

July 15, 1952

M. S. ROUSH

2,603,557

SUPPLEMENTARY FUEL

Filed Sept. 10, 1948

Fig. 1

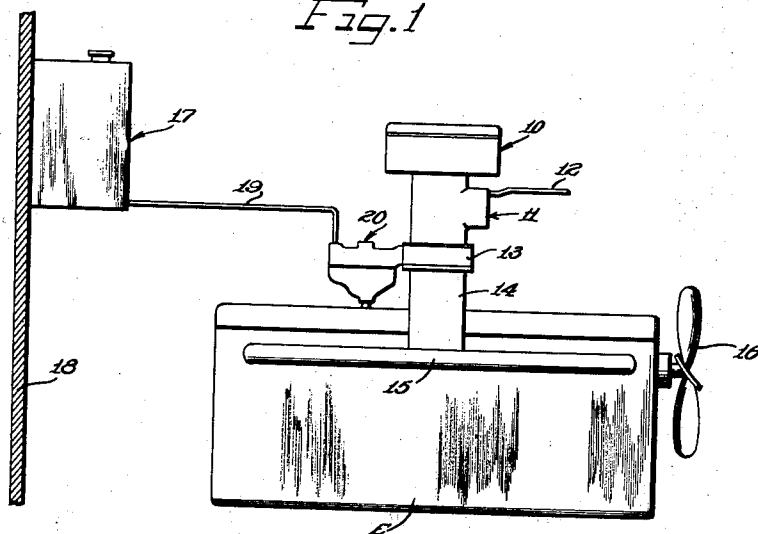
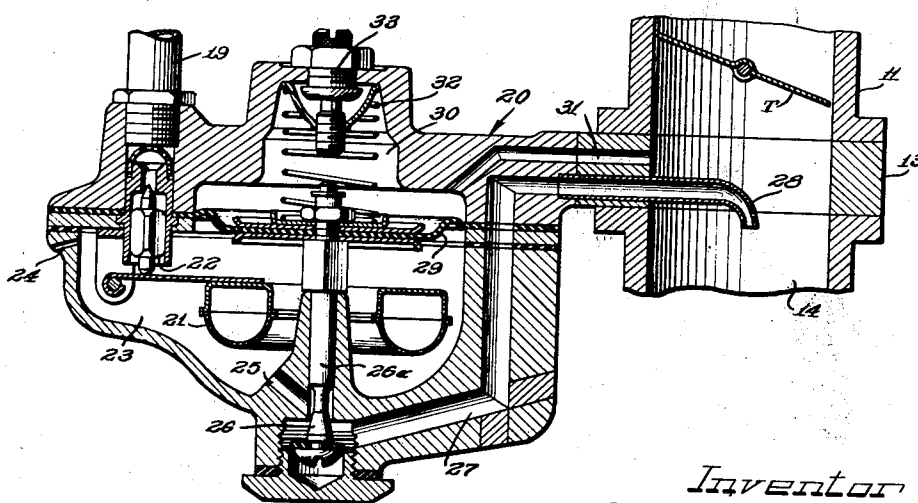


Fig. 2



Inventor  
Milton S. Roush

By The Firm of Charles H. Fittys

## UNITED STATES PATENT OFFICE

2,603,557

## SUPPLEMENTARY FUEL

Milton S. Roush, Painesville, Ohio, assignor to  
Thompson Products, Inc., Cleveland, Ohio, a  
corporation of Ohio

Application September 10, 1948, Serial No. 48,697

2 Claims. (Cl. 44-56)

1

This invention relates to an anti-detonant type of supplementary fuel for internal combustion engines, and includes a method for preparing the fuel in stable non-corrosive form.

Specifically, this invention deals with a stable alcohol-water-oil emulsion which can contain more than 80% monohydric alcohol, such as methanol, ethanol, or isopropanol, and as much as 3 cc. per gallon tetraethyl lead without forming precipitates even when heated or exposed to oxidizing atmospheres.

According to this invention, a detonation-inhibiting supplementary fuel, composed essentially of alcohol and water, and preferably also containing tetraethyl lead, is rendered stable and non-corrosive by incorporating small amounts of corrosion-inhibiting emulsifiers and oils or other hydrocarbons which are normally immiscible in the alcohol solution. It has been found that oxidation products produced by oxidation of the alcohol content of the fuel will form slimes and precipitates which clog filters, metering valves, and feed tubes, rendering the fuel unsatisfactory for commercial use. This oxidation is minimized by small amounts of oils either in the inhibitor or otherwise added. The oil addition is controlled to balance the specific gravity of the inhibitor and emulsifier with the specific gravity of the alcohol-water solution. Hydrocarbons, such as kerosene or heavier petroleum fractions having the desired specific gravity, are used for this purpose, but the total hydrocarbon content of the fuel is so insignificant that it will not interfere with the setting of a carburetor to enrich the power fuel-air mixture delivered to the engine even when the anti-detonant fuel is introduced at a relatively high rate. It is preferred to use slightly more kerosene or other immiscible hydrocarbon than can be rendered totally miscible with the alcohol solution by the emulsifier so that very minute quantities of the kerosene tend to float to the top, forming a thin covering film which additionally protects the fuel against oxidation.

The anti-detonant type supplementary fuels of this invention are immiscible with the conventional hydrocarbon power fuels, such as gasoline, and therefore they are fed to the engine in the form of a spray which is injected into the gasoline-air mixture supplied to the engine by the carburetor. Since engine detonating conditions are only encountered when the vacuum in the engine intake manifold decreases, as when the throttle valve is appreciably opened and the engine is operating under heavy load, the supple-

2

mentary fuel of this invention is conveniently fed to the engine only when needed, and in controlled amounts, by a metering device actuated by the intake manifold vacuum.

Since expensive anti-detonant agents, such as tetraethyl lead, are only needed when the engine is operating under detonating conditions, the supplementary fuel of this invention contains such an agent and the main power fuel may be free from such agents, thereby effecting appreciable economies in the operation of the engine. Because the tetraethyl lead is only introduced into the engine during a small percentage of its operating cycle, deleterious deposits of lead oxide formed in the engine by oxidation of the tetraethyl lead are minimized.

The fuel of this invention is prepared by first dissolving the tetraethyl lead in the alcohol and then diluting the solution with a part only of the water. The corrosion inhibitor and emulsifier, such as a soluble oil composed of petroleum sodium sulfonates of the green acid type, fatty sodium soaps and a glycol, is admixed with sufficient kerosene to reduce its specific gravity to about the specific gravity of the alcohol solution. A small amount of water is then slowly stirred into the kerosene-diluted soluble oil. The resulting mixture is then slowly stirred into the lead-containing diluted alcohol to form the stable emulsion. If the emulsifier is first added to the water-containing solution and the kerosene then added, stratification will occur. This procedure makes possible the retention of the tetraethyl lead in solution without the aid of large amounts of hydrocarbons as heretofore deemed essential.

It is, then, an object of the invention to provide an anti-detonant type supplementary fuel for internal combustion engines containing small amounts of corrosion-inhibiting emulsifiers for stabilizing the fuel even when used in contact with corrodible metals.

A further object of the invention is to provide an anti-detonant type supplementary fuel composed essentially of alcohol and water and stabilized with a corrosion-inhibiting emulsifier having a specific gravity balanced with the specific gravity of the alcohol-water solution.

Another object of the invention is to provide a stable alcohol-water-oil emulsion which can contain more than 80% monohydric alcohol, as much as 3 cc. per gallon tetraethyl lead, and a hydrocarbon in an amount insufficient to have a power fuel value.

A specific object of the invention is to provide an anti-detonant supplementary fuel for inter-

3

nal combustion engines which is composed of 80 to 90% methanol, 10 to 20% water, up to 3 cc. per gallon tetraethyl lead, minute quantities of corrosion-inhibiting emulsifier containing fatty acid soaps, petroleum sulfonates of the green acid type and a glycol, together with sufficient kerosene to reduce the specific gravity of the emulsifier to about the specific gravity of the alcohol solution.

A general object of the invention is to provide an antidetonant type supplementary fuel for internal combustion engines in the form of a stable emulsion composed of from 10 to 90% monohydric alcohol containing from 1 to 5 carbon atoms, and 90 to 10% water, together with minute quantities of a corrosion-inhibiting stabilizer diluted with a hydrocarbon to render its specific gravity substantially equal to the specific gravity of the alcohol solution but free from sufficient hydrocarbon to have a power fuel-enriching effect.

A still further object of the invention is to provide an antidetonant supplementary fuel for internal combustion engines which is composed essentially of alcohol and water but is stabilized against oxidation and heat deterioration by small amounts of immiscible hydrocarbons rendered compatible with the solution by minute amounts of a suitable emulsifier.

A further object of the invention is to provide a stable, alcohol-type antidetonant fuel by admixing a corrosion inhibiting emulsifier with a hydrocarbon such as kerosene prior to the incorporation of the emulsifier into the alcohol solution, thereby avoiding stratification of the fuel.

A further object of the invention is to provide a method of forming stable alcohol-type fuels with immiscible ingredients by balancing the specific gravities of the immiscible ingredients relative to the alcohol solution.

A still further object of the invention is to provide a supplementary fuel which is immiscible with gasoline and is composed essentially of alcohol and water together with minute amounts of alcohol-insoluble ingredients stabilized in colloidal dispersed condition in the alcohol solution.

Other and further objects of the invention will be apparent to those skilled in the art from the following detailed description including the annexed sheet of drawings which illustrates the manner in which the supplementary fuel of this invention is metered to the engine as needed by the engine to prevent detonation therein.

On the drawings:

Figure 1 is a diagrammatic side elevational view of an internal combustion engine and fuel intake assembly equipped with a supplementary fuel injector or metering device for supplying supplementary fuel of this invention to the intake manifold of the engine.

Figure 2 is a vertical cross-sectional view, with parts in elevation, of the fuel injector or metering device used for supplying the supplementary fuel of this invention to the engine in properly metered required amounts only when needed by the engine.

As shown on the drawings:

In Figure 1 a high compression internal combustion engine E is equipped with the customary air and fuel-charging assembly including an air cleaner 10, and a carburetor 11 receiving air from the cleaner 10. A main power fuel from the feed line 12 supplies fuel to the carburetor 11 for admixture with the air to form the power fuel-air mixture. A mounting block 13 is interposed be-

4

tween the carburetor 11 and the inlet 14 of the intake manifold 15 for the engine E. The atomized power fuel-air mixture from the carburetor 11 passes through the block 13 to the inlet 14 and is distributed by the manifold 15 to the cylinders of the engine. The conventional fan 16 is provided on the engine.

A relatively small tank 17 for the supplementary anti-detonant fuel of this invention is mounted on the fire wall 18 of the vehicle driven by the engine E. The supplementary anti-detonant fuel is fed from the tank 17 through a feed line 19 to a metering device 20 mounted on the block 13.

The metering device 20, as best shown in Figure 2, includes a float 21 for controlling an inlet valve 22 receiving the supplementary fuel from the feed line 19. The float 21 is mounted in a float chamber 23 receiving the fuel from the inlet valve 22. The float chamber 23 is vented to the atmosphere at 24 and fuel under atmospheric pressure in the float chamber flows through a passage 25 to a diaphragm-controlled metering valve 26 and thence through a passageway 27 to a nozzle or jet pipe 28 carried by the block 13 and opening downstream into the inlet 14.

The metering valve 26 has a stem portion 26a slidably mounted in a boss provided by the float chamber-defining casing. The upper end of this stem is connected to a diaphragm 29 which separates the float chamber 23 from a spring chamber 30. The spring chamber 30 is vented by a passageway 31 to the interior of the block 13 so that the spring chamber is under the influence of the vacuum existing in the inlet 14 of the engine E. A spring 32 is mounted in the spring chamber 30 and is adjusted by means of an adjusting mechanism 33 to exert a downward pressure on the diaphragm 29 tending to open the metering valve 26. As vacuum builds up in the engine inlet 14, the chamber 30 is evacuated and the diaphragm 29 is raised against pressure of the spring 32 to move the metering valve toward closed position.

Since the supplementary fuel of this invention is only to be fed to the engine during those periods of operation when detonation may occur, and since such periods of engine operation are accompanied by decreased vacuum or increased pressure in the inlet 14, the spring 32 is effective to move the metering valve 26 toward open position because the decreased vacuum in the chamber 30 is insufficient to overcome the spring pressure. Supplementary fuel is thereupon injected in amounts determined by the opening of the metering valve and is discharged through the nozzle 28 to commingle with the atomized power fuel (gasoline) and air mixture in the inlet 14. The nozzle 28 has its discharge orifice facing downstream so that the supplementary fuel will be intimately admixed in fine spray form with the main power fuel-air mixture. Of course, as the intake manifold pressure decreases to increase the vacuum in the chamber 30, likelihood of detonation decreases and the diaphragm 29 will pull the metering valve to closed position or substantially closed position.

The throttle T controls the feed of the main power fuel-air mix to the inlet 14 and, of course, when this throttle is substantially closed, the intake vacuum is high. The degree of intake vacuum is therefore a function of the degree of opening of this throttle T and supplementary fuel is introduced under full throttle conditions under the influence of the intake manifold pressure con-

5

trolled by this throttle. Therefore, if desired, the operation of the metering valve 26 can be controlled by a linkage arrangement with the throttle valve.

In accordance with this invention, the main fuel supplied to the carburetor 11 by the feed line 12 will be free from expensive anti-detonants such as tetraethyl lead or, if desired, can contain smaller amounts of such anti-detonants than are necessary for satisfactory operation of the engine when all of the anti-detonant is fed with the power fuel. The supplementary fuel of this invention entirely offsets the anti-detonant deficiency of the main fuel.

Reference to tetraethyl lead ( $\text{Pb}(\text{C}_2\text{H}_5)_4$ ) throughout this specification and in the claims denotes the commercial product containing ethylene dibromide and ethylene dichloride in minor amounts. This commercial product, under the present Federal health laws of the United States, can only be used in maximum concentrations in fuels which are vended to the public, in amounts up to 3 cc. per gallon, and the supplementary fuels of this invention therefore contain sufficient solvents for the tetraethyl lead to prevent its concentration beyond the legal limits. Thus, if 3 cc. of tetraethyl lead per gallon are to be used, the supplementary fuel should contain sufficient alcohol to dissolve this amount of tetraethyl lead. For this purpose, the fuels should contain at least 73.5% methanol, at least 55.1% ethanol, or at least 38.5% isopropanol. Of course, it should be understood that lesser amounts of the tetraethyl lead could be used with fuels containing larger percentages of water.

The corrosion-inhibiting emulsifiers used for stabilizing the fuels of this invention are wetting agents which coat metal surfaces and emulsify such immiscible materials as aqueous alcohol solutions and petroleum hydrocarbons. Fatty acid soaps, such as sodium or potassium salts of oleic, stearic, linoleic, and ricinoleic acids, and rosin soaps, such as sodium or potassium abietates, are satisfactory. These soaps conventionally contain free glycerine or other glycols which are soluble in water, and liquid at room temperatures. The preferred corrosion-resisting emulsifier, however, has the following composition expressed in percentages by weight:

- 5 to 15% fatty acid sodium soaps such as sodium oleates;
- 80 to 90% petroleum sodium sulfonates having molecular weights ranging from 250 to 500 and composed essentially of sodium salts of sulfonated petroleum acids of the green acid type;
- 5 to 10% glycols such as diethylene glycol.

A suitable corrosion-inhibiting emulsifier of the above listed preferred type is known as "Penola 2210," and is manufactured by the Standard Oil Company of New Jersey. This material has a specific gravity of 1.05 to 1.10. It can be diluted with a petroleum hydrocarbon such as kerosene to yield a mixture having a reduced specific gravity that is balanced with the specific gravity of the alcohol-water solution of the fuel.

It is preferred to dilute the corrosion-inhibiting emulsifier with sufficient lighter petroleum hydrocarbon so that the resulting diluted mixture has a specific gravity that is not appreciably more than, and preferably slightly less than, the water-alcohol solution in which it is to be used. When these conditions are maintained, the resulting emulsion will be stable at all temperatures including the high temperatures encoun-

6

tered under the hood of an engine where the supplementary fuel is stored in a tank such as 17. This petroleum hydrocarbon diluted corrosion-inhibiting emulsifier serves a three-fold function, as follows:

- (1) Prevention of the corrosion of various metal parts in which the supplementary fuel is stored or through which it flows en route to the engine;
- (2) Prevention of the precipitation of breakdown products of the corrosion inhibitor;
- (3) Prevention of formation of precipitation products produced by oxidation of the alcohol.

The kerosene or other petroleum hydrocarbon to be admixed with the corrosion-inhibiting emulsifier should preferably have a specific gravity in the range from about 0.78 to about 0.81, so that the blending of the kerosene with the emulsifier in varying proportions will result in specific gravities extending over the desired range determined by the specific gravity of the alcohol-water solution. For example, if a supplementary fuel containing 85% methanol and 15% water is desired, the specific gravity of this mixture will be 0.843, and a suitable kerosene-diluted emulsifier can be obtained by mixing 5 parts of kerosene with 1 part of the above-described "Penola" type emulsifier, which has an average specific gravity of 1.07. This will yield a kerosene-soluble oil mixture having a specific gravity of 0.845. In general, it is desirable that the specific gravity of the kerosene-emulsifier mixture lie within the range of from 0.95 to 1.05 times the specific gravity of the desired alcohol-water solution. The specific gravity of the emulsifier can therefore be easily controlled by controlling the percentage of the kerosene in the mixture.

The emulsifier itself is used in very minute quantities, being less than 1% by weight of the fuel and preferably only about  $\frac{1}{4}$  of 1% by weight of the fuel. The following specific example illustrates a preferred method of compounding a supplementary fuel according to this invention composed essentially of methanol and water:

#### Example

To produce 1 gallon of a stable supplementary fuel composed of about 85% by volume of methanol, and about 15% by volume of water, 2.3 to 3.0 cc. of tetraethyl lead are added to 0.84 to 0.86 gallon of pure methanol. The tetraethyl lead will readily dissolve in the alcohol. If the commercial "62 mix" yellow "Ethyl" anti-knock compound is used, about 4.72 to 5.05 cc. are dissolved into the alcohol. The methanol-tetraethyl lead solution is then diluted with 0.13 gallon of water and is allowed to stand.

A soluble oil corrosion-inhibiting emulsifier of the "Penola" type consisting mainly of alkali metal salts of sulfonated petroleum acids of the green acid type with small amounts of fatty acid soaps, such as sodium oleate and free glycols such as diethylene glycol in the amount of 3.83 to 4.15 grams is slowly stirred into 24.90 to 25.70 cc. of kerosene having a specific gravity of .78 to .81. The emulsifier has a specific gravity of about 1.05 to 1.10. The stirring is continued to produce a mixture of uniform viscosity. About 0.02 gallon of water is then slowly stirred into the kerosene mixture. It is important that the emulsifier be admixed with the kerosene prior to the incorporation of the water, in order to produce a stable emulsion. The uniform mixture of emulsifier, kerosene, and water is then added slowly to the alcohol solution, with constant stirring to produce the stable emulsion.

The kerosene content of the thus produced stable emulsion is somewhat in excess of the amount necessary for insuring the reduction of the specific gravity of the emulsifier to the specific gravity of the alcohol-water solution so as to allow for some loss through evaporation. It has been found that some of this kerosene will separate to form a very thin layer covering the top of the fuel and thereby further protecting it against oxidation. In general, the kerosene or other hydrocarbon is used within the range of from 75 to 90% by weight of the weight of the emulsifier. The kerosene-diluted emulsifier is present in amounts equivalent to about  $\frac{3}{4}$  of 1% by weight of the fuel. Instead of adding all of the kerosene to the emulsifier, a mixture of 75% kerosene and 25% emulsifier can be prepared and added to the alcohol solution in an amount equivalent to about  $\frac{1}{2}$ % by weight of the fuel. After this addition has been completed, kerosene in the amount equivalent to about  $\frac{1}{4}$  of 1% by weight of the fuel can then be added to provide the excess kerosene for insuring the maintenance of the specific gravity of the emulsifier within the desired range.

Since the specific gravity of isopropanol and ethanol is approximately the same as the specific gravity of methanol, the above-indicated procedures for producing the methanol-type fuel can be used to produce fuels composed of these other alcohols.

From the above descriptions it should therefore be understood that gasoline-immiscible anti-detonating supplementary fuels composed essentially of aqueous solutions of monohydric alcohol containing from 1 to 5 carbon atoms such as methanol, ethanol, and isopropanol, are rendered stable and non-corrosive by the addition of corrosion-inhibiting emulsifiers and petroleum hydrocarbons such as kerosene. These fuels preferably contain anti-knock agents such as tetraethyl lead. The alcohol content of the fuel can vary over a wide range, but should be sufficient to maintain the tetraethyl lead in solution. Very effective fuels, according to this invention, contain from 80 to 90% alcohol and from 10 to 20% water, with the preferred fuels containing about 85% alcohol and about 15% water. The preferred corrosion-inhibiting emulsifier for use with the fuels of this invention is composed of a sodium salt of sulfonated petroleum acids of the green acid type, small amounts of fatty acid soaps and free glycols. These emulsifiers are diluted with hydrocarbons such as kerosene to reduce their specific gravity to lie within the range of about 0.95 to 1.05 times the specific gravity of the aqueous alcohol solution. When so diluted, the emulsifiers will produce a stable emulsion. The added hydrocarbons present are in amounts insufficient to have any power fuel-enriching effect on the main power fuel fed to the engine. In addition, the hydrocarbon will

form a thin film on the aqueous alcohol solution to seal the solution from contact with the air, thereby further protecting it against oxidation. The fuels of this invention are stable even at high temperatures and will not form slimes and precipitates heretofore encountered with the use of alcohol-type fuels.

It will, of course, be understood that various details of the process and product may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

15 I claim as my invention:

1. A stable anti-knock supplementary fuel emulsion consisting of a solution composed of 10 to 20% by volume of water, 80 to 90% by volume of lower monohydric alcohol containing from 1 to 5 carbon atoms and about 3 cc. per gallon of tetra-ethyl-lead together with from  $\frac{3}{4}$  to 1% by weight of a mixture consisting of a soluble oil corrosion inhibiting emulsifier containing alkali metal salts of sulfonated petroleum acids of the green acid type, fatty acid soaps and glycols, and a sufficient amount of kerosene of a specific gravity range between about 0.78 to about 0.81 to reduce the specific gravity of said mixture to about 0.95 to 1.05 times the specific gravity of said solution.

2. A stable anti-knock fuel emulsion consisting of a solution composed of about 85% by volume of methanol, about 15% by volume of water, and about 3 cc. per gallon of tetra-ethyl-lead together with from  $\frac{3}{4}$  to about 1% by weight of a mixture consisting of a soluble oil corrosion inhibiting emulsifier containing alkali metal salts of sulfonated petroleum acids of the green acid type, fatty acid soaps and glycols, and a sufficient amount of kerosene of a specific gravity range between about 0.78 to about 0.81 to reduce the specific gravity of said mixture to about 0.95 to 1.05 times the specific gravity of said solution.

MILTON S. ROUSH.

#### REFERENCES CITED

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

#### UNITED STATES PATENTS

Number	Name	Date
1,869,486	Lantz	Aug. 2, 1932
2,316,739	Cook	Apr. 13, 1943
2,404,094	Robertson	July 16, 1946
2,429,707	Catalano	Oct. 28, 1947
2,504,361	Van Hartesveldt	Apr. 18, 1950

#### OTHER REFERENCES

60 "Sulphonation Products of Mineral Oil," Reuben Sperling, pages 890-897, Industrial and Eng. Chem., May 1948.