.01 percent by weight of the composition of a salt of a primary, aliphatic monoamine that contains 6 to 18 carbon atoms, and a dialkyl ester of o-phosphoric acid whose alkyl substituents each contain 3 to 10 carbon atoms, and about 0.5 percent by volume of the compo-

sition of a light lubricating distillate oil having a viscosity at 100° F. of about 50 to 500 Saybolt Universal seconds.

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