

TITLE OF INVENTION: METHOD FOR REDUCING EMISSIONS AND IMPROVING COMBUSTION EFFICIENCY AND ENGINE PERFORMANCE USING PYRO-ELECTRIC IONISATION

TECHNICAL FIELD

[0001] The present invention relates to a novel and proprietary method which increases the rate of combustion in an internal combustion engine, in order to reduce the production of noxious gases in vehicular emissions. As a result, the method allows for more complete combustion of fuel which promotes greater fuel efficiency.

BACKGROUND OF INVENTION

[0002] While the combustion of fuels is a main source of energy production today for automotive vehicles, it is also a major cause of air pollution. This can be attributed to the shortcomings of the combustion process in internal combustion engines. During combustion in motor vehicles, hydrocarbons (**HC**), carbon monoxide (**CO**) and nitrogen oxide (**NOx**) are produced and released from the exterior exhaust pipe into the surroundings. In addition, hydrocarbons are also emitted as a result of the vaporisation of fuel in the internal combustion engine. As pollution from vehicular emissions has become a worldwide problem, there is therefore a pressing need for effective solutions to address this issue.

[0003] Vehicular emissions may be controlled in several ways, one of which is to ensure a more complete combustion so as to reduce vehicular emissions. Another method is to reintroduce excessive hydrocarbons back into the engine

for further combustion. Other alternatives include the use of a catalytic converter in the exhaust system. The catalytic converter has the appearance of a muffler and a honeycomb structure made of materials such as platinum or palladium. The platinum or palladium is used as a catalyst to speed up the conversion of hydrocarbons or carbon monoxide to less harmful carbon dioxide and water.

[0004] Although there have been numerous devices and methods to try to decrease vehicular emissions over the years, the problem still persists. For example, a popular emission control device installed in vehicles would be a Positive Crankcase Ventilation (“**PCV**”) valve. The purpose of the PCV system is to redirect the vapours produced in the crankcase during normal combustion process into the air or fuel intake system, to be burnt during combustion. These vapours dilute the air and fuel mixture and have to be carefully controlled by the PCV valve so as to not affect the performance of the engine. When the vehicle is in an idle state, when the air and fuel mixture is critical, only a little of the vapours are allowed into the intake system. At high speed, when the air and fuel mixture is less critical and the pressures in the engine increases, more of the vapours are allowed into the intake system. However, problems arise when the PCV valve becomes clogged and when the excess pressure causes engine oil leaks. If the wrong valve is used, or if the system experiences air leaks, the engine oil may even be sucked out of the engine.

[0005] Another emission control device is the Exhaust Gas Recirculation (“**EGR**”) valve. The purpose of the EGR valve is to introduce a small amount of exhaust gas into the intake system, which dilutes the air/fuel mixture to lower the temperature within the combustion chamber. This is important as excessively high temperatures in the combustion chamber creates NO_x, which is a major pollutant.

[0006] While the EGR valve is one of the most effective methods of controlling the production of NO_x, the design of the EGR valve adversely affects engine performance as the engine was not designed to run on exhaust gases. For this reason, the amount of exhaust gas entering the intake system needs to be carefully monitored and controlled, through a series of electrical and vacuum switches and through the use of a vehicle computer. Further, as the action of the EGR valve reduces performance by diluting the air and fuel mixture, another disadvantage of the system is that its efficacy is limited when the engine is cold, or when the engine requires maximum power.

[0007] Another method to curb pollution caused by vehicular emissions is through an evaporative control system, which functions to trap and store evaporative emissions from the gasoline tank and carburettor. By incorporating sealed gasoline tank filler caps, gasoline tanks have been redesigned to include additional space for the vapours to collect, so that the vapours can then be vented to the charcoal canister. A purge valve, which is operated by the engine vacuum, is used to control the vapour flow into the engine to be burnt along with the air/fuel mixture. However, a common problem occurs when the purge valve becomes faulty and causes the engine vacuum to draw fuel directly into the intake system instead, and cause damage to the spark plugs. Further, most charcoal canisters comprise of a filter that should be replaced periodically, and the system must be carefully and regularly maintained.

[0008] As no internal combustion engine is completely efficient, there will usually always be some unburnt fuel in the exhaust gas, which increases hydrocarbon emissions. To reduce this source of emissions, the air injection system was developed created. Using this system, fresh air is injected into the exhaust system to oxidise any unburned or partially burned fuel to reduce hydrocarbon emissions. However, the air injection system has no effect on

engine performance or fuel effect as it takes place after the completion of the combustion process.

[0009]Based on the shortcoming of the present strategies for controlling vehicular emissions above, an alternative method which reduces NO_x by increasing the rate of combustion instead would be an improvement in the art.

[0010]Research has proven that negative ions present in ionised oxygen has a positive effect on combustion. In Miller, W. J. (1972). Ions in Flames Evaluation and Prognosis. *Power Branch Material Sciences Division, Office of Naval Research*. [Retrieved from <http://www.dtic.mil/dtic/tr/fulltext/u2/745306.pdf>] it has been found that fuel burns better in ozone (O₃) rather than in oxygen (O₂). Ozone is well known for its oxidising characteristics and its strong oxidation potential can be utilised for the combustion of fuels. If ozone is used for combustion, less carbon monoxide and hydrocarbons are produced as a by-product of combustion. Further, ozone decomposes very quickly when heated and releases oxygen radicals which causes an oxidation chain reaction. These chain reactions occur at a lower activation energy (E_a) which results greater energy efficiency in combustion. Therefore, using ozone in the combustion process results in lower emissions and a more energy-efficient combustion.

[0011]To promote the ionisation of air, it has been observed that there are crystals and steel balls with sharp edges which exhibit pyro-electrical properties and such pyro-electrically charged crystalline stones or steel balls with sharp edges were found to have a positive effect on such ionisation.

[0012]Crystalline stones may be classified based on its piezo-electric, ferro-electric and pyro-electric properties. Among these properties, the crystalline stone's pyro-electric properties have a direct relation to polarisation and

thermal ionisation, which relates to the increased rate of combustion in an internal combustion engine. Pyro-electricity is the ability the ability of certain materials to generate an electric potential when they are heated or cooled. As a result of this change in temperature, the positive and negative charges move towards the opposite ends through migration as the material becomes polarised and thereby establishing an electrical potential. The polar axis resulting from the pyro-electric properties of the crystalline stone allows a net polarisation when there is a change in temperature.

[0013] Similarly, steel balls in various forms, such as steel balls with sharp edges, or hollow steel balls cut along two parallel planes, or hollow steel balls cut in parallel at diametrically opposite sides can exhibit similar pyro-electric properties and have a direct relation to polarization and thermal ionization, which relates to the increased rate of combustion in an internal combustion engine.

[0014] Crystals that exhibit pyro-electric properties include Potassium Sodium Tartrate, Quartz and Barium Titanate. Based on studies on the pyro-electric properties of crystalline stones, a specific pyro-electric crystalline stone was selected based on its robustness and solvability. The selected pyro-electric crystalline stone has a hexagonal crystalline system that is either prismatic with a triangular cross section, or prismatic with a pyramidal termination. As the pyro-electric crystalline stone is opaque and brittle, it is easily broken during mining and is available in varied size and shapes, with no reference to its axis. The internal structure of the selected pyro-electric crystalline stone gave rise to the methods to determine the a, b and c axis of the crystalline stone.

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[0015] In its crystalline form, the selected pyro-electric crystalline stone is polarised along its c axis (i.e. the length of the crystalline structure). The pyro-

electric properties of the crystalline stone causes the electric charge to have a magnitude and direction represented by its polarity. This improves the ionisation process as the resultant asymmetric structure of the pyro-electric crystalline stone allows ions to move more easily along one axis than the other. When pressure is applied, each side of the pyro-electric crystalline stone takes on an opposite charge, resulting in a voltage drop across the crystalline stone.

[0016] Accordingly, the present invention seeks to mitigate the known limitations of the prior art by providing an efficient method of improving combustion and reducing vehicular emissions, while increasing the fuel efficiency of the internal combustion engine.

SUMMARY OF THE INVENTION

[0017] The present invention involves the pyro-electric ionisation of air to increase the rate of engine combustion, without the need for high voltage energy supply. The present invention introduces a method that results in a more efficient combustion of hydrocarbon-based fuels, reduction of NO_x in vehicular emissions and greater fuel efficiency.

[0018] A method is provided for the pyro-electric ionisation of air, which occurs when the airflow to the internal combustion engine passes through a pyro-electric device.

[0019] The pyro-electric device is located in front of the engine's primary air filter, and no further alteration is made to the engine. Air passes through the pyro-electric device and enters the air filter and before being channelled into the engine's combustion chamber. The power required to operate the pyro-electric device is obtained from the vehicle's inbuilt power source.

[0020] The source of power to ensure the smooth running of the ion generation unit is the electric power tapped from a battery or alternator.

[0021] In the preferred embodiment of the invention, the pyro-electric device is powered from a source that is activated after the engine is started, instead of a storage power source that is active when the engine is off.

[0022] Heat is generated using an electrically operated heater, which heats the pyro-electric material comprising of the crystalline stone. This causes the heated crystalline stone to release negative ions and thereby causing the air stream to become electrically polarised.

[0023] As the air stream passes through a filter, only dust and solid particles are filtrated and the charged ions are able to pass through the filter without any change in form. The charged ions are picked up by the air stream passing through the ionising chamber, and the air stream thus becomes ionised.

[0024] The ionised air stream is then fed to the engine and there is no obstruction of the flow of air to the engine. The ionised air will be channelled to the combustion chamber for combustion at the earliest possible stage, with a constant flow of air to the engine. The excess negative ions present in the ionised air can therefore aid in combustion of the hydrocarbon fuel.

[0025] The use of this method has yielded positive results in the improvement of fuel efficiency and the reduction of NO_x emissions, as the resulting combustion process is made more efficient and a more complete combustion can be achieved.

[0026] In another embodiment of the invention, the crystalline stones may be replaced with steel balls with sharp edges.

[0027] In yet another embodiment of the invention, the crystalline stones may be replaced with hollow steel balls cut along two parallel planes.

[0028] In yet another embodiment of the invention, the crystalline stones may be replaced with hollow steel balls cut in parallel at diametrically opposite sides.

[0029] In a further embodiment of the invention, the crystalline stones are used in combination with steel balls with sharp edges.

[0030] In yet a further embodiment of the invention, the crystalline stones are used in combination with hollow steel balls cut along two parallel planes.

[0031] In yet a further embodiment of the invention, the crystalline stones are used in combination with hollow steel balls cut in parallel at diametrically opposite sides.

[0032] In the preferred embodiment of the invention, different pyro-electric materials or combinations thereof can be used to produce varying levels of ionisation to suit different fuel types and engine capacities, as may have been described above or otherwise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] The following descriptions, considered together with the accompanying drawings will provide a more detailed explanation of the invention. The

components in the drawings are not necessarily drawn to scale, with emphasis instead being placed upon clearly illustrating the principles of the present invention, wherein:

[0034] Fig. 1 is a general overview of the invention which shows how the air is charged when it passes through the pyro-electric device with an input power of 12V DC supply and filtered through the air filter.

[0035] Fig. 2 is a static cut-a-way view which shows how the air is charged when it passes through the pyro-electric device.

[0036] Fig. 3 is a diagram of the operational flow of the present invention.

[0037] Fig. 4 shows an overview of the method and the components of the pyro-electric device.

[0038] Fig. 5 is a table showing the fuel consumption before and after the pyro-electric device was installed, for a driving distance of around 150km using Diesel Grade 92 and a drive speed controlled at 60km/h.

[0039] Fig. 6 is a table showing the readings of nitrogen oxides (in ppm) before and after the pyro-electric device was installed, when the engine was at idle status.

DETAILED DESCRIPTION

[0040] The present invention provides a method which uses the pyro-electric properties of a crystalline stone or steel balls with sharp edges, or a combination of both to aid in the combustion process in an internal combustion engine.

[0041] According to one aspect of the present invention, there is provided a method of increasing the rate of combustion comprising at least the steps of: (a) heating of a plurality of elements using an electrically operated heater; (b) generating an electric potential that is caused by an electric dipole; (c) the release of negative ions in the pyro-electric device; (d) the ionisation of molecular oxygen to produce charged oxygen ions (O^{2-}); (e) the reaction of charged oxygen ions (O^{2-}) with hydrocarbons to produce oxygenated hydrocarbons and break every spot of carbon content in the hydrocarbon chain; (f) a reduced production of waste products from the combustion process.

[0042] Fig. 1 shows the pyro-electric device **103** located in front of the engine air filter **105** situated within the air filter box **106**. The power required to operate the pyro-electric device is obtained from the power source (+12V) enclosed by a vehicle fuse box **102**. The inflow of air **101** enters the pyro-electric device **103** and undergoes pyro-electric ionisation, which produces charged air particles **107**. The air particles **104** and charged air particles **107** pass through the engine, and are mixed with petrol or diesel **108** in the combustion chamber **110**. The pressure of the expanding combustion gases in the combustion chamber **110** drives the moving piston **109** and the exhaust gases **111** are released.

[0043] Likewise in Fig. 2, the inflow of air **201** enters and passes through the pyro-electric device **204**, which further contains a heating element **207** and

pyro-electric material **206**. The pyro-electric material further comprises of crystalline stones or steel balls with sharp edges, or a combination of both. The heating element **207** is connected to the power source (+12V) **202**, which is turned on by an ignition switch **203** and connected to the fuse box with switch and light-emitting diode (LED) **205**. After passing through the pyro-electric device, charged air **208** is released from the outlet.

[0044] Fig. 3 depicts the operational flow of the invention. Air **301** enters and passes through the pyro-electric device **302** and subsequently, the air filter **303** before entering the combustion chamber **304** within the engine block **305**. The exhaust gases **306** are eventually released through the outlet.

[0045] Fig. 4 depicts the components of the pyro-electric device, namely an inlet cap **401**, an air filter **402**, a heater **403**, the pyro-electric material **404** which further comprises of crystalline stones or steel balls with sharp edges, or a combination of both, a thermostat **405** and a container **406** enclosed by an aluminium cylinder **407**. The respective materials used to line the insides of the aluminium cylinder **407** are felt **409** and rexine **410**. The outer cap **411** and nozzle **412** are located at the end of the aluminium cylinder **407**.

[0046] The pyro-electric device **204** is made of an aluminium cylinder **407** and comprises of pyro-electric material **206** which is made up of crystalline stones or steel balls with sharp edges, or a combination of both, and surrounded by an internal heating element **207**. Both ends of the aluminium cylinder **407** are open for air inflow **201** and outflow **208**, through the inlet cap **401** and outer cap **411**.

[0047] According to this aspect of the invention, pyro-electric crystalline stones **206** are used, namely Adularia, Agate Dendritic, Agate (Parallel Banded), Alabaster, Albite, Amazonite, Amber Black, Amethyst Green, Amphibole

Quartz, Amulet Stone, Anorthosite, Anthracite, Anandalite, Andalusite, Angel
 Phantom Quartz, Angel Aura Quartz, Angelite, Anhydrite Blue, Anyolite,
 Apache Gold, Aquamarine, Aragonite White, Atlantisite, Aurora Quartz,
 Aventurine Green, Barite (Rosette), Barite, Beryl Clear, Beryl Blue, Beryl
 Golden, Beryl Green, Beryl Pink, Beryl Red, Beryl White, Beryl Yellow,
 Bloodstone, Blue John, Bixbite, Buddstone, Calite Black, Calcite Cobaltian,
 Calcite Cave, Calcite Clear, Calcite Optical, Carnelian, Carnelian Onyx,
 Celestine, Celestite, Cerussite, Chalcedony Brown, Red/Brown, Chalcedony
 Chrome, Chalcopyrite (Acid Treated), Champagne Aura Quartz, Chiasolite,
 Chlinochlore, Chrysolite, Citrine Natural (Light Yellow), Clinoptilolite, Cordierite,
 Cornelian, Corundum Blue, Corundum Red, Dalmatian Stone, Desert Rose,
 Dianite, Diopside Blue/Purple, Diaspore (Gemmy), Dravite, Emerald, Fairy
 Stone and Fairy Cross, Falcon Eye, Feldspar White or Soda, Fluorite Banded,
 Fluorite Opalized, Fluorite Rainbow, Fools Gold, Fossil Wood, Fuschite, Garnet
 Andradite Black, Garnet Chrome Green, Garnet Gooseberry, Garnet Grossular
 Green, Garnet Grossular (Red), Garnet Raspberry, Goshenite, Girasol,
 Greenlandite, Gypsum (White, Translucent), Gypsum (Fine Grained),
 Hackmanite, Hawks Eye, Healers Gold, Heliodor, Heliotrope, Hematite
 Specular, Hiddenite, Hypersthene, Iceland Spar, Iodocrase, Iolite, Imperial
 Gold Aura Quartz, Indicolite, Infinite Stone, Jade African, Jade Blue, Jade
 Green, Jade Lemurian, Jade New, Jade Transvaal, Jade White, Jasper Black
 Net, Jasper Blood, Jasper Brecciated, Jasper Bumble Bee, Jasper Dalmatian,
 Jasper Fumaric, Jasper Leopard Skin, Jasper Ocean, Jasper Orbicular, Jasper
 Picasso, Jasper Picture, Jet, Kalahari Picture Stone, Klinoptiloth, Kunzite,
 Kunzite Green, Labradorite, Labradorite Black, Larimar, Lead Spar,
 Lepidolite, Lizardite, Llanite, Lodestone, Luvite, Mariposite, Master Shamanite,
 Magnetite, Melody Stone, Merlinite, Merlinite Black, Mica Muscovite Green,
 Mica Muscovite Pink/Purple, Moonstone, Morganite, Mtorolite, Mystery Stone,
 New Zealand Greenstone, Northosite, Opal Banded, Opal Blue, Opal Dendritic,
 Olivine (Green), Olivine (Yellow/Green), Peacock Ore, Pectolite Blue, Peridot,

Petrified Wood, Pietersite, Prasiolite, Psilomene, Preselli Bluestone, Pyrite, Quartz Amphibole, Quartz Angel Phantom, Quartz Angel Aura, Quartz Aurora, Quartz Black, Quartz Brandenburg, Quartz Cactus, Quartz Candle, Quartz Celestial, Quartz Champagne Aura, Quartz Clear, Quartz Elestial, Quartz Female, Quartz Flame Aura, Quartz Harlequin, Quartz Hollandite, Quartz Ice, Quartz Imperial Gold Aura, Quartz Indigo Aura, Quartz Jacare, Quartz Lemon/Yellow, Quartz Magdelene, Quartz Morion, Quartz Nirvana, Quartz Opal Aura, Quartz Rainbow, Quartz Rutilated, Quartz Shamanic Dream, Quartz Smokey (Dark), Quartz Smokey Aura, Quartz Spirit, Quartz Star, Quartz Tangerine Aura, Quartz Tanzan Aura, Quartz Titanium Aura, Que Sera, Rainbow Quartz Rhodochrosite, Rock Crystal, Rosinca, Rubellite, Ruby, Ruby and Zoisite, Sapphire, Sard, Sardonyx, Sardonyx Red/Orange, Satin Spar, Schorl, Selenite, Seraphinite, Serpentine, Serpentine White, Serpentine and Stichtite, Shamanic Dream Quartz or Stone, Smokey Aura Quartz, Sodalite Purple, Specularite, Spectrolite, Sphene, Spodumene, Staurolite, Stonehenge Bluestone, Sugilite, Super Seven, Tangerine Aura Quartz, Tanzanite, Tanzan Aura Quartz, Tempest Stone, Thulite, Thulite Green, Thunder Egg, Tiffany Stone, Tigers Eye Blue, Tiger Iron, Titanium Aura Quartz, Titanite, Tourmaline Black, Tourmaline Blue, Tourmaline Brown, Tourmaline Red or Dark Pink, Tsavorite (Garnet), TV Stone or TV Rock, Ulexite, Unakite, Uvarovite, Vesuvianite, Vesuvianite (Manganese Rich), Violane, Vulcanite, Water Sapphire, Xanthite, Youngite, Zoisite Blue, Zoisite Green, Zoisite Pink, Zultanite.

[0048] The selected pyro-electric crystalline stone **206** has a hexagonal crystalline system that is either prismatic with a triangular cross section, or prismatic with a pyramidal termination. As the pyro-electric crystalline stone **206** is opaque and brittle, it is easily broken during mining and is available in varied size and shapes, with no reference to its axis. The internal structure of the selected pyro-electric crystalline stone **206** gave rise to the methods to

determine the a, b and c axis of the crystalline stone or steel ball with sharp edges, or a combination of both.

[0049] In its crystalline form, the selected pyro-electric crystalline stone **206** is polarised along its c axis (the length of the crystalline structure). This improves the ionisation process as the asymmetric structure of the pyro-electric crystalline stone **206** allows ions to move more easily along one axis than the other. When pressure is applied, each side of the pyro-electric crystalline stone **206** takes on an opposite charge, resulting in a voltage drop across the crystalline stone as an electric dipole moment which is a vector quantity. The electric potential caused by the electric dipole results in the ionisation of the oxygen in the air, which results in more complete combustion of fuel and greater fuel efficiency.

[0050] The methods of using the pyro-electric polarisation of crystalline stones or steel balls with sharp edges, or a combination of both to ionise air and increase the rate of combustion in an internal combustion engine **110** described herein are not limited to the size, shape, design and physical properties of the pyro-electric device **204**.

[0051] Air enters into the pyro-electric device **204** through the air inlet **401**. After passing through the internally heated pyro-electric device **204**, the air is charged **208** and molecular oxygen is ionised to produce charged oxygen ions (O^{2-}) **107**. The O^{2-} ions **107** react with the hydrocarbons in the fuel **108**.

[0052] As air flows out **111** from the air outlet **411**, a tube connects the air outlet to the car before it reaches the air filter **303**. The charged air **208** will then pass into the engine burning chamber **304** by suction during the engine compression stroke, effectively resulting in a more rapid and complete combustion.

[0053]Through various tests, it is shown that the present invention has improved fuel efficiency by 39.86% (**Fig. 5**) and has reduced NOx emissions by 91% on average (**Fig. 6**).

CLAIMS

What is claimed is:

1. A method of increasing the rate of combustion in an internal combustion engine, comprising at least the steps of:
 - (a) the heating of a plurality of elements using an electrically operated heater;
 - (b) the polarisation of a selected pyro-electric crystalline stone;
 - (c) the release of negative ions in the pyro-electric device;
 - (d) the ionisation of molecular oxygen to produce charged oxygen ions (O^{2-}); and
 - (e) the reaction of charged oxygen ions (O^{2-}) with hydrocarbons.

to promote more complete combustion, decreased quantities of noxious emissions and greater fuel efficiency.
2. The method as claimed in Claim 1, wherein the pyro-electric crystalline stone may be one of a number of possible stones set out in the specification.
3. The method as claimed in Claim 1, wherein the pyro-electric crystalline stone may be replaced with steel balls with sharp edges.

4. The method as claimed in Claim 1, wherein the pyro-electric crystalline stone may be replaced with hollow steel balls cut along two parallel planes.
5. The method as claimed in Claim 1, wherein the pyro-electric crystalline stone may be replaced with hollow steel balls cut in parallel at diametrically opposite sides.
6. The method as claimed in Claim 1, wherein the pyro-electric crystalline stones may be used in combination with steel balls with sharp edges.
7. The method as claimed in Claim 1, wherein the pyro-electric crystalline stones may be used in combination with hollow steel balls cut along two parallel planes.
8. The method as claimed in Claim 1, wherein the pyro-electric crystalline stones may be used in combination with hollow steel balls cut in parallel at diametrically opposite sides.