

UNITED STATES PATENT OFFICE

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DIESEL ENGINE STARTING FLUID

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This invention relates to compositions adapted to facilitate the starting of compression ignition engines at low temperatures, and to methods of employing the same in such cold starting.

In Diesel engine operation, a liquid fuel is injected into a combustion chamber and ignited by compression and, since the ignition temperature of the fuel is reached, during normal and continued operation in any certain engine and with any certain fuel, as a result of the combined effect of compression and the temperature of engine parts, difficulty is often encountered in attempting to initiate compression ignition in a cold motor with a fuel satisfactorily adapted for thus running. In meeting such difficulties, externally derived heat is sometimes applied to significant engine parts, to raise their temperature, and fuels of relatively low ignition temperatures are often employed for such time as is required to start ignition and allow engine temperatures to rise; sometimes, but by no means invariably, the addition to the liquid fuel of a so-called "primer," normally effective in decreasing the ignition delay period of the fuel during continuous engine operation, will act to assist in the cold starting of the engine. As is well known, cold starting difficulties are so real and serious that Diesel engines are often allowed to run at idling speed for hours and frequently overnight, to maintain ignition temperatures, rather than attempt the initiation of compression ignition in an engine cooled to atmospheric temperature. These difficulties are immensely magnified in equipment employed in northern climates or in adverse weather conditions when, for example, the temperature may drop to as low as -20°F . and below.

The invention comprises the introduction of a particularly characterized auxiliary combustible fluid or fuel into the air stream entering the combustion chambers of a Diesel or compression ignition engine, in gaseous or vaporous or in finely divided liquid form, in fairly high concentration. Such introduction to the air stream, as through the air intake manifold of the engine, permits the presence of the auxiliary cold starting agents during the whole compression stroke of the motor rather than merely concomitant with the entry of the liquid hydrocarbon fuel normally injected into the combustion chambers at a point approaching top dead center.

It is accordingly an object of the invention to disclose and provide cold starting fluids capable of initiating or accelerating the starting of Diesel engines at low temperatures and to provide methods of accomplishing such starting by the intro-

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duction of the said fluids into the air intake streams of the engines. It is a further object of the invention to disclose and provide fluids or auxiliary combustion-initiating agents effective in such operations. Other objects and numerous advantages of the invention will be apparent to those skilled in the art to which it appertains.

The auxiliary combustible or cold starting fluid of the invention comprises a major proportion of a volatile alkyl ether of low molecular weight, such as diethyl ether, methylethyl ether or dimethyl ether, and a minor proportion of a refined, light and relatively non-viscous lubricating oil, preferably containing in addition a minute but sufficient amount of an ether-antioxidant such as hydroquinone in order to prevent peroxide formation in storage. The ether content should be higher than 60% by volume and may be as high as 95% of the fluid; the content of the light lubricating or valve oil should not be below about 5% by volume and may approach 30% but is preferably about 10% by volume of the fluid; the ether-antioxidant may be present in from 0.05% to 0.5% of the whole admixture. The preferred composition of the invention is

Per cent by volume

Commercial ethyl ether	90
Light valve oil	10

containing hydroquinone, 0.2% by weight, although these proportions may be varied within the limits indicated above.

The introduction of this fluid into the air intake stream of the engine, in accordance with the invention, may be accomplished by direct application to the air entry port or through a short section of the intake pipe, arranged on a by-pass as desirable. Very preferably, it may be sprayed in mist form into the intake port, as with one or a few ejections from an ordinary device of the paint spray gun or fly spray type. Alternatively, it may be swept off the open end of a small diameter pipe protruding through the wall of the air intake pipe, suitably fed from a storage chamber; or the fluid may be forced or poured onto a small mass of metal wool housed in a by-pass section of the intake pipe and, upon passage of the air through the by-pass at desired entry times, the liquid is carried into the combustion chamber in finely divided liquid spray form. In any case, the introduction of the cold starting fluid of the invention is stopped promptly upon the initiation of combustion of the hydrocarbon fuel normally introduced into the combustion chambers in the ordinary operations of the engine.

In exemplification of the compositions and

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methods of the invention, the results of certain tests are set forth in Table I. In these tests, a variable compression CFR Motor Method Engine, operated at 900 R. P. M., was employed under conditions to directly measure the compression ratio required for compression ignition and to indicate the minimum atmospheric temperature at which compression ignition would take place at a compression ratio of 16:1.

Table I

Example		Compression ratio for compression ignition	Min. Atm. Temp. for compression ignition at C. R. 16:1
			°F.
1.....	Ethyl ether+10% valve oil+0.2% hydroquinone.	4.91	-55
2.....	Ethyl ether+10% SAE 30 automobile crankcase lubricating oil.	5.00	-52
3.....	Ethyl ether+10% SAE 10 W automobile crankcase lubricating oil.	5.20	-47
4.....	Ethyl ether+10% valve oil.	4.91	-55
5.....	Ethyl ether+10% cumene.	5.42	-41
6.....	Ethyl ether+10% xylidine.	5.72	-33
7.....	Ethyl ether+0.2% hydroquinone.	5.00	-52
8.....	Ethyl ether.....	5.12	-49
9.....	Methylether.....	6.62	-9

It will be observed that the minimum cold starting temperature is not only not significantly increased by the addition of minor amounts of a light lubricating oil such as the valve oil and the SAE 10W and SAE 30 oils included in the compositions of Examples 1, 2, 3 and 4, as would be expected, but that in most cases they actually lower the cold starting temperatures obtainable by the use of the ether alone. That remarkable result is indeed fortuitous, as repeated motor operations with fluids composed wholly or essentially wholly of the ether, in actual service at these temperatures, has shown that the presence of the light lubricating oil, of a volatility at least lower than that of the kerosenes and illuminating oils, is positively necessary in order to provide piston ring and cylinder wall lubrication during the starting operations, during which starting operations the normal crankcase lubricants are not effective to prevent scoring and wear. Moreover, the presence of the ether antioxidant augments rather than degrades the cold starting effect, both of the ether alone and of the ether containing minor proportions of light hydrocarbon lubricant.

By contrast, and for purposes of indicating the utility of the compositions of the invention, some of which are exemplified by the data of Table I, there are shown in Table II certain results obtained in operations identical to those above, on compositions other than those described and claimed as a part of this invention.

Table II

Example		Compression ratio for compression ignition	Min. Atm. Temp. for compression ignition at C. R. 16:1
			°F.
10.....	The valve oil included in the compositions of Examples 1 and 4.	>10.00	>+59
11.....	Ethyl ether+50% methyl alcohol.	9.33	+47
12.....	Isopropyl ether.....	8.59	+33
13.....	Motor gasoline.....	>10.00	>+59
14.....	Isopentane.....	>10.00	>+59

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In further exemplification of the compositions and methods of the invention, a variable compression CFR 1-C engine was operated at 1200 R. P. M. under conditions to directly measure the compression ratio required for compression ignition and to indicate the minimum atmospheric pressure at which compression ignition would take place at a compression ratio of 16:1. The results of this series of operations are shown in Table III.

Table III

Example		Compression ratio for compression ignition	Min. Atm. Temp. for compression ignition at C. R. 16:1
			°F.
15.....	The composition of Example 4.	5.64	-51
20.....	Ethyl ether+30% valve oil.	6.09	-41
17.....	Ethyl ether+60% valve oil.	>7.20	>-17

As heretofore noted, the presence of the light lubricating oil is necessary to the proper functioning of the composition, and it will be seen that minor amounts thereof, with respect to the ether content, are not detrimental to the ability of the composition to perform its starting functions at very low temperatures. The refined light lubricating oil of petroleum distillate origin may advantageously be a cut or fraction of olefin polymer derivation such, for example, as the "light polymers" described in Holm, Lyman and Miller Patent No. 2,224,349, at lines 63-66 of column 2, page 6, and a composition comprising approximately 90% by volume of commercial ethyl ether and approximately 10% by volume of such light polymers, containing from 0.05 to 0.5% by weight of an ether antioxidant, for example 0.2% of hydroquinone, is one of the preferred examples of the invention. The "light polymers" referred to above are specified in the Holm et al. patent as follows:

Light polymers, line 52:

Yield, gallons per hours..... 116
Gravity, A. P. I.....degrees..... 37.4
Viscosity at 210° F..... 55

I claim:

1. A Diesel engine starting fluid adapted to initiate the operation of an internal combustion engine of the compression type at low temperatures, by compression alone, consisting essentially of an alkyl ether having at least two but less than five carbon atoms in the molecule in major proportion and a liquid hydrocarbon lubricant in an amount from about 5% to less than about 30% by volume based on the total volume of the starting fluid.

2. A Diesel engine starting fluid adapted to initiate the operation of an internal combustion engine of the compression type at low temperatures, by compression alone, consisting essentially of more than 60% of an alkyl ether having at least two but less than five carbon atoms in the molecule and a liquid hydrocarbon lubricant in an amount from about 5% to less than about 30% by volume based on the total volume of the starting fluid.

3. A Diesel engine starting fluid adapted to initiate the operation of an internal combustion engine of the compression type at low temperatures, by compression alone, consisting essentially of more than 60% of ethyl ether and from about

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5% to less than about 30% by volume based on the total volume of the fluid of a refined, light and relatively non-viscous liquid mineral oil lubricant, and containing an ether antioxidant in an amount sufficient to prevent peroxide formation.

4. A Diesel engine starting fluid adapted to initiate the operation of an internal combustion engine of the compression type at low temperatures, by compression alone, consisting essentially of more than 60% of ethyl ether and from about 5% to less than about 30% by volume based on the total volume of the fluid of volatile and relatively non-viscous liquid olefin polymers of approximately 37.4° A. P. I. gravity and a viscosity index of approximately 55 at 210° F., and containing an ether antioxidant in an amount sufficient to prevent peroxide formation.

5. A Diesel engine starting fluid adapted to initiate the operation of an internal combustion engine of the compression type at low temperatures, by compression alone, comprising about 90% commercial ethyl ether and about 10% by volume based on the total volume of the fluid of light hydrocarbon valve oil, and containing about 0.2% hydroquinone.

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