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MOTOR FUEL.

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This invention relates to processes of improving gasoline and products thereof; and it comprises a process of improving the burning qualities of gasoline, kerosene and other petroleum oils inclined to ignite in the engine with the production of detonative explosions resulting in undue shock to the engine wherein a plurality of non-detonating compounds are dissolved in the same body of fuel, each to the limit of its solubility therein, the number of such substances employed being so correlated with their solubility that the total amount of material dissolved shall be sufficient to deprive the treated fuel of detonating properties; and it further comprises as a new composition, a liquid fuel containing a plurality of dissolved detonating precluding substances, each of such substances being of limited solubility in the fuel; all as more fully hereinafter set forth and as claimed.

As is well known, under some conditions gasoline tends to give a detonative explosion in the engine; which is favored by increase in compression, by dirtiness in the engine, etc. Kerosene and gasoline rich in "heavy ends" detonate more than light gasolines. It is also known that to a large extent the detonating can be obviated by diluting the gasoline with special fuels, such as benzol (benzene), or by charging it with small proportions of anilin; anilin seeming to have a specific power of obviating detonation. Anilin is a liquid freely miscible with gasoline and there is no difficulty in using such proportions as may be necessary or desirable. Various other aromatic amines of nature similar to anilin (alkylated anilines), are, like it, liquid and miscible with gasoline and may also be used to preclude detonation.

There are, however, very many other compounds which are not readily miscible with or soluble in gasoline which we have discovered are nevertheless useful in preventing or lessening detonation. To the extent that they will dissolve, they obviate detonation, but this extent is commonly not sufficient to make them practically useful. For example, there are many of these substances having sufficient detonative precluding properties where proportions of 1 per cent or thereabouts (sometimes 2 or 3 per cent) are used in conjunction with gasoline or kerosene, which are not soluble however in gasoline to any such extent. Sometimes their solubility does not exceed 0.5 per cent in the usual types of gasoline.

While these bodies are of quite diverse classes, chemically speaking we have found, rather unexpectedly, that they have little action on each other in gasoline or kerosene solutions; they do not lose their identity in such a solution. And, further, in lieu of detracting from each other's solubility in joint solution, they may dissolve independently or may assist each other somewhat; that is, the solubility of substance *a* in gasoline solution may be enhanced somewhat by the presence of substance *b* and that of *b* by *a*. In joint solution, each preserves its detonative precluding properties, at least undiminished. The net result is that sufficient resistance to detonation can be built up in gasoline by the joint use of several of these substances where one alone, because of its limited solubility, would not suffice.

Among the various substances of the cyclic or aromatic series having active useful properties, but of only limited solubility in gasoline, we may name, b-naphthoquinone, para-anisidine, phthalimide, toluylene diamine, meta-phenylene diamine, para-phenylene diamine, azobenzene, dinitro para-toluidine, dimethyl-hydroresorcin, and aminoazobenzene. As will be noted, these are of quite diverse classes, chemically considered. All, however, are, to the extent of their solubility in gasoline, active substances precluding detonation.

Other substances, such as formanilide, also have like properties, although not in so high a degree as those just named and are also of limited solubility in gasoline.

There are also various substances belonging to the aliphatic group which have similar properties and may be used in conjunction with aromatic compounds. Among these may be listed capronitrile and hexamethylene tetramine.

The bodies listed are merely representative

of a wide variety of slightly soluble detonative precluding substances which may be usefully employed conjointly under the present invention.

The bodies here under consideration for the most part are solids of crystalline nature and, as such, rather difficult to use; partly because of the small amounts of each required and partly because of the length of the time required to effect formation of a saturated solution in gasoline. But by the use of an expedient, their use may be facilitated; this expedient consisting in the use of enough of a solvent to break down the crystalline structure. Sometimes two or three or more of them may be melted together, or one used as a fused solvent for others. This often gives a structureless melt which is easy to handle and to dissolve. Generally, however, it is more convenient to use a solvent to convert them into a liquid or paste form; this solvent being, of course, something which is miscible with gasoline. Benzol is the most convenient. Most of these bodies dissolve in benzol (benzene) and those which do not for the most part will dissolve in acetone or alcohol. Acetone or alcohol solutions will generally blend with benzol solutions. While these solvents do not always materially enhance the solubility of these substances in gasoline, sometimes they do; and in any event, the use of a solvent or a plurality of solvents in conjunction with the stated substances of the present invention has another advantage, in that it adds to the bulk of material; making it more convenient in adding the small proportions required to gasoline. Commonly, we add the assembled bodies to the gasoline after previously pulping or dissolving in a small quantity of an appropriate solvent or plurality of solvents.

As a typical embodiment of the present invention may be cited dissolving 0.5 per cent hexamethylene tetramine in 5 parts of alcohol and 0.1 per cent meta-phenylene diamine in 5 parts of benzol and adding to 90 parts of gasoline.

Another efficient non-detonating motor fuel is made by using 1 part p-iodo-anilin, 1 part p-anisidin, 10 parts alcohol, 10 parts benzol and 180 parts gasoline; all parts being by weight.

Another is made by using 0.5 parts hexamethylene tetramine, 0.1 part m-phenylene diamine, 10 parts alcohol, 10 parts benzol and 180 parts gasoline.

Still another is made by using 0.5 parts azobenzene, 20 parts benzol and 180 parts gasoline; or, 1 part amino azobenzene, 20 parts benzol and 180 parts gasoline.

The quantities of solvent employed are merely indicative; more or less can be used. Sometimes, however, it is noted that the presence of the blending solvent seems to decrease considerably the tendency toward detonation. Betanaphthoquinone is more useful in connection with alcohol than with benzol.

We regard our invention as covering any way of conferring entranced detonative precluding properties upon gasoline or kerosene or a mixture of the two or other liquid fuels wherein the desired properties are built up by the use of two or more detonative precluding substances, each of limited solubility in the fuel, but together of sufficient solubility, with the use of binders, to give conjointly a sufficient effect.

What we claim is:—

1. As a new composition of matter, gasoline containing in saturated solution a plurality of detonation precluding hydrocarbon derivative compounds each having a solubility in gasoline of the order of not more than 0.5 per cent and each of the respective hydrocarbon derivative compounds present imparting to the gasoline detonation precluding properties.

2. As a new composition of matter, gasoline containing in saturated solution a plurality of detonation precluding derivatives of aromatic hydrocarbons each having a solubility in gasoline of the order of not more than 0.5 per cent, and each of the respective derivatives of aromatic hydrocarbons present imparting to the gasoline detonation precluding properties.

3. As a new composition of matter, gasoline containing in saturated solution an organic substance having detonation precluding properties and a solubility therein of the order of not more than 0.5 per cent, and imparting to the gasoline some detonation precluding properties, such gasoline also containing a second organic substance having detonation precluding properties and a solubility therein of the order not more than about 0.5 per cent and imparting some detonation precluding properties, and cooperating with the first mentioned substances to give to the gasoline detonation precluding properties in excess of those imparted by either of the substances individually in solution in the gasoline.

4. A motor fuel consisting essentially of gasoline containing detonation precluding compounds therein, said detonation precluding compounds comprising at least two organic chemical compounds, each of such compounds being present in the gasoline as a saturated solution, the solubility of each of such compounds being of the order of 0.5 per cent, the entire composition having detonation precluding properties greater than the limited detonation precluding properties of any single compound.

5. A motor fuel consisting essentially of gasoline containing detonation precluding compounds therein, said detonation precluding compounds comprising at least two or-

ganic chemical compounds, at least one of which is an amine, each of such compounds having limited detonation precluding properties, each of such compounds being present in the gasoline as a saturated solution, the solubility of each of such compounds being of the order of 0.5 per cent, the entire composition having detonating precluding properties greater than the limited detonating properties of any single compound.

In testimony whereof, we have hereunto affixed our signatures.

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