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(54) **Device and method for ion current sensing**

(57) Ion current sensing device comprising an ion
sensing means and a voltage source for generating an

ion sensing supply voltage to be applied to said ion
sensing means. According to the invention said ion
sensing supply voltage is of negative polarity.

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Description

Introduction

[0001] The present invention relates to a device and a method for ion current sensing in an internal combustion engine.

State of the Art

[0002] In recent years, more effective emission control has been demanded in internal combustion engines for the protection of the environment. A more effective emission control can be achieved through an improved burning control system. Such a burning control system requires the detection of conditions of the burning of an air-fuel mixture in a combustion chamber of an engine. Many physical parameters, such as the pressure in the combustion chamber, the light generated by the burning of the air-fuel mixture, the ion current in the combustion chamber, and others can be detected as an indication of conditions of the burning of the air-fuel mixture. It is thought that particularly the ion current detection is very useful.

[0003] Ions are generated during the combustion of the air-fuel mixture, the ion concentration directly depending on the burning conditions inside the combustion chamber. Accordingly, the detection of the ion concentration in the combustion chamber means a direct observation of a chemical reaction caused during the burning of an air-fuel mixture.

[0004] In order to measure the concentration of the ions present in the combustion chamber an ion-sensing device, e.g. an ion-sensing electrode, is located inside the combustion chamber. Said ion-sensing device can be independently arranged inside the combustion chamber or integrated in an ignition device, e.g. a glow plug device or a sparking plug device. During an ion sensing function, said ion-sensing device is supplied with a supply voltage so that the ion sensing means and the walls of the combustion chamber form opposite electrodes for capturing the generated ions. An ion current is generated by the migrating ions, the value of which can be easily measured. The information on the ion current can then be used to control the burning conditions inside said combustion chamber.

[0005] In known ion sensing devices, a positive supply voltage is applied to the ion-sensing electrode. Accordingly, the ion-sensing electrode is positively charged with respect to the combustion chamber wall so that the negatively charged ions are attracted by the ion-sensing electrode while the positively charged ions are attracted by the combustion chamber wall. The value of the ion current induced by this migration of the ions can be easily measured by measuring the current flowing through the ion sensing supply voltage source.

[0006] A disadvantage of such a device is that the signal obtained by the described method is subject to high

variations even during stable burning conditions. It follows that the determination of the actual combustion conditions is not always accurate.

Object of the invention

[0007] The object of the present invention is to provide an improved ion current sensing device and method.

General description of the invention

[0008] This object is achieved by a method for ion current sensing, wherein an ion sensing supply voltage is applied to an ion sensing means, and wherein said ion sensing supply voltage is of negative polarity. Accordingly, an ion current sensing device according to the present invention comprises an ion sensing means and a voltage source for generating an ion sensing supply voltage to be applied to said ion sensing means, wherein said ion sensing supply voltage is of negative polarity.

[0009] In an ion-sensing device operated with positive supply voltage, the presence of negatively charged ions and of free electrons is detected. Hence free electrons contained in the air fuel mixture before the burning thereof contribute to the measured current thus leading to inaccuracies in the determination of combustion generated ions. This effect is worsened due to the fact that the free electrons have a higher mobility than the much heavier negative ions and therefore are attracted from a wider area of the combustion chamber than the negatively charged ions. It follows that the measured concentration of negatively charged particles is higher than the actual concentration in the considered area of the combustion chamber between the electrode and the chamber wall. Furthermore, the obtained signal is subject to fluctuations due to a temporary depletion of free electrons in the considered area.

[0010] If according to the invention a negative supply voltage is applied to the ion sensing means, the ion-sensing electrode is negatively charged with respect to the combustion chamber. The ion sensing means, e.g. an ion-sensing electrode, then only attracts positively charged ions, which are present in the combustion chamber. The positively charged ions having a lower mobility than free electrons, only those ions are attracted which are present in the immediate surrounding area of the ion sensing means. It follows that with the method and the device according to the present invention, the considered area in the combustion chamber is much more localised than in the known device operating with positive ion sensing supply voltages.

[0011] Furthermore, free electrons contained in the fuel-air mixture are not attracted by the ion sensing means and thus do not contribute to the measured ion current. This results in a very stable ion current during stable burning conditions and accordingly to a better signal to noise ratio. Hence, the actual burning conditions in the combustion chamber can be more accurately de-

terminated and the combustion more effectively controlled.

[0012] If the ion-sensing electrode is integrated in an ignition device, e.g. a glow plug device, the present invention provides a further advantage over state of the art devices. In this case, the negative ion sensing supply voltage in contrast to the generally glow plug supply voltage simplifies the electrical isolation between the ion current sensing function and the heating function of said glow plug device. In fact, the polarity of the applied voltage can now be used as switching criterion between both functions.

Claims

1. Method for ion current sensing, wherein an ion sensing supply voltage is applied to an ion sensing means, characterised in that said ion sensing supply voltage is of negative polarity.
2. Ion current sensing device comprising an ion sensing means and a voltage source for generating an ion sensing supply voltage to be applied to said ion sensing means, characterised in that said ion sensing supply voltage is of negative polarity.