Feb. 7, 1950 **M. R. BRIMER** **2,496,930**

COMPOSITION USEFUL AS GUM INHIBITOR FOR MOTOR FUELS

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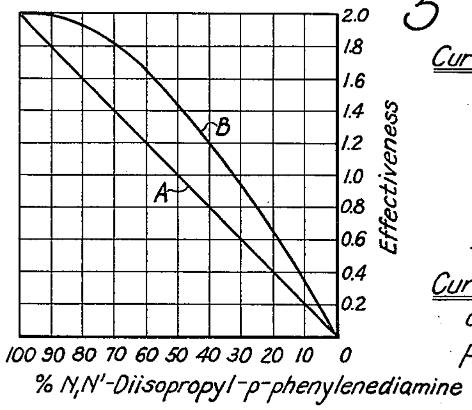
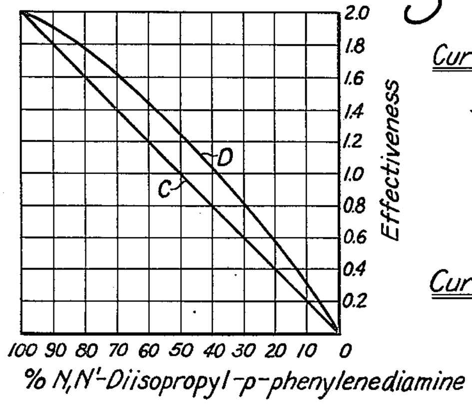
Fig. 1



Curve A = Gum inhibitor effectiveness of solutions of N,N'-diisopropyl-p-phenylenediamine in an inert solvent, e.g. isopropyl alcohol or toluene; effectiveness of 1.0 represents a 50% (by weight) solution of N,N'-diisopropyl-p-phenylenediamine in the inert solvent.

Curve B = Gum inhibitor effectiveness of mixture of N,N'-diisopropyl-p-phenylenediamine and aniline.

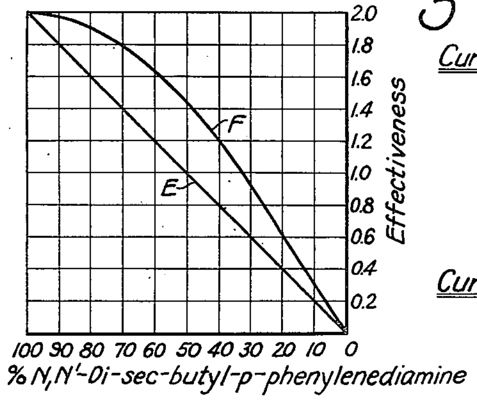
Fig. 2



Curve C = Gum inhibitor effectiveness of solutions of N,N'-diisopropyl-p-phenylenediamine in an inert solvent, e.g. isopropyl alcohol or toluene; effectiveness of 1.0 represents a 50% (by weight) solution of N,N'-diisopropyl-p-phenylenediamine in the inert solvent.

Curve D = Gum inhibitor effectiveness of mixtures of N,N'-diisopropyl-p-phenylenediamine and o-toluidine.

Fig. 3



Curve E = Gum inhibitor effectiveness of solutions of N,N'-di-sec-butyl-p-phenylenediamine in an inert solvent, e.g. isopropyl alcohol or toluene; effectiveness of 1.0 represents a 50% (by weight) solution of N,N'-di-sec-butyl-p-phenylenediamine in the inert solvent.

Curve F = Gum inhibitor effectiveness of mixtures of N,N'-di-sec-butyl-p-phenylenediamine and aniline.

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COMPOSITION USEFUL AS GUM INHIBITOR FOR MOTOR FUELS

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This invention relates to a composition useful as a gum inhibitor for motor fuels and to motor fuels stabilized against gum formation.

It is well known that many motor fuels which are produced to possess a high octane rating are susceptible to deterioration during storage, owing to a tendency to react with atmospheric oxygen. The result of the oxidation is formation of gum which may actually render inoperable the motor in which the fuel is used, and in any event the fuel loses in octane rating. Certain substances are known to act to prevent or inhibit oxidation of deteriorable motor fuels when added to the fuels in relatively low concentrations. The addition of the inhibitor to the motor fuel must be made as soon as possible in order to achieve the maximum inhibiting effect. Therefore, the addition of the inhibitor is customarily part of the manufacturing process and is carried out at the refinery.

The practical use of gum inhibitors places certain limitations upon the properties of such substances which may be considered for practical use. Of primary importance, of course, is the effectiveness of a given substance as an inhibitor of gum formation in the motor fuel.

However, substances possessing high effectiveness as inhibitors of gum formation in motor fuels must have certain additional properties in order to be of practical use. The inhibitor should be a liquid, in order to permit ready blending with the motor fuel.

A typical example of a highly efficacious gum inhibitor is N,N′-diisopropyl-p-phenylenediamine (hereinafter sometimes called DIPDA). DIPDA is a solid and must be dissolved in a suitable solvent before blending with the motor fuel, e. g. isopropyl alcohol or toluene. The gum inhibitor effectiveness of solutions of DIPDA in these commonly employed solvents is directly proportional to the concentration of the DIPDA

in solution, the solvent having substantially no gum inhibitor effectiveness.

I have now found that by mixing DIPDA with at least one primary aromatic monoamine of the benzene series which is devoid of —XH groups wherein X represents a divalent atom, a composition is obtained, which, when dissolved in a solvent having substantially no gum inhibitor effectiveness, e. g. isopropyl alcohol or toluene, gives an inhibitor solution which has an effectiveness substantially greater than a solution of only DIPDA in the same solvents containing the same concentration of DIPDA. This is surprising, since primary aromatic monoamines of the benzene series devoid of —XH groups have only a slight gum inhibitor effectiveness, in and of themselves, in the concentrations used in commercial practice. I have also found that primary aromatic monoamines of the benzene series have the same synergistic effect on other N,N-dialkyl-p-phenylenediamines, e. g. N,N′-di-secondary butyl-p-phenylenediamine.

It is, accordingly, an object of my invention to provide new compositions useful as gum inhibitors for motor fuels. A further object is to provide motor fuels stabilized against gum formation with such compositions. Other objects will become apparent hereinafter.

In preparing my new compositions, I mix together to give an intimate mixture or solution, at least one N,N′-dialkyl-p-phenylenediamine, e. g. N,N′-diisopropyl-p-phenylenediamine, N,N′-di-secondary butyl-p-phenylenediamine, etc., and at least one primary aromatic monoamine of the benzene series, e. g. aniline, a toluidine, a xylidine, etc. In my more useful compositions, the primary aromatic monoamine of the benzene series constitutes from about 0.5 to about 85% by weight of the mixture. Primary aromatic monoamines of the benzene series containing only carbon, hydrogen and nitrogen atoms are advantageously employed. The resulting mixture is advantageously dissolved in a solvent before blending with the motor fuels. Typical solvents include methyl, ethyl, n-propyl, isopropyl, n-butyl and isobutyl alcohols, n-propyl ethyl ether, n-propyl isopropyl ether, diisopropyl ether, di-n-propyl ether, benzene, toluene, xylenes, heptane, mixtures of petroleum hydrocarbons, e. g. straight-run gasoline, etc. These solvents are inert solvents, i. e. they have substantially no gum inhibitor effectiveness in and of themselves and substantially no synergistic effect on the gum inhibitor effectiveness of the N,N'-dialkyl-p-phenylenediamines.

The effects which I obtain in practicing my invention can be illustrated first with reference to a solution of DIPDA in isopropyl alcohol or toluene. The gum inhibitor effectiveness of such solutions of DIPDA in a standard reference gasoline is represented by curve A in Fig. 1 of the accompanying drawing. (As used herein, the effectiveness of an inhibitor is defined as the number of pounds of a standard comparison material required to produce the same induction period in an oxygen bomb test as is produced by one pound of the inhibitor being tested, the oxygen bomb test being that described by Egloff, Morell, Lowry and Dryer in Ind. Eng. Chem. 24, 1375–1378, 1932.) The scale used in Fig. 1 is such that the effectiveness of a 50% (by weight) solution of DIPDA in isopropyl alcohol or toluene is 1.0. On this scale the effectiveness of the isopropyl alcohol solution of N-butyl-p-aminophenol, which is commonly used as a commercial gum inhibitor for motor fuels, is approximately 1.0. Curve A of Fig. 1 shows that, for example, a 75% solution of DIPDA in isopropyl alcohol or toluene possesses an effectiveness of 1.5, and a 25% solution of DIPDA in the same solvents possesses an effectiveness of 0.5. In other words, the effectiveness of DIPDA solutions in solvents known to the art is equal to the effectiveness of pure DIPDA multiplied by the concentration of DIPDA in the solution, when the DIPDA concentration is expressed as a fraction of the weight of the solution in question.

Comparing the above DIPDA solutions with solutions of DIPDA in aniline, the DIPDA solutions in aniline possess effectiveness far in excess of that calculated by multiplying the effectiveness of pure DIPDA by the concentration of DIPDA in the aniline solution, yet the effectiveness of aniline alone as a gum inhibitor is less than 0.05.

Curve B in Fig. 1 of the accompanying drawing gives the effectiveness of solutions of DIPDA in aniline in the same standard reference gasoline, and it will be seen that curve B departs greatly in a positive direction from curve A. The shape of curve B can be explained if the presence of aniline enhances the effectiveness of DIPDA, or if DIPDA enhances the effectiveness of aniline. The unexpected nature of my discovery can be more clearly understood if the difference between curve B and curve A is ascribed to inhibitor effectiveness exerted by aniline in the aniline solutions of DIPDA. For example, at a given concentration of DIPDA, the difference between curve A and curve B represents the inhibitor effectiveness contributed by the aniline in the solution. When the effectiveness contributed by the aniline is divided by the weight fraction of the aniline in the solution, the quotient represents the apparent inhibitor effectiveness of the aniline in the solution. Representative values are as follows:

Weight Fraction		Apparent Effectiveness of Aniline
DIPDA	Aniline	
0.00	1.00	<0.05
.30	.70	0.44
.50	.50	0.84
.70	.30	1.43
.80	.20	1.70
.90	.10	1.80

Thus, when aniline is mixed with DIPDA, the effectiveness of the aniline appears to increase from less than 0.05 to more than 1.80, an increase of more than 3600 per cent.

As pointed out above, a practical inhibitor should be liquid, in order to facilitate blending with the motor fuels. Not only should the inhibitor be liquid, but the liquid should not be susceptible to freezing at temperatures normally encountered in refineries, and if the inhibitor is susceptible to freezing above 10° C., its freezing point may handicap its practicability.

I measure the freezing point of an inhibitor by cooling it to a temperature below its freezing point, inducing the formation of solid (by agitation or seeding), and then allowing the temperature of the liquid-solid mixture to rise slowly. I record the temperature at which the solid disappears as the freezing point.

In order to show the importance of this invention, I have prepared Table I (see below) which shows how the freezing points of practical inhibitors can be improved by taking advantage of the "apparent effectiveness" of aniline. Table I shows seven groups of five solutions each, the solutions being grouped according to inhibitor effectiveness. The first four columns of Table I show the composition of the solutions which were tested, the fifth column shows the effectiveness of the solutions, and the sixth column shows the freezing point of the solutions. Pure DIPDA is included for comparison. In each group, it will be observed that the inhibitors which do not contain aniline have freezing points which are much higher than the freezing point of the inhibitor solutions which do contain aniline. For example in the group which has an effectiveness of 1.6, the lowering of the freezing point, made possible by utilizing this discovery, is 16° to 20° C. Likewise, in the group having an effectiveness of 1.0, utilization of my discovery makes it possible to achieve a freezing point lowering of up to 18° C. Thus, by taking advantage of my discovery, great improvement, from the practical standpoint, in the freezing point of an inhibitor can be achieved without sacrifice of inhibitor potency, as would be necessary if the freezing point were improved by the use of other solvents. Likewise, Table I shows that if it be desired to maintain a certain maximum freezing point, the effectiveness can be greatly increased. If, for example, 10° C. is set as the maximum practical allowable freezing point, without using aniline, the attainable effectiveness is 0.9 (45% DIPDA+55% toluene, freezing point 9° C.) or 0.7 (35% DIPDA—65% isopropyl alcohol, freezing point 6° C.); but by using my invention, the attainable effectiveness can be raised to 1.4 (either 53% DIPDA—20% isopropyl alcohol—27% aniline, freezing point 10° C. or 53% DIPDA—20% toluene—27% aniline, freezing point 6° C.). Thus the attainable effectiveness can be doubled using my invention.

Table I

Composition, Per Cent (by weight)				Effectiveness	Freezing Point, ° C.
DIPDA	Isopropyl Alcohol	Toluene	Aniline		
100	0	0	0	2.0	45
80	20	0	0	1.6	34
80	0	20	0	1.6	34
58	0	0	42	1.6	18
60	10	0	30	1.6	17
60	0	10	30	1.6	14
70	30	0	0	1.4	27
70	0	30	0	1.4	27
49	0	0	51	1.4	11
53	20	0	27	1.4	10
53	0	20	27	1.4	6
60	40	0	0	1.2	20
60	0	40	0	1.2	20
41	0	0	59	1.2	6
45	30	0	25	1.2	4
45	0	30	25	1.2	−1
55	45	0	0	1.1	18
55	0	45	0	1.1	16
37	0	0	63	1.1	3
41	36	0	23	1.1	2
41	0	36	23	1.1	−8
50	50	0	0	1.0	15
50	0	50	0	1.0	12
34	0	0	66	1.0	2
37	42	0	21	1.0	−1
37	0	42	21	1.0	−6
45	55	0	0	0.9	12
45	0	55	0	0.9	9
30	0	0	70	0.9	−1
33	47	0	20	0.9	−3
33	0	47	20	0.9	−9
35	65	0	0	0.7	6
35	0	65	0	0.7	1
22	0	0	78	0.7	−4
26	59	0	15	0.7	−7
26	0	59	15	0.7	−13

Another important property of any gum inhibitor which is to have practical utility is the "20% separation temperature." It is common practice at the refinery to prepare a 20% solution of an inhibitor in straight run gasoline. Blending of this "20% stock solution" with motor fuel permits easier control of the final concentration of the inhibitor in the inhibited motor fuel. Since the tank in which the "20% stock solution" is prepared is normally located out-of-doors, it is important that the inhibitor should not separate from the stock solution at temperatures normally encountered in refinery practice. I measure the "20% separation temperature" by cooling a sample of the "20% stock solution" until turbidity is observed and then allowing the temperature of the "20% stock solution" to rise slowly. The temperature at which turbidity in the "20% stock solution" disappears is recorded as the "20% separation temperature."

By taking advantage of the present invention, it is possible to improve the "20% separation temperature" greatly. Table II (see below) compares the "20% separation temperature" of a number of groups of solutions of DIPDA. The solutions within each effectiveness group in Table II are arranged in order such that a solution containing no aniline can be readily compared with the solution containing aniline, and it will be seen that in every case (except where the "20% separation temperature" is below −50° C.) the lowering of the "20% separation temperature" is 13° C. or more. In other words, gum inhibitors prepared according to my invention can be made to possess a higher effectiveness with the same "20% separation temperature" or a lower "20% separation temperature" with the same effectiveness as inhibitors prepared according to the prior art. For example, if an inhibitor with an effectiveness of 1.0 (comparable to inhibitors now commercially in use) is desired, the attainable "20% separation temperature" is −45° C. (37% DIPDA—42% isopropyl alcohol—21% aniline) compared with −8° C. (50% DIPDA—50% isopropyl alcohol); or −10° C. (37% DIPDA—42% toluene—21% aniline) compared with 4° C. (50% DIPDA—50% toluene). Likewise, if −5° C. is set as the maximum practical allowable "20% separation temperature," the attainable effectiveness is 1.4 (53% DIPDA—20% isopropyl alcohol—27% aniline, −9° C.) compared with 1.0 (50% DIPDA—50% isopropyl alcohol, −8° C.); or 1.4 (53% DIPDA—20% toluene—27% aniline, −5° C.) compared with 0.58 (29% DIPDA—71% toluene, −5° C. (not shown in Table II). An increased effectiveness of 40% in one case and 142% in the second example is attainable without changing the "20% separation temperature" by taking advantage of my invention.

Table II

Composition, percent (by weight)				Effectiveness	20% Separation Temperature
DIPDA	Isopropyl Alcohol	Toluene	Aniline		
100	0	0	0	2.0	20
80	20	0	0	1.6	9
60	10	0	30	1.6	−4
80	0	20	0	1.6	14
60	0	10	30	1.6	−2
70	30	0	0	1.4	4
53	20	0	27	1.4	−9
70	0	30	0	1.4	11
53	0	20	27	1.4	−5
60	40	0	0	1.2	−1
45	30	0	25	1.2	−15
60	0	40	0	1.2	8
45	0	30	25	1.2	−7
55	45	0	0	1.1	−4
41	36	0	23	1.1	−25
55	0	45	0	1.1	6
41	0	36	23	1.1	−9
50	50	0	0	1.0	−8
37	42	0	21	1.0	−45
50	0	50	0	1.0	4
37	0	42	21	1.0	−10
45	55	0	0	0.9	−25
33	47	0	20	0.9	<−50
45	0	55	0	0.9	2
33	0	47	20	0.9	−12
35	65	0	0	0.7	<−50
26	59	0	15	0.7	<−50
35	0	65	0	0.7	−2
26	0	59	15	0.7	−15

Another important advantage to be derived from by invention can be seen at once. If it is desired to prepare an inhibitor with an effectiveness equivalent to commercial inhibitors now commonly used, for example, an effectiveness of 1.0, by using my invention very great savings can be achieved, in addition to attaining greatly improved properties already described. It is obvious that an inhibitor containing 37% DIPDA—42% isopropyl alcohol or toluene—21% aniline, is much cheaper than one containing 50% DIPDA—50% isopropyl alcohol or toluene, but the effectiveness of both is 1.0. This is true because DIPDA content of the inhibitor solution can be reduced from 50% to 37%, a saving of 26% of the most expensive component of the solution. In other words 13% of DIPDA and 8% of inert solvents have been replaced by 21% of aniline without loss of effectiveness, but with considerable savings in cost, due to the fact that DIPDA is much more difficult and expensive to manufacture than aniline.

Yet another important advantage to be derived from the use of my invention is the improvement which can be attained with respect to color stability. The color stability of the inhibitor is important from the standpoint of practical use. Inhibitor and inhibitor solutions commonly are in contact with air before and after addition to motor fuels If an inhibitor under consideration is found to produce strong color upon atmospheric oxidation, it is said to lack color stability, and if it does not produce deep color upon atmospheric oxidation, it is said to be color-stable. Inhibitors which show color instability are ordinarily not suitable for practical use because the color produced interferes with the saleability of the motor fuel. I measure the color stability of an inhibitor by observing the shade and depth of color produced when one ounce of fresh inhibitor is allowed to stand in a 2-ounce bottle, in the neck of which is fitted a stopper bearing a 1-inch length of 0.5 mm. tubing to permit access of air to the interior of the bottle. If a strong color develops upon a few hours' exposure. the inhibitor is unsatisfactory for practical use, while if the inhibitor merely darkens after standing several days, it is satisfactory for practical use.

Heretofore, DIPDA has not been used commercially as an inhibitor because of the fact that it lacks color stability when dissolved in solvents commonly used in the art. An isopropyl alcohol solution of DIPDA becomes very dark in color after only a few hours, even though the exposure of the solution to atmospheric oxygen has been slight. On the other hand, solutions of DIPDA in isopropyl alcohol and aniline are color-stable for several days, even when exposed continuously to atmospheric oxygen by the procedure described above. As little as 5% aniline in the solution is adequate to provide color stability and, since larger proportions of aniline are desirable in order to take full advantage of my invention with regards to other desirable properties described herein, color stability is no longer a problem with DIPDA when my invention is used.

It has been found that other aromatic amines are useful in practicing my invention. For example, curves C and D in Figure 2 of the accompanying drawing show the effectiveness of DIPDA solutions in inert solvents, such as, isopropyl alcohol and toluene compared with solutions of DIPDA in o-toluidine. The other important properties, such as, freezing point, "20% separation temperature," and color, as well as cost, are improved by the use of o-toluidine in the manner similar to aniline. The xylidines are likewise effective when used in accordance with my invention.

Other substituted phenylene diamines, such as N,N'-di-secondary-butyl-p-phenylene diamines are also effective in practicing my invention when used with the aromatic amines described above. For example, curves E and F in Figure 3 of the accompanying drawings shows the comparison between effectiveness of solutions of N,N'-di-secondary-butyl-p-phenylene diamines in inert solvents, e. g. isopropyl alcohol or toluene, and the effectiveness of mixtures of N,N'-di-secondary butyl-p-phenylenediamine in aniline. Other important properties, such as, freezing point, "20% separation temperature," and color, are effective advantages in this case also. As in the case of DIPDA, the toluidines and the xylidines behave in a similar manner as aniline does.

As set forth above, primary aromatic monoamines of the benzene series containing —XH groups, wherein X represents a divalent atom, are excluded from my invention. Thus, p-hydroxy aniline (p-aminophenol), p-mercapto aniline, etc. are excluded, but o-anisidine, m-chloroaniline, etc. are included.

Of my new compositions comprising a mixture of at least one N,N'-di-secondary alkyl-p-phenylenediamine and at least one primary aromatic monoamine of the benzene series which contains only carbon, hydrogen and nitrogen atoms, those in which the monoamine constitutes from about 15 to 45% by weight of the mixture are especially useful. Such compositions are advantageously dissolved in an inert solvent to give a solution containing from about 20 to about 45% by weight of the inert solvent.

My invention is directed to the stabilization of hydrocarbon motor fuels against deterioration. By the term "hydrocarbon motor fuel," I mean not only motor fuels constituted entirely of hydrocarbons but also motor fuels containing hydrocarbon and appreciable amounts of other combustible substances, such as alcohols. Cracked gasoline, as is well known, has an undesirable tendency to undergo deterioration upon storage. Straight-run gasolines, on the other hand, do not have the same undesirable tendency to deteriorate, although blended stock containing cracked gasoline and straight-run gasoline usually show the undesirable tendency to deteriorate. It is to the stabilization of any unstable liquid motor fuels comprising light hydrocarbons and normally tending to deteriorate that my invention is directed. To stabilize motor fuels against deterioration with my new composition, I dissolve a small amount of the composition in the motor fuel. Ordinarily an amount sufficient to give a concentration of from about 0.0001% to about 0.1% (by weight) of the composition in the motor fuel will suffice to give a motor fuel of suitable stability against deterioration. Of course, the quantity of any one of my new compositions which is actually employed will depend upon the nature of the motor fuel being stabilized and the conditions under which the fuel is stored. The tendency of the motor fuel to form gum can be determined among other methods by an accelerated oxidation test. The test described by Egloff et al., supra, is very satisfactory and is widely used. In accordance with this test, a sample of the motor fuel being tested, in an open 8-ounce bottle, is placed in a suitable metal bomb surrounded by a water bath. Oxygen is introduced to 100 pounds per square inch (7 kg. per square centimeter pressure). The bath is then heated to 100° C. As the temperature increases, the pressure rises, reaches a maximum and continues near this maximum for a shorter or longer period of time. The test is continued for 4 hours or until a drop in pressure is noted. The period from slightly before the attainment of maximum pressure (approximately 15 minutes from the beginning of heating), until more than a slight drop in pressure takes place (usually a sharp break in the pressure occurs), is recorded as the induction period.

An induction period of less than 75 minutes is usually indicative of very low stability, while an induction of 300 or more minutes, for freshly made motor fuels, represents a fuel possessing suitable stability for from 6 to 12 months' storage in the northern half of the United States. For more southern or warmer climates, the induction period should be increased somewhat for satisfactory bulk storage of about one year duration.

My new composition can be employed to retard gun formation in hydrocarbon motor fuels which tend to undergo deterioration whether the motor fuel contains small or large amounts of addition agents, such as tetraalkyl lead compositions. It is, of course, known that tetraalkyl lead compounds, such as tetraethyl lead, are added to hydrocarbon motor fuels to improve the octane rating of the motor fuels. In some cases only a relatively small amount of the tetraalkyl lead compound is added, but sometimes with certain aviation grades of gasoline, a larger amount is used, such as with aviation gasoline having an octane number above 80 and comprising essentially non-gum-forming hydrocarbons containing less than 1% by volume of olefinic or diolefinic hydrocarbons. Motor fuels having a relatively large amount of tetraalkyl lead compounds are usually referred to as "heavily leaded" gasoline.

Not only can my new compositions be used in all types of "leaded" gasoline, but my new compositions can, if desired, be added to the "ethyl fluid" itself. "Ethyl fluid" usually is a solution containing a mixture of tetraalkyl lead compound and a halogenated hydrocarbon, such as ethylene dibromide or ethylene dichloride, or both. My new compositions serve to retard the formation of haze in "ethyl fluid" or in hydrocarbon motor fuels containing the "ethyl fluid," whether the hydrocarbon motor fuel is one which forms gum upon storage or is one which is composed essentially of non-gum-forming hydrocarbons.

What I claim as my invention and desire to be secured by Letters Patent of the United States is:

1. A composition useful as a gum inhibitor for motor fuels consisting of a mixture of a N,N'-disecondary alkyl-p-phenylenediamine in which each alkyl group contains from 3 to 4 carbon atoms and a primary aromatic amine selected from the group consisting of aniline and o-toluidine, the primary aromatic amine constituting from about 0.5 to about 85% by weight of the mixture.

2. A composition useful as a gum inhibitor for motor fuels consisting of a mixture of N,N'-diisopropyl-p-phenylenediamine and aniline, the aniline constituting from about 0.5 to about 85% by weight of the mixture.

3. A composition useful as a gum inhibitor for motor fuels consisting of a mixture of N,N'-disecondary butyl-p-phenylenediamine and aniline, the aniline constituting from about 0.5 to about 85% by weight of the mixture.

4. A composition useful as a gum inhibitor for motor fuels consisting of a mixture of N,N'-diisopropyl-p-phenylenediamine and aniline, the aniline constituting from about 0.5 to about 85% by weight of the mixture, the mixture being dissolved in an inert solvent.

5. A composition useful as a gum inhibitor for motor fuels consisting of a mixture of N,N'-diisopropyl-p-phenylenediamine and aniline, the aniline constituting from about 0.5 to about 85% by weight of the mixture, the mixture being dissolved in isopropyl alcohol.

6. A composition useful as a gum inhibitor for motor fuels consisting of a mixture of N,N'-diisopropyl-p-phenylenediamine and aniline, the aniline constituting from about 0.5 to about 85% by weight of the mixture, the mixture being dissolved in toluene.

7. A composition useful as a gum inhibitor for motor fuels consisting of a mixture of N,N'-disecondary butyl-p-phenylenediamine and aniline, the aniline constituting from about 0.5 to about 85% by weight of the mixture, the mixture being dissolved in an inert solvent.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,323,948	Von Bramer et al.	July 13, 1943

FOREIGN PATENTS

Number	Country	Date
385,593	Great Britain	Mar. 25, 1931