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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0492611-0828
	Application Number	
Title of Invention	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES	

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Prefix	Given Name	Middle Name	Family Name	Suffix
	Leslie		Bromberg	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

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Citizenship under 37 CFR 1.41(b) i	US

Mailing Address of Applicant:

Address 1			
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	Daniel	R.	Cohn	

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Citizenship under 37 CFR 1.41(b) i	US

Mailing Address of Applicant:

Address 1			
Address 2			
City		State/Province	
Postal Code		Country i	

Applicant 3 Remove

Applicant Authority	◉ Inventor	○ Legal Representative under 35 U.S.C. 117	○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	John	B.	Heywood	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Newton	State/Province	MA	Country of Residence i	US

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Citizenship under 37 CFR 1.41(b) [i]	US		
Mailing Address of Applicant:			
Address 1			
Address 2			
City		**State/Province**	
Postal Code		**Country**[i]	

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Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	24280		
Email Address	spasternack@choate.com	Add Email	Remove Email
Email Address	patentdocket@choate.com	Add Email	Remove Email

Application Information:

Title of the Invention	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES		
Attorney Docket Number	0492611-0828	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)		**Sub Class (if any)**	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	3	**Suggested Figure for Publication (if any)**	3

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S. C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	24280		

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Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	11/758157	2007-06-05

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

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Application Number	Country [i]	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
			◉ Yes ○ No

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Assignee 1 Remove

If the Assignee is an Organization check here. ☒			
Organization Name	Massachusetts Institute of Technology		
Mailing Address Information:			
Address 1	77 Massachusetts Avenue		
Address 2			
City	Cambridge	**State/Province**	MA
Country [i]	US	Postal Code	02139
Phone Number		Fax Number	
Email Address			

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Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.					
Signature	/SamPasternack/			Date (YYYY-MM-DD)	2008-01-25
First Name	Sam	Last Name	Pasternack	Registration Number	29576

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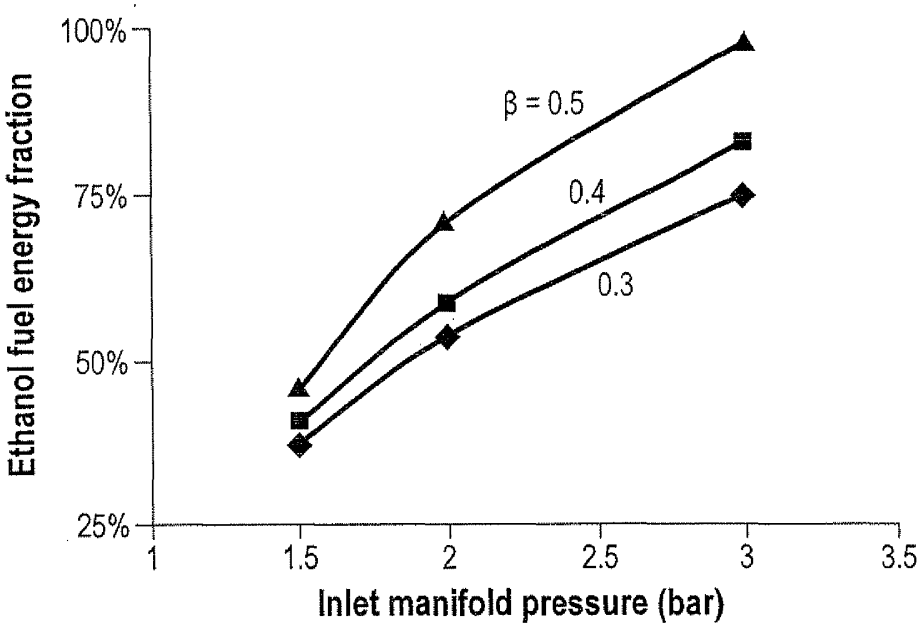
100%
75%
50%
25%
Ethanol fuel energy fraction
β = 0.5
0.4
0.3
1
1.5
2
2.5
3
3.5
Inlet manifold pressure (bar)

Fig. 1

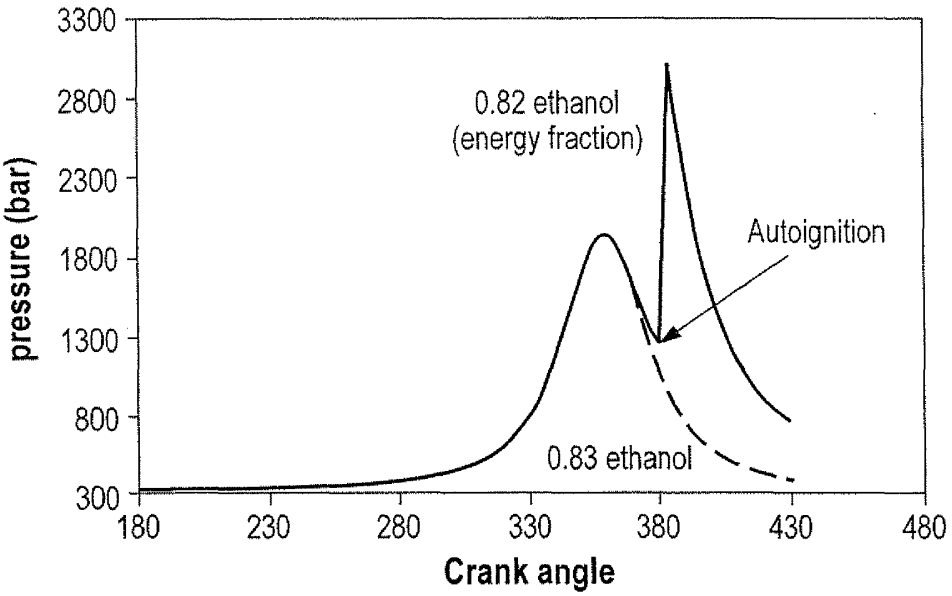
3300
2800
2300
1800
1300
800
300
pressure (bar)
0.82 ethanol
(energy fraction)
Autoignition
0.83 ethanol
180
230
280
330
380
430
480
Crank angle

Fig. 2a

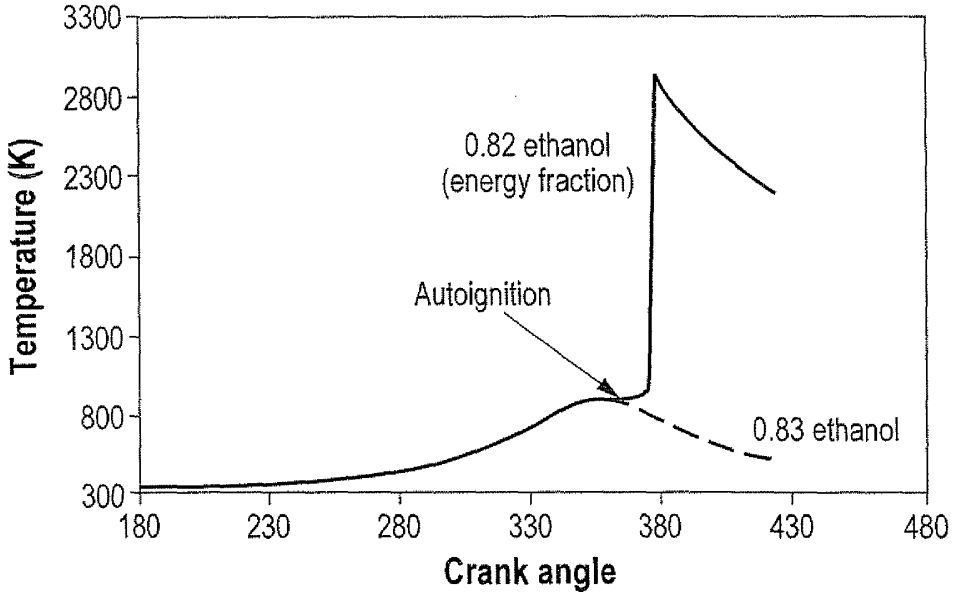
Temperature (K)
3300
2800
2300
1800
1300
800
300
180
230
280
330
380
430
480
Crank angle
0.82 ethanol
(energy fraction)
Autoignition
0.83 ethanol

Fig. 2b

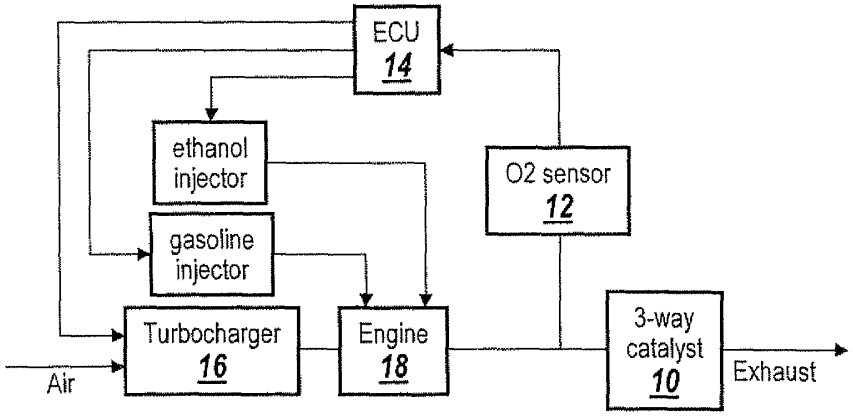
ECU
14
ethanol injector
gasoline injector
O2 sensor
12
Turbocharger
16
Engine
18
3-way catalyst
10
Air
Exhaust

Fig. 3

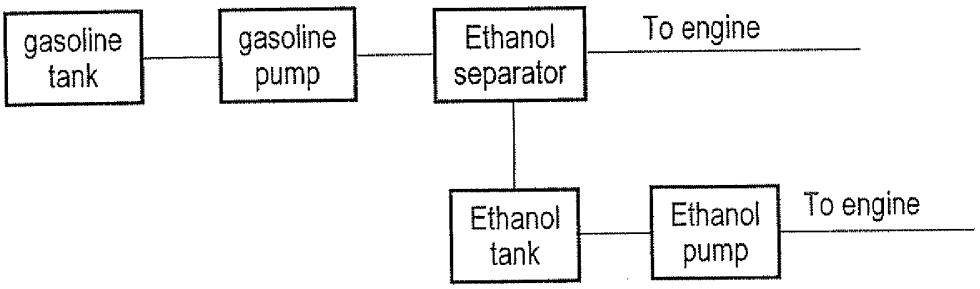

Fig. 4a

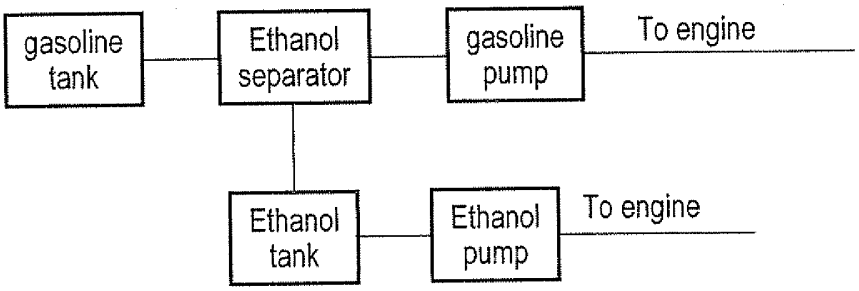

Fig. 4b

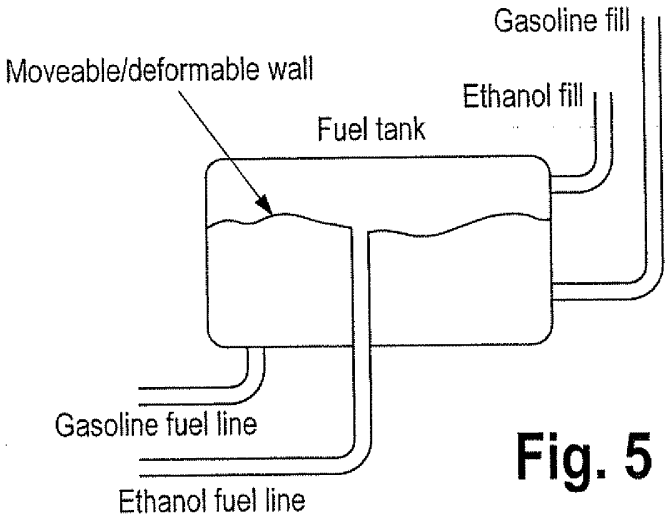

Fig. 5

OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

This application is a continuation of U.S. Patent Application Serial number 11/758,157 filed June 5, 2007, which is a continuation of U.S. Patent Application serial number 11/100, 026 filed April 6, 2005, now U.S. Patent number 7,225,787 the contents of both of which are incorporated herein by reference.

Background of the Invention

This invention relates to an optimized fuel management system for use with spark ignition gasoline engines in which an anti-knock agent which is a fuel is directly injected into a cylinder of the engine.

There are a number of important additional approaches for optimizing direct injection ethanol enhanced knock suppression so as to maximize the increase in engine efficiency and to minimize emissions of air pollutants beyond the technology disclosed in parent application serial number 10/991,774 set out above. There are also additional approaches to protect the engine and exhaust system during high load operation by ethanol rich operation; and to minimize cost, ethanol fuel use and ethanol fuel storage requirements. This disclosure describes these approaches.

These approaches are based in part on more refined calculations of the effects of variable ethanol octane enhancement using a new computer model that we have developed. The model determines the effect of direct injection of ethanol on the occurrence of knock for different times of injection and mixtures with port fuel injected gasoline. It determines the beneficial effect of evaporative cooling of the direct ethanol injection upon knock suppression.

Summary of the Invention

In one aspect, the invention is a fuel management system for operation of a spark ignition gasoline engine including a gasoline engine and a source of an anti-knock agent which is a fuel. The use of the anti-knock agent provides gasoline savings both by facilitating increased engine efficiency over a drive cycle and by substitution for gasoline as a fuel. An injector is provided for direct injection of the anti-knock agent into a cylinder of the engine and a fuel management control system controls injection of the anti-knock agent into the cylinder to control knock. The injection of the antiknock agent can be initiated by a signal from a knock sensor. It can also be

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IPR2020-00013

initiated when the engine torque is above a selected value or fraction of the maximum torque where the value or fraction of the maximum torque is a function of the engine speed. In a preferred embodiment, the injector injects the anti-knock agent after inlet valve/valves are closed. It is preferred that the anti-knock agent have a heat of vaporization that is at least twice that of gasoline or a heat of vaporization per unit of combustion energy that is at least three times that of gasoline. A preferred anti-knock agent is ethanol. In a preferred embodiment of this aspect of the invention, part of the fuel is port injected and the port injected fuel is gasoline. The directly injected ethanol can be mixed with gasoline or with methanol. It is also preferred that the engine be capable of operating at a manifold pressure at least twice that pressure at which knock would occur if the engine were to be operated with naturally aspirated gasoline. A suitable maximum ethanol fraction during a drive cycle when knock suppression is desired is between 30% and 100% by energy. It is also preferred that the compression ratio be at least 10. With the higher manifold pressure, the engine can be downsized by a factor of two and the efficiency under driving conditions increased by 30%.

It is preferred that the engine is operated at a substantially stoichiometric air/fuel ratio during part or all of the time that the anti-knock agent such as ethanol is injected. In this case, a three-way catalyst can be used to reduce the exhaust emissions from the engine. The fuel management system may operate in open or closed loop modes.

In some embodiments, non-uniform ethanol injection is employed. Ethanol injection may be delayed relative to bottom dead center when non-uniform ethanol distribution is desired.

Many other embodiments of the invention are set forth in detail in the remainder of this application.

Brief Description of the Drawings

Fig. 1 is a graph of ethanol fraction (by energy) required to avoid knock as a function of inlet manifold pressure. The ethanol fraction is shown for various values of β, the ratio of the change in temperature in the air cylinder charge due to turbocharging (and aftercooling if used) to the adiabatic temperature increase of the air due to the turbocharger.

Fig. 2a is a graph of cylinder pressure as a function of crank angle for a three bar manifold pressure.

Fig. 2b is a graph of charge temperature as a function of crank angle for a three bar manifold pressure.

Fig. 3 is a schematic diagram of an embodiment of the fuel management system disclosed herein for maintaining stoichiometric conditions with metering/control of ethanol, gasoline, and air flows into an engine.

Figs. 4a and 4b are schematic illustrations relating to the separation of ethanol from ethanol/gasoline blends.

Fig. 5 is a cross-sectional view of a flexible fuel tank for a vehicle using ethanol boosting of a gasoline engine.

Description of the Preferred Embodiment

Ethanol has a heat of vaporization that is more than twice that of gasoline, a heat of combustion per kg which is about 60% of that of gasoline, and a heat of vaporization per unit of combustion energy that is close to four times that of gasoline. Thus the evaporative cooling of the cylinder air/fuel charge can be very large with appropriate direct injection of this antiknock agent. The computer model referenced below shows that evaporative cooling can have a very beneficial effect on knock suppression. It indicates that the beneficial effect can be maximized by injection of the ethanol after the inlet valve that admits the air and gasoline into the cylinder is closed. This late injection of the ethanol enables significantly higher pressure operation without knock and thus higher efficiency engine operation than would be the case with early injection. It is thus preferred to the conventional approach of early injection which is used because it provides good mixing. The model also provides information that can be used for open loop (*i.e.*, a control system that uses predetermined information rather than feedback) fuel management control algorithms.

The increase in gasoline engine efficiency that can be obtained from direct injection of ethanol is maximized by having the capability for highest possible knock suppression enhancement. This capability allows the highest possible amount of torque when needed and thereby facilitates the largest engine downsizing for a given compression ratio.

Maximum knock suppression is obtained with 100% or close to 100% use of direct injection of ethanol. A small amount of port injection of gasoline may be useful in order to obtain combustion stability by providing a more homogeneous mixture. Port fuel injection of gasoline also removes the need for a second direct fuel system or a more complicated system which uses one set of injectors for both fuels. This can be useful in minimizing costs.

The maximum fraction of ethanol used during a drive cycle will depend upon the engine system design and the desired level of maximum torque at different engine speeds. A representative range for the maximum ethanol fraction by energy is between 20% and 100%.

In order to obtain the highest possible octane enhancement while still maintaining combustion stability, it may be useful for 100% of the fuel to come from ethanol with a fraction being port injected, as an alternative to a small fraction of the port-fueled gasoline.

The initial determination of the knock suppression by direct injection of ethanol into a gasoline engine has been refined by the development of a computer model for the onset of knock under various conditions. The computer modeling provides more accurate information for use in fuel management control. It also shows the potential for larger octane enhancements than our earlier projections. Larger octane enhancements can increase the efficiency gain through greater downsizing and higher compression ratio operation. They can also reduce the amount of ethanol use for a given efficiency increase.

The computer model combines physical models of the ethanol vaporization effects and the effects of piston motion of the ethanol/gasoline/air mixtures with a state of the art calculational code for combustion kinetics. The calculational code for combustion kinetics was the engine module in the CHEMKIN 4.0 code [R. J. Kee, F. M. Rupley, J. A. Miller, M. E. Coltrin, J. F. Grcar, E. Meeks, H. K. Moffat, A. E. Lutz, G. Dixon-Lewis, M. D. Smooke, J. Warnatz, G. H. Evans, R. S. Larson, R. E. Mitchell, L. R. Petzold, W. C.Reynolds, M. Caracotsios, W. E. Stewart, P. Glarborg, C. Wang, O. Adigun, W. G. Houf, C. P. Chou, S. F. Miller, P. Ho, and D. J. Young, CHEMKIN Release 4.0, Reaction Design, Inc., San Diego, CA (2004)]. The CHEMKIN code is a software tool for solving complex chemical kinetics problems. This new model uses chemical rates information based upon the Primary Reference gasoline Fuel (PRF) mechanism from Curran *et al.* [Curran, H. J., Gaffuri, P., Pitz, W. J., and Westbrook, C. K. "A Comprehensive Modeling Study of iso-Octane Oxidation," *Combustion and Flame* **129**:253-280 (2002) to represent onset of autoignition.

The compression on the fuel/air mixture end-gas was modeled using the artifact of an engine compression ratio of 21 to represent the conditions of the end gas in an engine with an actual compression ratio of 10. The end gas is defined as the un-combusted air/fuel mixture remaining after 75% (by mass) of the fuel has combusted. It is the end gas that is most prone to autoignition (knock). The larger compression ratio includes the effect of the increase in pressure

in the cylinder due to the energy released in the combustion of 75% of the fuel that is not in the end gas region. The effect of direct ethanol vaporization on temperature was modeled by consideration of the effects of the latent heat of vaporization on temperature depending upon the time of the injection.

The effect of temperature increase due to turbocharging was also included. The increase in temperature with turbocharging was calculated using an adiabatic compression model of air. It is assumed that thermal transfer in the piping or in an intercooler results in a smaller temperature increase. The effect is modeled by assuming that the increase in temperature of the air charge into the cylinder ΔT_{charge} is $\Delta T_{charge} = \beta \Delta T_{turbo}$ were ΔT_{turbo} is the temperature increase after the compressor due to boosting and beta is a constant. Values of β of 0.3, 0.4 and 0.6 have been used in the modeling. It is assumed that the temperature of the charge would be 380 K for a naturally aspirated engine with port fuel injection gasoline.

Fig. 1 shows the predictions of the above-referenced computer model for the minimum ethanol fraction required to prevent knock as a function of the pressure in the inlet manifold, for various values of β. In Fig. 1 it is assumed that the direct injection of the ethanol is late (i.e. after the inlet valve that admits air and gasoline to the cylinder is closed) and a 87 octane PRF (Primary Reference Fuel) to represent regular gasoline. The corresponding calculations for the manifold temperature are shown in Table 1 for the case of a pressure in the inlet manifold of up to 3 bar for an engine with a conventional compression ratio of 10. The temperature of the charge varies with the amount of ethanol directly injected and is self-consistently calculated in Table 1 and Fig. 1. The engine speed used in these calculations is 1000 rpm.

Table 1

Computer model calculations of temperature and ethanol fraction required for knock prevention for an inlet manifold pressure of 3 bar for an engine with a compression ratio of 10, for various values of β (ratio of change of the cylinder air charge temperature due to turbocharging to the adiabatic temperature increase due to turbocharging $\Delta T_{charge} = \beta \Delta T_{turbo}$). The engine speed is 1000 rpm.

β		0.3	0.4	0.6
T_charge init	K	380	380	380
Delta T turbo	K	180	180	180
Delta T after intercooler	K	54	72	108
Delta T due to DI ethanol and gasoline	K	-103	-111	-132
T_init equivalent charge	K	331	341	356
Gasoline octane		87	87	87
Ethanol fraction (by energy) needed to prevent knock		74%	82%	97%

Direct fuel injection is normally performed early, before the inlet valve is closed in order to obtain good mixing of the fuel and air. However, our computer calculations indicate a substantial benefit from injection after the inlet valve is closed.

The amount of air is constant in the case of injection after the inlet valve has closed. Therefore the temperature change is calculated using the heat capacity of air at constant volume (c_v). The case of early injection where the valve that admits air and fuel to the cylinder is still open is modeled with a constant-pressure heat capacity (c_p). The constant volume case results in a larger evaporation induced decrease in charge temperature than in the case for constant pressure, by approximately 30%. The better evaporative cooling can allow operation at higher manifold pressure (corresponding to a greater octane enhancement) without knock that would be the case of early injection by a difference of more than 1 bar. The increase in the evaporative cooling effect at constant volume relative to that at constant pressure is substantially higher for the case of direct injection of fuels such as ethanol and methanol than is the case for direct injection of gasoline.

Typical results from the calculations are shown in Fig. 2. The figure shows the pressure (a) and the temperature (b) of the cylinder charge as a function of crank angle, for a manifold pressure of 3 bar and a value of $\beta = 0.4$ Two values of the ethanol fraction are chosen, one that results in autoignition, and produces engine knock (0.82 ethanol fraction by fuel energy), and the other one without autoignition, i.e., no knock (0.83 ethanol fraction). Autoignition is a threshold phenomenon, and in this case occurs between ethanol fractions of 0.82 and 0.83. For an ethanol energy fraction of 0.83, the pressure and temperature rise at 360^{o} (top dead center) is due largely to the compression of the air fuel mixture by the piston. When the ethanol energy fraction is reduced to 0.82, the temperature and pressure spikes as a result of autoignition. Although the autoignition in Figure 2 occurs substantially after 360 degrees, the autoignition timing is very sensitive to the autoignition temperature (5 crank angle degrees change in autoignition timing for a change in the initial temperature of 1 K, or a change in the ethanol energy fraction of 1%).

The effect of evaporative cooling from the antiknock agent (in this case, ethanol) is shown in Table 2, where three cases are compared. The first one is with port fuel injection of ethanol. In this case the vaporization of the ethanol on the walls of the manifold has a negligible impact on the temperature of the charge to the cylinder because the walls of the manifold are cooled rather than the air charge. The second case assumes direct injection, but with the inlet valve open, with evaporation at constant pressure, where the cooling of the charge admits additional air to the cylinder. The third case assumes, as in the previous discussions, late injection after the inlet valve has closed. It is assumed stoichiometric operation, that the baseline temperature is 380 K, and that there is cooling in the manifold after the turbocharger with $\beta = 0.4$.

Table 2

Knock-free operation of ethanol port fuel injection (assuming no charge cooling), and of direct injection before and after the inlet valve is closed. Compression ratio of 10, baseline charge temperature of 380 K, intercooler/cooling post turbo with $\beta = 0.4$,stoichiometric operation, gasoline with 87 RON. Engine speed is 1000 rpm.

	No Evaporative Cooling	Evaporative cooling	
		Before Valve Closing	After Valve Closing
Ethanol fraction (by energy)	0.95	0.95	0.95
Max manifold pressure (bar)	1.05	2.4	4.0
Cylinder pressure after cooling (bar)	1.05	2.4	3.0
Cylinder charge temperature after cooling (K)	383	360	355

The results indicate the strong effect of the cooling. The maximum manifold pressure that prevents knock (without spark retard), with 0.95 ethanol fraction by energy in the case of port fuel injection is 1.05 bar. With direct injection of the ethanol, the maximum knock-free manifold and cylinder pressures are 2.4 bar, with a temperature decrease of the charge of ~75K. The final case, with injection after inlet valve closing, allows a manifold pressure of 4 bar, a cylinder pressure (after cooling) of 3 bar, and a charge temperature decrease of ~120 K. It should be noted that the torque of the late injection case after the valve has closed is actually higher than that of the early injection case, even though the early injection case allows for additional air (at constant pressure). For comparison, the model is also used to calculate the manifold pressure at which knock would occur for port fuel injection of 87 octane gasoline alone. This pressure is ~ 0.8 bar assuming spark timing at MBT (Maximum Brake Torque). Conventional gasoline engines operate at 1 bar by retarding the timing at high torque regions where knock would otherwise occur. Thus the model indicates that evaporative cooling effect of direct injection of ethanol after the inlet valve has closed can be significantly greater than that of the higher octane number rating of ethanol relative to gasoline.

A manifold pressure of 4 bar is very aggressive. Table 2 is indicative of the dramatically improved performance of the system with direct injection after the inlet valve has closed. The

improved performance in this case can be traded for increased compression ratio or reduced use of the anti-knock agent.

It should be noted that, as mentioned above, the calculations of autoignition (knock) are conservative, as autoignition for the case shown in Fig. 2 occurs relatively late in the cycle, and it is possible that the fuel has been combusted before it autoignites. Also it should be noted that the calculations in Fig. 2 break down after autoignition, as the pressure trace would be different from that assumed. Figures similar to Fig. 2 are used to determine conditions where autoignition would not occur, and those conditions are then used to provide the information for Fig. 1. The initial temperatures of the cases shown in Fig. 2 are 341 K for 0.82 ethanol fraction, and 340 K for 0.83 ethanol fraction, a difference of 1 K (the difference due to the cooling effect of the ethanol).

Because of the large heat of vaporization, there could be enough charge cooling with early injection so that the rate of vaporization of ethanol is substantially decreased. By instead injecting into the hot gases, which is the case with injection after the inlet valve has closed, the temperature at the end of full vaporization of the ethanol is substantially increased with respect to early injection, increasing the evaporation rate and minimizing wall wetting.

The optimum timing of the injection for best mixing and a near homogeneous charge is soon after the inlet valve closes, provided that the charge is sufficiently warm for antiknock agent vaporization. If, on the other hand, a non-uniform mixture is desired in order to minimize ethanol requirements and improve ignition stability, then the injection should occur later than in the case where the best achievable mixing is the goal.

Late injection of the ethanol after the inlet valve has closed can be optimized through the use of diesel-like injection schemes, such as injectors with multiple sprays. It is important to inject the fuel relatively quickly, and at velocities which minimize any cylinder wall wetting, which as described below could result in the removal of the lubrication oils from the cylinder liner. Multiple sprays from a nozzle that has multiple holes results in a distributed pattern of sprays, with relatively low injection velocities. This is particularly important for ethanol, because of the higher volume throughputs (as compared with gasoline) of ethanol for equal energy content.

Injection after the valve has closed may require that a modest fraction of the fuel (e.g. 25%) be port injected in order to achieve the desired combustion stability. A tumble-like or swirl

motion can be introduced to achieve the desired combustion stability. The port injected fuel can be either gasoline or ethanol.

Use of the computer model for operation with gasoline alone gives results that are consistent with the observed occurrence of knock in gasoline engine vehicles, thereby buttressing the credibility of the projections for ethanol. The computer model indicates that for knock-free gasoline operation alone with a compression ratio of 10, knock imposes a severe constraint upon the allowed manifold pressure for a naturally aspirated gasoline engine and very limited (*i.e.*, less than 1.2 bar) manifold pressure can be achieved even with direct injection of gasoline unless spark retard and/or rich operation is used. These changes, however, can reduce efficiency and increase emissions.

Fig. 1 shows that knock can be prevented at manifold pressures greater than 2 bar with direct injection of an ethanol fraction of between 40 and 80% in an engine with a compression ratio of 10. The manifold pressure can be at least 2.5 bar without engine knock. A pressure of 3 bar would allow the engine to be downsized to ~1/3 of the naturally aspirated gasoline engine, while still producing the same maximum torque and power. The large boosting indicated by the calculations above may require a multiple-stage turbocharger. In addition to a multiple stage turbocharger, the turbocharger may be of the twin-scroll turbo type to optimize the turbocharging and decrease the pressure fluctuations in the inlet manifold generated by a small number of cylinders.

With an increase in allowed manifold pressure in an engine by more than a factor of 2, the engine could be downsized by a factor of 2 (that is, the cylinder volume is decreased by a factor of 2 or more) and the compression ratio could be held constant or raised. For example, the performance of an eight cylinder engine is achieved by a four cylinder engine.

The occurrence of knock at a given value of torque depends upon engine speed. In addition to providing substantially more maximum torque and power, direct injection of ethanol can be used to provide a significant improvement in torque at low engine speeds (less than 1500 rpm) by decreasing or eliminating the spark retard. Spark retard is generally used with gasoline engines to prevent knock at low engine speeds where autoignition occurs at lower values of torque than is the case at high engine speeds.

Fig. 1 can also be used to determine the ethanol fraction required to prevent knock at different levels of torque and horsepower, which scale with manifold pressure in a given size engine. This information can be used in an open loop control system.

The efficiency of a gasoline engine under driving conditions using direct ethanol injection enhancement can be at least 20% and preferably at least 30 % greater than that of a naturally aspirated gasoline engine with a compression ratio of 10. This increase results from the substantial engine boosting and downsizing to give the same power, and also the high compression ratio operation (compression ratio of 11 or greater) that is enabled by a large octane enhancement. With more aggressive downsizing of more than 50% (where the same engine performance is obtained with less than one-half the displacement), the increase in efficiency could exceed 30%.

Greater downsizing and higher efficiency may also be obtained by decreasing the octane requirement of the engine by using variable valve timing (VVT). Thus, at conditions of high torque, variable valve timing can be used to decrease the compression ratio by appropriately changing the opening/closing of the inlet and exhaust valves. The loss in efficiency at high torque has a small impact on the overall fuel economy because the engine seldom operates in these conditions.

VVT can also be used to better scavenge the exhaust gases [B. Lecointe and G. Monnier, "Downsizing a Gasoline Engine Using Turbocharging with Direct Injection" SAE paper 2003-01-0542]. Decreasing the exhaust gas decreases the air/fuel temperature. Keeping both the inlet and exhaust valves open, while the pressure in the inlet manifold is higher than in the exhaust, can be used to remove the exhaust gases from the combustion chamber. This effect, coupled with slightly rich operation in-cylinder, can result in increased knock avoidance while the exhaust is still stoichiometric. Cooled EGR and spark timing adjustment can also be used to increase knock avoidance.

Any delay in delivering high engine torque at low engine speeds can decrease drivability of the vehicle. Under these conditions, because of the substantial engine downsizing, the vehicle would have insufficient acceleration at low engine speeds until the turbo produces high pressures. This delay can be removed through the use of direct injection of ethanol by reduction of the spark retard or ethanol/gasoline with rich operation and also with the use of variable valve timing.

Another approach would be to use an electrically assisted turbo charger. Units that can generate the required boosting for short periods of time are available. The devices offer very fast response time, although they have substantial power requirements.

A multiple scroll turbocharger can be used to decrease the pressure fluctuations in the manifold that could result from the decreased number of cylinders in a downsized engine.

The temperature of the air downstream from the turbocharger is increased by the compression process. Use of an intercooler can prevent this temperature increase from increasing the engine's octane requirement. In addition, in order to maximize the power available from the engine for a given turbocharging, cooling of the air charge results in increased mass of air into the cylinder, and thus higher power.

In order to minimize emissions, the engine should be operated substantially all of the time, or most of the time, with a stoichiometric air/fuel ratio in order that a 3-way exhaust catalyst treatment can be used. Fig. 3 shows a 3-way exhaust treatment catalyst 10 and air, gasoline and ethanol control needed to maintain the substantially stoichiometric ratio of fuel to air that is needed for its effective operation. The system uses an oxygen sensor 12 as an input to an electronic control unit (ECU) 14. The ECU 14 controls the amount of air into a turbocharger 16, the amount of gasoline and the amount of ethanol so as to insure stoichiometric operation. During transients, open-loop algorithms from a stored engine map (not shown) are used to determine air, gasoline and ethanol flows for keeping substantially stoichiometric combustion in a cylinder of the engine 18.

Thus when variable ethanol octane enhancement is employed, the fuel management system needs to adjust the amounts of air, gasoline and ethanol such that the fuel/air ratio is substantially equal to 1. The additional control is needed because, if the air/gasoline ratio determined by the fuel management were not be corrected during the injection of ethanol, the mixture would no longer be stoichiometric. In contrast to the lean boost approach of Stokes *et al* .[J. Stokes, T. H. Lake and R. J. Osborne, "A Gasoline Engine Concept for Improved Fuel Economy –The Lean Boost System," SAE paper 2000-01-2902] stoichiometric operation with a 3-way catalyst results in very low tailpipe emissions.

There are certain regions in the engine operating map where the ECU 14 may operate open loop, that is, the control is determined by comparison to an engine map lookup table rather

than by feedback from a sensed parameter which in this case is engine knock (closed loop). As mentioned previously, open loop operation during transients may be advantageous.

Another situation where open loop control can be advantageous would be under high load, where fuel rich conditions (where the fuel/air ratio is greater than stoichiometric) may be required to decrease the temperature of the combustion and thus protect the engine and the exhaust system (especially during prolonged operation). The conventional approach in gasoline engine vehicles is to use increased fuel/air ratio, that is, operating at rich conditions. The presence of ethanol on-board allows for two alternatives. The first is the use of ethanol fuel fractions beyond what is required to control knock, thus reducing the combustion temperature by a greater amount than could be obtained by gasoline alone due to the higher cooling effect of evaporation in direct ethanol injection, even while at stoichiometric conditions. The second one is, as in conventional applications, the use of increased fueling in rich operation (which could result in relative air/fuel mass ratios as low as 0.75 where a stoichiometric mixture has a relative air/fuel ratio of 1). The control system can choose between two fuels, ethanol and gasoline. Increased use of ethanol may be better than use of gasoline, with emissions that are less damaging to the environment than gasoline and decreased amount of rich operation to achieve the temperature control needed. Open loop operation with both gasoline and ethanol may require substantial modification of the engine's "lookup table."

Thus, a method of operating an engine is, under conditions of partial load, to operate closed loop with the use of only gasoline. As the engine load increases, the engine control system may change to open loop operation, using a lookup table.

The closed loop control of the engine can be such that a knock sensor (not shown) determines the fraction required of ethanol, while the oxygen sensor 12 determines the total amount of fuel. A variation of this scheme is to operate the knock control open loop, using a lookup table to determine the ethanol to gasoline ratio, but a closed loop to determine the total amount of fuel.

In order to minimize evaporative emission of the ethanol (which has a relatively low boiling point), solvents can be added to the ethanol to minimize the effect. An alternative means is to place an absorptive canister between the ethanol tank and the atmosphere that captures the ethanol and releases it when the engine is operational.

Because of the large cooling effect from ethanol, it has been known for some time that startup of a cold engine is difficult (for example, during the first 30 seconds). With the multiple fuels, it is possible to start up the engine without ethanol addition. Gasoline vaporizes easier than ethanol, and conventional operation with port-fuel or direct injected gasoline would result in easier engine start up. A greater fraction of gasoline than would be ordinarily used can be used to facilitate start-up operation at times during the first 30 seconds of engine operation.

Increased efficiency due to engine downsizing made possible through the use of 100% or close to 100% ethanol at the highest values of torque has the undesirable effect of requiring higher ethanol fractions. Hence the use of non-uniform ethanol distribution to minimize the use of ethanol at these values of torque becomes more attractive when achievement of the maximum efficiency gain is desired.

Below a certain value of torque or boost pressure it can be advantageous to use a non-uniform ethanol distribution in order to reduce the amount of ethanol that is used. Above certain torque or turbocharger or supercharger boost pressures, non-uniform charge would not be used since the engine is operating mostly on ethanol and ethanol non-uniformity cannot be used for minimizing ethanol consumption. This is especially important if the desired fraction is higher than 50%.

The capability to minimize the use of ethanol by non-uniform ethanol distribution in the cylinder can be realized by certain ethanol injection geometries. Ethanol can be injected in the periphery of a swirling charge. In order to minimize wall wetting by the ethanol, it would be convenient to achieve the injection in a manner such that the ethanol injection matches the swirling motion of the charge. The injection direction is thus positioned at an angle with respect to the main axis of the cylinder, injecting the ethanol with an angular direction component. Charge stratification in the case of swirl can be maintained by temperature stratification, with the cooler (and denser) regions in the periphery, which correspond to the end-gas zone.

An alternative or additional method to provide ethanol non-uniform distribution in the cylinder is to inject the ethanol relatively late with respect to bottom dead center. Thus the time for transport and diffusion of the ethanol is minimized. However, sufficient time should be allowed for full vaporization of the ethanol. As the temperatures are higher after Bottom-Dead-Center (BDC), the vaporization time is reduced, and it is less likely that the ethanol would wet the cylinder walls. Improved vaporization of the ethanol can also be achieved by using injectors

that produce small droplets. The injector could be a single spray pattern injector with a relatively narrow directed jet. This type of jet would optimize the deposition of the ethanol in the desired region.

Creating a non-uniform ethanol distribution in the cylinder (in the outer regions of the cylinder) has two advantages. The first one is the increased cooling effect of the region that has the propensity to autoignite (knock), the end gas region. The second is that the central region is not cooled, improving ignition and initial flame propagation. It is preferable to keep the central region hot, as having a fast flame speed early in the flame propagation has antiknock advantages, by reducing the burn time and the time for precombustion chemistry of the end gas. Minimizing the burn time decreases the propensity to knock, as there is no knock if the end gas is burned before it can autoignite. Thus it is possible to have good ignition properties of the air/fuel mixture, even under conditions where the gasoline is evenly spread throughout the cylinder.

Stratified operation can result in locally increased charge cooling. This is because the injected ethanol cools only a small fraction of the charge, and thus, for a given amount of ethanol, the local decrease in temperature is larger with stratified operation than the average decrease of temperature with uniform ethanol distribution. Late injection can aid in the formation of a non-uniform air/ethanol mixture as mixing time is limited. Since a fraction of the gasoline is port-fuel injected, it can be assumed that this fuel is homogeneously distributed in the cylinder, but ethanol is preferentially in the cooler edges (the end-gas). Thus, although overall the air/fuel charge is stoichiometric, locally near the spark it is lean while in the region of the end gas it is rich. Both of these conditions are advantageous, since the ignition occurs in a region with higher temperature (although slightly lean), while the outside is rich and cool, both of which are knock-suppressors.

In the case of swirl or tumble stratified air fuel charges with hot air/gasoline in the center and colder air/ethanol or air/ethanol/gasoline mixtures in the end gas, it is advantageous to place the spark in the region of the hot air/gasoline mixture (substantially near the center of the combustion chamber).

Ethanol consumption can be minimized if the gasoline is also directly injected. In this case, the heat of vaporization of gasoline is also useful in decreasing the temperature of the charge in the cylinder. The gasoline can be injected using a separate set of injectors. This would provide the most flexibility. However, it may be difficult to fit two sets of injectors per cylinder

in the limited space in the cylinder head. An alternative means is to provide a single set of injectors for injection of both the ethanol and the gasoline. Two options are possible, one in which there is a single nozzle and valve (and the gasoline and ethanol are co-injected), and one in which each fuel has a separate nozzle and valve.

Using direct injection of both the gasoline and the ethanol has the disadvantage of increased cost. In addition to a sophisticated injector or injectors, a second high pressure fuel pump is also needed. The ethanol and the gasoline also need to have parallel common plenums.

When a single nozzle is used, the ethanol and the gasoline are distributed in the same manner in the cylinder. In the case with a single nozzle and single valve, the fuels need to be mixed prior to the valve/nozzle part of the injector. This could be done either outside of the injector or in the injector body. The volume between the mixing point and the nozzle should be minimized to allow for fast response of the fuel mixture.

A slight modification of the above embodiment involves an injector that has two valves but a single nozzle. This minimizes the need for a second valve outside the injector for controlling the gasoline/ethanol mixture, in addition to minimizing the volume between the mixing point and the valves.

It is possible to use a separate nozzle/valve for each fuel in a single injector. In this case, the gasoline and the ethanol can be deposited in different regions of the cylinder. An additional advantage would be to provide different spray patterns for the ethanol and for the gasoline. This would provide the most flexible system (comparable to two independent injectors), with possibilities of simultaneous or asynchronous injection of varying fractions of ethanol/gasoline, as well as being able to deposit the ethanol and the gasoline in the desired location of the charge, for optimal non-uniform distribution of ethanol in the cylinder. Optimal distribution means knock avoidance with minimal consumption of ethanol, while maintaining engine drivability. Optimal non-uniform ethanol distribution can be obtained by centrally depositing the gasoline and by preferentially depositing the ethanol in the periphery of the cylinder, where the end gas will be. This can be accomplished more easily with direct injection as opposed to achieving non-uniform distribution of the gasoline through non-uniform spraying in the inlet manifold. Because the heat of vaporization of the gasoline is substantially lower than for ethanol (a factor of 4 smaller on an energy basis), the cooling effect in the region near the spark is smaller, affecting

less the initial flame propagation. In addition, it may be beneficial to retard the injection of the ethanol with respect to the gasoline.

When the ethanol has been exhausted, the engine can operate in a 'lower performance gasoline only' mode with turbocharger boost decrease (e.g. by a wastegate) and elimination or avoidance of operation at maximum torque levels. These conditions could be limiting, and in some cases a means of operating the vehicle at higher loads would be desired. This could be accomplished by using gasoline in the ethanol system with gasoline direct injection (GDI), while at the same time port-fuel injecting a fraction of the gasoline. Under these conditions the engine will operate at higher loads and higher torques, but still far below what ethanol could achieve. Only the cooling effect of the direct injection fuel is obtained, since the directly injected fuel has the same octane number as the port-injection fuel (gasoline in both cases).

If the ratio of ethanol in the ethanol fuel tank to gasoline in the gasoline fuel tank is lower than a predetermined value (because of the lack or availability of ethanol or for some other reason), it is possible to change the engine operation condition such that the ethanol/gasoline consumption ratio over a drive cycle is decreased. This is done for reducing the maximum ethanol fraction at a given engine speed that can be used in the engine. The allowed level of turbocharging and the maximum pressure, torque and horsepower would be correspondingly reduced to prevent knock. In this way, a continuous tradeoff between the ethanol/gasoline consumption ratio and the maximum torque and horsepower can be accomplished.

By proper expert system evaluation of the recent ethanol/gasoline usage and amounts of gasoline and ethanol it is possible to provide means to minimize the need of the 'low performance, gasoline only' mode. The usage of the antiknock agent can be restricted when the amount left in the tank is below a predetermined level, such that the main fuel will be exhausted prior to or simultaneously with the ethanol. It would be desirable to place a switch so that the operator could override the limitations, in those conditions where the desired vehicle operation will not be limited by the exhaustion of the antiknock agent.

Over a drive cycle, the amount of ethanol (by energy) required to enhance the octane number sufficiently to increase efficiency by at least 25% would be less than 15% of the fuel (ethanol + gasoline energy) without ethanol stratification and less than 5% with ethanol stratification.

Onboard separation of ethanol from diesel by fractional distillation has been demonstrated for use in ethanol exhaust aftertreatment catalysts ["Fuel-Borne Reductants for NOx Aftertreatment: Preliminary EtOH SCR Study", John Thomas, Mike Kass, Sam Lewis, John Storey, Ron Graves, Bruce Bunting, Alexander Panov, Paul Park, presented at the 2003 DEER (Diesel Engine Emissions Reduction] Workshop, Newport RI August 2003]. This approach could be employed for onboard separation of ethanol from a gasoline mixture. However, use of membrane separation can be simpler and less expensive. Although there is information about the use of membranes for the separation of ethanol from water, to our knowledge there is no available information on the membrane separation of ethanol from gasoline. Because the ethanol molecule is on the order of 4 Angstroms and the typical hydrocarbon fuel molecules are much larger, it is possible to use membranes for the separation. Both organic and inorganic membranes could be used. Since it is not necessary to obtain high purity ethanol, the process is relatively simple and requires low pressure.

Both porous and transfusion membranes can be used because ethanol with two carbon atoms has significantly different properties than most other gasoline compounds which have five to ten carbon atoms. The other antiknock agents contemplated for use in this invention also have a small number of carbons relative to gasoline. For example, methanol has one carbon. The membrane approach can be significantly simpler than the distillation or absorption/desorption approaches (see Ilyama et al, US patent no. 6,332,448) that have been suggested for separation of various gasoline/diesel fuels where there is much less of a difference in the number of carbon atoms.

The location of the membrane could be in the region of high pressure in the fuel line (downstream from the pump), or upstream from it. If it is located downstream, the separation occurs only when the engine is operational and the pump is on, while if it is upstream the separation is continuous. The pressure of the fuel downstream from the pump is a few bars (characteristic of port fuel injection). This is to be differentiated from the pressure of the ethanol system, which is directly injected and thus requires much higher pressures.

The separated ethanol is transported to a separate tank where it is stored. If there is too much ethanol, three options are available: 1) additional separation is stopped; 2) some ethanol is used in the engine, even if not required 3) ethanol is returned to the main gasoline tank.

The tank should be reachable, in order to be able to introduce additional ethanol when required, as when towing, in high temperatures, or when doing extensive climbing, conditions that require operation at high torque and which if for extended periods of time would consume ethanol at a rate higher than what can be extracted from the fuel.

Extraction of ethanol from the gasoline can have the unintended effect of reducing the octane of the rest of the fuel. Thus, it is likely that somewhat increased use of injected ethanol would be required to prevent knock. Even in the case without non-uniform distribution of the ethanol, under normal driving conditions the system can be designed so that the amount of ethanol extracted from the fuel matches the required ethanol.

It may also be advantageous to separate the ethanol from a gasoline/ethanol mixture at the fueling station. As with onboard separation, this approach also allows use of the present fuel transportation infrastructure. The potential advantages could be greater flexibility in choice of a fuel separation system and lower cost relative to onboard separation. It may be of particular interest during the introductory phase of ethanol boosted engine vehicles.

It can be useful to have the capability to adjust the volume of the ethanol tank, thus varying the maximum amount of ethanol in the ethanol tank. This capability would make it possible to drive longer distances between ethanol refueling and to operate on different gasoline/ethanol ratios over a drive cycle, depending on the availability and cost of ethanol and gasoline. In some cases, it may be advantageous to use more ethanol than is needed to provide the desired octane enhancement (*e.g.*, to meet alternative fuel or CO_2 reduction goals). It is desirable to have this capability without increasing the overall fuel tank size. A single fuel tank with a membrane or plate separating variable amounts of gasoline and ethanol can be used to accomplish this goal.

The tank can be configured to have a horizontal or vertical moveable/deformable walls that are substantially impervious and separate the regions that are filled with gasoline and ethanol. Separate filling ports and fuel lines are incorporated for each region as shown in Figs. 4a and b. The separation between the gasoline and ethanol (or other anti-knock agent) does not have to be perfect since a small amount of leakage of one fuel into the other will not adversely affect operation of the vehicle. The wall can be moved in response to the amount of either fuel in the tank. This process is automatic in the case of a separating membrane, and the latter can be more impervious to leaks from one fuel to the other.

Ethanol is denser than gasoline. The movable/deformable wall can be placed such that the ethanol is located either on top of the gasoline or below the gasoline. However, since it is expected that less ethanol is required than gasoline, the preferred embodiment has the ethanol above the gasoline, as shown in Figure 5.

If the ethanol is stored so that it is separate from the gasoline, it can be mixed with various additives to insure the desired operation of the ethanol injection system. In addition, it is possible to use gasoline-ethanol mixtures, such as E85 (which contains 15% by volume of gasoline). The lubricity additives include fatty acids, organic amine salts (amine salts of acid phosphates and polyethyleneoxy acid phosphates), alkyl and aryl acid phosphates and dialkyl alkyl phosphonates.

The modeling calculations show that for direct injection of alcohols, the larger impact of knock suppression is not the intrinsic knock-resistance of the fuel antiknock agent but rather its high heat of vaporization. In order to evaluate alternatives to ethanol, Table 3 shows the properties of proposed fuel antiknock/alternative fuels. Although some of these additives have higher octane numbers than gasoline, some of them have a much larger effect on the cylinder charge temperature (Table 3 assumes injection after the inlet valve has closed). Some of these additives (mostly the ethers) have a comparable charge temperature effect to that of gasoline direct injection, and thus are of less interest. The alcohols have optimal properties for the application, with temperature changes that are a factor of 3 or more larger than the temperature change due to gasoline direct injection (for 100% or near 100% operation with the additive). For ethanol, the change in temperature is a factor of more than 4 larger than that of gasoline, and for methanol the change is about 9 times larger. The temperature decrease of the air increases with the amount of oxygen in the fuel (in terms of the O/C ratio). Thus, it is highest for methanol, with an O/C ratio of 1, second for ethanol (O/C =2), and so on.

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Table 3

Antiknock properties of various fuels (calculated from data obtained in SAE standard J 1297 Alternative Automotive Fuels, Sept 2002)

Fuel type	Chemical formula	RON	MON	(R+M)/2	Net heat of Combustion MJ/kg	Latent heat of vaporization MJ/kg	Vaporization energy/ heat of combustion	Stoic air/fuel ratio	Equiv. Latent heat of vaporization MJ/kg air	ΔT air K
Gasoline					42.8	0.30	0.007	14.6	0.020	-28
Ethyl t-Butyl Ether	CH3CH2-O-C(CH3)3	118	102	110	36.3	0.31	0.009	12.1	0.026	-35
t-Amyl Methyl Ether	C2H5 C (CH3)2-O-CH3	111	98	105	36.3	0.32	0.009	12.1	0.027	-36
Toluene	C7H8	111	95	103	40.5	0.36	0.009	13.5	0.027	-37
Methyl t-Butil Ether	CH3-O-C(CH3)3	116	103	110	35.2	0.32	0.009	11.7	0.028	-37
Diisopropyl Ether	(CH3)2CH-O-CH(CH3)2	110	97	103	38.2	0.34	0.009	12.1	0.028	-39
t-Butyl Alcohol	(CH3)3 C-OH	103	91	97	32.9	0.60	0.018	11.1	0.054	-74
Isopropanol	(CH3)2CHOH	118	98	108	30.4	0.74	0.024	10.4	0.071	-97
Methanol with cosolvent	50% methanol/TBA	114	96	105	26.5	0.88	0.033	8.8	0.100	-137
Ethanol	CH3CH2OH	129	102	115	26.7	0.91	0.034	9	0.102	-138
Methanol	CH3OH	133	105	119	20.0	1.16	0.058	6.4	0.181	-246

Also shown in Table 3 are the ratios of the heat of vaporization to the heat of combustion, a measure of the potential effects when used as antiknock agents. This parameter gives a measure of the amount of evaporative cooling for a given level of torque. The last entry, ΔT_{air}, measures the decrease in air temperature for a stoichiometric mixture with injection after the inlet valve closes. Although the effect clearly is maximized by the use of methanol, other considerations may make ethanol the preferred choice. Methanol is toxic and corrosive.

Hydrous ethanol (with a small amount of water) has the advantage of lower cost than pure (neat) ethanol. Removing the last 10% to 15% water from ethanol has significant expense and consumes considerable energy. Manufacturing facilities typically produce ethanol with about 10% water by volume unless there is a need for essentially pure (anhydrous) ethanol. It could be advantageous to use ethanol with a water concentration of 5% to 15% by volume.

By using a closed loop approach to identify engine knock, flexible gasoline grades (with different octane ratings) and flexible knock-prevention fuel grades can be used. An open loop system would require measurement of the quality of the antiknock additive. Similarly, an open loop system would require determining the quality of the fuel (octane number). Closed loop operation allows the use of less expensive gasoline, when available, thus partially compensating for the more expensive anti-knock agent. It is also possible to use different antiknock fuel according to its availability, such as ethanol in the regions that produce and process corn, and methanol in those that have methanol production capabilities. Thus, the least expensive grade of

gasoline available and the least expensive antiknock fuel can be used, allowing a decrease of the cost of operating the vehicle as well as increasing the availability of the antiknock fuel.

Although the above discussion has featured ethanol as an exemplary anti-knock agent, the same approach can be applied to other high octane fuel and fuel additives with high vaporization energies such as methanol (with higher vaporization energy per unit fuel), and other anti-knock agents such as isopropanol, tertiary butyl alcohol, or ethers such as methyl tertiary butyl ether (MTBE), ethyl tertiary butyl ether (ETBE), or tertiary amyl methyl ether (TAME). It may be advantageous to use various mixtures of these fuels and additives with each other and with ethanol.

Particularly during the introduction phase of the present invention, the ethanol fueling could be performed by the use of containers, such as one-gallon containers. To facilitate ease of fueling an expandable pipe and funnel can be built into the ethanol fuel tank of the vehicle.

The ethanol in these containers would be denatured so as to prevent human consumption as an alcoholic beverage and could contain the additives described above. Ethanol sold for fuel, such as in Brazil, is denatured by a small fraction of gasoline (2%) among other denaturing agents (methanol, isopropanol and others).

Recycling of the container could take place at certain specific locations such as gasoline stations

Using a signal from a knock sensor to determine when and how much ethanol or other anti-knock agent must be used at various times in a drive cycle to prevent knock, the fuel management system can be employed to minimize the amount of ethanol or other anti-knock agent that is consumed over the drive cycle. If sufficient ethanol or other ant-knock agent is available, the fuel management system can also be used to employ more ethanol than would be needed to prevent knock. This would allow greater gasoline savings (the gasoline savings component from substitution of ethanol for gasoline would increase) and carbon dioxide reduction. In this case it may be desirable to operate at an anti-knock agent fraction which is either varied or constant during the drive cycle.

The contents of all of the references cited in this specification are incorporated by reference herein in their entirety.

It is recognized that modifications and variations of the inventions disclosed herein will be apparent to those of ordinary skill in the art and all such modifications and variations are included within the scope of the appended claims.

What is claimed is:

1. A turbocharged or supercharged spark ignition engine which is fueled by a directly injected mixture of ethanol and gasoline wherein under some operating conditions the ethanol energy fraction is at least 20% and wherein manifold pressure is at least 2 bar and;
wherein the maximum level of pressure increase from the turbocharger or supercharger is decreased when the ethanol/gasoline ratio is lowered.

2. The engine system of claim 1 wherein the maximum level of pressure increase is decreased so as to prevent knock.

3. The engine system of claim 1 wherein spark retard is increased when the ethanol/gasoline ratio is lowered.

4. The engine system of claim 1 wherein the compression ratio is 11 or greater.

5. A turbocharged or supercharged spark ignition engine wherein an ethanol–gasoline mixture is directly injected from a first source and there is also a means for independently controlling fueling with gasoline from a second source comprising:
a spark ignition engine;
a turbocharger or supercharger;
a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder;
a means for fueling the engine with gasoline from the second source;
wherein the energy fraction in the cylinder that is provided by the directly injected ethanol is at least 20 % and further wherein under some driving conditions the manifold pressure is greater than 2 bar; and
wherein the engine is operated at a substantially stoichiometric fuel/air ratio during at least part the operating time.

6. The engine system of claim 5 wherein more gasoline from the second source than would ordinarily be used is employed during the first 30 seconds of engine operation.

7. The engine system of claim 5 wherein the engine is started up with only the gasoline from the second source.

8. The engine system of claim 5 wherein under some driving conditions the engine is operated with only the directly injected ethanol –gasoline mixture from the first source.

9. The engine system of claim 5 wherein the level of turbocharging or supercharging is decreased so as to reduce the amount of the ethanol-gasoline mixture from the first source that is needed to prevent knock.

10. The engine system of claim 5 wherein the usage of the ethanol-gasoline mixture from the first source is determined by the amount of fuel in the first source.

11. The engine system of claim 5 wherein the usage of the ethanol-gasoline mixture from the first source is determined by the driver.

12. The engine system of claim 5 wherein spark retard is changed when the ethanol/gasoline ratio is changed.

13. The engine system of claim 5 wherein the fuel/air ratio in the engine is rich at high loads.

14. The engine system of claim 5 wherein the gasoline from the second source is port fuel injected.

15. A turbocharged or supercharged spark ignition engine wherein ethanol is separated onboard from an ethanol-gasoline mixture which is stored in a fuel tank and wherein the separated ethanol is directly injected into the engine and ;
wherein the mixture in the fuel tank that is not separated is used to fuel the engine using a

fuel injection system that is controlled separately from a direct injection system for direct injection of the separated ethanol.

16. The turbocharged or supercharged spark ignition engine system of claim 15 wherein the mixture from the fuel tank that is not separated is port fuel injected.

17. The turbocharged or supercharged spark ignition engine of claim 15 wherein the ratio of the directly injected ethanol that is separated onboard to the nonseparated mixture that is used for separately controlled fueling of the engine increases with increasing torque and wherein during at least part of the operating time the fuel/air ratio in the engine is maintained at a substantially stoichiometric ratio as the torque is increased.

18. The turbocharged or supercharged spark ignition engine system of claim 15 wherein a porous membrane is used for separation.

19. The turbocharged or supercharged spark ignition engine of claim 15 wherein a transfusion membrane is used for separation.

20. A turbocharged or supercharged spark ignition engine system wherein a mixture of alcohol and gasoline is directly injected from a single injector and wherein the alcohol/gasoline ratio is increased as the torque is increased so as to prevent knock and wherein during at least part of the operating time the fuel/air ratio in the engine is maintained at a stoichiometric fuel/air ratio as the alcohol/gasoline ratio is changed.

21. The turbocharged or supercharged spark ignition engine system of claim 20 wherein the injector has one nozzle and two valves and these valves are used to vary the alcohol/gasoline ratio.

22. The turbocharged or supercharged spark ignition engine system of claim 20 wherein the gasoline and alcohol are mixed outside of an injector with a single nozzle.

23. The turbocharged or supercharged engine system of claim 22 where the volume between the mixing point and the nozzle is minimized to allow for fast response change of the alcohol/gasoline mixture as the torque increases.

24. The turbocharged or supercharged engine system of claim 20 where the injector has two nozzles.

25. A turbocharged or supercharged engine wherein alcohol is directly injected from a first source and wherein the engine is also fueled with gasoline from a second source and wherein the ratio of volumes of the first and second sources can be varied and wherein the alcohol/gasoline ratio is adjusted so as to prevent knock.

Abstract of the Disclosure

Fuel management system for enhanced operation of a spark ignition gasoline engine. Injectors inject an anti-knock agent such as ethanol directly into a cylinder. It is preferred that the direct injection occur after the inlet valve is closed. It is also preferred that stoichiometric operation with a three way catalyst be used to minimize emissions. In addition, it is also preferred that the anti-knock agents have a heat of vaporization per unit of combustion energy that is at least three times that of gasoline.

Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	Optimized Fuel Management System for Direct Injection Ethanol Enhancement of Gasoline Engines
First Named Inventor/Applicant Name:	Leslie Bromberg
Filer:	Sam Pasternack/Michelle Hayes
Attorney Docket Number:	0492611-0828
Filed as Small Entity	

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	75	75
Utility Search Fee	2111	1	255	255
Utility Examination Fee	2311	1	105	105
Pages:				
Claims:				
Claims in excess of 20	2202	5	25	125
Independent claims in excess of 3	2201	2	105	210
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**770**

Electronic Acknowledgement Receipt	
EFS ID:	2770061
Application Number:	12020285
International Application Number:	
Confirmation Number:	1610
Title of Invention:	Optimized Fuel Management System for Direct Injection Ethanol Enhancement of Gasoline Engines
First Named Inventor/Applicant Name:	Leslie Bromberg
Customer Number:	24280
Filer:	Sam Pasternack/Michelle Hayes
Filer Authorized By:	Sam Pasternack
Attorney Docket Number:	0492611-0828
Receipt Date:	25-JAN-2008
Filing Date:	
Time Stamp:	17:08:38
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$770
RAM confirmation Number	2471
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)

1	Application Data Sheet	ADS.pdf	1173369 980c89af0eb598663fcff8213604fdcd7597b7d0	no	5
Warnings:					
Information:					
2	Drawings-only black and white line drawings	Figures.pdf	77759 3ff8d393838bb4f68b50f97b2da820385d5a750c	no	3
Warnings:					
Information:					
3		CONTApplication.pdf	216473 d2634105c24ea2ce4d603dbbd9464a037da5b28f	yes	28

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Specification	1	23
	Claims	24	27
	Abstract	28	28

Warnings:					
Information:					
4	Fee Worksheet (PTO-06)	fee-info.pdf	8592 b18ffeb9827d7732fecfa542eea074a544b01cf9	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	1476193	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (12-04)

Filing Date: 01/25/08

Approved for use through 7/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD
Substitute for Form PTO-875

Application or Docket Number
12/020,285

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	255		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	105		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	25 minus 20 =	5	X$ 25	125	OR	X$50	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	5 minus 3 =	* 2	X$105	210		X$210	
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $260 ($130 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR						
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))			185			370	
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	770		TOTAL	0

APPLICATION AS AMENDED – PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	X =		OR	X =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X =		OR	X =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					N/A		OR	N/A	
						TOTAL ADD'T FEE		OR	TOTAL ADD'T FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)	OR	RATE ($)	ADDITIONAL FEE ($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	X =		OR	X =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X =		OR	X =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					N/A		OR	N/A	
						TOTAL ADD'T FEE		OR	TOTAL ADD'T FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/020,285	01/25/2008	3747	770	0492611-0828	25	5

CONFIRMATION NO. 1610

24280
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

FILING RECEIPT

OC000000028225133

Date Mailed: 02/11/2008

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Filing Receipt Corrections. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Leslie Bromberg, Sharon, MA;
Daniel R. Cohn, Cambridge, MA;
John B. Heywood, Newton, MA;

Assignment For Published Patent Application

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 11/758,157 06/05/2007
which is a CIP of 11/100,026 04/06/2005 PAT 7,225,787

Foreign Applications

If Required, Foreign Filing License Granted: 02/09/2008

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/020,285**

Projected Publication Date: To Be Determined - pending completion of Missing Parts

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****

Title

OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

Preliminary Class

123

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/020,285	01/25/2008	Leslie Bromberg	0492611-0828

CONFIRMATION NO. 1610

24280
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

FORMALITIES LETTER

OC000000028225134

Date Mailed: 02/11/2008

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The oath or declaration is missing.
  A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.
  Note: If a petition under 37 CFR 1.47 is being filed, an oath or declaration in compliance with 37 CFR 1.63 signed by all available joint inventors, or if no inventor is available by a party with sufficient proprietary interest, is required.

The applicant needs to satisfy supplemental fees problems indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee or oath or declaration) as set forth in 37 CFR 1.16(f) of $**65** for a small entity in compliance with 37 CFR 1.27, must be submitted with the missing items identified in this notice.

SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is $**65** for a small entity
- $**65** Surcharge.

Replies should be mailed to:

Mail Stop Missing Parts
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P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

/tnguyen/

Office of Initial Patent Examination (571) 272-4000 or 1-800-PTO-9199

ATTORNEY'S DOCKET NUMBER: 0492611-0828(MIT CON 11381)
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Bromberg, et al.	Examiner:	Not yet assigned
Serial No.:	12/020,285	Art Unit:	Not yet assigned
Filing Date:	January 25, 2008	Confirmation No.:	1610
Title:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES		

VIA EFS WEB FILING – WWW.USPTO.GOV

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Sir:

RESPONSE TO NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

Enclosed herewith in response to the Notice to File Missing Parts of A NonProvisional Application mailed February 11, 2008 are the following documents:

1. The Notice States that an executed Declaration is missing.

   The executed Declaration is being submitted herewith. Applicant thus submits that the present Response is timely submitted on March 28, 2008.

2. The Notice States that a late surcharge in the amount of $65.00 for a small entity must be submitted.

   The $65.00 fee is being electronically paid herewiith

Please charge any additional fees or credit any overpayments that may be required to our Deposit Account No. 03-1721.

4315906v1

Respectfully Submitted,
CHOATE, HALL & STEWART LLP

Date: March 28, 2008

/SamPasternack/_____
SamPasternack
Reg. No. 29,576

PATENT DEPARTMENT
CHOATE, HALL & STEWART LLP
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Boston, Massachusetts 02110
Telephone: (617) 248-5000
Facsimile: (617) 248-4000

4315906v1

DECLARATION

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention titled: **OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES**, the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulation, § 1.56. I hereby claim foreign priority benefits under Title 35, United States Code, §119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate disclosing the subject matter claimed in their application and having a filing date (1) before that of the application on which priority is claimed, or (2) if no priority is claimed, before the filing date of this application.

Prior Foreign Application(s)

Number	Country	Day/Month/Year Filed	Priority Claimed
			( ) Yes ( ) No

I hereby claim the benefit under Title 35, United States Code, §120/365 of any United States application(s) listed below and PCT International Applications listed above or below, and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

10/991,774	November 18, 2004	Pending
(Application Number)	Day/Month/Year Filed	Status (Patented, Pending, Abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Inventor's signature Leslie Bromberg Date 6/29/05

Full name of first inventor (given name, family name): **Leslie Bromberg**

Residence: 76 Wilshire Drive, Sharon, MA 02067 Citizenship: U.S.

Post Office Address (include zip code): **Same**

Inventor's signature Daniel Cohn Date 6/29/05

Full name of second inventor (given name, family name): **Daniel R. Cohn**

Residence: 100 Memorial Drive, Apt. # 11-22E Cambridge, MA 02142 Citizenship: U.S.

Post Office Address (include zip code): **Same**

(X) Additional inventors are being named on separately numbered sheets attached hereto.

3909186v1

DECLARATION
(continued)

Inventor's signature John B Heywood Date 6/29/05

Full name of third inventor (given name, family name): **John B. Heywood**

Residence: 218 Mill Street, Newton, MA 02460 Citizenship: U.S.

Post Office Address (include zip code): **Same**

Electronic Patent Application Fee Transmittal

Application Number:	12020285
Filing Date:	25-Jan-2008
Title of Invention:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES
First Named Inventor/Applicant Name:	Leslie Bromberg
Filer:	Sam Pasternack/Michelle Hayes
Attorney Docket Number:	0492611-0828
Filed as Small Entity	

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Late filing fee for oath or declaration	2051	1	65	65
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**65**

Electronic Acknowledgement Receipt	
EFS ID:	3068512
Application Number:	12020285
International Application Number:	
Confirmation Number:	1610
Title of Invention:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES
First Named Inventor/Applicant Name:	Leslie Bromberg
Customer Number:	24280
Filer:	Sam Pasternack/Michelle Hayes
Filer Authorized By:	Sam Pasternack
Attorney Docket Number:	0492611-0828
Receipt Date:	28-MAR-2008
Filing Date:	25-JAN-2008
Time Stamp:	13:09:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$65
RAM confirmation Number	7952
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)

1	Applicant Response to Pre-Exam Formalities Notice	ResponseNTFMP.pdf	111271 352f03f27637553090f8c7ea62fa9cdb6740366b	no	2
Warnings:					
Information:					
2	Oath or Declaration filed	Declaration.pdf	190781 4db3ed52a72fab07cc967c9a164059b4328a75b5	no	2
Warnings:					
Information:					
3	Fee Worksheet (PTO-06)	fee-info.pdf	8216 86ebd96954450018a08bdf7e1abc29e3affb484d	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	310268	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/020,285	01/25/2008	3747	835	0492611-0828(MITCON11381)	25	5

CONFIRMATION NO. 1610

24280
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

UPDATED FILING RECEIPT

OC000000029262301

Date Mailed: 04/09/2008

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Filing Receipt Corrections. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Leslie Bromberg, Sharon, MA;
Daniel R. Cohn, Cambridge, MA;
John B. Heywood, Newton, MA;

Assignment For Published Patent Application

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 11/758,157 06/05/2007
which is a CIP of 11/100,026 04/06/2005 PAT 7,225,787

Foreign Applications

If Required, Foreign Filing License Granted: 02/09/2008

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/020,285**

Projected Publication Date: 07/17/2008

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****

Title

OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

Preliminary Class

123

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where

the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/020,285	01/25/2008	Leslie Bromberg	0492611-0828(MITCON11381)

CONFIRMATION NO. 1610

24280
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

PUBLICATION NOTICE

Date Mailed: 07/17/2008

Title:OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

Publication No.US-2008-0168966-A1
Publication Date:07/17/2008

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/020,285	01/25/2008	Leslie Bromberg	0492611-0828(MITCON11381)	1610

24280 7590 04/16/2009

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EXAMINER	
DUFF, DOUGLAS J	

ART UNIT	PAPER NUMBER
3748	

NOTIFICATION DATE	DELIVERY MODE
04/16/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@choate.com

Office Action Summary	Application No.	Applicant(s)	
	12/020,285	BROMBERG ET AL.	
	Examiner	Art Unit	
	DOUGLAS J. DUFF	3748	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-25 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) _____ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) 1-25 are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-14, drawn to a turbocharged engine means, classified in class 123, subclass 559.1.

II. Claims 15-25, drawn to a fuel injection means, classified in class 239, subclass 5.

The inventions are distinct, each from the other because of the following reasons:

2. Inventions I and II are unrelated. Inventions are unrelated if it can be shown that they are not disclosed as capable of use together and they have different designs, modes of operation, and effects (MPEP § 802.01 and § 806.06). In the instant case, the different inventions have different designs (turbocharger/supercharger control system and fuel injection structure), modes of operation (operating conditions of the intake and fuel injector/tank operation) and effects (intake pressure and knock prevention).

3. Restriction for examination purposes as indicated is proper because all these inventions listed in this action are independent or distinct for the reasons given above and there would be a serious search and examination burden if restriction were not required because one or more of the following reasons apply:

(a) the inventions have acquired a separate status in the art in view of their different classification;

(b) the inventions have acquired a separate status in the art due to their recognized divergent subject matter;

(c) the inventions require a different field of search (for example, searching different classes/subclasses or electronic resources, or employing different search queries);

(d) the prior art applicable to one invention would not likely be applicable to another invention.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a invention to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected invention**.

The election of an invention may be made with or without traverse. To reserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the restriction requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected invention.

If claims are added after the election, applicant must indicate which of these claims are readable upon the elected invention.

Should applicant traverse on the ground that the inventions are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the inventions to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other invention.

4. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DOUGLAS J. DUFF whose telephone number is (571)272-3459. The examiner can normally be reached on M-Th 7 AM - 5 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Denion can be reached on (571) 272-4859. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Thomas E. Denion/
Supervisory Patent Examiner, Art Unit 3748

/Douglas J Duff/
Examiner, Art Unit 3748
4/8/09

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BIB DATA SHEET

CONFIRMATION NO. 1610

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/020,285	01/25/2008 RULE	123	3748	0492611-0828(MITCON11381)

APPLICANTS

Leslie Bromberg, Sharon, MA;
Daniel R. Cohn, Cambridge, MA;
John B. Heywood, Newton, MA;

**** CONTINUING DATA ************************

This application is a CON of 11/758,157 06/05/2007
which is a CIP of 11/100,026 04/06/2005 PAT 7,225,787

**** FOREIGN APPLICATIONS ************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **
02/09/2008

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /DOUGLAS J DUFF/ Examiner's Signature	☐ Met after Allowance djd Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		MA	3	25	5

ADDRESS

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110
UNITED STATES

TITLE

OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

FILING FEE RECEIVED		
835	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

ATTORNEY DOCKET NO.: 0492611-0828 (MITCON11381)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Leslie Bromberg	Examiner:	Douglas J. Duff
Serial No.:	12/020285	Art Unit:	3748
Filing Date:	January 25, 2008	Confirmation No.	1610
Title:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES		

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Madam:

RESPONSE TO ELECTION REQUIREMENT

In response to the election requirement set forth in the Office Action mailed April 16, 2009, Applicant hereby elects invention 1 for examination purposes. Invention 1 includes claims 1-14. This election is being made without traverse.

Respectfully submitted,

/Sam Pasternack, Ph.D./
Sam Pasternack, Ph.D.
Registration No. 29,576

Date: May 8, 2009

Patent Department
CHOATE, HALL & STEWART
Exchange Place
53 State Street
Boston, MA 02109-2804
Tel: (617) 248-5000
Fax: (617) 248-4000

Electronic Acknowledgement Receipt	
EFS ID:	5302449
Application Number:	12020285
International Application Number:	
Confirmation Number:	1610
Title of Invention:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES
First Named Inventor/Applicant Name:	Leslie Bromberg
Customer Number:	24280
Filer:	Sam Pasternack/Christina Andrews
Filer Authorized By:	Sam Pasternack
Attorney Docket Number:	0492611-0828(MITCON11381)
Receipt Date:	08-MAY-2009
Filing Date:	25-JAN-2008
Time Stamp:	15:22:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Response to Election / Restriction Filed	ResponsetoRestriction.pdf	71086 e27773d0bfbcc8233a02ba27df2e145079b802a7	no	1
Warnings:					
Information:					

Total Files Size (in bytes):	71086

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/020,285	Filing Date 01/25/2008	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☒		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	05/08/2009	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 25	Minus	** 25	= 0	X $26 =	0	OR	X $ =	
	Independent (37 CFR 1.16(h))	* 5	Minus	***5	= 0	X $110 =	0	OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE	0	OR	TOTAL ADD'L FEE	

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/DIANIECE JACOBS/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/020,285	01/25/2008	Leslie Bromberg	0492611-0828(MITCON11381)	1610

24280 7590 09/04/2009

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EXAMINER	
DUFF, DOUGLAS J	

ART UNIT	PAPER NUMBER
3748	

NOTIFICATION DATE	DELIVERY MODE
09/04/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@choate.com

Office Action Summary	Application No.	Applicant(s)	
	12/020,285	BROMBERG ET AL.	
	Examiner	Art Unit	
	DOUGLAS J. DUFF	3748	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 May 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6 and 9-14* is/are rejected.

7)☒ Claim(s) *7, 8* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claim 6 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The claimed phrase "than would ordinarily be used" is not definite as it does not distinctly claim an amount that would be considered ordinary. Given the multiple configurations of these diverse fuel engines, a person having ordinary skill in the art would not be able to ascertain an ordinary amount used.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-6 and 9-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gray, Jr. et al. (US 6651432) in view of Mochizuki et al. (US 5131228). Regarding claims 1 and 5, Gray, Jr. et al. discloses a turbocharged (27) or supercharged spark ignition engine wherein a mixture is directly injected from a first source (23) and there is also a means for independently controlling fueling with gasoline from a second source (53) comprising a spark ignition engine; a turbocharger or supercharger; a means for

directly injecting a gasoline mixture from the first source into at least one cylinder; a means for fueling the engine with gasoline from the second source; further wherein under some driving conditions the manifold pressure is greater than 2 bar (col. 8, lines 62-67); and wherein the engine is operated at a substantially stoichiometric fuel/air ratio during at least part the operating time (col. 10, lines 24-32). Gray, Jr. et al. discloses an ethanol-gasoline mixture to be directly injected (col. 10, lines 34-49), but fails to specifically disclose a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder wherein the energy fraction in the cylinder that is provided by the directly injected ethanol is at least 20 % and fails to disclose the maximum level of pressure increase from the turbocharger is decreased when an ethanol/gasoline ratio is lowered.

5. Mochizuki et al. teaches a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder wherein the energy fraction in the cylinder that is provided by the directly injected ethanol is at least 20 % (Figure 4). It would have been obvious for a person having ordinary skill in the art at the time the invention was made to utilize an ethanol-gasoline mixture with an energy fraction of ethanol of at least 20% directly injected into the first source cylinder injector of Gray, Jr. et al. in order to avoid auto-ignition of the mixture of the supercharged engine of Gray, Jr. et al. (col. 4, lines 41-50).

6. Additionally, Mochizuki et al. teaches a supercharged engine wherein the maximum level of pressure increase from the supercharger is decreased when an ethanol/gasoline ratio is lowered (col. 4, lines 41-50). It would have been obvious for a

person having ordinary skill in the art at the time the invention was made to utilize the lowering of maximum supercharger pressure when the ethanol/gasoline ratio is lowered in order to avoid engine knock due to the lowering of octane of the fuel mixture.

7. Regarding claims 2-4, the modified Gray, Jr. et al. device discloses the maximum pressure increase is decreased so as to prevent knock (col. 4, lines 41-50), the spark retard is increased when the ethanol/gasoline ratio is lowered (claim 26) and the compression ratio is 11 or greater (claim 21).

8. Regarding claims 6 and 9-14, the modified Gray, Jr. et al. device discloses wherein more gasoline from the second source than would ordinarily be used is employed during the first 30 seconds of engine operation (Gray, an inherent rich air/fuel ratio upon cold startup), wherein the level of turbocharging is decreased so as to reduce the amount of the ethanol/gasoline mixture from the first source that is needed to prevent knock (col. 4, lines 41-50), wherein the usage of the ethanol/gasoline mixture from the first source is determined by the amount of fuel in the first source (fuel supply), wherein the usage of the mixture from the first source is determined by the driver (demand/throttle), wherein the spark retard is changed when the ethanol/gasoline ratio is changed (col. 6, lines 29-31), wherein the fuel/air ratio in the engine is rich at high loads and wherein the gasoline from the second source is port fuel injected (col. 4, lines 13-40).

Allowable Subject Matter

9. Claims 7 and 8 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DOUGLAS J. DUFF whose telephone number is (571)272-3459. The examiner can normally be reached on M-Th 7 AM - 5 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Denion can be reached on (571) 272-4859. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Thomas E. Denion/
Supervisory Patent Examiner, Art Unit 3748

/Douglas J Duff/
Examiner, Art Unit 3748

8/30/09

Notice of References Cited	Application/Control No. 12/020,285	Applicant(s)/Patent Under Reexamination BROMBERG ET AL.	
	Examiner DOUGLAS J. DUFF	Art Unit 3748	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,651,432	11-2003	Gray, Jr., Charles L.	60/605.2
*	B	US-6,575,147	06-2003	Wulff et al.	123/525
*	C	US-6,230,683	05-2001	zur Loye et al.	123/435
*	D	US-6,076,487	06-2000	Wulff et al.	123/1A
*	E	US-7,188,607	03-2007	Kobayashi, Tatsuo	123/431
*	F	US-7,444,987	11-2008	Cohn et al.	123/431
*	G	US-4,993,386	02-1991	Ozasa et al.	123/25J
*	H	US-5,131,228	07-1992	Mochizuki et al.	60/602
*	I	US-5,233,944	08-1993	Mochizuki, Kenji	123/1A
*	J	US-7,533,651	05-2009	Surnilla, Gopichandra	123/304
*	K	US-7,461,628	12-2008	Blumberg et al.	123/304
*	L	US-7,426,925	09-2008	Leone et al.	123/575
*	M	US-7,426,908	09-2008	Brehob, Diana	123/25C

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
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	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
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	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
12/020,285	BROMBERG ET AL.
Examiner	**Art Unit**
DOUGLAS J. DUFF	3748

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
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Claim		Date
Final	Original	8/30/09
	1	√
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Search Notes	Application/Control No.	Applicant(s)/Patent under Reexamination	
	12/020,285	BROMBERG ET AL.	
	Examiner	Art Unit	
	DOUGLAS J. DUFF	3748	

SEARCHED			
Class	Subclass	Date	Examiner
123	299, 300, 304, 406.45	8/30/2009	DJD
123	406.47	8/30/2009	DJD
123	559.1	8/30/2009	DJD
123	559.2	8/30/2009	DJD
123	564	8/30/2009	DJD
123	575	8/30/2009	DJD
123	576	8/30/2009	DJD
123	577	8/30/2009	DJD
60	597, 598	8/30/2009	DJD
60	600-603	8/30/2009	DJD
60	605.1	8/30/2009	DJD
60	614	8/30/2009	DJD
60	615	8/30/2009	DJD
60	619	8/30/2009	DJD

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT)	8/30/2009	DJD

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CONFIRMATION NO. 1610

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/020,285	01/25/2008 RULE	123	3748	0492611-0828(MITCON11381)

APPLICANTS

Leslie Bromberg, Sharon, MA;
Daniel R. Cohn, Cambridge, MA;
John B. Heywood, Newton, MA;

**** CONTINUING DATA ************************

This application is a CON of 11/758,157 06/05/2007
which is a CIP of 11/100,026 04/06/2005 PAT 7,225,787

**** FOREIGN APPLICATIONS ************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **
02/09/2008

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /DOUGLAS J DUFF/ Examiner's Signature	☐ Met after Allowance djd Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		MA	3	25	5

ADDRESS

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110
UNITED STATES

TITLE

OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

FILING FEE RECEIVED		
835	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	6623	(123/299,300,304,406.45,406.47,559.1,559.2,564,575,576,577).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	OFF	2009/08/30 19:03
L2	3552	(60/597,598,600,601-603,605.1,614,615,619,).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	OFF	2009/08/30 19:07
L3	42	(1 2) and spark and ((direct$2 or "in-cylinder" or cylinder) near2 inject$3) and ((intake or manifold or boost) near pressure) and (turbo or supercharg$3 or turbocharg$3) and (ethanol with ratio)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2009/08/30 19:12
L4	0	("2009/0076705").URPN.	USPAT	OR	ON	2009/08/30 19:24
L5	9	(US-7159568-$ or US-7287492-$ or US-7287509-$ or US-7357101-$ or US-7412966-$ or US-7426908-$ or US-7426925-$ or US-7461628-$ or US-7533651-$).did.	USPAT	OR	ON	2009/08/30 19:47
L9	229	("20010035215" | "20020038645" | "20020121263" | "20030089337" | "20030127072" | "20030168037" | "20030221660" | "20040035395" | "20040065274" | "20040083717" | "20040250790" | "20040261763" | "20050051135" | "20050066939" | "20050097888" | "20050103285" | "20050109316" | "20050109319" | "20050155344" | "20050155577" | "20050155578" | "20050166896" | "20050172931" | "20050178356" | "20050178360" | "20050183698" | "20050235959" | "20050274353" | "20060016429" | "20060016430" | "20060075991" | "20060090732" | "20060102136" | "20060102145" | "20060102146" | "20060102158" | "20060150952" | "20060174853" | "20060180099" | "20060180121" | "20060191727" | "20061800099" | "20070019413" | "20070028600" | "20070028861" | "20070028905" | "20070034192" | "20070044753" | "20070062484" | "20070095326" | "20070119391" | "20070119392" | "20070119394" | "20070119411" | "20070119412" | "20070119413" | "20070119414" | "20070119415" | "20070119416" | "20070119421" | "20070119422" | "20070119425" | "20070204813" | "20070204830" | "20070215069" | "20070215071" | "20070215072" | "20070215101" | "20070215102" | "20070215104" | "20070215110" | "20070215111" | "20070215125" | "20070215127" | "20070215130" | "20070219674" | "20070219679" | "20070219701" | "20070221163" | "20070234976" | "20070289573" | "20070295307" | "20080017171" | "20080035106" | "20080046161"	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 19:48

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L10	61	9 and (ratio near3 (alcohol or ethanol))	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 19:49
L11	49	10 and (turbo or turbocharg$3 or supercharg$3)	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 19:50
L12	20	("4424676" | "4539948" | "4703732").PN. OR ("5131228").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 19:59
L13	38	("4342287" | "4346689" | "4369736" | "4422413" | "4495930" | "4502453" | "4705010" | "4800859" | "4905655" | "4922862" | "4945881" | "4957087" | "5044344").PN. OR ("5233944").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 20:04
L14	24	("20020014226" | "20060102136" | "20060102145" | "20070039588" | "4402296" | "4480616" | "4541383" | "5233944" | "5937799" | "6076487" | "6287351" | "6298838" | "6332448" | "6508233" | "6513505" | "6543423" | "6575147" | "6668804" | "6725827" | "6990956" | "7159568" | "7178503" | "7188607" | "7225787").PN. OR ("7444987"). URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 20:08
L15	4	("2007/0039588").URPN.	USPAT	OR	ON	2009/08/30 20:08
L16	8	"607128"	USPAT	OR	ON	2009/08/30 20:10

L17	20	("20020007816" | "3924598" | "4254741" | "4414940" | "4612898" | "4748949" | "5076229" | "5243940" | "5365902" | "5941210" | "6227151" | "6341487" | "6354264" | "6390057" | "6494064" | "6659071" | "6684849" | "6684852").PN. OR ("7188607"). URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 20:13
L18	6	17 and (port with inject$3) and ((direct$2 or cylinder) near3 inject$3) and (turbo or supercharg$3 or turbocharg$3)	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 20:15
L19	180	("20010017127" | "20020014226" | "20060102136" | "20060102145" | "20070039588" | "2977942" | "3924598" | "4306526" | "4402296" | "4421280" | "4430978" | "4480616" | "4499885" | "4541383" | "4572133" | "4574754" | "4603674" | "4606322" | "4622939" | "4768481" | "4774909" | "4924828" | "4926806" | "4949689" | "5031594" | "5048470" | "5050550" | "5052360" | "5060610" | "5067467" | "5076244" | "5119780" | "5123397" | "5190006" | "5205254" | "5233944" | "5237812" | "5265562" | "5322044" | "5329908" | "5365902" | "5394852" | "5467757" | "5476072" | "5497737" | "5531193" | "5535716" | "5549087" | "5609131" | "5623909" | "5642705" | "5713328" | "5797367" | "5832880" | "5875743" | "5890459" | "5937799" | "5950603" | "6026781" | "6032617" | "6076487" | "6213086" | "6230683" | "6234123" | "6240895" | "6267097" | "6276334" | "6286482" | "6287351" | "6293246" | "6298838" | "6321157" | "6332448" | "6349698" | "6352490" | "6363908" | "6386177" | "6390055" | "6474293" | "6508233" | "6513505" | "6543423" | "6561157" | "6575132" | "6575147" | "6595181" | "6668804" | "6725827" | "6990956" | "7159568" | "7178503" | "7188607" | "7225787").PN. OR ("2002/0007816" | "5941210" | "6354264" | "6684849" | "6684852" | "7444987").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 20:19
L20	25	19 and ethanol	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 20:20
L21	22	20 and ((direct$2 or "in-cylinder" or cylinder) near2 inject$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2009/08/30 20:23
L22	15	20 and ((direct$2 or "in-cylinder" or cylinder) near2 inject$3) and (port near3 inject$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2009/08/30 20:23
L23	72	(9 10 11 12 13 14 15 16 17 18 19 20 21 22) and (bar or psi)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2009/08/30 20:37

L24	60	(9 10 11 12 13 14 15 16 17 18 19 20 21 22) and (pressure with (bar or psi))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2009/08/30 20:38
L25	25	(9 10 11 12 13 14 15 16 17 18 19 20 21 22) and (supercharg$3 or turbo or turbocharg $3) and (pressure with (bar or psi))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2009/08/30 20:39
L26	24	("20020134362" | "20030164162" | "20040149255" | "3150645" | "4201553" | "4502453" | "4750453" | "5379740" | "5775309" | "6003478" | "6073592" | "6202601" | "6276345" | "6382182" | "6550430" | "6561157" | "6575147" | "6684849" | "7019626" | "7055506" | "7228841" | "7258090" | "7270089").PN. OR ("7574993").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 20:51
L27	34	(10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26) and ((direct$2 or "in-cylinder" or cylinder) near2 inject$3) and ((bar or psi) same pressure) and "compression ratio"	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 21:07
L28	33	("4612770" | "5778857" | "6209515" | "6230683" | "6276139" | "6276334" | "6279550" | "6286482" | "6295816" | "6325054" | "6516774").PN. OR ("6651432").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/08/30 21:30

8/30/2009 11:03:13 PM
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ATTORNEY DOCKET NO.: 0492611-0828 (MITCON11381)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Leslie Bromberg	Examiner:	Douglas J. Duff
Serial No.:	12/020285	Art Unit:	3748
Filing Date:	January 25, 2008	Confirmation No.	1610
Title:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES		

VIA EFS WEB FILING – WWW.USPTO.GOV

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

AMENDMENT

In response to the office action mailed September 4, 2009 please Amend the Application as follows:

Amendment to the Claims begin on page 2;

Remarks begin on page 6;

Listing of Claims

1. (Original) A turbocharged or supercharged spark ignition engine which is fueled by a directly injected mixture of ethanol and gasoline wherein under some operating conditions the ethanol energy fraction is at least 20% and wherein manifold pressure is at least 2 bar and; wherein the maximum level of pressure increase from the turbocharger or supercharger is decreased when the ethanol/gasoline ratio is lowered.

2. (Original) The engine system of claim 1 wherein the maximum level of pressure increase is decreased so as to prevent knock.

3. (Original) The engine system of claim 1 wherein spark retard is increased when the ethanol/gasoline ratio is lowered.

4. (Original)The engine system of claim 1 wherein the compression ratio is 11 or greater.

5. (Original)A turbocharged or supercharged spark ignition engine wherein an ethanol–gasoline mixture is directly injected from a first source and there is also a means for independently controlling fueling with gasoline from a second source comprising:
   a spark ignition engine;
   a turbocharger or supercharger;
   a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder;
   a means for fueling the engine with gasoline from the second source;
   wherein the energy fraction in the cylinder that is provided by the directly injected ethanol is at least 20 % and further wherein under some driving conditions the manifold pressure is greater than 2 bar; and
   wherein the engine is operated at a substantially stoichiometric fuel/air ratio during at least part the operating time.

6. (Cancelled)

7. (Original) The engine system of claim 5 wherein the engine is started up with only the gasoline from the second source.

8. (Original) The engine system of claim 5 wherein under some driving conditions the engine is operated with only the directly injected ethanol –gasoline mixture from the first source.

9. (Original) The engine system of claim 5 wherein the level of turbocharging or supercharging is decreased so as to reduce the amount of the ethanol-gasoline mixture from the first source that is needed to prevent knock.

10. (Original) The engine system of claim 5 wherein the usage of the ethanol-gasoline mixture from the first source is determined by the amount of fuel in the first source.

11. (Original) The engine system of claim 5 wherein the usage of the ethanol-gasoline mixture from the first source is determined by the driver.

12. (Original) The engine system of claim 5 wherein spark retard is changed when the ethanol/gasoline ratio is changed.

13. (Original) The engine system of claim 5 wherein the fuel/air ratio in the engine is rich at high loads.

14. (Original) The engine system of claim 5 wherein the gasoline from the second source is port fuel injected.

15. (Withdrawn) A turbocharged or supercharged spark ignition engine wherein ethanol is separated onboard from an ethanol-gasoline mixture which is stored in a fuel tank and wherein the separated ethanol is directly injected into the engine and ;
wherein the mixture in the fuel tank that is not separated is used to fuel the engine using a fuel injection system that is controlled separately from a direct injection system for direct injection of the separated ethanol.

16. (Withdrawn) The turbocharged or supercharged spark ignition engine system of claim 15 wherein the mixture from the fuel tank that is not separated is port fuel injected.

17. (Withdrawn) The turbocharged or supercharged spark ignition engine of claim 15 wherein the ratio of the directly injected ethanol that is separated onboard to the nonseparated mixture

that is used for separately controlled fueling of the engine increases with increasing torque and wherein during at least part of the operating time the fuel/air ratio in the engine is maintained at a substantially stoichiometric ratio as the torque is increased.

18. (Withdrawn) The turbocharged or supercharged spark ignition engine system of claim 15 wherein a porous membrane is used for separation.

19. (Withdrawn) The turbocharged or supercharged spark ignition engine of claim 15 wherein a transfusion membrane is used for separation.

20. (Withdrawn) A turbocharged or supercharged spark ignition engine system wherein a mixture of alcohol and gasoline is directly injected from a single injector and wherein the alcohol/gasoline ratio is increased as the torque is increased so as to prevent knock and wherein during at least part of the operating time the fuel/air ratio in the engine is maintained at a stoichiometric fuel/air ratio as the alcohol/gasoline ratio is changed.

21. (Withdrawn) The turbocharged or supercharged spark ignition engine system of claim 20 wherein the injector has one nozzle and two valves and these valves are used to vary the alcohol/gasoline ratio.

22. (Withdrawn) The turbocharged or supercharged spark ignition engine system of claim 20 wherein the gasoline and alcohol are mixed outside of an injector with a single nozzle.

23. (Withdrawn) The turbocharged or supercharged engine system of claim 22 where the volume between the mixing point and the nozzle is minimized to allow for fast response change of the alcohol/gasoline mixture as the torque increases.

24. (Withdrawn) The turbocharged or supercharged engine system of claim 20 where the injector has
two nozzles.

25. (Withdrawn) A turbocharged or supercharged engine wherein alcohol is directly injected from a first source and wherein the engine is also fueled with gasoline from a second source and wherein the ratio of volumes of the first and second sources can be varied and wherein the alcohol/gasoline ratio is adjusted so as to prevent knock.

Remarks

Re-examination and reconsideration of the rejections are hereby requested.

Claims 1-25 are pending in the Application. Claims 15-25 have been withdrawn as directed to a non- elected invention. Claims 1-6 and 9-14 stand rejected. Claims 7 and 8 have been objected to as being dependent upon a rejected base claim but would be allowable if re-written into independent form including all of the limitations of the base claim and any intervening claims. Claim 6 has also been rejected under 35 USC §112, 2nd Paragraph, as being indefinite. To move prosecution forward, Claim 6 is being cancelled herein.

The present invention is directed to an optimized fuel management system for direct-injection ethanol enhancement of gasoline engines. Independent Claim 1 requires that a turbo-charged or super-charged spark ignition engine be fueled by a directly-injected mixture of ethanol and gasoline. Under some operating conditions the ethanol energy fraction is at least 20% and the manifold pressure is at least 2 bar. The maximum level of pressure increase from the turbo-charger or super-charger is decreased when the ethanol/gasoline ratio is lowered. Independent Claim 5 is directed to a turbo-charged or super-charged spark ignition engine in which an ethanol/gasoline mixture is directly injected from a first source and means are provided for independently controlling fueling with gasoline from a second source. This Claim also requires that the engine be operated at a substantially stoichiometric fuel/air ratio during at least part of the operating time.

The present invention allows the amount of ethanol that is mixed with gasoline to be controlled depending on torque requirements of the engine and the maximum level of pressure is decreased when the ethanol/gasoline ratio is lowered. The present invention allows the engine to be down-sized considerably by utilizing ethanol as an anti-knock agent thereby permitting higher compression ratios and higher boost pressures than could be achieved without the introduction of alcohol.

Claims 1-6 and 9-14 stand rejected under the 35 USC §103(a) as being unpatentable over *Gray, Jr., et al* US Patent No.: 651,432 in view *Mochizuki,* US Patent No.: 5131228. Gray is directed to a controlled temperature combustion engine in which combustion temperature is controlled to be below approximately 2100˚K so as to prevent the formation of oxides of

nitrogen which are pollutants. It is important to recognize that Gray does not teach introducing a mixture of ethanol and gasoline into the engine. In fact, Gray does not teach the mixing of any fuels whatsoever. The only mixture referred to is a mixture of a single fuel with charge air. Gray discloses three embodiments. A first embodiment uses a fuel such as conventional diesel fuel. The second embodiment utilizes a fuel characterized by a relatively high octane and relatively low cetane such as conventional gasoline fuel. No mixture is taught. A third embodiment in Gray utilizes a very high octane fuel such as methanol, ethanol or certain gasolines. Again, no mixture is taught whatsoever.

Near the bottom of page 2 of the Office Action, the examiner asserts that Gray discloses that a mixture is directly injected. Again, the only mixture taught by Gray is a mixture of one of the fuels from the three embodiments along with the charge air to promote combustion. Thus, Gray does not meet the limitation in Claim 1 of an engine fueled by a directly injected mixture of ethanol and gasoline. Nor does Gray meet the limitation in independent Claim 5 of a directly injected ethanol/gasoline mixture, nor a means for fueling the engine with gasoline from a second source. It is submitted that the primary reference to Gray lacks the material teaching of introducing a mixture of gasoline and ethanol into the engine. The examiner has combined this flawed primary reference with the reference to *Mochizuki, et al*. Mochizuki is directed to a control apparatus for a turbo-charged alcohol engine. In Mochizuki, an alcohol/gasoline mixture that is of fixed proportion is injected into the engine. A detector determines the concentration of alcohol and determines an appropriate boost pressure. In Mochizuki, the relative amount of alcohol cannot be altered. It is merely the amount that happens to have been put into the fuel tank. This is unlike the present invention in which the alcohol to gasoline ratio is adjusted depending on operating conditions. In summary, Gray lacks any teaching of introducing a directly injected mixture of ethanol and gasoline into an engine. Thus this material limitation is totally lacking. It is submitted that Claims 1-5 and 9-14 are patentable over the prior art. It is noted that Claim 7 and 8 are directed to allowable subject matter and applicant reserves the right to rewrite those claims into independent form at a later stage if necessary.

For the foregoing reasons, it is submitted that the pending claims are in condition for allowance and early favorable action is requested.

Respectfully submitted,

/Sam Pasternack, Ph.D./
Sam Pasternack, Ph.D.
Registration No. 29,576

Date: December 4, 2009

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Docket No.: 0492611-0828 (MIT-11381CON)
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Leslie Bromberg

Application No.: 12/020,285 | Confirmation No.: 1610

Filed: January 25, 2008 | Art Unit: 3748

For: OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES | Examiner: Duff, Douglas J.

INFORMATION DISCLOSURE STATEMENT (IDS)

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Pursuant to 37 CFR 1.56, 1.97 and 1.98, the attention of the Patent and Trademark Office is hereby directed to the references listed on the attached PTO/SB/08. It is respectfully requested that the information be expressly considered during the prosecution of this application, and that the references be made of record therein and appear among the "References Cited" on any patent to issue therefrom.

This Information Disclosure Statement is filed more than three months after the U.S. filing date, OR more than three months after the date of entry of the national stage of a PCT application, AND after the mailing date of the first Office Action on the merits, whichever occurs first, but before the mailing date of a Final Office Action or Notice of Allowance (37 CFR 1.97(c)).

In accordance with 37 CFR 1.98(a)(2)(ii), Applicant has not submitted copies of U.S. patents and U.S. patent applications. Applicant submits herewith copies of foreign patents and non-patent literature in accordance with 37 CFR 1.98(a)(2).

In accordance with 37 CFR 1.97(g), the filing of this Information Disclosure Statement shall not be construed to mean that a search has been made or that no other material information as defined in 37 CFR 1.56(a) exists. In accordance with 37 CFR 1.97(h), the filing of this Information Disclosure Statement shall not be construed to be an admission that any patent, publication or other information referred to therein is "prior art" for this invention unless specifically designated as such.

It is submitted that the Information Disclosure Statement is in compliance with 37 CFR 1.98 and the Examiner is respectfully requested to consider the listed references.

Our credit card payment in the amount of $180.00 covering the fee set forth in 37 CFR 1.17(p) is enclosed. Please charge only fees that are *necessary* to maintain pendency and/or protect the filing date of the present application to our Deposit Account Number 03-1721, referencing Attorney's Docket Number 0492611-0828(MIT-11381CON). **No authorization is given to charge any other fees.** To the extent that there are any discrepancies between what Applicant has paid with the filing of the present Application and what the USPTO believes is owed, Applicant respectfully requests that a Notice be issued explaining any such discrepancy.

Dated: December 4, 2009

Respectfully submitted,
/Sam Pasternack/

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Attorney for Applicant

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Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 4

Complete if Known	
Application Number	12/020,285
Filing Date	January 25, 2008
First Named Inventor	Leslie Bromberg
Art Unit	3748
Examiner Name	Duff, Douglas J.
Attorney Docket Number	0492611-0828 (MITCON11381)

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	A1	2007/0119391	05-2007	Fried, et al.	
	A2	2006/0102146	05-2006	Cohn et al.	
	A3	2006/0102145	05-2006	Cohn et al.	
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	A8	2002/0014226	02-07-2002	Wulff et al.	
	A9	2741230	04-10-1956	Reynolds, Blake	
	A10	3089470	05-14-1963	Payne, W.H.	
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	A28	4993386	02-19-1991	Ozasa et al.	
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	A35	5937799	08-17-1999	Binion, W. Sidney	
	A36	5983855	11-16-1999	Benedikt et al.	
	A37	6073607	06-13-2000	Liber, Bruno	
	A38	6076487	06-20-2000	Wulff et al	
	A39	6086376	08-08-2006	McKay	
	A40	6260525	07-17-2001	Moyer, David F.	
	A41	6287351	09-11-2001	Wulff, et al.	
	A42	6298838	10-09-2001	Huff, et al.	
	A43	6321692	11-27-2001	Rayner, Bradford, William	
	A44	6332448	12-25-2001	Ilyama, et al	
	A45	6340015	01-22-2002	Benedikt et al.	

Examiner Signature		Date Considered	

4581304v1

Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/020,285
				Filing Date	January 25, 2008
				First Named Inventor	Leslie Bromberg
(Use as many sheets as necessary)				Art Unit	3748
				Examiner Name	Duff, Douglas J.
Sheet	2	of	4	Attorney Docket Number	0492611-0828 (MITCON11381)

	A46	6358180	03-19-2002	Kuroda et al	
	A47	6508233	01-21-2003	Suhre et al.	
	A48	6513505	02-04-2003	Watanabe et al.	
	A49	6536405	03-25-2003	Rieger et al.	
	A50	6543423	04-08-2003	Dobryden, et al.	
	A51	6555324	12-2003	Oda	
	A52	6561157	05-13-2003	zur Loye et al.	
	A53	6575147	06-10-2003	Wulff et al.	
	A54	6622663	09-23-2003	Weissman et al.	
	A55	6668804	12-30-2003	Dobryden, et al.	
	A56	6725827	04-27-2004	Ueda et al.	
	A57	6745744	06-08-2004	Suckewer et al.	
	A58	6748918	06-15-2004	Rieger et al.	
	A59	6755175	06-29-2004	McKay et al.	
	A60	6799551	10-2004	Nakakita et al.	
	A61	6892691	05-17-2005	Uhl, et al.	
	A62	6951202	10-04-2005	Oda, Tomihisa	
	A63	6955154	10-18-2005	Douglas, Denis	
	A64	6959693	11-2005	Oda	
	A65	6981487	01-2006	Ohtani	
	A66	6990956	01-31-2006	Niimi, Kuniaki	
	A67	7013847	03-21-2006	Auer, Gerhard	
	A68	7021277	04-04-2006	Kuo et al.	
	A69	7077100	06-18-2006	Vogel et al.	
	A70	7086376	08-08-2006	McKay, Michael	
	A71	7107942	09-19-2006	Weissman et al.	
	A72	7156070	01-02-2007	Strom et al.	
	A73	7159568	01-2007	Lewis et al.	
	A74	7178503	02-2007	Brehob	
	A75	7188607	03-13-2007	Kobayashi, Tatsuo	
	A76	7201136	04-10-2007	McKay, et al.	
	A77	7225787	06-2007	Bromberg et al.	
	A78	7302933	12-2007	Kerns, James Michael	
	A79	7314033	01-2008	Cohn et al.	
	A80	7320302	01-22-2008	Kobayashi, Tatsuo	
	A81	7395786	07-2008	Leone et al.	
	A82	7406947	08-2008	Lewis et al.	
	A83	7444987	11-2008	Cohn et al.	
	A84	7461628	12-2008	Blumberg et al.	
	A85	7546835	06-2009	Hilditch, James	
	A86	7581528	09-2009	Stein et al.	

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No.[1]	Foreign Patent Document: Country Code[3]-Number[4]-Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]

Examiner Signature		Date Considered	

4581304v1

Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/020,285
				Filing Date	January 25, 2008
				First Named Inventor	Leslie Bromberg
(Use as many sheets as necessary)				Art Unit	3748
				Examiner Name	Duff, Douglas J.
Sheet	3	of	4	Attorney Docket Number	0492611-0828 (MITCON11381)

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. * CITE NO.: Those application(s) which are marked with an single asterisk (*) next to the Cite No. are not supplied (under 37 CFR 1.98(a)(2)(iii)) because that application was filed after June 30, 2003 or is available in the IFW. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	C1	MODAK et al., Engine Cooling by Direct Injection of Cooling Water, Society of Automotive Engineers, Inc. 700887	
	C2	Lecointe et al., "Downsizing a gasoline engine using turbocharging with direct injection" SAE paper 2003-01-0542.	
	C3	GRANDIN et al., Replacing Fuel Enrichment in a Turbo Charged SI Engine: Lean Burn or Cooled EGR, Society of Automotive Engineers, Inc. 199-01-3505	
	C4	GRANDIN et al., Knock Suppression in a Turbocharged SI Engine by Using Cooled EGR, Society of Automotive Engineers, Inc. 982476, International Fall Fuels and Lubricants Meeting and Exposition in San Francisco, California (October 19-22, 1998)	
	C5	STAN et al., Internal Mixture Formation and Combustion – from Gasoline to Ethanol, Society of Automotive Engineers, Inc. 2001-01-1207s	
	C6	YUKSEL et al., "The Use of Ethanol-Gasoline Blend as a Fuel in an SI Engine," Renewable Energy, Vol. 29 (2004) pp. 1181-1191.	
	C7	H. J. Curran et al., "A comprehensive modeling study of iso-octane oxidation," Combustion and Flame 129:263-280 (2002) pp. 253-280.	
	C8	International Search Report and The Written Opinion of the International Searching Authority for PCT/US05/41317, mailed on April 6, 2006	
	C9	International Search Report and The Written Opinion of the International Searching Authority for PCT/US06/12750, mailed on June 28, 2007	
	C10	J. Stokes et al., "A gasoline engine concept for improved fuel economy - the lean-boost system," SAE paper 2001-01-2902, pp. 1-12.	
	C11	J.B. Heywood, "Internal Combusion Engine Fundamentals," McGraw Hill, 1988, page 477.	
	C12	LoRUSSO et al., Direct Injection Ignition Assisted Alcohol Engine, Society of Automotive Engineers, Inc. 880495, International Congress and Exposition in Detroit Michigan (February 29-March 4, 1998)	
	C13	Yuksel et al., Renewable Energy, volume 29, issue 7, June 2004, pages 1181-1191	
	C14	PCT International Search Report and Written Opinion, Application No. PCT/IB07/03004, July 9, 2008.	
	C15	PCT International Search Report and Written Opinion, Application No. PCT/US07/05777, March 24, 2008.	
	C16	PCT International Search Report and Written Opinion, Application No. PCT/US07/74227, February 25, 2008.	
	C17	PCT International Search Report and Written Opinion, Application No. PCT/US08/69171, October 3, 2008.	
	C18	USPTO Final Office Action, Application No. 10/991,774, September 27, 2006.	
	C19	USPTO Final Office Action, Application No. 11/682,372, October 17, 2008.	
	C20	USPTO Non-Final Office Action, Application No. 10/991,774, April 25, 2006.	
	C21	USPTO Non-Final Office Action, Application No. 10/991,774, May 25, 2007.	

Examiner Signature		Date Considered	

4581304v1

Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** *(Use as many sheets as necessary)*				***Complete if Known***	
				Application Number	12/020,285
				Filing Date	January 25, 2008
				First Named Inventor	Leslie Bromberg
				Art Unit	3748
				Examiner Name	Duff, Douglas J.
Sheet	4	of	4	Attorney Docket Number	0492611-0828 (MITCON11381)

	C22	USPTO Non-Final Office Action, Application No. 11/100,026, August 3, 2006.	
	C23	USPTO Non-Final Office Action, Application No. 11/229,755, March 22, 2007.	
	C24	USPTO Non-Final Office Action, Application No. 11/229,755, October 4, 2007.	
	C25	USPTO Non-Final Office Action, Application No. 11/682,372, January 2, 2008.	
	C26	USPTO Non-Final Office Action, Application No. 11/684100, June 3, 2008.	
	C27	USPTO NOn-Final Office Action, Application No. 11/840,719, July 11, 2008.	
	C28	USPTO Notice of Allowance, Application No. 11/684,100, March 3, 2009.	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1]Applicant's unique citation designation number (optional). [2]Applicant is to place a check mark here if English language Translation is attached.

Examiner Signature		Date Considered	

4581304v1

Docketed Due 9.18.06 SP to Written Opinion

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
SAM PASTERNACK
CHOATE, HALL & STUART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

Amend Claims
Docketed
Due 6.06.06

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 0492612-0406	Date of mailing (*day/month/year*) 06 APR 2006 **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US05/41317	International filing date (*day/month/year*) 14 November 2005 (14.11.2005)
Applicant MASSACHUSETTS INSTITUTE OF TECHNOLOGY	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70.

   For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

   In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

   See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/ US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer For HENRY YUEN Virginia Sliby Telephone No. (703) 308-0861

Form PCT/ISA/220 (January 2004) (*See notes on accompanying sheet*)

RECEIVED
APR 10 2006
PATENT DEPARTMENT

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 0492612-0406	**FOR FURTHER ACTION** see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/US05/41317	International filing date (*day/month/year*) 14 November 2005 (14.11.2005)	(Earliest) Priority Date (*day/month/year*) 18 November 2004 (18.11.2004)
Applicant MASSACHUSETTS INSTITUTE OF TECHNOLOGY		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the Report**
   a. With regard to the **language**, the international search was carried out on the basis of:
      ☒ the international application in the language in which it was filed.
      ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. ☐ **Certain claims were found unsearchable** (See Box No. II)
3. ☐ **Unity of invention is lacking** (See Box No. III)
4. With regard to the **title**,
   ☐ the text is approved as submitted by the applicant.
   ☒ the text has been established by this Authority to read as follows:

Variable Ethanol Octane Enhancement of Gasoline Engines

5. With regard to the **abstract**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. With regard to the **drawings**,
   a. the figure of the **drawings** to be published with the abstract is Figure No. 1
      ☐ as suggested by the applicant.
      ☒ as selected by this Authority, because the applicant failed to suggest a figure.
      ☐ as selected by this Authority, because this figure better characterizes the invention.
   b. ☐ none of the figures is to be published with the abstract.

FORD Ex. 1126, page 100
IPR2020-00013

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/41317

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8): **F02B 75/12**(2006.01)

USPC: 123/198A,575,1A,525
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 123/ 198A, 575, 1A, 525

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,076,487 A (WULFF et al) 20 June 2000 (20.06.2000), column 4, lines 60-64 and column 5, lines 3-6.	1,4,54
A	US 4,495,930 A (NAKAJIMA) 29 January 1985 (29.01.1985), see entire document.	1-22,24-85
A	US 4,402,296 A (SCHWARZ) 06 September 1983 (06.09.1983), see entire document.	1-22,24-85

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 March 2006 (13.03.2006)	06 APR 2006
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer For HENRY YUEN Virginia Luby Telephone No. (703) 308-0861

Form PCT/ISA/210 (second sheet) (April 2005)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
SAM PASTERNACK
CHOATE, HALL & STUART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing (*day/month/year*)	06 APR 2006
Applicant's or agent's file reference 0492612-0406	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date (*day/month/year*)	Priority date (*day/month/year*)
PCT/US05/41317	14 November 2005 (14.11.2005)	18 November 2004 (18.11.2004)

International Patent Classification (IPC) or both national classification and IPC

IPC(8): **F02B 75/12**(2006.01)
USPC: 123/198A,575,1A,525

Applicant

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

1. This opinion contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☒	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(*b*) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	13 March 2006 (13.03.2006)	For HENRY YUEN Telephone No. (703) 308-0861

Form PCT/ISA/237 (cover sheet) (April 2005)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US05/41317

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed

☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

☐ a sequence listing

☐ table(s) related to the sequence listing

b. format of material

☐ on paper

☐ in electronic form

c. time of filing/furnishing

☐ contained in the international application as filed.

☐ filed together with the international application in electronic form.

☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US05/41317

Box No. V Reasoned statement under Rule 43 *bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 2,3,5-22,24-53,55-85	YES
	Claims 1,4,54	NO
Inventive step (IS)	Claims 2,3,5-22,24-53,55-85	YES
	Claims 1,4,54	NO
Industrial applicability (IA)	Claims 1-22,24-85	YES
	Claims NONE	NO

2. Citations and explanations:

Claims 1,4,54 lack novelty under PCT Article 33(2) as being anticipated by Wulff et al (US 6,076,487).

As to Claim 1, Wulff et al discloses fuel management system for operation of a spark ignition gasoline engine comprising: a gasoline engine; a source of an anti-knock agent; an injector 57 for direct injection of the anti-knock agent into a cylinder of the engine 14; and a fuel management control system 45 for controlling injection of the anti-knock agent into the cylinder to control knock.

As to Claim 4, Wulff et al discloses the anti-knock agent is selected from the group consisting of ethanol, methanol, tertiary butyl alcohol, MTBE, ETBE and TAME.

As to Claim 54, Wulff et al discloses fuel management system for operation of a spark ignition gasoline engine comprising: a gasoline engine; a source of an anti-knock agent; an injector 57 for direct injection of the anti-knock agent into a cylinder of the engine 14; and a fuel management control system 45 for controlling injection of the anti-knock agent into the cylinder to control knock; wherein the anti-knock agent is selected from the group consisting of methanol, tertiary butyl alcohol, MTBE, ETBE, and TAME.

Claims 2,3,5-22,24-53,55-85 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest a measure of the amount of anti-knock agent in the source to control turbocharging, supercharging or spark retard when the amount of anti-knock agent is low.

Claims 1-22,24-85 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US05/41317

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

Claims 1 and 23 are objected to under PCT Rule 66.2(a)(iii) as containing the following defect(s) in the form or contents thereof: Regarding claim 1, currently there are two claims, which are numbered 1. Regarding claim 23, currently there is no claim 23 in the application.

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under Article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the *PCT Applicant's Guide*, a publication of WIPO.

In these Notes, "Article," "Rule" and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report and the written opinion of the International Searching Authority, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only (see *PCT Applicant's Guide*, Volume I/A, Annexes B1 and B2).

The attention of the applicant is drawn to the fact that amendments to the claims under Article 19 are not allowed where the International Searching Authority has declared, under Article 17(2), that no international search report would be established (see *PCT Applicant's Guide*, Volume I/A, paragraph 296).

What parts of the international application may be amended ?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Preliminary Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When ? Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments ?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How ? Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments ?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

FORD Ex. 1126, page 106
IPR2020-00013

Resp to Written Opinion

Docketed
Due 9.28.07

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
SAM PASTERNACK
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

Amend Claims
Docketed
Due 8.28.07

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 0492611-~~0617~~ 0433	Date of mailing *(day/month/year)* 28 JUN 2007 **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US06/12750	International filing date *(day/month/year)* 06 April 2006 (06.04.2006)
Applicant MASSACHUSETTS INSTITUTE OF TECHNOLOGY	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70.

   For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

   In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

   See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/ US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer Stephen Kirk Cronin Telephone No. (703) 308-0861

Form PCT/ISA/220 (January 2004) *(See notes on accompanying sheet)*

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 0492611-0617	**FOR FURTHER ACTION** see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/US06/12750	International filing date (*day/month/year*) 06 April 2006 (06.04.2006)	(Earliest) Priority Date (*day/month/year*) 06 April 2005 (06.04.2005)
Applicant MASSACHUSETTS INSTITUTE OF TECHNOLOGY		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the Report**
   a. With regard to the **language**, the international search was carried out on the basis of:
      ☒ the international application in the language in which it was filed.
      ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. ☐ **Certain claims were found unsearchable** (See Box No. II)
3. ☐ **Unity of invention is lacking** (See Box No. III)
4. With regard to the **title**,
   ☐ the text is approved as submitted by the applicant.
   ☒ the text has been established by this Authority to read as follows:

DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

5. With regard to the **abstract**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.
6. With regard to the **drawings**,
   a. the figure of the **drawings** to be published with the abstract is Figure No. 3
      ☒ as suggested by the applicant.
      ☐ as selected by this Authority, because the applicant failed to suggest a figure.
      ☐ as selected by this Authority, because this figure better characterizes the invention.
   b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US06/12750

A. CLASSIFICATION OF SUBJECT MATTER
IPC: **F02B 77/04**(2006.01)

USPC: 123/198A,435,406.29,406.47,25C,559.1
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 123/198A,435,406.29,406.47,25C,559.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,513,505 B2 (WATANABE et al) 04 February 2003 (04.02.2003), column 5, lines 45-66.	1,2,17,36
A	US 4,541,383 A (JESSEL) 17 September 1985 (17.09.1985), column 1, lines 10-20.	1-51
A	US 5,937,799 A (BINION) 17 August 1999 (17.08.1999), column 8, lines 20-35.	1-51

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 May 2007 (31.05.2007)	28 JUN 2007
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer Stephen Kirk Cronin Telephone No. (703) 308-0861

Form PCT/ISA/210 (second sheet) (April 2005)

PATENT COOPERATION TREAT

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
SAM PASTERNACK
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* 28 JUN 2007	
Applicant's or agent's file reference 0492611-0617	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US06/12750	06 April 2006 (06.04.2006)	06 April 2005 (06.04.2005)

International Patent Classification (IPC) or both national classification and IPC

IPC: **F02B 77/04**(2006.01)
USPC: 123/198A,406.29,406.47,435,559.1,25C

Applicant

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

1. This opinion contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☒	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis(b)* that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	31 May 2007 (31.05.2007)	Stephen Kirk Cronin Telephone No. (703) 308-0861

Form PCT/ISA/237 (cover sheet) (April 2005)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US06/12750

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed

☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

☐ a sequence listing

☐ table(s) related to the sequence listing

b. format of material

☐ on paper

☐ in electronic form

c. time of filing/furnishing

☐ contained in the international application as filed.

☐ filed together with the international application in electronic form.

☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US06/12750

Box No. V Reasoned statement under Rule 43 *bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 3-16,18-35,37-51	YES
	Claims 1,2,17,36	NO
Inventive step (IS)	Claims 3-16,18-35,37-51	YES
	Claims 1,2,17,36	NO
Industrial applicability (IA)	Claims 1-51	YES
	Claims NONE	NO

2. Citations and explanations:

Claims 1,2,17,36 lacks novelty under PCT Article 33(2) as being anticipated by Watanabe et al (US 6,513,505).

As to Claim 1, Watanabe et al discloses fuel management system for operation of a spark ignition gasoline engine comprising: a spark ignition engine 1; a source of gasoline; a source of anti-knock agent 9 which is a fuel; an injector 2 for direct injection of the anti-knock agent 9 into a cylinder 1a of the engine 1; and a fuel management control system 30 for controlling injection of the anti-knock agent 9 into the cylinder 1a to control knock, wherein the antiknock agent 9 has a heat of vaporization per unit of combustion energy that is at least three times that of gasoline. See col. 2, lines 12-20, col. 5, lines 45-66 and col. 6, lines 1-27 and Figs. 1-6.

As to Claim 2, Watanabe et al discloses fuel management system for operation of a spark ignition gasoline comprising: a spark ignition engine 1; a source of gasoline; a source of an anti-knock agent 9 which is a fuel an injector 2 for direct injection of the anti-knock agent 9 into a cylinder of the engine; and a fuel management control system 30 for controlling injection of the anti-knock agent 9 into the cylinder when engine torque is above a selected value or fraction of maximum torque where the value or fraction of maximum torque is a function of engine speed.

As to Claim 17, Watanabe et al discloses wherein the anti-knock agent is ethanol and where the amounts of air, ethanol and gasoline per cylinder per cycle are controlled so as to achieve a substantially stoichiometric fuel/ air ratio.

As to Claim 36, Watanabe et al discloses fuel management system for efficient operation of a spark ignition gasoline engine comprising: a gasoline engine 1; a source of an anti-knock agent 9; an injector 2 for direct injection of both the anti-knock agent and the gasoline into a cylinder of the engine; and a fuel management control system 30 for controlling injection of the anti-knock agent into the cylinder to control knock.

Claims 3-16,18-35,37-51 meets the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest wherein the maximum anti-knock agent energy fraction used during a drive cycle is between 30% and 100%.

Claims 1-51meets the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US06/12750

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

Claims 4,42,48 objected to under PCT Rule 66.2(a)(iii) as containing the following defect(s) in the form or contents thereof: The inlet valve of claim 4 lacks proper antecedent basis. The claim 42 is an improper multiple dependent claim (not in alternative format, and dependent upon other multiple dependent claims). The claim 48, "expandable pipe and funnel" is not shown in the drawings.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
SAM PASTERNACK
CHOATE, HALL & STEWART
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

	Date of mailing (*day/month/year*) 09 JUL 2008
Applicant's or agent's file reference 2006734-0002	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/IB07/03004	International filing date (*day/month/year*) 06 March 2007 (06.03.2007)
Applicant ETHANOL BOOSTING SYSTEMS. LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70.

   For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

   In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

   See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/ US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer Stephen K Cronin Telephone No. (571) 272-4383

Form PCT/ISA/220 (January 2004) (*See notes on accompanying sheet*)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 2006734-0002	**FOR FURTHER ACTION** see Form PCT/ISA/220 as well as, where applicable, item 5 below	
International application No. PCT/IB07/03004	International filing date (*day/month/year*) 06 March 2007 (06.03.2007)	(Earliest) Priority Date (*day/month/year*) 08 March 2006 (08.03.2006)
Applicant ETHANOL BOOSTING SYSTEMS. LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the Report**
   a. With regard to the **language**, the international search was carried out on the basis of:
      ☒ the international application in the language in which it was filed.
      ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 Rule 43.6 *bis(a)*
   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. ☐ **Certain claims were found unsearchable** (See Box No. II)
3. ☐ **Unity of invention is lacking** (See Box No. III)
4. With regard to the **title**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,
   a. the figure of the **drawings** to be published with the abstract is Figure No. 1
      ☐ as suggested by the applicant.
      ☒ as selected by this Authority, because the applicant failed to suggest a figure.
      ☐ as selected by this Authority, because this figure better characterizes the invention.
   b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB07/03004

A. CLASSIFICATION OF SUBJECT MATTER
IPC: **F02M 17/00**(2006.01)

USPC: 123/447
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 123/447

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2005/0056264 A1, (WEISSMAN et al) 17 March 2005, Figure 2, claim 11.	1-15
A	US 5,560,344 A (CHAN) 1, October 1996 (01.10.1996), whole document.	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 June 2008 (08.06.2008)	09 JUL 2008
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer Stephen K Cronin Telephone No. (571) 272-4383

Form PCT/ISA/210 (second sheet) (April 2007)

PATENT COOPERATION TREATY

FILE COPY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
SAM PASTERNACK
CHOATE, HALL & STEWART
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

	Date of mailing *(day/month/year)*
Applicant's or agent's file reference 2006734-0002	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/IB07/03004	International filing date *(day/month/year)* 06 March 2007 (06.03.2007)
Applicant ETHANOL BOOSTING SYSTEMS, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70.

   For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

   In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

   See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/ US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer Stephen K Cronin Telephone No. (571) 272-4383

Form PCT/ISA/220 (January 2004) *(See notes on accompanying sheet)*

PATENT COOPERATION TREATY FILE COPY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 2006734-0002	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/IB07/03004	International filing date (*day/month/year*) 06 March 2007 (06.03.2007)	(Earliest) Priority Date (*day/month/year*) 08 March 2006 (08.03.2006)
Applicant ETHANOL BOOSTING SYSTEMS. LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of _____ sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the Report**
   a. With regard to the **language**, the international search was carried out on the basis of:
      ☒ the international application in the language in which it was filed.
      ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 Rule 43.6 *bis(a)*
   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. ☐ **Certain claims were found unsearchable** (See Box No. II)
3. ☐ **Unity of invention is lacking** (See Box No. III)
4. With regard to the **title**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,
   a. the figure of the **drawings** to be published with the abstract is Figure No. 1
      ☐ as suggested by the applicant.
      ☒ as selected by this Authority, because the applicant failed to suggest a figure.
      ☐ as selected by this Authority, because this figure better characterizes the invention.
   b. ☐ none of the figures is to be published with the abstract.

Form PCT/ISA/210 (first sheet) (April 2007)

FILE COPY

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB07/03004

A. CLASSIFICATION OF SUBJECT MATTER
IPC: **F02M 17/00**(2006.01)

USPC: 123/447
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 123/447

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2005/0056264 A1, (WEISSMAN et al) 17 March 2005, Figure 2, claim 11.	1-15
A	US 5,560,344 A (CHAN) 1, October 1996 (01.10.1996), whole document.	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 June 2008 (08.06.2008)	

Name and mailing address of the ISA/US	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450	Stephen K Cronin
Facsimile No. (571) 273-3201	Telephone No. (571) 272-4383

Form PCT/ISA/210 (second sheet) (April 2007)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

FILE COPY

PCT

To:
SAM PASTERNACK
CHOATE, HALL & STEWART
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

		Date of mailing *(day/month/year)*
Applicant's or agent's file reference 2006734-0002		**FOR FURTHER ACTION** See paragraph 2 below
International application No. PCT/IB07/03004	International filing date *(day/month/year)* 06 March 2007 (06.03.2007)	Priority date *(day/month/year)* 08 March 2006 (08.03.2006)
International Patent Classification (IPC) or both national classification and IPC IPC: Please See Continuation Sheet USPC: 123/447,1A,300,304,431,478,575,577,198C,198A;701/101		
Applicant ETHANOL BOOSTING SYSTEMS. LLC		

1. This opinion contains indications relating to the following items:

- ☒ Box No. I — Basis of the opinion
- ☐ Box No. II — Priority
- ☐ Box No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV — Lack of unity of invention
- ☒ Box No. V — Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI — Certain documents cited
- ☐ Box No. VII — Certain defects in the international application
- ☐ Box No. VIII — Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(*b*) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	08 June 2008 (08.06.2008)	Stephen K Cronin Telephone No. (571) 272-4383

Form PCT/ISA/237 (cover sheet) (April 2007)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/IB07/03004

FILE COPY

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed

☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of:

a. type of material

☐ a sequence listing

☐ table(s) related to the sequence listing

b. format of material

☐ on paper

☐ in electronic form

c. time of filing/furnishing

☐ contained in the international application as filed.

☐ filed together with the international application in electronic form.

☐ furnished subsequently to this Authority for the purposes of search.

4. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/IB07/03004

FILE COPY

Box No. V Reasoned statement under Rule 43 *bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1-15	YES
	Claims NONE	NO
Inventive step (IS)	Claims 1-15	YES
	Claims NONE	NO
Industrial applicability (IA)	Claims 1-15	YES
	Claims NONE	NO

2. Citations and explanations:

Claims 1-15 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest claimed invention.

Claim1-15 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/IB07/03004

FILE COPY

Supplemental Box
In case the space in any of the preceding boxes is not sufficient.

Continuation of IPC:
F02M 63/00(2006.01),**43/00**(2006.01);**F02B 47/00**(2006.01),**47/04**(2006.01),**13/00**(2006.01),**13/10**(2006.01)

Form PCT/ISA/237 (Supplemental Box) (April 2007)

PATENT COOPERATION TREATY

MAR 2 6 2008
PATENT DEPARTMENT

PCT

From the INTERNATIONAL SEARCHING AUTHORITY

To: Sam Pasternack
Choate, Hall & Stewart
Two International Place
Boston, Massachusetts 02110

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

	Date of mailing *(day/month/year)*
Applicant's or agent's file reference 2006734-0003PC	FOR FURTHER ACTION See paragraphs 1 and 4 below
International application No. PCT/US 07/05777	International filing date *(day/month/year)* 08 March 2007 (08.03.2007)
Applicant Ethanol Boosting Systems, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: +41 22 740 14 35

   For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

   In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

   See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/220 (January 2004)

(See notes on accompanying sheet)

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: Sam Pasternack
Choate, Hall & Stewart
Two International Place
Boston, Massachusetts 02110

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

	Date of mailing *(day/month/year)* 24 MAR 2008
Applicant's or agent's file reference 2006734-0003PC	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US 07/05777	International filing date *(day/month/year)* 08 March 2007 (08.03.2007)
Applicant Ethanol Boosting Systems, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes, 1211 Geneva 20, Switzerland, Facsimile No.: +41 22 740 14 35

   For more detailed instructions, see the notes on the accompanying sheet.

Docketed Due Article 19 Amend. 5/24/08 MPL

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

   In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

   See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

RECEIVED MAR 26 2008 PATENT DEPARTMENT

Form PCT/ISA/220 (January 2004) *(See notes on accompanying sheet)*

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 2006734-0003PC	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US 07/05777	International filing date *(day/month/year)* 08 March 2007 (08.03.2007)	(Earliest) Priority Date *(day/month/year)* 10 March 2006 (10.03.2006)
Applicant Ethanol Boosting Systems, LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

   a. the figure of the **drawings** to be published with the abstract is Figure No. 1

   ☐ as suggested by the applicant.

   ☒ as selected by this Authority, because the applicant failed to suggest a figure.

   ☐ as selected by this Authority, because this figure better characterizes the invention.

   b. ☐ none of the figures is to be published with the abstract.

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MAR 26 2008
PATENT DEPARTMENT

Form PCT/ISA/210 (first sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 07/05777

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - F02B 77/04 (2007.10)
USPC - 123/198A
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
USPC: 123/198A

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 123/198R, 406.29, 406.47 (text search - see terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(USPT,PGPB,EPAB,JPAB); Google Patents; Google Scholar
Search Terms: gasoline engine, ethanol, direct injection, engine knock, emissions, restart, control system, shut down, deceleration, port injection, motor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Calculations of Knock Suppression in Highly Turbocharged Gasolin/Ethanol Engines Using Direct Ethanol Injection (L. Bromberg et al.) 23 February 2006 (23.02.2006), entire document especially Abstract, Section I, para [0003], Section II, para [0001], [0003], [0006]	1-18
Y	US 4,312,310 A (Chivilo' et al.) 26 January 1982 (26.01.1982), col 2, ln 20-26 and ln 36-54	1-18
Y	US 6,358,180 B1 (Kuroda et al.) 19 March 2002 (19.03.2002), Fig 4, col 3, ln 65-67 to col 4, ln 1 -15, col 8, ln 3-27col 12, ln 54-56	2, 9-10, 13-18
Y	US 4,974,416 A (Taylor) 04 December 1990 (04.12.1990), col 4, ln 15-21	5
Y	US 6,260,525 B1 (Moyer) 17 July 2001 (17.07.2001), col 3, ln 5-8	6, 8, 13-18
Y	US 4,967,714 A (Inoue) 06 November 1990 (06.11.1990), col 3, ln 27-30 and ln 66-67	11

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 December 2007 (03.12.2007)	24 MAR 2008
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (April 2007)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: Sam Pasternack
Choate, Hall & Stewart
Two International Place
Boston, Massachusetts 02110

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	24 MAR 2008
Applicant's or agent's file reference 2006734-0003PC	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 07/05777	08 March 2007 (08.03.2007)	10 March 2006 (10.03.2006)

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - F02B 77/04 (2007.10)
USPC - 123/198A

Applicant Ethanol Boosting Systems, LLC

1. This opinion contains indications relating to the following items:

Docketed
Due Response to Written Opinion 6/24/08 MPL

- [X] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [X] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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MAR 26 2008
PATENT DEPARTMENT

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer:
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	03 December 2007 (03.12.2007)	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (April 2007)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 07/05777

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of:

   a. type of material

      ☐ a sequence listing

      ☐ table(s) related to the sequence listing

   b. format of material

      ☐ on paper

      ☐ in electronic form

   c. time of filing/furnishing

      ☐ contained in the international application as filed

      ☐ filed together with the international application in electronic form

      ☐ furnished subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 07/05777

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-18	YES
	Claims	None	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-18	NO
Industrial applicability (IA)	Claims	1-18	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1, 3-4, 7 and 12 lack an inventive step under PCT Article 33(3) as being obvious over the article entitled "Calculations of Knock Suppression in Highly Turbocharged Gasoline/Ethanol Engines Using Direct Ethanol Injection" by L. Bromberg et al. (hereinafter 'Bromberg') in view of US 4,312,310 A to Chivilo et al. (hereinafter 'Chivilo').

As per claim 1, Bromberg discloses a fuel management system for operation of a spark ignition gasoline engine in a vehicle comprising: a gasoline engine powering the vehicle (see Abstract); a source of gasoline for introduction into the engine (see Section II, para [0003]); a separate source of ethanol (see Section II, para [0003]); an injector for direct injection of the ethanol into a cylinder of the engine (see Section II, para [0001]). Bromberg does not disclose a control system for shutting down the engine by stopping gasoline and ethanol flow into the engine during vehicle deceleration and idling and restarting the engine upon driver demand. Chivilo discloses a control system for shutting down the engine by stopping gasoline flow into the engine during vehicle deceleration and idling and restarting the engine upon driver demand (col 2, ln 20-26 and ln 36-54). It would have been obvious to one of ordinary skill in the art to modify the fuel management system as disclosed by Bromberg with the control system as taught by Chivilo since a major development in the system disclosed by Bromberg is fuel conservation and an obvious way to conserve fuel is to shut down the engine during idle or deceleration.

As per claim 3, Bromberg further discloses the system wherein the engine uses direct ethanol injection during a range of engine operating conditions to prevent engine knock (see Section I, para [0003]). Bromberg does not specifically disclose direct ethanol injection during engine restart to prevent engine knock. However, it would have been obvious to one of ordinary skill in the art to include ethanol injection during engine restart as one of the operating conditions since engine knock often occurs during restart and one of the objects of Bromberg is to prevent engine knock.

As per claim 4, Bromberg discloses the system wherein the engine uses direct ethanol injection to minimize hydrocarbon emissions (see Section II, para [0006]). Bromberg does not specifically disclose direct ethanol injection during engine restart to minimize hydrocarbon emissions. However, it would have been obvious to one of ordinary skill in the art to include ethanol injection during engine restart to minimize hydrocarbon emissions since hydrocarbon emissions can be high during restart and one of the objects of Bromberg is to minimize hyrdrocarbon emissions.

As per claim 7, Bromberg further discloses the system wherein the engine is turbocharged or supercharged (see Section II, para [0001]).

As per claim 12, Bromberg further disclose the system wherein gasoline is not used and ethanol, E85, methanol, other alcohols or a blend thereof are used as the only fuel (see Abstract). Bromberg states direct ethanol injection could be be used to displace gasoline.

Claims 2, 9 and 10 lack an inventive step under PCT Article 33(3) as being obvious over Bromberg in view of Chivilo, further in view of US 6,358,180 B1 to Kuroda et al. (hereinafter 'Kuroda').

As per claim 2, Chivilo discloses a control system for shutting down the engine by stopping gasoline flow into the engine during vehicle deceleration and idling and restarting the engine upon driver demand (col 2, ln 20-26 and ln 36-54). Chivilo does not specifically disclose wherein the control system disables the shutting down of the engine during deceleration and idling when an auxiliary power or energy requirement exceeds a selected level. Kuroda discloses wherein the control system disables the shutting down of the engine during deceleration and idling when an auxiliary power or energy requirement exceeds a selected level (col 3, ln 65-67 to col 4, ln 1-15). It would have been obvious to one of ordinary skill in the art to modify the control system as disclosed by Chivilo with the system as taught by Kuroda, since both relate to the technology of shutting engines down to conserve fuel and since such would avoid having the engine shut down when the batteries are unable to perform important functions such as restarting.

As per claim 9, Kuroda further discloses the system further including a 12V motor to restart the engine after shutdown during deceleration and/or idle (Fig 4; col 12, ln 54-56).

--- Please See Continuation Sheet ---

FORD Ex. 1126, page 130
IPR2020-00013

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:
Box V. 2. Citations and explanations:

As per claim 10, Kuroda further discloses the system including a restart motor (Fig 4; col 12, ln 54-56), wherein the low voltage motor is a low voltage motor (Fig 4 - the motor used for restarting the engine is a low voltage motor operating on 12 V).

Claim 5 lacks an inventive step under PCT Article 33(3) as being obvious over Bromberg in view of Chivilo, further in view of US 4,974,416 A (Taylor).

As per claim 5, Bromberg discloses the system wherein the engine uses direct injection (see Section II, para [0001]). Bromberg does not specifically disclose the system wherein the engine uses direct injection during engine restart to supplement port fuel injection while a fuel film that feeds the engine is established so as to minimize energy, emissions and time required for engine restart. Taylor discloses a system wherein the engine includes port fuel injection while a fuel film that feeds the engine is established (col 4, ln 15-21). It would have been obvious to one of ordinary skill in the art to modify the system as disclosed by Bromberg with the port fuel injection and fuel film as taught by Taylor, since it is well known in the art to supplement port injection with direct injection and since fuel films are well known and the use of such would have minimized energy, emissions and time required for engine restart.

Claims 6 and 8 lack an inventive step under PCT Article 33(3) as being obvious over Bromberg in view of Chivilo, further in view of US 6,260,525 B1 (Moyer).

As per claim 6, Chivilo discloses a control system for shutting down the engine by stopping gasoline flow into the engine (col 2, ln 20-26 and ln 36-54). Chivilo does not specifically disclose the system further including a valve disabler for all engine valves. Moyer discloses the system further including a valve disabler for all engine valves (col 3, ln 5-8). It would have been obvious to one of ordinary skill in the art to modify the system as disclosed by Chivilo and Bromberg with the valve disabler as taught by Moyer, since all relate to the technology of shutting engines down to conserve fuel and since such would have enagled the engine to be a variable displacement engine so that when less than maximum power is required some cylinders can be shut down and power increased in the remaining cylinders which will then operate at greater efficiency.

As per claim 8, Bromberg further discloses the system wherein maximum manifold pressure is increased by at least a factor of two over a non-pressure-boosted engine (see Abstract).

Claims 11 lacks an inventive step under PCT Article 33(3) as being obvious over Bromberg in view of Chivilo, further in view of US 4,967,714 A (Inoue).

As per claim 11, Bromberg further discloses the system wherein the ethanol is injected through a fuel injector (see Section II, para [0001]). Bromber does not specifically disclose wherein the gasoline and the ethanol are injected through the same fuel injector. Inoue discloses the system wherein the gasoline and the ethanol are injected through the same fuel injector (col 3, ln 27-30 and ln 66-67). It would have been obvious to one of ordinary skill in the art to modify the system as disclosed by Bromberg to enable the system to inject ethanol and gasoline through the same fuel injector as taught by Inoue, since both relate to the technology of ethanol burning systems and since such would have enabled the system to operate using only one fuel injector per cylinder which is a well known design to one of ordinary skill in the art.

Claims 13-18 lack an inventive step under PCT Article 33(3) as being obvious over Bromberg in view of Chivilo, further in view of Kuroda, further in view of Moyer.

As per claim 13, Bromberg discloses a turbocharged spark ignition engine which uses separately controlled direct injection of ethanol and port fuel injection of gasoline (see Abstract). Bromberg does not specifically disclose where the engine is shut down during periods of deceleration and idle. Kuroda discloses where the engine is shut down during periods of deceleration and idle (col 8, ln 3-27). Bromberg further discloses the engine comprising a first source of gasoline (see Section II, para [0003]); a second source of ethanol (see Section II, para [0003]); a gasoline engine (see Abstract). Bromberg does not specifically disclose a means to engine cylinder deactivation through valve disabling during engine deceleration and idling. Moyer discloses a means to engine cylinder deactivation through valve disabling (col 3, ln 5-8). It would have been obvious to one of ordinary skill in the art to modify the engine as disclosed by Bromberg with the shut down during deceleration and idle as taught by Kuroda and the disabling of the valves as taught by Moyer, since all relate to the technology of improving fuel economy and since the disabling of the valves is well known in the art as an effective way to shut down the engine and since shutting down the engine during deceleration and idle is an obvious means to conserving fuel.

As per claim 14, Bromberg further discloses the turbocharged spark ignition engine (see Section II, para [0001]) wherein the engine uses direct ethanol injection during a range of engine operating conditions to prevent engine knock (see Section I, para [0003]). Bromberg does not specifically disclose direct ethanol injection during engine restart to prevent engine knock. However, it would have been obvious to one of ordinary skill in the art to include ethanol injection during engine restart as one of the operating conditions since engine knock often occurs during restart and one of the objects of Bromberg is to prevent engine knock.

---- Please See Continuation Sheet ---

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**

Continuation of:
Suplemental Box 1:

As per claim 15, Bromberg discloses the turbocharged spark ignition engine (see Section II, para [0001]) wherein the engine uses direct ethanol injection to minimize hydrocarbon emissions (see Section II, para [0006]). Bromberg does not specifically disclose direct ethanol injection during engine restart to minimize hydrocarbon emissions. However, it would have been obvious to one of ordinary skill in the art to include ethanol injection during engine restart to minimize hydrocarbon emissions since hydrocarbon emissions can be high during restart and one of the objects of Bromberg is to minimize hyrdrocarbon emissions.

As per claim 16, Bromberg discloses the turbocharged spark ignition engine (see Section II, para [0001]). Bromberg does not specifically disclose the turbocharged spark ignition engine where a low voltage motor is used to restart the engine. Kuroda discloses the system wherein the low voltage motor is a low voltage motor (Fig 4; col 12, ln 54-56). Furthermore, it would have been obvious to one of ordinary skill in the art to modify the engine as disclosed by Bromberg and Chivilo with the low voltage motor for restart since most vehicles currently operate with a 12 V battery and using a low voltage motor for restart would not require an additional battery for operating the restart motor.

As per claim 17, Bromberg discloses a turbocharged spark ignition engine which uses separately controlled direct injection of ethanol and port fuel injection of gasoline (see Abstract). Bromberg does not specifically disclose where the engine is shut down during periods of deceleration and idle. Kuroda discloses where the engine is shut down during periods of deceleration and idle (col 8, ln 3-27). Bromberg further discloses the engine comprising a first source of gasoline (see Section II, para [0003]); a second source of ethanol (see Section II, para [0003]); a gasoline engine (see Abstract). Bromberg does not specifically disclose a means to disable the engine cylinders and where direct ethanol injection is used during engine restart and further where a low voltage motor is used for engine restart. Moyer discloses a means to engine cylinder deactivation through valve disabling (col 3, ln 5-8). Kuroda further discloses where a low voltage motor is used for engine restart (Fig 4; col 12, ln 54-56). It would have been obvious to one of ordinary skill in the art to modify the engine as disclosed by Bromberg with the shut down during deceleration and idle and low voltage restart motor as taught by Kuroda and the disabling of the valves as taught by Moyer, since all relate to the technology of improving fuel economy and since the disabling of the valves is well known in the art as an effective way to shut down the engine and since shutting down the engine during deceleration and idle is an obvious means to conserving fuel.

As per claim 18. Bromberg discloses a turbocharged spark ignition engine which uses direct injection of ethanol (see Abstract). Bromberg does not specifically disclose where the engine is shut down during periods of deceleration and idle comprising a turbocharged spark ignition engine; and a means to shutdown the engine cylinders and where direct ethanol injection is used during engine restart and further where a low voltage motor is used for engine restart. Kuroda discloses where the engine is shut down during periods of deceleration and idle (col 8, ln 3-27). Moyer discloses a means to engine cylinder deactivation through valve disabling (col 3, ln 5-8). Kuroda further discloses where a low voltage motor is used for engine restart (Fig 4; col 12, ln 54-56). It would have been obvious to one of ordinary skill in the art to modify the engine as disclosed by Bromberg with the shut down during deceleration and idle and low voltage restart motor as taught by Kuroda and the disabling of the valves as taught by Moyer, since all relate to the technology of improving fuel economy and since the disabling of the valves is well known in the art as an effective way to shut down the engine and since shutting down the engine during deceleration and idle is an obvious means to conserving fuel.

Claims 1-18 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.

resp to Written Opinion

PATENT COOPERATION TREATY

Docketed
Due 5-25-08

From the INTERNATIONAL SEARCHING AUTHORITY

To:
SAM PASTERNACK
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

Amend Claims
Docketed
Due 4-25-08

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

	Date of mailing (*day/month/year*) 25 FEB 2008
Applicant's or agent's file reference 2006734-0015 ✓	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US07/74227	International filing date (*day/month/year*) 24 July 2007 (24.07.2007)
Applicant ETHANOL BOOSTING SYSTEMS, LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70.

   For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

   In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

   See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/ US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer Stephen K Cronin Telephone No. (571) 272-4383

Form PCT/ISA/220 (January 2004) *(See notes on accompanying sheet)*

RECEIVED
FEB 27 2008
PATENT DEPARTMENT

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 2006734-0015	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US07/74227	International filing date (*day/month/year*) 24 July 2007 (24.07.2007)	(Earliest) Priority Date (*day/month/year*) 24 July 2006 (24.07.2006)
Applicant ETHANOL BOOSTING SYSTEMS, LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the Report**
   a. With regard to the **language**, the international search was carried out on the basis of:
      ☒ the international application in the language in which it was filed.
      ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. ☐ **Certain claims were found unsearchable** (See Box No. II)
3. ☐ **Unity of invention is lacking** (See Box No. III)
4. With regard to the **title**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,
   a. the figure of the **drawings** to be published with the abstract is Figure No. 1
      ☒ as suggested by the applicant.
      ☐ as selected by this Authority, because the applicant failed to suggest a figure.
      ☐ as selected by this Authority, because this figure better characterizes the invention.
   b. ☐ none of the figures is to be published with the abstract.

Form PCT/ISA/210 (first sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US07/74227

A. CLASSIFICATION OF SUBJECT MATTER
IPC: **F02D 41/30**(2006.01);**F02B 1/08**(2006.01)

USPC: 123/1A,431,447,575
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 123/1A,300,304,431,447,478,575,577,198C,198A

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Please See Continuation Sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- P, Y	US 2007/0119416 A1 (Boyarski) 31 May 2007 (31.05.2007), figures 16, 17, 23, 28, 37, 44, paragraphs [0066], [0107]-[0117], [0284]-[0318], claims 3, 5, 11, 15.	1-23, 26, 42-48, 56 --- 24,25,27-41,49-55
X --- Y	US 2002/01393321 A1 (Weissman et al.) 3 October 2002 (03.10.2002), figure 2, paragraphs [0022]-[0046].	24-25, 27-56 --- 1-23, 26

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
07 December 2007 (07.12.2007)

Date of mailing of the international search report
25 FEB 2008

Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
Facsimile No. (571) 273-3201

Authorized officer
Stephen K Cronin

Telephone No. (571) 272-4383

Form PCT/ISA/210 (second sheet) (April 2005)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
SAM PASTERNACK
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	25 FEB 2008
Applicant's or agent's file reference 2006734-0015	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US07/74227	24 July 2007 (24.07.2007)	24 July 2006 (24.07.2006)

International Patent Classification (IPC) or both national classification and IPC

IPC: **F02D 41/30**(2006.01);**F02B 1/08**(2006.01)
USPC: 123/1A,431,447,575

Applicant

ETHANOL BOOSTING SYSTEMS, LLC

1. This opinion contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis(b)* that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	18 February 2008 (18.02.2008)	Stephen K Cronin Telephone No. (571) 272-4383

Form PCT/ISA/237 (cover sheet) (April 2007)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US07/74227

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed

☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of:

a. type of material

☐ a sequence listing

☐ table(s) related to the sequence listing

b. format of material

☐ on paper

☐ in electronic form

c. time of filing/furnishing

☐ contained in the international application as filed.

☐ filed together with the international application in electronic form.

☐ furnished subsequently to this Authority for the purposes of search.

4. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US07/74227

Box No. V Reasoned statement under Rule 43 *bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1-56	YES
	Claims NONE	NO
Inventive step (IS)	Claims 1-56	YES
	Claims NONE	NO
Industrial applicability (IA)	Claims 1-56	YES
	Claims NONE	NO

2. Citations and explanations:

Claims 1-56 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest the claimed invention.

Claim1-56 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

SKS

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: SAM PASTERNACK
Choate, Hall & Stewart LLP
Two International Place
Boston, Massachusetts 02110

Amend Claims
cite Art in US.
Resp to Writt. Opin.

Action:
Due Date
Final Due Date 12/3/08 - 1/3/09 - 5/10/09
Docket Administrator NH Date: 10/6/08
Attorney:

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference 2006734-0021	Date of mailing *(day/month/year)* 03 OCT 2008 **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US2008/069171	International filing date *(day/month/year)* 03 July 2008
Applicant ETHANOL BOOSTING SYSTEMS LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: +41 22 740 14 35

   For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

   In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

   See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver Telephone No. 571-272-7774

Form PCT/ISA/220 (January 2004)

(See notes on accompanying sheet)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 2006734-0021	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US2008/069171	International filing date *(day/month/year)* 03 July 2008	(Earliest) Priority Date *(day/month/year)* 10 July 2007
Applicant ETHANOL BOOSTING SYSTEMS LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language**, the international search was carried out on the basis of:
      ☒ the international application in the language in which it was filed
      ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☒ **Certain claims were found unsearchable** (see Box No. II)

3. ☐ **Unity of invention is lacking** (see Box No. III)

4. With regard to the **title**,
   ☒ the text is approved as submitted by the applicant
   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,
   ☒ the text is approved as submitted by the applicant
   ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,
   a. the figure of the **drawings** to be published with the abstract is Figure No. 1
      ☐ as suggested by the applicant
      ☒ as selected by this Authority, because the applicant failed to suggest a figure
      ☐ as selected by this Authority, because this figure better characterizes the invention
   b. ☐ none of the figures is to be published with the abstract

Form PCT/ISA/210 (first sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/069171

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 15-17, 31-33
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/069171

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - F02B 77/04 (2008.04)
USPC - 123/198A
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - F02B 77/04 (2008.04)
USPC - 123/198A, 406.29, 435

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
MicroPatent, DialogPro, IP.com

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 7,225,787 B2 (BROMBERG et al) 05 June 2007 (05.06.2007) entire document	1-14, 18-30, 34-35
Y	US 2006/0102145 A1 (COHN et al) 18 May 2006 (18.05.2006) entire document	1-14, 18-30, 34-35
Y	US 6,561,157 B2 (ZUR LOYE et al) 13 May 2003 (13.05.2003) entire document	6, 23, 35
A	US 3,557,763 A (PROBST) 26 January 1971 (26.01.1971) entire document	1-35
A	US 4,056,087 A (BOYCE) 01 November 1977 (01.11.1977) entire document	1-35
A	US 4,230,072 A (NOGUCHI et al) 28 October 1980 (28.10.1980) entire document	1-35
A	US 4,594,201 A (PHILLIPS et al) 10 June 1986 (10.06.1986) entire document	1-35
A	US 5,179,923 A (TSURUTANI et al) 19 January 1993 (19.01.1993) entire document	1-35
A	US 7,156,070 B2 (STROM et al) 02 January 2007 (02.01.2007) entire document	1-35
A	US 2007/0119421 A1 (LEWIS et al) 31 May 2007 (31.05.2007) entire document	1-35
A	US 2007/0125321 A1 (RITTER) 07 June 2007 (07.06.2007) entire document	1-35

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 September 2008	03 OCT 2008
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (April 2005)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: SAM PASTERNACK
Choate, Hall & Stewart LLP
Two International Place
Boston, Massachusetts 02110

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* 03 OCT 2008	
Applicant's or agent's file reference 2006734-0021	FOR FURTHER ACTION See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2008/069171	03 July 2008	10 July 2007

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - F02B 77/04 (2008.04)
USPC - 123/198A

Applicant
ETHANOL BOOSTING SYSTEMS LLC

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☒ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability: citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer:
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	25 September 2008	Blaine Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (April 2007)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2008/069171

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of:

   a. type of material

      ☐ a sequence listing

      ☐ table(s) related to the sequence listing

   b. format of material

      ☐ on paper

      ☐ in electronic form

   c. time of filing/furnishing

      ☐ contained in the international application as filed

      ☐ filed together with the international application in electronic form

      ☐ furnished subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2008/069171

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of

☐ the entire international application

☒ claims Nos. 15-17, 31-33

because:

☐ the said international application, or the said claims Nos. _____ relate to the following subject matter which does not require an international search *(specify)*:

☒ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. 15-17, 31-33 are so unclear that no meaningful opinion could be formed *(specify)*:

Claims 15-17, 31-33 are multiple dependent claims not drafted in accordance with the second and third sentences of Rule 6.4(a).

☐ the claims, or said claims Nos. _____ are so inadequately supported by the description that no meaningful opinion could be formed *(specify)*:

☒ no international search report has been established for said claims Nos. 15-17, 31-33

☐ a meaningful opinion could not be formed without the sequence listing; the applicant did not, within the prescribed time limit:

- ☐ furnish a sequence listing on paper complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in a form and manner acceptable to it.
- ☐ furnish a sequence listing in electronic form complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in a form and manner acceptable to it.
- ☐ pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rule 13*ter*.1(a) or (b).

☐ a meaningful opinion could not be formed without the tables related to the sequence listings; the applicant did not, within the prescribed time limit, furnish such tables in electronic form complying with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions, and such tables were not available to the International Searching Authority in a form and manner acceptable to it.

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in electronic form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.

☐ See Supplemental Box for further details.

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2008/069171

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-14, 18-30, 34-35	YES
	Claims	None	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-14, 18-30, 34-35	NO
Industrial applicability (IA)	Claims	1-14, 18-30, 34-35	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-5, 7-14, 18-22, 24-30, and 34 lack an inventive step under PCT Article 33(3) as being obvious over Bromberg et al. in view of Cohn et al.

Regarding claim 1, Bromberg et al. disclose a fuel management system for a spark ignition gasoline engine (Abstract) comprising: a gasoline engine (18); a source of gasoline (Fig. 4a); a source of a second liquid fuel (Fig. 4a); a means for introducing gasoline (Fig. 4b) into the cylinders of the engine (18); injectors for direct injection of the second liquid fuel (Col. 11, lines 23-50) into the cylinders of the engine (18); a fuel management control system (Col. 1, lines 45-50) for controlling injection of the second fuel into the cylinder so that it is provided in an amount needed to prevent knock (Fig. 3) as other conditions require; and a means for providing fast flame speed (Col. 10, lines 45-55). Bromberg et al. do not show controlling injection of the second fuel into the cylinder so that it is provided in an amount needed to prevent knock as torque increases; and a means for providing fast burn. It is deemed obvious that a fast flame speed produces a fast burn. Cohn et al. show a fuel management control system (14) for controlling injection of a second fuel into a cylinder so that it is provided in an amount needed to prevent knock as torque increases (paragraph 32). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. in the device of Bromberg et al. in order to provide improved engine performance.

Regarding claim 2, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where the 10% - 90% burn occurs in 15-20 crank angle degrees. It is obvious from Bromberg et al. (Figs. 2A-2B) that a significant portion of the energy fraction (burn) occurs in a small crank angle range including that claimed.

Regarding claim 3, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. show where the fast burn (Col. 10, lines 45-55) in the engine is provided by charge motion (Col. 10, lines 15-20).

Regarding claim 4, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. show where the fast burn (Col. 10, lines 45-55) in the engine is provided by increased temperature (Col. 4, lines 1-10) in the unburned zone of air/fuel mixture zone that burns early in the cycle after the firing of the spark (Col. 4, lines 30-45).

Regarding claim 5, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where there are dual ignition sites on either side of the cylinder but show two ignition sources (Col. 1, lines 13-15, Col. 6, lines 23-30). It is obvious that the dual sites can be on opposite cylinder sides to promote complete combustion.

Regarding claim 7, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where the spray of the second fuel is aimed toward the end gas on the exhaust valve side of the cylinder and the injector is located near the periphery. Cohn et al. show where spray of the second fuel is aimed toward an end gas on an exhaust valve side of the cylinder and an injector is located near the periphery (paragraph 7). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. in the device of Bromberg et al. in order to provide improved engine performance.

Regarding claim 8, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. show where the time of the direct injection of the second fuel is adjusted to minimize the ethanol consumption (Col. 6, lines 48-52, Col. 10, lines 25-35).

Regarding claim 9, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where turbulence is created at or near the intake port. Cohn et al. show where turbulence is created at or near an intake port (paragraph 28). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. in the device of Bromberg et al. in order to provide improved engine performance.

Regarding claim 10, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. show where combustion is retarded by means of spark retard relative to what it would be if fast burn were not employed (Col. 8, lines 20-25).

Regarding claim 11, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where combustion, as measured by the 50% burn crank angle, is retarded using appropriate spark retard by an amount between 5 and 10 degrees but show spark retard (Col. 8, lines 20-25). It is deemed obvious that spark retard is a small but significant amount including that claimed.

(Continued in Supplemental Box)

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:
Box V

Regarding claim 12, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. show where the amount of second fuel that is used is reduced when the fast burn is provided (Col. 3, lines 25-30).

Regarding claim 13, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. show where the amount of combustion retard is varied as a function of load (Col. 1, lines 20-25) and speed by means of appropriate spark retard (Col. 8, lines 20-25).

Regarding claim 14, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where the degree of combustion retard is chosen so as to optimize the combination of efficiency gain and minimization of the required amount of the second fluid fuel. Cohn et al. show where a degree of combustion retard is chosen so as to optimize the combination of efficiency gain and minimization of the required amount of the second fluid fuel (Fig. 5, paragraphs 14 and 35). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. in the device of Bromberg et al. in order to provide improved engine performance.

Regarding claim 18, Bromberg et al. disclose a fuel management system for a spark ignition gasoline engine (Abstract) comprising: a gasoline engine (18) of compression ratio between 13 and 14 (Col. 7, lines 55-60); a source of a second liquid fuel (Fig. 4a); a means for introducing gasoline (Fig. 4b) into the cylinders of the engine (18); injectors for direct injection of the second liquid fuel (Col. 11, lines 23-50) into the cylinder of the engine (18); a fuel management control system (Col. 1, lines 45-50) for controlling injection of the second fuel into the cylinder so that it is provided in an amount needed to prevent knock (Fig. 3) as torque increases or other conditions require; and a means for fast flame speed (Col. 10, lines 45-55). Bromberg et al. do not show controlling injection of the second fuel into the cylinder so that it is provided in an amount needed to prevent knock as torque increases; and a means for providing fast burn. It is deemed obvious that a fast flame speed produces a fast burn. Cohn et al. show a fuel management control system (14) for controlling injection of a second fuel into a cylinder so that it is provided in an amount needed to prevent knock as torque increases (paragraph 32). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. in the device of Bromberg et al. in order to provide improved engine performance.

Regarding claim 19, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where the 10% - 90% burn occurs in 15-20 crank angle degrees. It is obvious from Bromberg et al. (Figs. 2A-2B) that a significant portion of the energy fraction (burn) occurs in a small crank angle range including that claimed.

Regarding claim 20, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. show where the fast burn (Col. 10, lines 45-55) in the engine is provided by charge motion (Col. 10, lines 15-20).

Regarding claim 21, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. show where the fast burn (Col. 10, lines 45-55) in the engine is provided by increased temperature (Col. 4, lines 1-10) in the unburned zone of air/fuel mixture zone that burns early in the cycle after the firing of the spark (Col. 4, lines 30-45).

Regarding claim 22, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where there are dual ignition sites on either side of the cylinder but show two ignition sources (Col. 1, lines 13-15, Col. 6, lines 23-30). It is obvious that the dual sites can be on opposite cylinder sides to promote complete combustion.

Regarding claim 24, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where the spray of the second fuel is aimed toward the end gas on the exhaust valve side of the cylinder. Cohn et al. show where spray of the second fuel is aimed toward an end gas on the exhaust valve side of the cylinder (paragraph 7). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. in the device of Bromberg et al. in order to provide improved engine performance.

Regarding claim 25, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where turbulence is created at or near the intake port. Cohn et al. show where turbulence is created at or near an intake port (paragraph 28). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. in the device of Bromberg et al. in order to provide improved engine performance.

Regarding claim 26, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. show where combustion is retarded by means of spark retard relative to what it would be if fast burn were not employed (Col. 8, lines 20-25).

Regarding claim 27, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where combustion, as measured by the 50% burn crank angle, is retarded using appropriate spark retard by an amount between 5 and 15 degrees but show spark retard (Col. 8, lines 20-25). It is deemed obvious that spark retard is a small but significant amount including that claimed.

Regarding claim 28, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. show where the amount of second fuel that is used is reduced when the fast burn is provided (Col. 3, lines 25-30).

Regarding claim 29, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. show where the amount of combustion retard is varied as a function of load (Col. 1, lines 20-25) and speed by means of appropriate spark retard (Col. 8, lines 20-25).

(Continued in next Supplemental Box)

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:
Previous Supplemental Box

Regarding claim 30, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where the degree of combustion retard is chosen so as to optimize the combination of efficiency gain and minimization of the required amount of the second fluid fuel. Cohn et al. show where a degree of combustion retard is chosen so as to optimize the combination of efficiency gain and minimization of the required amount of the second fluid fuel (Fig. 5, paragraphs 14 and 35). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. in the device of Bromberg et al. in order to provide improved engine performance.

Regarding claim 34, Bromberg et al. disclose a spark ignition gasoline engine (18) where alcohol and gasoline are both directly injected (Col. 1, lines 55-60) and where the alcohol/gasoline ratio needed to prevent knock uses fast burn. Bromberg et al. do not show where the alcohol/gasoline ratio needed to prevent knock is reduced by using fast flame speed. It is deemed obvious that a fast flame speed (Bromberg - Col. 10, lines 45-55) produces a fast burn. Cohn et al. show where an alcohol/gasoline ratio needed to prevent knock is reduced (paragraph 19). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. in the device of Bromberg et al. in order to provide improved engine performance.

Claims 6, 23, 35 lack an inventive step under PCT Article 33(3) as being obvious over Bromberg et al. in view of Cohn et al. and zur Loye et al.

Regarding claim 6, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where the direct injector is located in the center of the cylinder. zur Loye et al. show where a direct injector (62) is located in a center of a cylinder (Fig. 1). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. and zur Loye et al. in the device of Bromberg et al. in order to provide improved engine performance.

Regarding claim 23, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where the direct injector is located in the center of the cylinder. zur Loye et al. show where a direct injector (62) is located in a center of a cylinder (Fig. 1). It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. and zur Loye et al. in the device of Bromberg et al. in order to provide improved engine performance.

Regarding claim 35, Bromberg et al. and Cohn et al. disclose that as applied above. Bromberg et al. do not show where a high energy spark plug is used to provide fast burn. zur Loye et al. show where a high energy spark plug (52) is used to provide fast burn. It would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ the structures and processes as taught by Cohn et al. and zur Loye et al. in the device of Bromberg et al. in order to provide improved engine performance.

Claims 1-14, 18-30, and 34-35 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

(i) the claim is unchanged;
(ii) the claim is cancelled;
(iii) the claim is new;
(iv) the claim replaces one or more claims as filed;
(v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under Article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments and any accompanying statement, under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the time of filing the amendments (and any statement) with the International Bureau, also file with the International Preliminary Examining Authority a copy of such amendments (and of any statement) and, where required, a translation of such amendments for the procedure before that Authority (see Rules 55.3(a) and 62.2, first sentence). For further information, see the Notes to the demand form (PCT/IPEA/401).

If a demand for international preliminary examination is made, the written opinion of the International Searching Authority will, except in certain cases where the International Preliminary Examining Authority did not act as International Searching Authority and where it has notified the International Bureau under Rule 66.1*bis*(b), be considered to be a written opinion of the International Preliminary Examining Authority. If a demand is made, the applicant may submit to the International Preliminary Examining Authority a reply to the written opinion together, where appropriate, with amendments before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later (Rule 43*bis*.1(c)).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see the *PCT Applicant's Guide*, Volume II.

Electronic Patent Application Fee Transmittal	
Application Number:	12020285
Filing Date:	25-Jan-2008
Title of Invention:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES
First Named Inventor/Applicant Name:	Leslie Bromberg
Filer:	Sam Pasternack/Christina Andrews
Attorney Docket Number:	0492611-0828(MITCON11381)
Filed as Small Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	180	180
		Total in USD ($)		**180**

Electronic Acknowledgement Receipt

EFS ID:	6574315
Application Number:	12020285
International Application Number:	
Confirmation Number:	1610
Title of Invention:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES
First Named Inventor/Applicant Name:	Leslie Bromberg
Customer Number:	24280
Filer:	Sam Pasternack/Christina Andrews
Filer Authorized By:	Sam Pasternack
Attorney Docket Number:	0492611-0828(MITCON11381)
Receipt Date:	04-DEC-2009
Filing Date:	25-JAN-2008
Time Stamp:	13:41:03
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$180
RAM confirmation Number	9579
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1		Response.pdf	136745 00c8d4188b28f80b712d265591bf4e4872606d33	yes	7
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
	Claims		2	4	
	Applicant Arguments/Remarks Made in an Amendment		5	7	
Warnings:					
Information:					
2	Transmittal Letter	IDS_12_04_09.pdf	112173 7fe6d0fb8b798fe5b3ff43b4a9cc922d158bc78e	no	2
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Filed (SB/08)	SB08.pdf	137456 6ad5057faa0857f42622617e323b780a4fa404f9	no	4
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
4	NPL Documents	C1.pdf	977500 49572517f403a828c6b797bd96fbd58cfc9719c2	no	6
Warnings:					
Information:					
5	NPL Documents	C2.pdf	2319176 c6ece8e7eb3963d115c6cc0c6a63fa1fde5b078a	no	12
Warnings:					
Information:					
6	NPL Documents	C3.pdf	2067866 1371d15efbae941ebd35ca63106eae856e24f616	no	10
Warnings:					
Information:					
7	NPL Documents	C4.pdf	1817215 847951023a2b68bac43de6e552e6c4d35d241111	no	11
Warnings:					
Information:					

8	NPL Documents	C5.pdf	3129945 b04621c30518b8fb94ad1c71883e1a06b985577b	no	11
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Information:					
9	NPL Documents	C6.pdf	1249019 eb3b9a60df93bf1484b42d19212fdb7bc064c64c	no	9
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10	NPL Documents	C7.pdf	5487863 1c53ae6e30396382dde35f1b6655b0547dfdcd1e	no	28
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11	NPL Documents	C8.pdf	1209060 101bf11ad7bb2453d583cc3b0ea52d518a306999	no	8
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12	NPL Documents	C9.pdf	925435 51f32f45ecbf104faf7c8b07fc87466aef2c213d	no	7
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Information:					
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14	NPL Documents	C11.pdf	296309 f69d9161e570cbdcecaf08c0bdbccf929bc1c057	no	3
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17	NPL Documents	C14.pdf	1390586 51f74c3938d33cff846be46d8fef6e3cf70dd84d	no	10
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18	NPL Documents	C15.pdf	1774764 2bafc48f69f805f2733680c8f3670b6217d79295	no	9
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Information:					
19	NPL Documents	C16.pdf	835215 6314e3e3725b3e2eea24e55dee4e004e421409cd	no	6
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20	NPL Documents	C17.pdf	1844447 00347b6ce8718c5aade97aa5130578c085f21676	no	11
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21	NPL Documents	C18.pdf	1382439 73051eb88af3968ff777a4aba828f44cb272ca7d	no	13
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22	NPL Documents	C19.pdf	583066 1777cc1301dff0ed48c0df28b9af9b015b131d66	no	7
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23	NPL Documents	C20.pdf	1058548 7ca4a9e873d72536ffc293e3391b6e346370cbff	no	10
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24	NPL Documents	C21.pdf	567841 2966c1f79eb1090966b49b391d585b7363bb8712	no	5
Warnings:					
Information:					
25	NPL Documents	C22.pdf	735838 9e863d0473226e798ebbfb74b01bffe37c8a7719	no	7
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Information:					

26	NPL Documents	C23.pdf	574389 90e879b3957c6478240ec07b9f5a05c3591dadae	no	5
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27	NPL Documents	C24.pdf	457803 d33a8f1f1974a3a3542f5f069fe85f7e08895e2d	no	4
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28	NPL Documents	C25.pdf	667320 667d6555bc5d48d75664ef76a79dec22b9c4109a	no	6
Warnings:					
Information:					
29	NPL Documents	C26.pdf	470331 3ca823cce4cc7ae0695bb31d42b6942f02e733af	no	5
Warnings:					
Information:					
30	NPL Documents	C27.pdf	766308 b2540106806f6ed011fab766b5b0cc1b56ad2238	no	6
Warnings:					
Information:					
31	NPL Documents	C28.pdf	764037 c88bef97266f9cc52245bc85ad3f5459d73779ac	no	7
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Information:					
32	Fee Worksheet (PTO-875)	fee-info.pdf	30784 4ad39f52dc90c51c808ce21f25a4c75894702799	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	41517494	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/020,285	Filing Date 01/25/2008	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☒		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☒ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	75		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	75		TOTAL	

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
	12/04/2009	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	* 24	Minus	** 25	= 0	X $26 =	0	OR	X $ =	
	Independent (37 CFR 1.16(h))	* 5	Minus	***5	= 0	X $110 =	0	OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE	0	OR	TOTAL ADD'L FEE	

		(Column 1)		(Column 2)	(Column 3)					
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/TAMMY MCBETH BROWN/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PAGE 2/002 * RCVD AT 12/30/2009 3:41:12 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-5/26 * DNIS:2738300 * CSID:617 258 8790 * DURATION (mm-ss):03-28

PTO/SB/81 (01-09)
Approved for use through 11/30/2011. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	12/020285
Filing Date	01/25/2008
First Named Inventor	Daniel R. Cohn et al.
Title	OPTIMIZED FUEL MANAGMENT SYSTEM FOR DIRECT
Art Unit	unknown
Examiner Name	unknown
Attorney Docket Number	11381.106198

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith: 91197

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified application to:

☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Applicant/Inventor.

OR

☒ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) (Form PTO/SB/96) submitted herewith or filed on 03/09/2009

SIGNATURE of Applicant or Assignee of Record

Signature	Daniel O'Brien	Date	12/30/2009
Name	Daniel O'Brien	Telephone	617.258.7148
Title and Company	IP Manager Massachusetts Institute of Technology		

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Dec 30 2009 4:52PM Technology Licensing Offi 617 258 6790 p.2

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PAGE 3/15 * RCVD AT 12/30/2009 3:41:12 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-5/26 * DNIS:2738300 * CSID:617 258 6790 * DURATION (mm-ss):03-28

PTO/SB/96 (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
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STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Daniel R. Cohn et al.

Application No./Patent No.: 12/020285 Filed/Issue Date: 01/25/2008

Titled: OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

Massachusetts Institute of Technology , a Non-profit
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.

states that it is:

1. ☒ the assignee of the entire right, title, and interest in;

2. ☐ an assignee of less than the entire right, title, and interest in
(The extent (by percentage) of its ownership interest is _____ %); or

3. ☐ the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

the patent application/patent identified above, by virtue of either:

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 022365, Frame 0720, or for which a copy therefore is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

3. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Daniel O'Brien 12/30/2009
Signature Date

Daniel O'Brien IP Manager
Printed or Typed Name Title

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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PAGE 1/15 * RCVD AT 12/30/2009 3:41:12 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-5/26 * DNIS:2738300 * CSID:617 258 6790 * DURATION (mm-ss):03-28

Five Cambridge Center, Kendall Square
Room NE25-230
Cambridge, Massachusetts

MIT
Technical Licensing Office

To:	Commissioner for Patents	From:	Maureen Joyce Patent Docket Manager
Fax:	571.273.8300	Pages:	Fifteen
Phone:	617.258.6729	Date:	December 30, 2009
Re:	Please reference below.	cc:	

Dear Sir:

Please process the Revocation of Power of Attorney document (PTO/SB/81) along with the required accompanying Statement Under 37 C.F.R. 3.73 (b) form (PTO/SB/96) for each of the following pending patent applications:

12/020285
12/563469
12/621425
11/758157
12/594766
12/488174
12/562766

Thank you for your assistance with these filings. Please contact me with any questions.

Sincerely,

Maureen A. Joyce

Dec 30 2009 4:52PM Technology Licensing Off 617 258 6790 p.1

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/020,285	01/25/2008	Leslie Bromberg	11381.106198

CONFIRMATION NO. 1610

POA ACCEPTANCE LETTER

91197
Technology Licensing Office
Masachusetts Institute of Technology
Five Cambridge Center
Kendall Square
Cambridge, MA 02142-1493

OC000000039626787

Date Mailed: 01/15/2010

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 12/30/2009.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/hgray/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/020,285	01/25/2008	Leslie Bromberg	11381.106198	1610

91197 7590 02/19/2010

Technology Licensing Office
Masachusetts Institute of Technology
Five Cambridge Center
Kendall Square
Cambridge, MA 02142-1493

EXAMINER	
DUFF, DOUGLAS J	
ART UNIT	PAPER NUMBER
3748	

NOTIFICATION DATE	DELIVERY MODE
02/19/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mitdocket@mit.edu
mjoyce@mit.edu

Office Action Summary	Application No.	Applicant(s)	
	12/020,285	BROMBERG ET AL.	
	Examiner	Art Unit	
	DOUGLAS J. DUFF	3748	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 December 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5 and 7-14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5 and 9-14* is/are rejected.

7)☒ Claim(s) *7 and 8* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *12/4/09*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

This Office Action is in response to Applicant's request for reconsideration filed 12/4/09.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-5 and 9-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gray, Jr. et al. (US 6651432) in view of Mochizuki et al. (US 5131228). Regarding claims 1 and 5, Gray, Jr. et al. discloses a turbocharged (27) or supercharged spark ignition engine wherein a mixture is directly injected from a first source (23) and there is also a means for independently controlling fueling with gasoline from a second source (53) comprising a spark ignition engine; a turbocharger or supercharger; a means for directly injecting a gasoline mixture from the first source into at least one cylinder; a means for fueling the engine with gasoline from the second source; further wherein under some driving conditions the manifold pressure is greater than 2 bar (col. 8, lines 62-67); and wherein the engine is operated at a substantially stoichiometric fuel/air ratio during at least part the operating time (col. 10, lines 24-32). Gray, Jr. et al. discloses an ethanol-gasoline mixture to be directly injected (col. 10, lines 34-49), but fails to specifically disclose a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder wherein the energy fraction in the cylinder that is provided by the directly injected ethanol is at least 20 % and fails to disclose the

maximum level of pressure increase from the turbocharger is decreased when an ethanol/gasoline ratio is lowered.

3. Mochizuki et al. teaches a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder wherein the energy fraction in the cylinder that is provided by the directly injected ethanol is at least 20 % (Figure 4). It would have been obvious for a person having ordinary skill in the art at the time the invention was made to utilize an ethanol-gasoline mixture with an energy fraction of ethanol of at least 20% directly injected into the first source cylinder injector of Gray, Jr. et al. in order to avoid auto-ignition of the mixture of the supercharged engine of Gray, Jr. et al. (col. 4, lines 41-50).

4. Additionally, Mochizuki et al. teaches a supercharged engine wherein the maximum level of pressure increase from the supercharger is decreased when an ethanol/gasoline ratio is lowered (col. 4, lines 41-50). It would have been obvious for a person having ordinary skill in the art at the time the invention was made to utilize the lowering of maximum supercharger pressure when the ethanol/gasoline ratio is lowered in order to avoid engine knock due to the lowering of octane of the fuel mixture.

5. Regarding claims 2-4, the modified Gray, Jr. et al. device discloses the maximum pressure increase is decreased so as to prevent knock (col. 4, lines 41-50), the spark retard is increased when the ethanol/gasoline ratio is lowered (claim 26) and the compression ratio is 11 or greater (claim 21).

6. Regarding claims 9-14, the modified Gray, Jr. et al. device discloses the level of turbocharging is decreased so as to reduce the amount of the ethanol/gasoline mixture

from the first source that is needed to prevent knock (col. 4, lines 41-50), wherein the usage of the ethanol/gasoline mixture from the first source is determined by the amount of fuel in the first source (fuel supply), wherein the usage of the mixture from the first source is determined by the driver (demand/throttle), wherein the spark retard is changed when the ethanol/gasoline ratio is changed (col. 6, lines 29-31), wherein the fuel/air ratio in the engine is rich at high loads and wherein the gasoline from the second source is port fuel injected (col. 4, lines 13-40).

Allowable Subject Matter

7. Claims 7 and 8 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

8. Applicant's arguments filed 12/4/09 have been fully considered but they are not persuasive. Applicant argues that Gray, Jr. fails to disclose a mixture of ethanol and gasoline. Examiner respectfully disagrees. Column 10, lines 34-39 discusses “an engine which utilizes a pre-mixed charge of very high octane fuel ... such as methanol *or* ethanol *and* certain gasolines, with spark or similar controlled ignition means." Gray, Jr. discloses *either* methanol *or* ethanol mixed with gasoline to form a high octane fuel.

9. Applicant further argues that Mochizuki fails to disclose that the ethanol/gasoline ratio is adjusted depending on operating conditions because the ratio is determined by what has been put into the fuel tank. Applicant asserts that the relative amount of ethanol of the Mochizuki engine cannot be altered. However, Mochizuki teaches

adjusting the fuel ratio by filling the tank with varying fuel ratios. Based on the required operating conditions, the ethanol/gasoline ratio is lowered (col. 4, lines 34-40 and 46-50).

10. In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., an adjusting of the ethanol/gasoline ratio outside of filling the fuel tank) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Conclusion

11. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DOUGLAS J. DUFF whose telephone number is (571)272-3459. The examiner can normally be reached on M-Th 7 AM - 5 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Denion can be reached on (571) 272-4859. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Thomas E. Denion/
Supervisory Patent Examiner, Art Unit 3748

/Douglas J Duff/
Examiner, Art Unit 3748
2/9/10

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BIB DATA SHEET

CONFIRMATION NO. 1610

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/020,285	01/25/2008	123	3748	11381.106198

APPLICANTS

Leslie Bromberg, Sharon, MA;
Daniel R. Cohn, Cambridge, MA;
John B. Heywood, Newton, MA;

**** CONTINUING DATA ***************************

This application is a CON of 11/758,157 06/05/2007
which is a CIP of 11/100,026 04/06/2005 PAT 7,225,787

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **
02/09/2008

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /DOUGLAS J DUFF/ Examiner's Signature	☐ Met after Allowance djd Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		MA	3	25	5

ADDRESS

Technology Licensing Office
Masachusetts Institute of Technology
Five Cambridge Center
Kendall Square
Cambridge, MA 02142-1493
UNITED STATES

TITLE

OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

FILING FEE RECEIVED		
835	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

BIB (Rev. 05/07).

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	6623	(123/299,300,304,406.45,406.47,559.1,559.2,564,575,576,577).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	OFF	2009/08/30 19:03
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S21	60	(S6 S7 S8 S9 S10 S11 S12 S13 S14 S15 S16 S17 S18 S19) and (pressure with (bar or psi))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2009/08/30 20:38
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Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 4

Complete if Known	
Application Number	12/020,285
Filing Date	January 25, 2008
First Named Inventor	Leslie Bromberg
Art Unit	3748
Examiner Name	Duff, Douglas J.
Attorney Docket Number	0492611-0828 (MITCON11381)

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	A1	2007/0119391	05-2007	Fried, et al.	
	A2	2006/0102146	05-2006	Cohn et al.	
	A3	2006/0102145	05-2006	Cohn et al.	
	A4	2006/0102136	05-2006	Bromberg et al.	
	A5	2004/0065274	04-2004	Cohn et al.	
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	A13	4031864	06-28-1977	Crothers, William T.	
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	A16	4230072	10-28-1980	Noguchi et at.	
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Examiner Signature		Date Considered	

4581304v1

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.D./

Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 2 of 4

Complete if Known	
Application Number	12/020,285
Filing Date	January 25, 2008
First Named Inventor	Leslie Bromberg
Art Unit	3748
Examiner Name	Duff, Douglas J.
Attorney Docket Number	0492611-0828 (MITCON11381)

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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document: Country Code[3]-Number[4]-Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]

Examiner Signature	/Douglas Duff/	Date Considered	02/09/2010

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.D./

Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	12/020,285
				Filing Date	January 25, 2008
				First Named Inventor	Leslie Bromberg
				Art Unit	3748
(Use as many sheets as necessary)				Examiner Name	Duff, Douglas J.
Sheet	3	of	4	Attorney Docket Number	0492611-0828 (MITCON11381)

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. * CITE NO.: Those application(s) which are marked with an single asterisk (*) next to the Cite No. are not supplied (under 37 CFR 1.98(a)(2)(ii)) because that application was filed after June 30, 2003 or is available in the IFW. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	C1	MODAK et al., Engine Cooling by Direct Injection of Cooling Water, Society of Automotive Engineers, Inc. 700887	
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Examiner Signature	/Douglas Duff/	Date Considered	02/09/2010

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.D./

Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** *(Use as many sheets as necessary)*				***Complete if Known***	
				Application Number	12/020,285
				Filing Date	January 25, 2008
				First Named Inventor	Leslie Bromberg
				Art Unit	3748
				Examiner Name	Duff, Douglas J.
Sheet	4	of	4	Attorney Docket Number	0492611-0828 (MITCON11381)

	C22	USPTO Non-Final Office Action, Application No. 11/100,026, August 3, 2006.	
	C23	USPTO Non-Final Office Action, Application No. 11/229,755, March 22, 2007.	
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	C26	USPTO Non-Final Office Action, Application No. 11/684100, June 3, 2008.	
	C27	USPTO NOn-Final Office Action, Application No. 11/840,719, July 11, 2008.	
	C28	USPTO Notice of Allowance, Application No. 11/684,100, March 3, 2009.	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1]Applicant's unique citation designation number (optional). [2]Applicant is to place a check mark here if English language Translation is attached.

Examiner Signature	/Douglas Duff/	Date Considered	02/09/2010

4581304v1

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.D./

Search Notes	Application/Control No.	Applicant(s)/Patent under Reexamination
	12/020,285	BROMBERG ET AL.
	Examiner	Art Unit
	DOUGLAS J. DUFF	3748

SEARCHED			
Class	Subclass	Date	Examiner
123	299, 300, 304, 406.45	8/30/2009	DJD
123	406.47	8/30/2009	DJD
123	559.1	8/30/2009	DJD
123	559.2	8/30/2009	DJD
123	564	8/30/2009	DJD
123	575	8/30/2009	DJD
123	576	8/30/2009	DJD
123	577	8/30/2009	DJD
60	597, 598	8/30/2009	DJD
60	600-603	8/30/2009	DJD
60	605.1	8/30/2009	DJD
60	614	8/30/2009	DJD
60	615	8/30/2009	DJD
60	619	8/30/2009	DJD

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT)	8/30/2009	DJD

Doc code: RCEX
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	12020285	Filing Date	2008-01-25	Docket Number (if applicable)	11381.106198	Art Unit	3748
First Named Inventor	Leslie Bromberg et al.			Examiner Name	Douglas J. Duff		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

☐ Other _____

☒ Enclosed

☒ Amendment/Reply

☐ Information Disclosure Statement (IDS)

☐ Affidavit(s)/ Declaration(s)

☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

☒ The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 192553

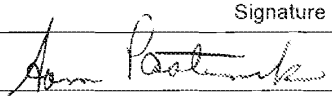
SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

☐ Applicant Signature

PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012 OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature		Date (YYYY-MM-DD)	2010-07-30
Name	Sam Pasternack	Registration Number	29576

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Patent Application Fee Transmittal

Application Number:	12020285
Filing Date:	25-Jan-2008
Title of Invention:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES
First Named Inventor/Applicant Name:	Leslie Bromberg
Filer:	Sam Pasternack/Anna Yem
Attorney Docket Number:	11381.106198

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 3 months with $0 paid	1253	1	1110	1110

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Request for continued examination	1801	1	810	810
		Total in USD ($)		**1920**

Electronic Acknowledgement Receipt	
EFS ID:	8123364
Application Number:	12020285
International Application Number:	
Confirmation Number:	1610
Title of Invention:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES
First Named Inventor/Applicant Name:	Leslie Bromberg
Customer Number:	91197
Filer:	Sam Pasternack/Anna Yem
Filer Authorized By:	Sam Pasternack
Attorney Docket Number:	11381.106198
Receipt Date:	30-JUL-2010
Filing Date:	25-JAN-2008
Time Stamp:	11:15:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$1920
RAM confirmation Number	8275
Deposit Account	192553
Authorized User	O'BRIEN,DANIEL
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees) Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Extension of Time	11381106198extime.pdf	60255 43275a2983de6505278a0753f207b9eeac76ec25	no	1
Warnings:					
Information:					
2	Amendment Submitted/Entered with Filing of CPA/RCE	11381106198oasrsp.pdf	98919 bc963e499840c866a80dd917c75006fe76acf141	no	4
Warnings:					
Information:					
3	Request for Continued Examination (RCE)	11381106198rce.pdf	67840 aff4882cb98ea28eca627f69e274eb91a5f6e72d	no	2
Warnings:					
This is not a USPTO supplied RCE SB30 form.					
Information:					
4	Fee Worksheet (PTO-875)	fee-info.pdf	32705 26d487fd46f23b1c8a770ba57ae089ad001e4a89	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	259719		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/22 (07-09)
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Under the paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a) **FY 2009** *(Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).)*	Docket Number (Optional) 11381.106198
Application Number 12/020285	Filed January 25, 2008
For OPTIMIZED FUEL MANAGEMENT SYSTEM...	
Art Unit 3748	Examiner Douglas J. Duff

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	Fee	Small Entity Fee	
☐ One month (37 CFR 1.17(a)(1))	$130	$65	$
☐ Two months (37 CFR 1.17(a)(2))	$490	$245	$
☑ Three months (37 CFR 1.17(a)(3))	$1110	$555	$ 1110.00
☐ Four months (37 CFR 1.17(a)(4))	$1730	$865	$
☐ Five months (37 CFR 1.17(a)(5))	$2350	$1175	$

☐ Applicant claims small entity status. See 37 CFR 1.27

☐ A check in the amount of the fee is enclosed.

☑ Payment by credit card. ~~Form PTO-2038 is attached.~~

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 192553.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant/inventor.

☐ assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed (Form PTO/SB/96).

☑ attorney or agent of record. Registration Number 29576

☐ attorney or agent under 37 CFR 1.34.
Registration number if acting under 37 CFR 1.34 _____

Signature — July 30, 2010 (Date)

Sam Pasternack (Typed or printed name) — 617.258.7171 (Telephone Number)

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

☑ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any *comments on the amount of time you require* to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

ATTORNEY DOCKET NO.: 11381.106198
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Leslie Bromberg et al.	Examiner:	Douglas J. Duff
Serial No.:	12/020285	Art Unit:	3748
Filing Date:	January 25, 2008	Confirmation No.:	1610
Title:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES		

AMENDMENT

Via EFS-Web
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Office Action mailed February 19, 2010, please amend the application as follows.

Remarks

Accompanying this amendment is a Request for Continuing Examination. Also enclosed is a Petition for a three months Extension of Time.

Claims 1 – 5 and 7 – 14 are pending. Claims 1 – 5 and 9 – 14 stand finally rejected and are being cancelled herein without prejudice and will be pursued in a continuing application.

Claims 7 and 8 are indicated as allowable and are being amended herein into independent form. It is submitted that amended claims 7 and 8 are now in condition for allowance.

If there is a fee occasioned by this communication, the director hereby authorized to charge any deficiency or credit any overpayment in the fees filed, asserted to be filed or which should have been filed herewith to our Deposit Account No. 192553, under Docket No. 11381.106198.

Respectfully Submitted,

Sam Pasternack
Registration No.: 29576
Massachusetts Institute of Technology
Five Cambridge Center
Room NE25-230
Cambridge, MA 02412-1493
617.258.7171

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/020,285	Filing Date 01/25/2008	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☒		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
	07/30/2010	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	* 2	Minus	** 25	= 0	X $26 =	0	OR	X $ =	
	Independent (37 CFR 1.16(h))	* 2	Minus	***5	= 0	X $110 =	0	OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE	0	OR	TOTAL ADD'L FEE	

		(Column 1)		(Column 2)	(Column 3)					
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/TONI HAKIM/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Listing of Claims

Claims 1 – 6 (cancelled)

Claim 7 (currently amended) A turbocharged or supercharged spark ignition engine wherein an ethanol–gasoline mixture is directly injected from a first source and there is also a means for independently controlling fueling with gasoline from a second source comprising:
a spark ignition engine;
a turbocharger or supercharger;
a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder;
a means for fueling the engine with gasoline from the second source;
wherein the energy fraction in the cylinder that is provided by the directly injected ethanol is at least 20 % and further wherein under some driving conditions the manifold pressure is greater than 2 bar; and
wherein the engine is operated at a substantially stoichiometric fuel/air ratio during at least part the operating time ~~The engine system of claim 5~~ wherein the engine is started up with only the gasoline from the second source.

Claim 8 (currently amended) A turbocharged or supercharged spark ignition engine wherein an ethanol–gasoline mixture is directly injected from a first source and there is also a means for independently controlling fueling with gasoline from a second source comprising:
a spark ignition engine;
a turbocharger or supercharger;
a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder;
a means for fueling the engine with gasoline from the second source;
wherein the energy fraction in the cylinder that is provided by the directly injected ethanol is at least 20 % and further wherein under some driving conditions the manifold pressure is greater than 2 bar; and
wherein the engine is operated at a substantially stoichiometric fuel/air ratio during at least part

the operating time ~~The engine system of claim 5~~ wherein under some driving conditions the engine is operated with only the directly injected ethanol –gasoline mixture from the first source.

Claims 9 – 14 (cancelled)

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	12020285
Filing Date	2008-01-25
First Named Inventor	Leslie Bromberg
Art Unit	3748
Examiner Name	TRIEU, THAI BA
Attorney Docket Number	11381.106198

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4993386		1991-02-19	Ozasa et al.	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12020285
	Filing Date	2008-01-25
	First Named Inventor	Leslie Bromberg
	Art Unit	3748
	Examiner Name	TRIEU, THAI BA
	Attorney Docket Number	11381.106198

	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12020285
	Filing Date	2008-01-25
	First Named Inventor	Leslie Bromberg
	Art Unit	3748
	Examiner Name	TRIEU, THAI BA
	Attorney Docket Number	11381.106198

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

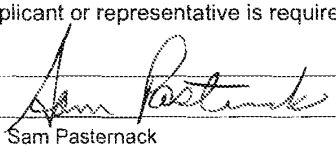
☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature		Date (YYYY-MM-DD)	2011-05-09
Name/Print	Sam Pasternack	Registration Number	29576

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Electronic Patent Application Fee Transmittal	
Application Number:	12020285
Filing Date:	25-Jan-2008
Title of Invention:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES
First Named Inventor/Applicant Name:	Leslie Bromberg
Filer:	Sam Pasternack/Ellen Byal
Attorney Docket Number:	11381.106198
Filed as Large Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	180	180
		Total in USD ($)		**180**

Electronic Acknowledgement Receipt	
EFS ID:	10047119
Application Number:	12020285
International Application Number:	
Confirmation Number:	1610
Title of Invention:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES
First Named Inventor/Applicant Name:	Leslie Bromberg
Customer Number:	91197
Filer:	Sam Pasternack/Ellen Byal
Filer Authorized By:	Sam Pasternack
Attorney Docket Number:	11381.106198
Receipt Date:	09-MAY-2011
Filing Date:	25-JAN-2008
Time Stamp:	14:38:08
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$180
RAM confirmation Number	1075
Deposit Account	192553
Authorized User	O'BRIEN,DANIEL
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	11381106198STATEMENT.pdf	73592 1592fa445fcd19a0ed0105c43da6f846bc19bd48	no	2
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Filed (SB/08)	11381106198TRANS.pdf	120662 8257f48bf249a2a17e0a97ba91b514dd5f720235	no	3
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Fee Worksheet (PTO-875)	fee-info.pdf	30476 215c64cad799d00387a06962a35a295ab765b548	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	224730		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

ATTORNEY DOCKET NO.: 11381.106198
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Leslie Bromberg	Examiner:	TRIEU, THAI BA
Serial No.:	12/020285	Art Unit:	3748
Filing Date:	January 25, 2008	Confirmation No.:	1610
Title:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES		

INFORMATION DISCLOSURE STATEMENT

Via EFS-Web
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Pursuant to 37 CFR 1.56, 1.97 and 1.98, the attention of the Patent and Trademark Office is hereby directed to the references listed on the attached PTO/SB/08a. It is respectfully requested that the information be expressly considered during the prosecution of this application, and that the references be made of record therein and appear among the "References Cited" on any patent to issue there from.

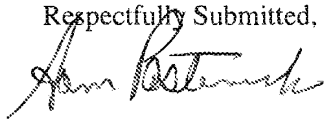
In accordance with 37 CFR 1.98(a)(2)(ii), Applicant has not submitted copies of U.S. patents and U.S. patent applications. Applicant submits herewith copies of non-patent literature and a PCT Search report in accordance with 37 CFR 1.98(a)(2).

In accordance with 37 CFR 1.97(g), the filing of this Information Disclosure Statement shall not be construed to mean that a search has been made or that no other material information as defined in 37 CFR 1.56(a) exists. In accordance with 37 CFR 1.97(h), the filing of this Information Disclosure Statement shall not be construed to be an admission that any patent, publication or other information referred to therein is "prior art" for this invention unless specifically designated as such.

It is submitted that the Information Disclosure Statement is in compliance with 37 CFR 1.98 and the Examiner is respectfully requested to consider the listed references.

If there is a fee occasioned by this communication, the director hereby authorized to charge any deficiency or credit any overpayment in the fees filed, asserted to be filed or which should have been filed herewith to our Deposit Account No. 192553, under Docket No. 11381.106198.

Respectfully Submitted,



Sam (Bo) Pasternack
Registration Number: 29576
Massachusetts Institute of Technology
One Cambridge Center
Room NE18-501
Cambridge, MA 02142
617.258.7171

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

91197 7590 10/12/2011

MIT's Technology Licensing Office
One Cambridge Center
Kendall Square, NE 18-501
Cambridge, MA 02142-1493

EXAMINER	
TRIEU, THAI BA	
ART UNIT	PAPER NUMBER
3748	

DATE MAILED: 10/12/2011

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/020,285	01/25/2008	Leslie Bromberg	11381.106198	1610

TITLE OF INVENTION: OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$870	$300	$0	$1170	01/12/2012

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 02/11)

FORD Ex. 1126, page 201
IPR2020-00013

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

91197 7590 10/12/2011

MIT's Technology Licensing Office
One Cambridge Center
Kendall Square, NE 18-501
Cambridge, MA 02142-1493

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/020,285	01/25/2008	Leslie Bromberg	11381.106198	1610

TITLE OF INVENTION: OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$870	$300	$0	$1170	01/12/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
TRIEU, THAI BA	3748	123-559100

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

FORD Ex. 1126, page 202
IPR2020-00013

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/020,285	01/25/2008	Leslie Bromberg	11381.106198	1610

91197 7590 10/12/2011

MIT's Technology Licensing Office
One Cambridge Center
Kendall Square, NE 18-501
Cambridge, MA 02142-1493

EXAMINER	
TRIEU, THAI BA	
ART UNIT	**PAPER NUMBER**
3748	

DATE MAILED: 10/12/2011

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 266 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 266 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 02/11)

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
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4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Examiner-Initiated Interview Summary	**Application No.** 12/020,285	**Applicant(s)** BROMBERG ET AL.	
	Examiner THAI BA TRIEU	**Art Unit** 3748	

All participants (applicant, applicant's representative, PTO personnel):

(1) *THAI BA TRIEU*. (3)_____.

(2) *Mr. Sam Pasternack (Reg. No. 29,576)*. (4)_____.

Date of Interview: *26 September 2011*.

Type: ☒ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☒ No.
If Yes, brief description: _____.

Issues Discussed ☐101 ☒112 ☐102 ☐103 ☒Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: *7 and 8*.

Identification of prior art discussed: *None*.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

The Examiner's Amendments to claims 7 and 8 are to address the redundancy of and to clarify the claimed limitations; and to overcome the rejection under 35 USC § 112, second paragraph of indefiniteness and lack of antecedent basis in claims.

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/Thai-Ba Trieu/ Primary Examiner, Art Unit 3748	September 27, 2011

Notice of Allowability	Application No. 12/020,285	Applicant(s) BROMBERG ET AL.	
	Examiner THAI BA TRIEU	Art Unit 3748	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *the RCE filed on 07/30/2010 and IDS filed on 05/09/2011*.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are *7 and 8*.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 05/09/2011
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☒ Interview Summary (PTO-413), Paper No./Mail Date *hereto* .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/Thai-Ba Trieu/
Primary Examiner, Art Unit 3748
September 27, 2011

FORD Ex. 1126, page 206
IPR2020-00013

DETAILED ACTION

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 07/30/2010 has been entered.

Claims 7-8 were amended; and

Claims 1-6 and 9-14 were cancelled.

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mr. Sam Pasternack (reg. No. 29,576) on Monday September 26, 2011.

The application has been amended as follows:

Claims 7 and 8 have been amended as following (See Pages 6-8 below).

EXAMINER'S COMMENT

The Examiner's Amendments to claims 7 and 8 are to address the redundancy of and to clarify the claimed limitations; and to overcome the rejection under 35 USC § 112, second paragraph of indefiniteness and lack of antecedent basis in claims.

Allowable Subject Matter

The following is an examiner's statement of reasons for allowance:

Regarding claim 7, the prior art fails to disclose or renders obvious the claimed combination of an engine system having a spark ignition engine; at least one of turbocharger and supercharger for compressing air into said spark ignition engine; a first source of an ethanol-gasoline mixture; a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder of the spark ignition engine; a second source of gasoline; a means for independently controlling fueling the engine with the gasoline from the second source; and including:

> *"an energy fraction in the cylinder provided by the directly injected ethanol being at least 20%;*
> *under driving conditions, a manifold pressure being greater than 2 bar;*
> *during at least part of an operating time under said driving conditions, the engine being operated at a substantially stoichiometric fuel/air ratio; and*
> *at a start-up condition, the engine being operated with only the gasoline from the second source."*

Regarding claim 8, the prior art fails to disclose or renders obvious the claimed combination of an engine system having a spark ignition engine; at least

one of turbocharger and supercharger for compressing air into said spark ignition engine; a first source of an ethanol-gasoline mixture; a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder of the spark ignition engine; a second source of gasoline; a means for independently controlling fueling the engine with the gasoline from the second source; and including:

> *"an energy fraction in the cylinder provided by the directly injected ethanol being at least 20%;*
> *under driving conditions, a manifold pressure being greater than 2 bar;*
> *during at least part of an operating time under said driving conditions, the engine being operated at a substantially stoichiometric fuel/air ratio; and*
> *under said driving conditions, the engine being operated with only the directly injected ethanol-gasoline mixture from the first source."*

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to THAI BA TRIEU whose telephone number is (571)272-4867. The examiner can normally be reached on Monday - Thursday (6:30-5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas E. Denion can be reached on (571) 272-4859 or Kenneth Bomberg

can be reached on (571) 272-4922. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

TTB
September 27, 2011

/Thai-Ba Trieu/
Primary Examiner
Art Unit 3748

AMENDED CLAIMS:

Claim 7 (currently amended) [[~~A turbocharged or supercharged spark ignition engine wherein an ethanol-gasoline mixture is directly injected from a first source and there is also a means for independently controlling fueling with gasoline from a second source~~]] **An engine system** comprising:

a spark ignition engine;

at least one of turbocharger [[or]] and supercharger for compressing air into said spark ignition engine;

a first source of an ethanol-gasoline mixture;

a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder **of the spark ignition engine**;

a second source **of gasoline**;

a means for **independently controlling** fueling the engine with **the** gasoline from the second source;

wherein [[~~the~~]] **an** energy fraction in the cylinder [[~~that is~~]] provided by the directly injected ethanol is at least 20 %**;** and further **comprising:**

wherein under [[~~some~~]] driving conditions**,** [[~~the~~]] a manifold pressure is greater than 2 bar; [[~~and~~]]

wherein **during at least part of an operating time under said driving conditions,** the engine is operated at a substantially stoichiometric fuel/air ratio [[~~during at least part the operating time~~]]; and

wherein **at a start-up condition,** the engine is [[~~started up~~]] **operated** with only the gasoline from the second source.

Claim 8 (currently amended) [[~~A turbocharged or supercharged spark ignition engine wherein an ethanol-gasoline mixture is directly injected from a first source and there is also a means for independently controlling fueling with gasoline from a second source~~]] **An engine system** comprising:

a spark ignition engine;

at least one of turbocharger [[or]] and supercharger for compressing air into said spark ignition engine;

a first source of an ethanol-gasoline mixture;

a means for directly injecting a liquid ethanol-gasoline mixture from the first source into at least one cylinder **of the spark ignition engine**;

a second source **of gasoline**;

a means for **independently controlling** fueling the engine with **the** gasoline from the second source;

wherein [[~~the~~]] **an** energy fraction in the cylinder [[~~that is~~]] provided by the directly injected ethanol is at least 20 %**;** and further **comprising:**

wherein under [[~~some~~]] driving conditions**,** [[~~the~~]] a manifold pressure is greater than 2 bar; [[~~and~~]]

wherein **during at least part of an operating time under said driving conditions,** the engine is operated at a substantially

stoichiometric fuel/air ratio [[~~during at least part the operating time~~]]; and

wherein under [[~~some~~]] **said** driving conditions**,** the engine is operated with only the directly injected ethanol-gasoline mixture from the first source.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12020285	BROMBERG ET AL.
	Examiner	Art Unit
	THAI BA TRIEU	3748

ORIGINAL		INTERNATIONAL CLASSIFICATION															
CLASS	SUBCLASS	CLAIMED										NON-CLAIMED					
60	601	F	0	2	D	23 / 00 (2006.01.01)											
CROSS REFERENCE(S)		F	0	2	B	77 / 04 (2006.01.01)											
		F	0	2	B	15 / 00 (2006.01.01)											
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)	F	0	2	B	13 / 00 (2006.01.01)											
123	198A 432 575 304	F	0	2	M	25 / 00 (2006.01.01)											
		F	0	2	M	43 / 00 (2006.01.01)											

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1														
	2														
	3														
	4														
	5														
	6														
1	7														
2	8														
	9														
	10														
	11														
	12														
	13														
	14														

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	2	
/THAI BA TRIEU/ Primary Examiner.Art Unit 3748	09/27/2011	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1,2	3,1

FORD Ex. 1126, page 214
IPR2020-00013

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12020285	BROMBERG ET AL.
	Examiner	Art Unit
	THAI BA TRIEU	3748

SEARCHED			
Class	Subclass	Date	Examiner
60	600-603, 605.1, 614-615, 619, and 597-598	9/27/11	TTB
123	299, 300, 304, 406.45, 406.47, 432, 559.1-559.2, 564, and 575-577	9/27/11	TTB

SEARCH NOTES		
Search Notes	Date	Examiner
All classes and subclasses are updated and BRS EAST SERACH is attached.	9/27/11	TTB

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
	Interference Searched History is Print-Out.	9/27/11	TTB

	/THAI BA TRIEU/ Primary Examiner.Art Unit 3748

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	67	"4993386"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/01 17:14
S2	48	"6651432"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/01 17:20
S3	44	"5131228"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/01 17:21
S4	64	"7225787"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:10
S5	85	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:21

S6	73	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:22
S7	1	((turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:22
S8	57	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or p [erecent or "%")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:24
S9	1	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or p [erecent or "%") and bar$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:24

S10	0	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and ((manifold near5 (pressure or boost)) with bar) and (start$3 with gasoline) and (percentage or p[erecent or "%")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:25
S11	1	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and ((manifold near5 (pressure or boost)) and bar) and (start$3 with gasoline) and (percentage or perecent or "%")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:25
S12	60	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or percent or "%")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:26

S13	1	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or percent or "%") and bar	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:26
S14	59	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or percent or "%") and (bar or "atm" or atmosphere or atmospheric or ambient)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:27
S15	55	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or percent or "%") and (bar or "atm" or atmosphere or atmospheric)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:27

S16	0	((turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or percent or "%") and (bar or "atm" or atmosphere or atmospheric)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:29
S17	0	((turbocharg$3 or supercharg$3) and (spark near5 engine$1) and (((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or percent or "%") and (bar or "atm" or atmosphere or atmospheric)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:30
S18	0	((turbocharg$3 or supercharg$3) and (spark near5 engine$1) and (((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or percent or "%") and (bar or "atm" or atmosphere or atmospheric))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:30

S19	1	((turbocharg$3 or supercharg$3) and (spark near5 engine$1) and (((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or percent or "%"))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:30
S20	2	((turbocharg$3 or supercharg$3) and (spark near5 engine$1) and (((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:31
S21	1	((turbocharg$3 or supercharg$3) and (spark near5 engine$1) and (((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:32

S22	2	((turbocharg$3 or supercharg$3) and (spark near5 engine$1) and (((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) and ((second or secondary) near5 gasoline) and (start$3 with gasoline))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:33
S23	2	((spark near5 engine $1) and (((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) and ((second or secondary) near5 gasoline) and (start$3 with gasoline))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:34
S24	6	((spark near5 engine $1) and (((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) and ((second or secondary) near5 gasoline) and (driv$3 with (ethanol near3 gasoline)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:35
S25	3	((spark near5 engine $1) and (((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) and ((second or secondary) near5 gasoline) and (driv$3 with (ethanol near3 gasoline)) and ((percentage or percent or "%") near5 ethanol))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:37

S26	0	((spark near5 engine $1) and ((((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) with cylinder$1) and ((second or secondary) near5 gasoline) and (driv$3 with (ethanol near3 gasoline)) and ((percentage or percent or "%") near5 ethanol))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:38
S27	0	((spark near5 engine $1) and ((((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) with engine$1) and ((second or secondary) near5 gasoline) and (driv$3 with (ethanol near3 gasoline)) and ((percentage or percent or "%") near5 ethanol))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:39
S28	3	((spark near5 engine $1) and ((((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) with engine$1) and ((second or secondary) near5 gasoline) and (driv$3 with (ethanol near3 gasoline)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/23 07:39
S37	2	"7223787"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:40
S38	64	"7225787"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:40

S39	63	"7225787" and ethanol	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:41
S40	63	"7225787" and ethanol and gasoline	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:41
S41	61	"7225787" and ethanol and gasoline and mixture	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:42
S42	13	"7225787" and ethanol and gasoline and mixture and (pressure with bar)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:45
S43	193	ethanol and gasoline and mixture and (pressure with bar) and (spark near5 ignition)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:49
S44	143	ethanol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (start or "start up" or "cold start")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:50
S45	70	(turbocharg$3 or supercharg$3) and ethanol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (start or "start up" or "cold start")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:50

S46	49239	(turbocharg$3 or supercharg$3) and ethanol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (start or "start up" or "cold start") stoichiometry	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:51
S47	29	(turbocharg$3 or supercharg$3) and ethanol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (start or "start up" or "cold start") and (stoichiometry or stoichiometric)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:51
S48	7	(turbocharg$3 or supercharg$3) and ethanol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (gasoline with (start or "start up" or "cold start")) and (stoichiometry or stoichiometric)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:52
S49	0	((turbocharg$3 or supercharg$3) and ethanol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (gasoline with (start or "start up" or "cold start")) and (stoichiometry or stoichiometric)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:52
S50	1	((turbocharg$3 or supercharg$3) and ethanol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (gasoline with (start or "start up" or "cold start")) and (stoichiometry or stoichiometric) and (mixture with driving))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 14:53

S51	1	((turbocharg$3 or supercharg$3) and alcohol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (gasoline with (start or "start up" or "cold start")) and (stoichiometry or stoichiometric) and (mixture with driving))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 16:00
S52	7	((turbocharg$3 or supercharg$3) and alcohol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (gasoline with (start or "start up" or "cold start")) and (stoichiometry or stoichiometric))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 16:00
S53	0	((turbocharg$3 or supercharg$3) and alcohol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (gasoline with (start or "start up" or "cold start")) and (stoichiometry or stoichiometric)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 16:01
S54	4	((turbocharg$3 or supercharg$3) and alcohol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (stoichiometry or stoichiometric) and (mixture with driving))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 16:01
S55	1	((turbocharg$3 or supercharg$3) and alcohol and gasoline and mixture and (pressure with bar) and (spark near5 ignition) and (stoichiometry or stoichiometric) and (mixture with driving)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2011/09/26 16:01

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S29	0	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and ((manifold near5 (pressure or boost)) and bar) and (start$3 with gasoline) and (percentage or perecent or "%")	USPAT; UPAD	OR	OFF	2011/09/23 07:26
S30	28	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or p[erecent or "%")	USPAT; UPAD	OR	OFF	2011/09/23 07:26
S31	29	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or percent or "%")	USPAT; UPAD	OR	OFF	2011/09/23 07:26

S32	27	(turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or percent or "%") and (bar or "atm" or atmosphere or atmospheric)	USPAT; UPAD	OR	OFF	2011/09/23 07:28
S33	0	((turbocharg$3 or supercharg$3) and (spark near5 engine$1) and ((first or primary) with ((ethanol near3 gasoline) near5 mixture)) and ((second or secondary) near5 gasoline) and (manifold near5 (pressure or boost)) and (start$3 with gasoline) and (percentage or percent or "%") and (bar or "atm" or atmosphere or atmospheric)).clm.	USPAT; UPAD	OR	OFF	2011/09/23 07:29
S34	0	((turbocharg$3 or supercharg$3) and (spark near5 engine$1) and (((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) and ((second or secondary) near5 gasoline) and (start$3 with gasoline))	USPAT; UPAD	OR	OFF	2011/09/23 07:33
S35	0	((spark near5 engine$1) and (((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) and ((second or secondary) near5 gasoline) and (start$3 with gasoline))	USPAT; UPAD	OR	OFF	2011/09/23 07:33

S36	0	((spark near5 engine$1) and ((((first or primary) with ((ethanol near3 gasoline) near5 mixture)) with (direct$2 near3 inject$3)) with cylinder$1) and ((second or secondary) near5 gasoline) and (driv$3 with (ethanol near3 gasoline)) and ((percentage or percent or "%") near5 ethanol))	USPAT; UPAD	OR	OFF	2011/09/23 07:38

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Receipt date: 05/09/2011

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)		
	Application Number	12020285
	Filing Date	2008-01-25
	First Named Inventor	Leslie Bromberg
	Art Unit	3748
	Examiner Name	TRIEU, THAI BA
	Attorney Docket Number	11381.106198

U.S.PATENTS						
Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/TTB/	1	4993386		1991-02-19	Ozasa et al.	
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Receipt date: 05/09/2011

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12020285
	Filing Date	2008-01-25
	First Named Inventor	Leslie Bromberg
	Art Unit	3748
	Examiner Name	TRIEU, THAI BA
	Attorney Docket Number	11381.106198

	1		☐

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Examiner Signature	/Thai-Ba Trieu/	Date Considered	09/23/2011

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CONFIRMATION NO. 1610

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/020,285	01/25/2008	123	3748	11381.106198

APPLICANTS

Leslie Bromberg, Sharon, MA;
Daniel R. Cohn, Cambridge, MA;
John B. Heywood, Newton, MA;

**** CONTINUING DATA ***************************

This application is a CON of 11/758,157 06/05/2007 ABN
which is a CIP of 11/100,026 04/06/2005 PAT 7,225,787

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **
02/09/2008

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /THAI-BA TRIEU/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		MA	3	~~25~~ 2	~~5~~ 2

ADDRESS

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UNITED STATES

TITLE

OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

FILING FEE RECEIVED		
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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12020285	BROMBERG ET AL.
	Examiner	**Art Unit**
	THAI BA TRIEU	3748

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/27/2011								
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	5	-								
	6	-								
1	7	=								
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/020,285	01/25/2008	Leslie Bromberg	11381.106198	1610

TITLE OF INVENTION: OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$870	$300	$0	$1170	01/12/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
TRIEU, THAI BA	3748	123-559100

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☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☒ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
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3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

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(B) RESIDENCE: (CITY and STATE OR COUNTRY): 77 Massachusetts Avenue Cambridge, MA 02139

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

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☑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

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Authorized Signature Sam Pasternack Date 11/9/11

Typed or printed name Sam Pasternack Registration No. 29576

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Electronic Patent Application Fee Transmittal

Application Number:	12020285
Filing Date:	25-Jan-2008
Title of Invention:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES
First Named Inventor/Applicant Name:	Leslie Bromberg
Filer:	Sam Pasternack/Ellen Byal
Attorney Docket Number:	11381.106198

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl issue fee	1501	1	1740	1740
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2040**

Electronic Acknowledgement Receipt	
EFS ID:	11366548
Application Number:	12020285
International Application Number:	
Confirmation Number:	1610
Title of Invention:	OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES
First Named Inventor/Applicant Name:	Leslie Bromberg
Customer Number:	91197
Filer:	Sam Pasternack/Ellen Byal
Filer Authorized By:	Sam Pasternack
Attorney Docket Number:	11381.106198
Receipt Date:	09-NOV-2011
Filing Date:	25-JAN-2008
Time Stamp:	10:26:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$2040
RAM confirmation Number	7547
Deposit Account	192553
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Bib Data Sheet

CONFIRMATION NO. 1610

SERIAL NUMBER	FILING OR 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/020,285	01/25/2008 RULE	123	3748	11381.106198

APPLICANTS

Leslie Bromberg, Sharon, MA;
Daniel R. Cohn, Cambridge, MA;
John B. Heywood, Newton, MA;

**** CONTINUING DATA ***************************

This application is a CON of 11/758,157 06/05/2007 ABN which is a CIP of 11/100,026 04/06/2005 PAT 7,225,787

**** FOREIGN APPLICATIONS ********************

IF REQUIRED, FOREIGN FILING LICENSE GRANTED
** 02/09/2008

Foreign Priority claimed	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ yes ☐ no	MA	3	25	5
35 USC 119 (a-d) conditions met ☐ yes ☐ no ☐ Met after Allowance				
Verified and Acknowledged Examiner's Signature Initials				

ADDRESS
91197

TITLE
OPTIMIZED FUEL MANAGEMENT SYSTEM FOR DIRECT INJECTION ETHANOL ENHANCEMENT OF GASOLINE ENGINES

FILING FEE RECEIVED	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit
1135		

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Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 4

Complete if Known	
Application Number	12/020,285
Filing Date	January 25, 2008
First Named Inventor	Leslie Bromberg
Art Unit	3748
Examiner Name	Duff, Douglas J.
Attorney Docket Number	0492611-0828 (MITCON11381)

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Change(s) applied to document,
/A.J.P./
11/22/2011

Examiner Signature		Date Considered	

4581304v1

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.D./

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91197 7590 12/07/2011

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Cambridge, MA 02142-1493

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 266 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

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