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METHOD FOR THE MEASUREMENT OF PINKING IN INTERNAL-COMBUSTION ENGINES

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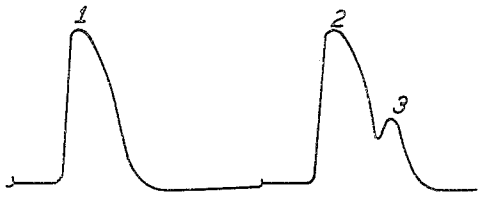


Fig. 1

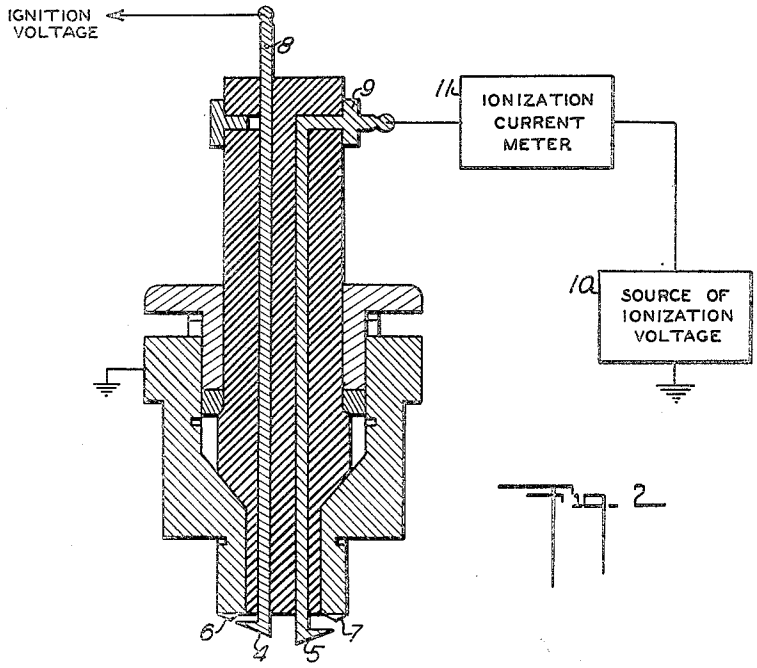


Fig. 2

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METHOD FOR THE MEASUREMENT OF PINKING IN INTERNAL-COMBUSTION ENGINES

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A limit is set by pinking, that is, by the shock phenomena which appear in internal combustion engines, for each fuel, to the compression ratio, the pressure and temperature of the air admitted into the cylinders, the cooling temperature or the percentage of the mixture, and it is agreed generally to classify the fuels depending on their pinking properties according to what has been called the octane number scale. Methods and equipments have been devised for the determination, as a function of the variation of one of the engine setting parameters, of the moment when pinking appears and even of the intensity of such pinking.

However, the beginning of the said phenomenon is not always easy to perceive, the methods used allow too much place for the appreciation of the persons who use them, or else, where they provide for better accuracy, they can be applied only on special engines operated in well defined conditions and running at comparatively low speed. Now, the classification obtained in a given motor will not necessarily be retained in another; likewise, pinking can set in sooner in certain cylinders than in others of the same motor. Consequently, it is necessary that methods should be devised and equipment designed which can be used for measuring pinking in any desired cylinder of any given motor, irrespective of its running speed.

This invention has for its object a method and an arrangement for the measurement of pinking which can be used in the said conditions as well on conventional test motors for refining the theoretic fuel grading as on any one of the cylinders of a motor in use for the ascertainment of the real behaviour of each fuel in the motor considered, in either normal or abnomal operation and, as far as an airplane motor is concerned, both in ground-level and flying operation.

It is well known that if a potential difference be created between a pair of points located in a gas mass a current can set in through the latter, the intensity of which is a function of its degree of ionisation. This property has already been taken advantage of for studying flame propagation in engine cylinders, since the jump in the intensity of the ionisation current which appears between the two points at the moment when the latter are reached by the hot gases allows ascertainment of the passing of the flame at the level of the tell-tale plug carrying the pair of points and connected with a suitable detector device.

Figure 1 of the drawing represents a typical curve showing ionisation current during combustion,

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Figure 2 shows an arrangement for carrying out the method of detecting pinking.

It has now been found, according to this invention, that if the intensity of the ionisation current thus generated be recorded in accordance with time or the angle of rotation of the crank or any other variable related with the latter, the curve of the current of ionisation in normal combustion conditions shows only one maximum corresponding each time to a combustion, whereas in pinking conditions of operation the first maximum is followed by an additional maximum the value of which is a measure the intensity of the pinking. Figure 1 illustrates the appearance of the curve of the current of ionisation in non-pinking conditions with one single peak 1 and in pinking conditions with two successive peaks 2 and 3; the consideration of the curve of intensity of the current of ionisation thus provides a method whereby the setting in of pinking can be detected definitely and even its intensity can be measured.

The researches of the applicant have revealed that for the purpose of bringing the phenomenon to view and of obtaining values that are independent of the shape of the cylinder head a condition which is one of the peculiarities of this invention is that the electrodes of the tell-tale plug should be located as close as possible to the sparking plug. Effectively, the appearance of the said additional peak can be explained by the crossing of the tell-tale plug electrodes by the compression wave created at the spontaneous ignition of the mass of yet unburnt gases; at some points in the cylinder head said wave may happen to reach the wall at the same time as the flame, or even before, and the additional peak then can be concealed or inexistent where the tell-tale plug is located at the said point. On the contrary, close to the sparking plug, the flame wave will certainly sweep the tell-tale plug before the same is reached by the compression wave propagating through the already burnt gases.

In the performance of this method one is led to construct a tell-tale plug comprising a pair of insulated electrodes, or one insulated and one earthed electrode, where an auxiliary plug boss is available directly adjacent to the sparking plug boss. A plug boss or a special socket can also be conceived, according to this invention, which will allow to insert two separate plugs, viz.: the normal sparking plug and the tell-tale plug. Advantageously however, as a preferred embodiment of this invention, a special plug can be provided which, as shown in cross-sectional view in Fig. 2,

comprises a pair of insulated electrodes 4, 5 and a pair of earthed electrodes 6, 7, the ignition being taken care of by the spark which passes between the electrode 4 and the earthed electrode 6 adjusted to the normal gap, while the electrode 5 and the other earthed electrode 7, adjusted to a somewhat wider gap, provide the tell-tale element between the points of which the current of ionisation is established. The sparking and tell-tale plug then can be constructed as shown in Fig. 2, the sparking electrode being connected with the normal ignition circuit by a central terminal 8 while the tell-tale electrode is connected by means of collar 9 in circuit with a source of ionising potential 10 and an indicating or recording instrument 11 for the measurement of the current of ionisation. It is to be understood that this embodiment is given only by way of example and that the invention covers all the arrangements leading to the same result, that is, to provide, either in two plugs placed very near one relatively to the other, or preferably in one and the same plug, the points serving for the passage of the ignition spark and the points between which the ionisation current is established, whose intensity depends on what is happening in the gap of the tell-tale element.

What I claim as my invention and desire to secure by Letters Patent is:

1. A method for measuring the pinking in a cylinder of an internal combustion engine, consisting in producing inside the gaseous mass contained inside the cylinder an ionisation current the intensity of which is constant for predetermined temperature and pressure conditions of the gaseous mass and measuring the variations of the said intensity throughout the course of a cycle of operation of the engine, which variations are significative of detonation.

2. A method for measuring the pinking in a cylinder of an internal combustion engine, consisting in producing inside the gaseous mass contained inside the cylinder an ionisation current the intensity of which is constant for predetermined temperature and pressure conditions of the gaseous mass, recording in the form of a curve the variations of intensity of said ionisation current throughout the cycle, a maximum of which corresponds with the ignition of the gaseous mass and measuring on said curve the second maximum following the maximum considered and defining the value of the pinking.

3. A method for measuring the pinking in a cylinder of an internal combustion engine, consisting in producing inside the gaseous mass contained inside the cylinder and in the immediate vicinity of the point at which the ignition of the gaseous mass begins an ionisation current the intensity of which is constant for predetermined temperature and pressure conditions of the gaseous mass and measuring the variations of said intensity throughout the cycle for obtaining the value of the pinking.

ROSTISLAV VICHNIEVSKY.

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