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HYDROCARBON FUELS

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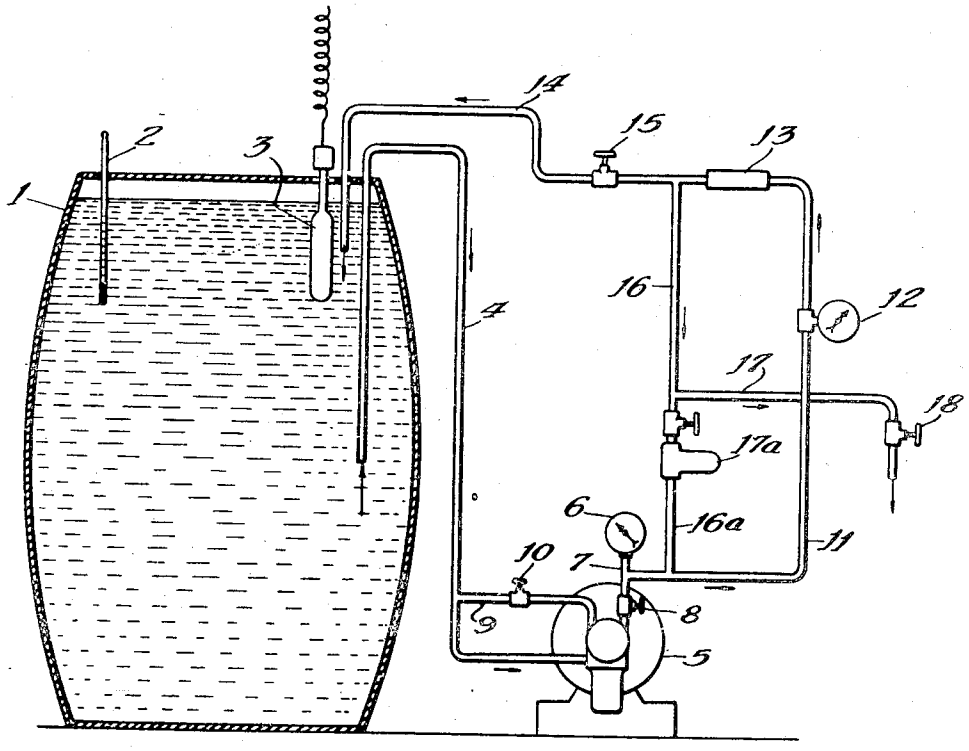


Fig. 1.

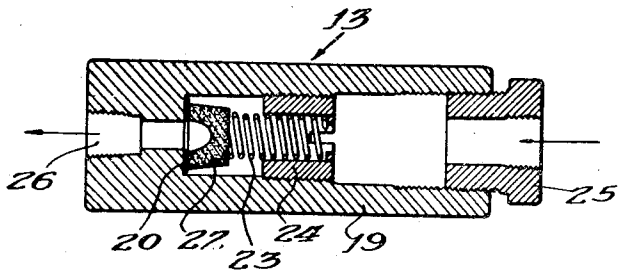


Fig. 2.

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HYDROCARBON FUELS

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12 Claims. (Cl. 44—66)

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This invention relates to improvements in hydrocarbon fuels, particularly hydrocarbon fuels such as furnace or burner oils and fuels for compression-ignition internal combustion engines such as Diesel engines. More specifically the invention relates to hydrocarbon fuel oil compositions which are substantially unsusceptible to filter clogging and to the method of inhibiting the filter clogging tendency of such hydrocarbon fuels.

The requirements for acceptable fuels for oil burners and for Diesel engines include freedom from the tendency to clog filter screens and the numerous fine passages and openings present in fuel oil burners and in Diesel engines. The fuel oil used in such equipment can interfere with the performance of various parts in such equipment in several ways, among which are clogging, gumming, corrosion, etc. Particularly detrimental to good performance are sediments, which may be of the so-called casual type or so-called non-casual type. Casual sediments include sand, dirt, iron rust, dust, water emulsions and miscellaneous debris. The nature of casual sediment is such that its avoidance is entirely a problem of keeping the original oil clean and free of added dirt, etc. The non-casual sediment is that sediment which may form in an oil during use. Such sediment is a hydrocarbon sediment originating mainly in the oxidation and polymerization of all, or a portion of the oil. It is very finely divided as it forms and either clogs small openings and fine pores of the filters or it can coagulate into coarser sediment to form massive deposits which also clog larger openings in the filter. It is responsible for the major part of so-called sediment difficulties.

The tendency of fuels to clog filters varies with different fuels. For example, it has been observed that virgin fuels or fuels containing a substantial amount of virgin stocks clog filters to a lesser degree than do fuels of crack stocks.

It is an object of the present invention to provide a hydrocarbon fuel having substantially non-clogging tendencies.

It is another object of the invention to provide a hydrocarbon fuel inhibited against the tendency to cause clogging.

Still another object of the invention is to provide a method of inhibiting the clogging tendency of hydrocarbon fuels.

Other objects and advantages of the invention will become apparent from the following description thereof.

I have discovered that the foregoing objects can

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be attained by adding to a hydrocarbon fuel oil, particularly those hydrocarbon fuel oils which normally have a tendency to cause clogging of filters, small openings and the like, small amounts of a dispersing agent, preferably an oil-soluble or oil-dispersable polyvalent metal soap in combination with small amounts of a metal deactivator such as, for example, the condensation product of an aldehyde or a ketone with a primary amine. particularly polyalkylene amines having at least three amino nitrogen atoms, at least two of which are primary nitrogen atoms; or ortho hydroxy aryl oximes, such as ortho hydroxy aryl aldoximes and ortho hydroxy aryl ketoximes, such as, for example, 2-hydroxy-benzaldoxime, 2-hydroxy-acetophenoxime and the like. The polyvalent metal soaps are used in small but sufficient quantities; namely, from about 0.001% to about 0.1% and preferably from 0.01% to about 0.05% and the metal deactivators are used in small amounts, for example from about 0.005% to about 0.05% and preferably from about 0.001% to about 0.005%.

The polyvalent metal soaps employed in the present invention are preferably the heavy metal soaps of saturated and unsaturated aliphatic fatty acids, naphthenic acids, sulfonic acids and the like. Specific examples of metal soaps which can be used in the present invention are aluminum oleate, aluminum naphthenate, aluminum sulfonate, aluminum stearate, iron oleate, iron naphthenate, zinc oleate, chromium oleate, chromium naphthenate, etc.

It has heretofore been observed that the tendency of organic substances to oxidize in the presence of certain metals can be substantially reduced by adding to such organic substances certain compounds which have the property of rendering the metal inactive. Such compounds exhibiting this property are commonly referred to as metal deactivators and the term "metal deactivators" as used herein and in the appended claims mean those compounds which exhibit this metal deactivating property.

Metal deactivators which can be suitably used in combination with the metal soaps of the foregoing type are condensation products obtained by the reacting of ortho hydroxy aromatic aldehydes or ketones such as 2-hydroxybenzaldehyde, 2-4-dihydroxybenzaldehyde, 2-hydroxy-3-methoxy benzaldehyde, 2,2'-dihydroxybenzophenone, etc., with a primary amine, particularly a polyalkylene amine, containing at least three nitrogen atoms of which at least two are primary amino nitrogen atoms such as, for example, methyl di-

amine, ethylene diamine, diethylene triamine, 1:10-decylene diamine, triethylene tetramine, propylene diamine, tetraethylene pentamine, N,N'dibeta amina ethylene piperazine; or the condensation product obtained by reacting an aromatic, aliphatic alicyclic, or heterocyclic aldehyde or ketone such as crotonaldehyde, butyraldehyde, heptaldehyde, isobutyraldehyde, methyl hexyl ketone, furfural, acetaldehyde, acetophenone, benzaldehyde, acetone, vanilin, valeraldehyde, octyl aldehyde, cinnamaldehyde, hexone, diisobutyl ketone and the like, with a primary amine, particularly a polyalkylene amine having at least 3 nitrogen atoms of which at least two are primary amino nitrogen atoms of the type above described. Other suitable metal deactivators are the reaction products of an hydroxylamine with an ortho hydroxy aromatic aldehyde or an ortho hydroxy aromatic ketone.

Examples of reaction products of the foregoing type are disalicylal ethylene diamine, di(2-hydroxy-3-methoxybenzol)-propylene diamine, furfural triethylene tetramine, benzaldehyde tetraethylene pentamine, disalicylal N,N'dibeta amino ethyl piperazine, dihydroxy benzophenone diethylene triamine, tributyraldehyde triethylene tetramine, tetra diisobutyl ketones, tri-propylene tetramine, ortho hydroxybenzandoxime, ortho hydroxy acetophenon-oxime and the like.

The clogging effect of fuel oils can be determined in an apparatus of the type illustrated in the accompanying drawings in which:

Figure 1 is a diagrammatic illustration of an apparatus for determining the clogging time of hydrocarbon fuel oils; and

Figure 2 is an enlarged sectional view of the filter element of Figure 1.

Referring to Figure 1, the oil in a container 1, for example a barrel of about 50 gallon capacity, is maintained at a temperature of about 140° F., as indicated by thermometer 2, by heating means, for example an electric heater 3. The oil is then pumped through a pipe 4 extending into the container 1 substantially to the half-way mark, by means of a suitable pump 5, for example a standard oil burner pump having a sediment bulb and a fine mesh screen (not shown), for separating out any coarse casual sediment. A pressure gauge 6 is connected to the pump 5 by means of pipe 7 provided with a valve 8. The outlet pressure on the pump 5 is regulated by means of a by-pass line 9 and by-pass regulator valve 10. Oil leaving the pump 5 passes through line 11 provided with a suitable pressure gauge such as a Bourdon gauge 12, and passes through a filter element 13. The oil passes through the filter element 13 and is returned to the container 1 through line 14 provided with a valve 15. The outlet pressure of pump 5 is regulated by passing the oil from the container 1 through the by-pass line 9 and regulating the flow therethrough by means of valve 10. A sensitive Bourdon gauge measures the oil pressure immediately before the oil enters the filter and since the outlet line 14 is opened to the atmosphere and is unthrottled, the pressure indication on the Bourdon gauge is equal to the pressure drop across the filter element 13. The pressure drop across the filter element 13 is kept constant and the flow therethrough measured by closing valve 15 in line 14 and by-passing the fuel oil through lines 16 and 17 and valve 18. By withdrawing a portion of the fuel oil in this manner into a graduated container the rate of flow through the filter element 13 can be measured and regulated to a constant flow. The oil withdrawn through lines 16 and 17 for measuring the rate of flow is returned to container 1. In the event the filter becomes completely clogged, pressure on the system is released by means of safety valve 17a in valved line 16a.

Referring to Figure 2, the filter element 13 comprises a holder 19 provided with a shoulder 20 on which rest gasket 21 and sintered copper filter 22. Filter 22 is held against the shoulder 20 by means of compression spring 23 and threaded runner 24. Line 11 of the system is coupled to the filter element 13 by means of the threaded bushing 25 and line 14 of the system is connected to the outlet of the filter element 13 through threaded portion 26 of the holder 19.

In making a test a minimum oil sample of about 50 gallons is used to secure the high oil to surface ratio generally met with in practice. Before a test is made, the oil container is allowed to stand overnight to permit any coarse casual sediment to settle out. The oil used in the test maintained at a temperature of about 140° F. is circulated through the filter element 13, and the rate of flow and clogging time noted.

A furnace fuel oil and the same fuel oil containing 0.01% aluminum naphthenate and 0.002% salicylaldoxime (orthohydroxy benzaldoxime) were tested in the apparatus just described and the following results obtained:

Oil Sample	Clogging Time in Hours [1]
Control furnace oil	158
Control+0.01% aluminum naphthenate+0.002% salicylaldoxime	658

[1] Corrected to same initial flow rate.

The above data clearly demonstrate the effectiveness of small amounts of aluminum soap and a metal deactivator in increasing the clogging time of a hydrocarbon fuel oil. Inasmuch as the filter element 22 is used in actual Diesel engines, and since fuel is circulated in actual Diesel engines, it is obvious that a similar improvement in fuel performance would occur if the treated fuel were used in practice.

While the present invention has been described by reference to various representative compounds and has been illustrated by reference to specific examples thereof, the invention is not to be limited to the various named compounds or to the specific examples but includes within its scope such modifications as come within the spirit of the appended claims.

I claim:

1. A substantially non-clogging fuel oil composition comprising a normally liquid hydrocarbon fuel normally susceptible to cause clogging containing in combination therewith from about 0.001% to about 0.1% of an oil-soluble polyvalent metal soap and from about 0.005% to about 0.05% of a condensation product selected from the class consisting of (1) the reaction product of a polyalkylene compound having at least 3 amino nitrogen atoms, at least two of which are primary nitrogen atoms, with a carbonyl compound selected from the group consisting of aromatic aldehydes, aromatic ketones, aliphatic aldehydes, aliphatic ketones, alicyclic aldehydes, alicyclic ketones, heterocyclic aldehydes, and heterocyclic ketones, and (2) the reaction product of an hydroxylamine and a phenolic compound selected from the group consisting of ortho hy-

droxy aromatic aldehydes and ortho hydroxy aromatic ketones.

2. A fuel oil composition as described in claim 1 in which the polyvalent metal soap is an aluminum soap.

3. A fuel oil composition as described in claim 1 in which the polyvalent metal soap is an iron soap.

4. A fuel oil composition as described in claim 1 in which the polyvalent metal soap is a chromium soap.

5. A substantially non-clogging fuel oil composition comprising a normally liquid hydrocarbon fuel oil normally susceptible to cause clogging and in combination therewith from about 0.001% to about 0.1% of a polyvalent metal soap and from about 0.005 to about 0.05% of the condensation product obtained by reacting an aliphatic aldehyde with a polyalkylene amine having at least 3 amino nitrogen atoms, at least two of which are primary nitrogen atoms.

6. A fuel oil composition as described in claim 5 in which the polyvalent metal soap is an aluminum soap and the condensation product is furfural triethylene tetramine.

7. A substantially non-clogging fuel oil composition comprising a normally liquid hydrocarbon fuel oil normally susceptible to cause clogging, from about 0.001% to about 0.1% of a polyvalent metal soap and from about 0.005% to about 0.05% of the condensation product of a phenolic compound selected from the class consisting of ortho hydroxy aromatic aldehydes and ortho hydroxy aromatic ketones with an hydroxylamine.

8. A fuel oil composition as described in claim 7 in which the polyvalent metal soap is an aluminum soap and the condensation product is ortho hydroxy aryl aldoxime.

9. A fuel oil composition as described in claim 7 in which the polyvalent metal soap is aluminum naphthenate and the condensation product is 2-hydroxy-benzaldoxime.

10. A substantially non-clogging fuel oil composition comprising a normally liquid hydrocarbon fuel oil normally susceptible to cause clogging and in combination therewith from about

0.001% to about 0.1% of aluminum naphthenate and from about 0.005% to about 0.05% of furfural triethylene tetramine.

11. A substantially non-clogging fuel oil composition comprising a normally liquid hydrocarbon fuel oil normally susceptible to cause clogging and in combination therewith from about 0.001% to about 0.1% of iron naphthenate and from about 0.005% to about 0.05% of furfural triethylene tetramine.

12. In a system having small passages subject to clogging in which a normally liquid hydrocarbon fucl oil normally having the tendency to cause clogging of said passages is employed, the method of substantially inhibiting such clogging comprising employing in said system a normally liquid hydrocarbon fuel oil normally susceptible to cause clogging containing from about 0.001% to about 0.1% of a polyvalent metal soap and from about 0.005% to about 0.05% of a condensation product selected from the class consisting of (1) the reaction product of a polyalkylene compound having at least three amino nitrogen atoms, at least two of which are primary nitrogen atoms, with a carbonyl compound selected from the group consisting of aromatic aldehydes, aromatic ketones, aliphatic aldehydes, aliphatic ketones, alicyclic aldehydes, alicyclic ketones, heterocyclic aldehydes, and heterocyclic ketones, and (2) the reaction product of a hydroxy amine and a phenolic compound selected from the group consisting of ortho hydroxy aromatic aldehydes and ortho hydroxy aromatic ketones.

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