

DESCRIPTION

Emulsion Fuel

[Technical Field]

[0001]

The invention relates to a novel emulsion fuel, specifically to an emulsion fuel which will not undergo oil water separation even under long-term storage, and achieves efficient combustion in a stable combustion state.

[Background Art]

[0002]

Conventionally used fuels are mainly fossil fuels or the like.

However, when these fuels are burned, pollutants such as nitrogen oxides (NO_x), sulfur oxides (SO_x), carbon monoxide (CO), and dust are emitted, which are considered as primary causes of environmental pollution.

As countermeasures, diversified studies haven been carried out with the intention of decreasing air pollutants, and development of alternative fuels or the like is actively pursued today.

[0003]

Combustion of fossil fuels requires oxygen. Air is commonly used as the source of oxygen, but air contains about 78% of nitrogen which causes exhaust gas loss and produces nitrogen oxides.

If combustion air is preheated for the purpose of reducing exhaust gas loss, nitrogen oxides in exhaust gas can be greatly

increased. At present energy saving must be trade off for prevention of air pollution.

On the other hand, it has been confirmed that combustion with oxygen produces little nitrogen oxides, but the combustion temperature is so high that oxygen is hard to use.

[0004]

In recent years, as part of air pollution prevention measures, there have been many studies regarding the use of emulsion fuels produced by mixing fuel oil with water. Emulsion fuels are effective for energy saving and pollution prevention, which are basic issues in industry.

[0005]

Emulsion fuels produced by mixing fuel oil with water generally include two types: water-in-oil type emulsions in which fine water droplets are contained in oil; and oil-in-water type emulsions in which fine oil droplets are contained in water. Most emulsions commonly used for fuel are of water-in-oil type.

When such a water-in-oil type emulsion fuel is burned, water vapor atomizes oil to extend its surface area, thereby the contact area between the oil and air is increased to achieve complete combustion.

[0006]

However, in order to achieve the above-described effect, an emulsion fuel must maintain an optimum ratio between fuel oil and water to maintain the emulsion in a stable state.

In particular, when combustion load on a boiler or the like is variable, the mixing ratio between fuel oil and water

must be adjusted to achieve an optimum state, which involves the necessity for apparatus for controlling mixing of fuel oil and water.

Emulsion fuels remarkably decrease the formation of nitrogen oxides due to the effect of atomized water.

[0007]

Regarding conventional emulsion fuels, it is well known that stable emulsion fuels can be produced by mixing fuel oil such as heavy oil with water using a mixed additive (e.g., emulsifying agent, stabilizing agent, surfactant) (e.g., Japanese Patent No. 3776188, and Japanese Patent No. 3103923).

However, the addition of the additive still cannot solve the problems of lack of long-term storage and necessity of using a great amount of emulsifying agent. Therefore in recent years development of emulsion fuels is oriented toward the study of additives or the like.

[0008]

However, even though prepared with an emulsifying agent and others, conventional emulsion fuels undergo oil water separation after a lapse of an extended period, or about 20 minutes to seven days depending on circumstances, which makes them unsuitable for long-term storage.

In practical cases, when an emulsion fuel thus prepared is stored in a tank, water gradually accumulates on the bottom, which must be removed.

[0009]

Further, conventional emulsion fuels involve heat loss

because of included water , thus they cannot be used for a boiler or other applications which requires high heat efficiency.

As described above, conventional emulsion fuels undergo oil water separation with the lapse of time, which varies the composition of oil and water in the emulsion fuels.

[Patent Document 1] Patent No.3776188

[Patent document 2] Patent No.3103923

[Disclosure of the invention]

[Problems to be Solved by the Invention]

[0010]

The object of the invention is to provide a novel emulsion fuel having excellent long-term storage stability and offering stable and optimum combustion efficiency, which solves the above-described problems, maintains an emulsified state free from separation between fuel oil and water during long-term storage with no necessity of additives such as an emulsifying agent and stabilizing agent, and does not cause separation between fuel oil and water by temperature change.

Further, the object of the invention is to provide an emulsion fuel which promotes energy saving by achieving efficient combustion and reducing pollutant emission such as nitrogen oxides and carbon dioxide.

Further, another object of the invention is to provide an emulsion fuel production method for readily and reliably producing said emulsion fuel of the invention.

[Means for Solving the Problem]

[0011]

As a result of keen study, the inventors of the invention have discovered that the use of functional water allows fuel oil and water to maintain a favorable emulsified state for a long-term with no necessity of additives such as an emulsifying agent and stabilizing agent, which have been essential ingredients for conventional emulsion fuels, and have completed the invention.

[0012]

The emulsion fuel of the invention comprises fuel oil and functional water, said functional water being electronic water and harmonic reduced water.

The emulsion fuel of the invention preferably further comprises sodium chloride.

The emulsion fuel production method of the invention comprises a first step of mixing fuel oil with harmonic reduced water while stirring to obtain an emulsion, and a subsequent second step of mixing the emulsion obtained in the first step with electronic water while stirring.

Said emulsion fuel production method preferably comprises dissolving sodium chloride in harmonic reduced water in advance.

[Advantageous Effect of the Invention]

[0013]

The emulsion fuel of the invention causes no separation between the fuel oil and water during long-term storage, and offers excellent long-term storage stability in a storage tank.

Accordingly, the emulsion fuel is easy to handle, maintains stable combustion efficiency for a long term, and reduces the

emission of nitrogen oxides and dust.

In particular, the emulsion fuel causes no separation between fuel oil and water by temperature change, hence it is useful for a long term in both cold and hot climate areas, and thus has extremely higher practicality and commercial value in comparison with conventional fuels.

Further, the emulsion fuel production method of the invention is capable of readily and reliably producing said emulsion fuel which exhibits stable combustion efficiency and reduces emission of nitrogen oxides and dust.

[Best Mode for Carrying Out The Invention]

[0014]

The invention is further illustrated by, but not limited to, preferable examples.

The emulsion fuel of the invention is formed by emulsification of fuel oil and functional water.

In the invention, through the use of said ingredients, fuel oil and water are uniformly emulsified with no necessity of a surfactant, emulsifying agent, or stabilizing agent, by which a stable emulsion fuel which causes no separation between fuel oil and water during long-term storage is obtained.

[0015]

The fuel to be used in the emulsion fuel of the invention may be any fuel oil as long as it is a known one used as fuel oil, and examples thereof include petroleum fuel oils such as heavy oil, petroleum, kerosene, and light oil, coal-derived fuel

oils, and bunker oil, which may be used alone or in combination of them.

[0016]

In particular emulsion fuels can effectively use heavy oil. Heavy oil refers to oils in a solid or semisolid state at normal temperature, and examples thereof include petroleum asphalts and mixtures thereof, various processed products, intermediate products, and residues of petroleum asphalts and mixtures thereof, high pour point oils, crude oils, or petroleum tar pitch and mixtures thereof which do not flow at high temperatures, and bitumen (Orinoco tar, Athabasca bitumen).

[0017]

The functional water to be used in the emulsion fuel of the invention corresponds to electronic water and harmonic reduced water.

Functional water refers to water which has been subjected mainly to physical treatment to have a function of some kind, specifically to water which has been treated in an energy field such as an electric field, magnetic field, far infrared ray, acoustic wave, and pressure, and examples thereof include electronic water and harmonic reduced water.

Electronic water refers to water which has been applied with a harmonic voltage and subsequently irradiated with carbon light.

Further, harmonic reduced water refers to water which has been applied with a harmonic, irradiated with carbon light, and applied with energy by carbon electrode discharge for dissolving carbon therein.

[0018]

Specifically, in order to prepare the functional water to be used in the invention, in the first place, industrial water, tap water, or preferably pure water is applied with a harmonic voltage, and subsequently irradiated with carbon light to form an electronic water (functional water A).

The electronic water (functional water A) production apparatus 1 for producing the electronic water (functional water A) comprises, as shown in Fig. 1, a harmonic voltage generating device 2, a harmonic voltage application tank 3 equipped with carbon electrodes 11 and 12, and a carbon light irradiation tank 4 equipped with a carbon light generating device 13.

[0019]

The harmonic voltage generating device 2 may be, for example, a transformer which uses a commercial voltage (100 V) as an input voltage and generates a harmonic voltage in which a harmonic is superimposed on a commercial frequency (60 Hz) under an arbitrarily chosen voltage within a range from 1 k to 50 kv, and is a device for applying a harmonic voltage to water in the harmonic application tank 3 through the carbon electrode (carbon rod) 11.

[0020]

The harmonic voltage generating device 2 may be, for example, a transformer disclosed in Japanese Patent Application Laid-Open No. 2-100661. Alternatively, the harmonic voltage generating device 2 may be, for example, a transformer in which a plurality of conductive ring barrels are fitted onto a secondary

coil such that they are insulated from each other, and the coils are piled up in a linear or cylindrical shape. When an electric current is passed through from the primary coil to the secondary coil, reaction occurs in the secondary coil to hunt the electric current (trapezoidal wave form).

More specifically, when an electric current is passed through from the primary coil to the secondary coil, the conductive ring barrel generates electromotive force by the magnetic flux in the iron core according to the shape of the conductive ring barrel, and the magnetic flux by the electromotive power gives displacement to the waveform of the basic potential of the secondary coil (sine wave curve) to form several projecting waveforms on the sine wave curve, thereby a harmonic potential is generated in the secondary coil, and electronic water (functional water A) stabilized with the thus generated harmonic voltage is produced.

[0021]

The harmonic voltage application tank 3 is a tank for retaining a predetermined amount (for example, 1 t) of, for example, tap water supplied through a tube 14, and applying said harmonic voltage from said harmonic voltage generating device 2 to water.

A carbon electrode (charcoal) 12 which serves as an earth electrode is disposed on the bottom of the harmonic application tank 3. A harmonic voltage is applied between the carbon electrode 11 submerged near the water surface and the carbon electrode 12 disposed on the bottom of the harmonic application

tank 2, and lightning discharge occurs between them.

[0022]

More specifically, in a preferable example of the invention for producing electronic water (functional water) through the application of said harmonic voltage, for example, a harmonic voltage of 19,500 volts (V) was applied for 60 minutes to 1 t of water in the harmonic voltage application tank 3 as shown in Fig. 1 for imparting energy from a high electric field or lightning discharge to the water.

As a result of this, water clusters are decomposed to be downsized, and clusters of water molecules are shrunk to preferably single water molecules, thereby their molecular motion is activated.

The application of a high voltage downsizes clusters of water molecules to increase ring-form water, and produces electronic water (functional water A) which is active water having high binding energy and a structure less prone to binding with other substances.

[0023]

The harmonic voltage application tank 3 is equipped with a tube 15 for as necessary circulating and resupplying the water irradiated with carbon light in the carbon light irradiation tank 4, and also equipped with tube 16 for as necessary extracting the circulated electronic water (functional water A).

[0024]

The carbon light irradiation tank 4 is a tank for retaining water supplied from the harmonic voltage application tank 3

through a tube 17, and sufficiently irradiating the water with carbon light from a carbon light generating device 13.

The carbon light generating device 13 is a device for applying a voltage to bulbs comprising carbon as a filament to cause light emission, and applying the light to water in the carbon light irradiation tank 4.

The water irradiated with carbon light is used as the electronic water (functional water A) in the invention.

[0025]

More specifically, carbon light irradiation is performed by applying carbon light from the carbon light generating device 13 to the water or electronic water (when circulated), which is composed of small water clusters, from the harmonic voltage application tank 4. In order to achieve sufficient irradiation of water with carbon light, for example in a preferable example of the invention, ten liter portions of water were irradiated with carbon light using bulbs of 2,400 watts ($60\text{ W} \times 40$) over a period of one hour.

Through the irradiation of water, vibration energy exhibiting a similar spectrum to that of solar light is imparted to water by the carbon light emitted from the bulbs comprising carbon as the filament.

[0026]

The carbon light irradiation decreases the oxidation-reduction potential of water molecules. For exhibiting reduction, it is important to increase the energy of water molecules and stabilize active hydrogen having strong

reducing power. Since atomic hydrogen has strong reducing power, it reduces metal element ions contained in water to decrease the content of active hydrogen. Therefore the amount of metal ions contained in water must be minimized.

Accordingly, atomic carbon which weakly binds to atomic hydrogen to hinder its reducing power must be present in water. Atomic carbon is dissolved in activated electronic water by carbon spark discharge in the second step.

[0027]

The carbon light irradiation tank 4 is equipped with a tube 18 for extracting the obtained electronic water (functional water A), and a tube 15 for circulating the water after being irradiated with carbon light from the irradiation tank 4 to the harmonic voltage application tank 3. As necessary, circulated electronic water (functional water A) obtained by repeating said operation for circulating water several times may be used.

Thus, the electronic water (functional water A) to be used in the emulsion fuel of the invention is obtained.

[0028]

The obtained electronic water (functional water A) is further used for preparing the harmonic reduced water (functional water B) to be used in the emulsion fuel of the invention.

Specifically, the harmonic reduced water (functional water B) to be used in the invention is prepared by irradiating said electronic water (functional water A) with carbon light, and then subjecting it to carbon electrode spark discharge.

[0029]

The harmonic reduced water (functional water B) production apparatus 5 for producing the harmonic reduced water (functional water B) comprises, as shown in Fig. 2, a carbon light irradiation tank 6 equipped with a carbon light generating device 20, and a spark discharge tank 7 equipped with a device for generating spark discharge by carbon electrodes.

The carbon light irradiation tank 6, which may be a similar tank to the carbon light irradiation tank 4 used for producing said electronic water (functional water A), introduces the electronic water (functional water A) produced in the apparatus shown in Fig. 1 to the tank 6 through a tube 19, and sufficiently irradiates the water with carbon light from a carbon light generating device 20. The carbon light irradiation is similar to that performed in said carbon light irradiation tank in Fig. 1.

The carbon light irradiation tank 6 is also equipped with a tube 21 for circulating the water irradiated with carbon light into the spark discharge tank 7.

The carbon light irradiation tank 6 is also equipped with a tube 22 for, as necessary, circulating and resupplying the water which has been subjected to spark discharge in the spark discharge tank 7, and further equipped with a tube 24 for extracting the circulated harmonic reduced water (functional water B).

[0030]

The water irradiated with carbon light is introduced into the carbon light spark discharge tank 7 through the tube 21.

The carbon light spark discharge tank 7 is equipped with a spark discharge generating device in which at least one pair of carbon electrodes is disposed, and also equipped with a tube communicating with the tank 1.

The water from the carbon light irradiation tank 6 is supplied to the tank 7 and subjected to carbon electrode spark discharge, thereby the water contains carbon. The water thus subjected to spark discharge is used as the harmonic reduced water (functional water B) in the invention.

[0031]

The spark discharge tank 7 is also equipped with a tube 23 for extracting the obtained harmonic reduced water (functional water B), and a tube 22 for circulating the water which has been subjected to spark discharge from the spark discharge tank 7 to the carbon light irradiation tank 6. As necessary, harmonic reduced water (functional water B) obtained by repeating said operation for circulating water several times may be used.

Thus, the harmonic reduced water (functional water B) to be used in the emulsion fuel of the invention is obtained.

[0032]

More specifically, the carbon electrode spark discharge device 7 schematically shown in Fig. 2 is a device for including particulate carbon in water.

Water molecules produce atomic hydrogen upon decomposition at a high temperature. Atomic hydrogen has strong reducing power for reducing metal ions to hydrogen having no reducing power. For stabilizing atomic hydrogen in water, it

is necessary to decrease metal ions, and include atomic or molecular substance capable of binding to atomic hydrogen in water for trapping atomic hydrogen. An example of such substance is "particulate carbon" which is present in a hydrated state as a result of spark discharge.

Particulate carbon is capable of efficiently trapping active atomic hydrogen. For producing water containing abundant active hydrogen, the raw water is preferably pure water free of metal ions which will not cause reduction of active hydrogen by metal ions. Particulate carbon hydrated through the affinity between hydrogen and carbon allows atomic hydrogen to be present in an active state.

[0033]

When spark discharge is performed with carbon electrodes, atomic carbon is vaporized and evaporated from the carbon electrodes. The atomic carbon recombines into fine particles by itself, but if oxygen is present in the process, combustion occurs to produce carbon dioxide. Prevention of the combustion allows to increase the abundance of vaporized and evaporated carbon in the water treated by spark discharge.

The spark discharge generating device to be used for carbon spark discharge comprises a plurality of carbon electrodes, two or more of the electrodes being disposed axisymmetrically. The rod-like two carbon electrodes must not cause electric current leakage. The discharge spacing is determined in consideration of the fall velocity of particles during vaporization and evaporation, quantity of water, and the effects of light and

heat during spark discharge. The spacing is from 10 to 50 cm in normal cases, and must be kept at 1 m or more for a large capacity. Since carbon electrodes are highly thermal conductive, the insulation must be made of a heat resistant material.

Carbon electrode spark discharge exhausts carbon electrodes particularly in air. For inhibiting the exhaustion, the spacing between the electrodes must be prevented from increasing and maintained constant. When the spacing between the electrodes is from 2 to 30 mm, the voltage between the electrodes during spark discharge is 700 volts (V) or more, this allows stable spark discharge in the invention.

In a preferable example of the invention, the spark discharge was performed by subjecting 1 liter of water which had been treated in the carbon light irradiation tank 6 to spark discharge at 700 V for five minutes.

[0034]

The shock wave of spark discharge atomizes water molecules. Atomized water molecules has a half width of 60 Hz in a NMR spectrum, and has higher viscosity than tap water. Further it has a low vapor pressure and thus is hard to evaporate. Assuming that the time necessary for evaporating tap water at a constant temperature and humidity is 10, that for water treated by carbon electrode spark discharge is 20.

In water treated with carbon electrode spark discharge, water molecules have high energy and in an active state. Such active water molecules form a ring. Cyclic water binds to atomic carbon

to form a sugar-like molecular structure. Part of atomic hydrogen formed by decomposition of water molecules binds to oxygen to return to water. The remaining active atomic hydrogen is considered to be held by carbon having a sugar-like molecular structure in a hydrated state formed by hydrated carbon, or combined with hydrated carbon atoms. Chlorine contained in raw water is removed by carbon light irradiation and spark discharge.

[0035]

The functional water to be used in the invention contains about 1,000 ppb of active hydrogen.

Since tap water used as raw water contains 5 ppb or less of dissolved hydrogen, it is assumed that atomized water is decomposed into oxygen and hydrogen during said spark treatment process, and the resulting active hydrogen is dissolved in the water.

The functional water to be used in the invention contains ultrafine carbon particles in a hydrated state, the carbon combines active hydrogen together.

For producing atomic carbon in addition to the atomic carbon vaporized and evaporated from the carbon electrodes, it is an effective method to perform spark treatment in a carbon-containing gas such as carbon dioxide, and decompose carbon dioxide by the heat of spark discharge to form atomic carbon.

[0036]

The thus harmonic reduced water (functional water B) obtained further preferably comprises sodium chloride to be

chlorine ion-containing functional water.

The sodium chloride may be added to 1 liter of functional water in an amount equal to or less than the saturated concentration. The chlorine ions serves as a binder between the fuel oil and functional water contained in the obtained emulsion, by which more favorable emulsified state is maintained. [0037]

The emulsion fuel of the invention is obtained by mixing the functional water obtained as described above with fuel oil while stirring.

An example of the emulsion fuel of the invention, in which a heavy oil A is used as fuel oil, is described in detail below.

An emulsion obtained by mixing the functional water B as harmonic reduced water (as necessary including those containing sodium chloride) with a heavy oil A while stirring is further mixed with the functional water A while stirring to produce an emulsion fuel.

In the first step of mixing the harmonic reduced water (functional water B) with the heavy oil A while stirring for emulsification, the harmonic reduced water (functional water B) is mixed with the heavy oil A in a proportion, for example, 9:1 to 3:7 in a mass ratio, and stirred until a sufficient emulsified state is uniformly achieved, for example at 4000 rpm for three minutes to produce a drum of emulsion, to produce a first process emulsion. The mixing proportion may be determined as appropriate according to the intended fuel efficiency, combustion calorie, and ignition temperature.

Further, the stirring conditions are not particularly limited as long as a favorable emulsified state is formed, and may be determined as appropriate according to the fuel oil to be used and the mixing proportion between functional water and fuel oil.

[0038]

In the subsequent second step of mixing the emulsion obtained in the first step with electronic water (functional water A) while stirring for causing emulsification to obtain the emulsion fuel of the invention, the first step emulsion is mixed with the electronic water at a mixing proportion of 9 : 1 to 5 : 5 in a mass ratio, and stirred until a sufficient emulsified state is uniformly achieved, for example at 4000 rpm for one minute to produce a drum of emulsion, to produce the emulsion fuel of the invention. The mixing proportion may be also determined as appropriate according to the intended fuel efficiency, combustion calorie, and ignition temperature.

Further, the stirring conditions are not particularly limited as long as a favorable emulsified state is formed, and may be determined as appropriate according to the fuel oil to be used and the mixing proportion between functional water and fuel oil.

[0039]

The mixing and stirring apparatus may be a known one, and examples thereof include high-shearing type stirrers such as a line mixer, arrow blade turbine blade mixer, full margin type blade mixer, high-shearing type turbine mixer, and homogenizer.

[0040]

In a preferable example, in the first step of mixing the harmonic reduced water (functional water B) obtained in the description of said preferable example with the heavy oil A while stirring, the mixing proportion between the harmonic reduced water (functional water B) and the heavy oil A was 1 : 5 in a mass ratio, and mixing and string was conducted until a favorable emulsified state was uniformly achieved, for example the stirring conditions include stirring for three minutes at 4000 rpm for producing a drum of emulsion, thus the first step emulsion in a sufficiently and uniformly emulsified state was obtained.

In the harmonic reduced water (functional water B) used herein, a saturated amount of sodium chloride was dissolved.

In the subsequent second step of mixing the first step emulsion obtained in the first step with the electronic water (functional water A) obtained in the description of said preferable example while stirring, the mixing proportion between the first step emulsion and the electronic water (functional water A) was 6 : 4 in a mass ratio, and mixing and string was conducted until a favorable emulsified state was uniformly achieved, for example the stirring conditions include stirring for one minute at 4000 rpm for producing a drum of emulsion, thus a milk-white emulsion fuel in a sufficiently and uniformly emulsified state, which is an example of the invention, was obtained.

[0041]

As described above, the emulsion fuel of the invention

is an emulsion fuel which maintains a favorable emulsified state free from separation between fuel oil and water with no necessity of additives such as emulsifying agent, surfactant, or stabilizing agent, and offers long-term storage stability.

[0042]

As a comparative example, the heavy oil A, tap water, and alkyl ether sulfate sodium as surfactant were mixed in a mass ratio of 70 : 25 : 5, and mixed while being stirred. These raw materials were mixed as follows: in the first place the heavy oil A was mixed while being stirred with the surfactant, to which water was added, and mixed while being stirred until a favorable emulsified state was uniformly achieved. For example, stirring may be performed at 8000 rpm for 12 minutes. Thus a milk-white emulsion fuel in a sufficiently and uniformly emulsified state was obtained.

At the time of preparation, both of the emulsion fuels of said example and comparative example was a milk-white emulsion fuel in a visually uniform emulsified state.

[0043]

The change in the emulsified state (separated state) was examined for the emulsion fuel of said preferable example of the invention after storage at a normal temperature and normal pressure (25°C, atmospheric pressure) for three months, six months, and one year, and the emulsion fuel of said comparative example containing a surfactant after storage at a normal temperature and normal pressure (25°C, atmospheric pressure) for one week were examined.

The results are shown in Figs. 3 through 6.

[0044]

As described above, when the emulsion fuel of the example of the invention is compared with the conventional emulsion fuel containing a surfactant stored under the same conditions, the conventional emulsion fuel caused separation between oil and water in three months, but the emulsion fuel of the example of the invention maintained the same milk-white emulsified state as that at time of preparation and underwent no separation between oil and water after three and six months, and showed little separation even after one year, which indicates its high stability.

[Industrial Applicability]

[0045]

The emulsion fuel of the invention is, with no necessity of specific control apparatus, useful as a fuel for railway vehicles, ships, motor vehicles such as bus and truck, oil fired power plants, industrial electrical generators (for common use and emergency use), and boilers of various sizes.

[Brief Description of the Drawings]

[0046]

Fig. 1 is a schematic view of an apparatus for producing electronic water to be used in the emulsion fuel of the invention.

Fig. 2 is a schematic view of an apparatus for producing harmonic reduced water to be used in the emulsion fuel of the invention.

Fig. 3 is a photograph representing an example of the

emulsion fuel of the invention after storage for three months.

Fig. 4 is a photograph representing an example of the emulsion fuel of the invention after storage for six months.

Fig. 5 is a photograph representing an example of the emulsion fuel of the invention after storage for one year.

Fig. 6 is a photograph representing an example of a conventional emulsion fuel containing a surfactant after storage for one week.

[Explanations of Letters or Numerals]

[0047]

1 --- electronic water production apparatus

2 --- harmonic voltage generating device

3 --- harmonic application tank

4, 6 --- carbon light irradiation tank

5 --- harmonic reduced water production apparatus

7 --- spark discharge tank

11, 12 --- carbon electrode

13, 20 --- carbon light generating device

14, 15, 16, 17, 18, 19, 21, 22, 23 --- tubes

Claims

1. An emulsion fuel comprising fuel oil and functional water.

2. The emulsion fuel as described in Claim 1, wherein said functional water is electronic water and harmonic reduced water.

3. The emulsion fuel as described in Claim 1 or 2 further comprising sodium chloride.

4. An emulsion fuel production method comprising a first step of mixing fuel oil with harmonic reduced water while stirring to obtain an emulsion, and a subsequent second step of mixing the emulsion obtained in the first step with electronic water while stirring.

5. The emulsion fuel production method as described in Claim 4, wherein sodium chloride is previously dissolved in harmonic reduced water.