



FORMULARIO ÚNICO DE SOLICITUD DE PATENTE

PCT

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☒ Patente de invención		☐ Patente de Modelo de Utilidad	
☐ Capitulo I.		☒ Capitulo II.	
2) SOLICITANTE (71)	Nombre: BAJAJ AUTO LIMITED Dirección: Akurdi, Pune 411 035, Maharashtra, India Nacionalidad o domicilio: Pune, Maharashtra, India Lugar de constitución: India		IDENTIFICACIÓN C.C. ☐ NIT: ☒ C.E. ☐ OTRO ☐ Cual _____ NÚMERO _____
	Teléfono: _____ Fax: _____ E. Mail: _____		
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4) INVENTOR (ES) (72)	Nombre: ABRAHAM, Joseph Dirección: Bajaj Auto Limited, Akurdi, Pune 411 035, Maharashtra, India Nacionalidad o Domicilio: Pune, Maharashtra, India		
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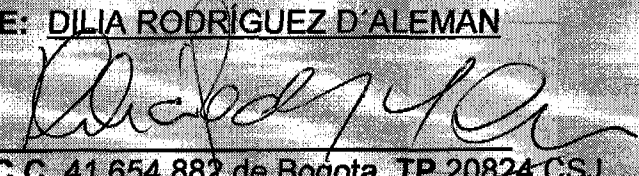
ANEXOS

- ☒ Comprobante de pago de la tasa de presentación de la solicitud
- ☐ Comprobante de pago por reivindicación de prioridad
- ☐ Documento que acredita la existencia y representación legal cuando el solicitante sea persona Jurídica
- ☐ Poderes, si fuera el caso
- ☐ Documento de cesión del inventor al solicitante o a su causante
- ☐ Declaraciones
- ☒ Copia de la solicitud Internacional. (Resumen, descripción, reivindicación, Dibujos).
- ☒ Traducción de la solicitud internacional al castellano. (Resumen, descripción, reivindicación, Dibujos)
- ☒ Copia del examen preliminar efectuado por la IPEA
- ☐ De ser el caso, copia del contrato de acceso
- ☐ De ser el caso, documento que acredite la licencia o autorización de uso de conocimientos tradicionales de las comunidades indígenas
- ☐ De ser el caso, certificado de depósito del material biológico
- ☐ Arte final 12 x 12 y 6 x 6 cm
- ☐ De ser el caso, información sobre otras solicitudes de patente o títulos obtenidos en el extranjero por el mismo titular o su causante, relacionados parcial o totalmente con la invención de esta solicitud.
- ☒ Otros:
1. Reporte internacional de búsqueda
 2. IPEA/416,
 3. Request, IB/304
 4. Opinión escrita
 5. Declaraciones

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FIRMA: 

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **METHOD AND SYSTEM FOR CONTROLLING ENGINE NOISE**

(57) Abstract: The present invention provides a method of controlling noise and harshness caused by combustion in a spark ignited engine having a combustion chamber; a fuel delivery means for delivering a fuel charge to the combustion chamber; a plurality of spark ignition means located in the combustion chamber for igniting the fuel charge and a control unit. The control unit controls operation of each ignition means in response to measured value of a least one combustion noise associated parameter, being an engine operating condition. Control may be a response to the combustion noise associated parameter breaching a threshold value. The combustion noise associated parameter may be rate of rise of combustion pressure in the combustion chamber. However, the method may be implemented in response to rate of rise of combustion pressure and one or more further parameters, such as engine speed, acceleration and/or engine load breaching threshold values. An ignition control system for implementing the method in a vehicle forms another aspect of the invention. The method and ignition control system may be implemented in fuel injected engines or carburetted engines but is particularly advantageous for fuel injected engines.

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TITLE OF THE INVENTION

METHOD AND SYSTEM FOR CONTROLLING ENGINE NOISE

This invention relates to a method and system for controlling engine noise, particularly noise associated with combustion.

The Applicant has invented an engine having a plurality of ignition means for each combustion chamber. Such a small bore or small displacement engine, as described in the Applicant's granted Indian Patent 195905 dated July 16, 2002, the contents of which are hereby incorporated herein by reference, allows efficient burning of lean air-fuel mixtures. Particularly applicable to small displacement engines, the plural or dual ignition means arrangement allows two spark plugs to be energized simultaneously at a predetermined instant below top dead centre to burn a lean air-fuel mixture in an efficient manner. Such vehicles have been well received but the Applicant wished to improve noise levels which, while within statutory limits, were slightly high.

It appears that simultaneous energizing of spark plugs may lead to uncomfortable noise levels or sound harshness when an engine is rapidly accelerated or operated in higher speed engine operating regimes. This noise is to be distinguished from noise generated as a result of the well known "knock" phenomenon in that it does not necessarily cause mechanical damage to the engine.

When a vehicle employing the engine is cruising at a constant speed, say between 15 to 60 km/h, an engine may burn a lean fuel-air mixture at a quick enough rate to achieve efficient combustion without uncomfortable noise and sound harshness. In such condition, the rate of rise of combustion pressure is good enough to achieve efficient combustion. However, when the engine is accelerated rapidly, the cylinder instantaneously fills with a greater amount of air-fuel mixture which is compressed to higher pressures leading to a higher rate of rise of combustion pressure. At this instant, in known engines, dual spark plug ignition causes the rate of rise of combustion pressure to increase further, leading to uncomfortable noise levels and harshness of sound. Such a rapid rise in combustion pressure also leads to rapid acceleration of the moving parts taking up the clearances between them rapidly during a piston stroke. This increases the noise and harshness problem. It has been observed that if the rate of rise of combustion pressure is more than a threshold value, about 3.5 bar per degree of crank rotation, it leads to uncomfortable noise levels or harshness of sound.

It has also been observed that, when the engine runs at a higher engine speed, say greater than 6000 rpm, uncomfortable noise levels or harshness of sound is produced. At these speeds, the higher flow velocity of the air fuel mixture creates turbulence in the engine cylinder. The air fuel ratio is also richer to take care of the durability of engine components. These factors ie: turbulence in the cylinder and the higher amount of richer charge leads to a higher rate of rise of combustion pressure in known engines due to dual spark plug ignition thus causing uncomfortable noise levels or harshness of sound.

It is an object of the present invention to address the problem of combustion associated noise and harshness in engines having combustion chambers fitted with a plurality of spark ignition means.

With this object in view, the present invention provides a method of controlling noise and harshness caused by combustion in a spark ignited engine having a combustion chamber; a fuel delivery means for delivering a fuel charge to the combustion chamber; a plurality of spark ignition means located in the combustion chamber for igniting the fuel charge and a control unit wherein said control unit controls operation of each ignition means of said plurality of ignition means in response to measured value of a combustion noise associated parameter. Such control may be implemented in response to the measured value of the combustion noise associated parameter breaching a predetermined threshold level.

Preferably, the fuel delivery means is a fuel injector located in a manifold for the engine. The fuel delivery means may comprise a carburettor.

Preferably, the fuel charge is a mixture of air and fuel. The fuel charge may have an air fuel ratio in the lean range or the rich range. Dual spark ignition may be avoided when air fuel ratio is in the rich range.

The combustion noise associated parameter may be selected from a suite of possible engine operating conditions. The rate of rise of combustion pressure in a combustion chamber is strongly associated with combustion noise and harshness as above described and is the preferred or primary parameter for control. Indeed, the method may be implemented to maintain rate of rise of combustion pressure below a predetermined threshold value at which noise levels are acceptable. The rate of rise of combustion pressure may be expressed as pressure rise per degree of crank rotation and, accordingly, the predetermined threshold may be 3.5 bar per degree of crank rotation. The rate of rise of combustion pressure may also be expressed as pressure rise per unit time.

Rise in combustion pressure has associated parameters such as speed, acceleration, engine load, throttle position, air fuel ratio and manifold vacuum pressure or variation in these each of which are secondary noise associated parameters that may be sensed or measured for a given plural, likely dual, ignition means engine and used as a control parameter in combination with rate of rise of combustion pressure or possibly alone, particularly at high engine speeds, for example greater than 5000 rpm. Advantageously, control over ignition means and combustion proceeds on the basis of measured rate of rise of combustion pressure and at least one other parameter, particularly engine speed or acceleration, breaching predetermined threshold values particularly under mid engine speed conditions, for example 1600 to 5000 rpm.

In another aspect, the invention provides an ignition control system for a vehicle comprising:
a plurality of spark ignition means; and

a control unit for controlling operation of each ignition means wherein said control unit is programmed to receive combustion noise associated parameter data and operate each ignition means in accordance with said combustion noise associated parameter data.

The method and system are particularly applicable to the situation in which the engine is in a load transition, usually from part load to full load. The nature of ignition means timing control in accordance with the method may be varied dependent on engine load conditions.

Sensing of engine speed and acceleration provides a convenient way to provide data to the control unit. The control unit, which may be a micro-controller, may then operate the ignition means to control the noise level through control over firing time for one or both ignition means. Firing of an ignition means may be discontinued, if necessary, to achieve desired noise control. Retarding of the firing timing of one ignition means relative to firing timing of another ignition means is a preferred mode of control as well. Such retard may vary as a function of engine operating conditions.

Under "normal" conditions, where noise is unlikely to be problematic, both ignition means or spark plugs may be fired at the same time, especially if combustion of lean mixtures is required, though the spark plugs could be fired at some fixed offset in timing. If engine speed and/or acceleration, for example, exceed a predetermined value, the control unit may retard or delay energizing the firing event of one of the spark ignition means or spark plugs. Under such conditions, even a lean mixture may not require promotion of ignition by plural ignition means.

If engine speed and/or acceleration is below the predetermined value, for example 1600 rpm for engine speed, the spark plugs may be energized simultaneously with the emphasis on engine power output. The control unit may implement such steps in response to combustion noise associated parameter data other than engine speed and acceleration data. The control unit may be programmed with maps of ignition firing time/ignition means discontinuation for various engine operating conditions, for example engine speed. Such maps may correspond with part open throttle or wide open throttle conditions.

Further, control over operation of the ignition means, for example in terms of retarding the firing event or timing of one of the spark plugs, relative to the firing event or timing of another spark plug may occur in response to a noise prone combination of measured or sensed combustion noise associated parameter data. For example, delay over the timing of the firing event may occur in response to both rate of rise of combustion pressure and engine speed or acceleration being above threshold values for the implementation of control.

The ignition timing for the spark plugs may be retarded in stepwise manner under operating conditions when noise control is required. This requires less capacity for the control unit. However, a smoothed transition of ignition firing event timing may be preferred, the degree of retardation being determined as a function of the selected combustion noise associated control parameter. The degree of retardation of firing or suspension of firing of one of the spark plugs may be determined from ignition timing/engine speed maps which may correspond with part open throttle or wide open throttle conditions. Maps using combustion noise associated parameters other than engine speed may also be employed.

The engine controlled in accordance with the method or implementing the ignition control system aspects of the invention may be a carburetted engine, a manifold injected engine or a direct injected engine. Use of the method and control system in relation to a fuel injected engine is a particularly advantageous embodiment of the invention. The engine may be a two stroke or four stroke engine and may particularly advantageously be applied to a small bore or small displacement engine.

In a further aspect, the present invention provides a method of controlling noise and harshness in an engine having a cylinder provided with a plurality of ignition means comprising, during operation of an engine in transition from part load to full load:

- a) measuring rate of rise of combustion pressure in said cylinder; and

b) retarding energising or firing of an ignition means in said cylinder by controlled degree if measured rate of rise of combustion pressure exceeds a predetermined value; wherein degree of retardation of firing of said ignition means is controlled dependent on sensed engine speed and load conditions.

The present invention will now be described in detail with reference to non limiting preferred embodiments as illustrated in the accompanying drawings, wherein;

Figure 1 illustrates a section of a cylinder head of a dual ignition means engine.

Figure 2 illustrates ignition timing curves of an engine ignition system according to the present invention.

Figure 3 illustrates ignition timing curves of an engine ignition system according to the prior art.

Figure 4 illustrates a block diagram of one embodiment of ignition system according to the present invention.

Figure 5 illustrates a flowchart for operation of the ignition system according to one embodiment of the present invention under Part Open Throttle Conditions.

Figure 6 illustrates a flowchart for operation of the ignition system according to one embodiment of the present invention under Wide Open Throttle Conditions.

Figure 7 is a schematic sectional view of an engine cylinder head for a dual ignition means fuel injected engine.

Figure 8 illustrates an ignition timing map for the engine of Figure 7.

Referring now to Figure 1, there is shown the cylinder head 14 of a small bore internal combustion engine 100. The engine 100 works on the four stroke principle. Typical characteristics of such a small bore engine include a swept cylinder volume ranging from 70 cc to 200 cc and cylinder bore diameter 45mm to 70mm, employed as prime movers for operation of two or three wheeled vehicles or other motorized vehicles, for example as here, motorcycles.

Cylinder head 14 defines the top of a combustion chamber 120, of pent roof construction, and is fitted with two spark plugs 15 and 16, of conventional manufacture, allowing the engine 100 to operate in a lean combustion mode to improve fuel economy. 10

Spark plugs 15 and 16 form part of a capacitive discharge ignition system (CDI system) 7. The CDI system 7 is schematically shown in Figure 4 and comprises of a wave shaping means 3, a sensing means or a micro-controller control unit 4, a charging coil 5, a power supply rectification means 6, an ignition capacitor charging and trigger circuit A 8, and an ignition capacitor charging and trigger circuit B 9. CDI system 7 controls the manner and timing of firing of spark plugs 15 and 16 through the micro-controller control unit 4.

Magneto rotor 1 generates pulses in the pick up coil 2 which are input to micro-controller 4 through wave shaping means 3. The power supply to micro-controller 4 is provided by conventional charging coil 5 through power supply rectification means 6. Two outputs of the said micro-controller 4 are connected to the ignition capacitor charging and trigger circuit A 8 and ignition capacitor charging and trigger circuit B 9. The ignition capacitor charging trigger circuit A 8 is connected to the spark plug 15 through ignition coil A 10 and the ignition capacitor charging and trigger circuit B 9 is connected to the spark plug 16 through ignition coil B 11. The vehicle fitted with this system can also be fitted with a throttle position sensor 12. Sensor 12 may be of a construction identifying the two states of wide open throttle and part open throttle. A sensor providing more detailed data for throttle position could also be employed.

When a rider of the motorcycle increases the speed of the vehicle by operating the throttle, the rate of rise of combustion pressure, a strongly combustion noise associated parameter, is sensed by micro-controller 4 through pick up coil 2. In addition, the rate of increase of engine speed may be input to micro-controller 4. In the preferred embodiment, it is these two combustion noise associated parameters, one primary and one secondary, that are used in a strategy to control combustion noise to acceptable levels. These acceptable levels can be set and tested in a factory environment. Further parameters, such as manifold vacuum or pressure, may also be input to the control strategy.

Under low engine speed conditions, illustratively under 1600 rpm, both spark plugs 15 and 16 will be fired, on instruction of the micro-controller 4, to promote ignition of a lean fuel-air mixture charge delivered to engine 100. The micro-controller 4 is programmed with maps of the required ignition timings as a function of engine speed and rate of rise of combustion pressure. 9

At a threshold engine speed, illustratively above 1600 rpm, and a measured rate of rise of combustion pressure above a threshold value, say 3.5 bar per degree crank rotation, micro-controller 4 retards or discontinues firing of one of the spark plugs 16 by a predetermined value. Such control is implemented, in the illustrated embodiment, by a step wise maneuver, the step value or degree of retardation being dependent on measured engine speed. That is, over a mid speed range of say 1600 rpm to 5000 rpm, the degree of retardation will vary dependent on engine speed value. The degree of retardation may also vary with measured rate of rise of combustion pressure. The ignition timing of other spark plug 15 remains unchanged.

When the engine speed increases beyond certain value, say 5000 rpm, to the high speed range, particularly on wide open throttle acceleration conditions, where a rich air fuel ratio range fuel charge is delivered to combustion chamber 14, firing of the spark plug (16) is discontinued as unnecessary and the engine 100 runs only with one spark plug energized.

Exemplary maps of spark plug firing timing vs engine speed or ignition timing curves according to which noise and harshness control is implemented in accordance with the invention as above described is shown in Figure 2. Figure 2 illustrates ignition timing curves for the engine 100 having two spark plugs 15 and 16 per cylinder for the control strategy of the present invention wherein x-axis shows the engine speed (RPM) and Y-axis shows the ignition timing. When engine speed increases rapidly, ignition firing timing of one of the spark plug 16 retards by a predetermined value as indicated by D keeping ignition timing of spark plug 15 unchanged as indicated by C in the figure. This achieves noise and harshness reduction.

In contrast, Figure 3 illustrates ignition timing curves for engines according to the prior art wherein the x-axis shows the engine speed (RPM) and the y-axis shows the ignition timing in degrees before Top Dead Center. As the engine speed increases, the ignition timing also varies and is applicable for both spark plugs, which are energized simultaneously. This simultaneous operation of spark plugs results in an over-promotion of combustion and potentially excessive noise and harshness. No control strategy for the ignition means to reduce such noise levels is provided.

Comparison of Figures 2 and 3 demonstrates that, using the ignition control strategy of the present invention under mid and high speed conditions, the progress of ignition and combustion may be controlled with consequential benefits in terms of noise and harshness reduction. Controlled retardation or discontinued spark plug operation when engine operating conditions in terms of measured or computed combustion noise associated parameters dictate, results in less noise since simultaneous firing of spark plugs 15 and 16 is not needlessly implemented.

The degree of control in terms of degree of retardation, ignition timings, conditions under which firing of a spark plug is discontinued and spark plug firing offset timings are dependent on whether the engine 100 is operated in part open throttle mode or wide open throttle mode and the engine speed. Flowcharts corresponding with control algorithms for the two throttle position modes are presented in Figures 5 and 6.

In such manner, the benefits of a dual spark plug ignition system for combustion of lean air-fuel mixtures may be maintained without the noise and harshness cost or disadvantage of dual ignition when rich air-fuel ratio fuel charges are required to be delivered to engine 100. Further benefits may also accrue insofar as spark plugs 15 and 16 would be expected to wear at a slower rate as firing timings are optimized to the engine operating conditions.

However, as the rider completes an acceleration phase by maintaining constant throttle position, as sensed by pick up coil 2, simultaneous ignition timing of both spark plugs 15 and 16 is restored being advantageous to good engine combustion performance.

The mapped values of the rate of increase of the engine speed during acceleration phase, variation in ignition timing required to be made for one spark plug and to which of the two spark plugs this is to be applied and the engine speed at which the cut-off of one of the spark plugs takes place depend upon engine design. Engine design parameters such as cylinder swept volume, engine maximum power and maximum torque and at which engine speed these occur, maximum speed of the vehicle, transmission gear ratios, dynamic rolling radius of tyres etc. affect such decisions. The maps will be programmed having regard to these parameters.

The above description relates to a system wherein the input of the engine speed has been taken from the said pulser coil, based on which the micro-controller 4 controls the ignition timing of one of the two spark plugs. The inputs can also be taken based on parameters such as manifold vacuum pressure (Figure 8), instantaneous throttle position sensor or other parameters which can indicate or lead to indication of higher rate of combustion pressure and thus greater noise and harshness. When it is required to account for the load on the engine also, it is necessary to take the input from locations such as the manifold vacuum and / or the throttle position sensor. Such variations in the inputs taken are well within the scope of this invention.

Modifications and variations to the method and ignition control system of the present invention may be apparent to the skilled reader of this disclosure. Such modifications and variations are deemed within the scope of the present invention.

For example, the method and control system may be advantageously applied to a fuel injected engine as shown in Figure 7. Here the cylinder head 114 of engine 200 defines the top of a combustion chamber 120 being fitted with two spark plugs 104 and 105, of conventional manufacture, allowing the engine 200 to operate in a lean combustion mode to improve fuel economy.

Engine 200 is a manifold fuel injected engine in which a manifold fuel injector 101 delivers a fuel charge to air manifold 102 delivering air to the engine combustion chamber 120. Combustion noise control is achieved using the same general strategy as above described.

Specifically, during constant speed running, depending on the manifold pressure and engine speed, an electronic engine control unit (ECU, not shown) triggers ignition sparking at required timing for both spark plugs 104 and 105. Such timings may be simultaneous or different, for example firing in some timing relationship which may be a fixed timing relationship.

During acceleration, firing of second spark plug 105 is retarded with respect to the first spark plug 104 by a crank angle functionally dependent on the engine speed. Acceleration may be sensed in two ways. For example, acceleration may be sensed if (1) the rate of change of throttle position sensor position exceeds a threshold value; or (2) the rate of change of engine speed is more than a threshold value. The ECU retards the spark timing of the second spark plug 105 if one of these two conditions is met. The spark timing of the second spark plug 105 is restored once the rate of change of engine speed is less than the threshold value.

The ignition timings are controlled in accordance with an ignition map, presented as Figure 8, which sets ignition timing as a function of engine speed and manifold vacuum or pressure.

CLAIMS:

1. A method of controlling noise and harshness caused by combustion in a spark ignited engine having a combustion chamber; a fuel delivery means for delivering a fuel charge to the combustion chamber; a plurality of spark ignition means located in the combustion chamber for igniting said fuel charge; and a control unit wherein said control unit controls operation of each ignition means of said plurality of ignition means in response to measured value of at least one combustion noise associated parameter.
2. The method of claim 1 wherein control is implemented when measured value of said combustion noise associated parameter breaches a predetermined threshold level.
3. The method of claim 1 or 2 wherein a primary combustion noise associated parameter is rate of rise of combustion pressure.
4. The method of claim 3 wherein a secondary combustion noise associated parameter is at least one parameter associated with the rate of rise of combustion pressure selected from the group consisting of engine speed, engine load, acceleration throttle position, air fuel ratio and manifold pressure and variation in these.
5. The method of any one of the preceding claims wherein firing of an ignition means is retarded if rate of rise of combustion exceeds a threshold value.
6. The method of claim 5 wherein firing timing of an ignition means is retarded if engine speed or acceleration also exceeds a threshold value.
7. The method of claim 6 wherein firing timing is retarded in a step change.
8. The method of claim 7 wherein a smooth transition from one ignition means firing timing to a retarded firing timing is effected by the control unit.
9. The method of any one of the preceding claims wherein firing of an ignition means is discontinued if at least one combustion noise associated parameter breaches a threshold value.
10. The method of any one of the preceding claims wherein the engine is injected with said fuel charge.
11. The method of any one of claims 1 to 10 wherein the manifold of the engine is injected with fuel.
12. The method of any one of the preceding claims wherein air fuel ratio of the fuel charge is in a lean range.

13. The method of any one of the preceding claims wherein the engine is operated in lean combustion mode.
14. The method of any one of the preceding claims wherein control is implemented during a load transition of the engine.
- 5 15. A method of any one of the preceding claims wherein control is implemented by retarding firing timing of one of ignition means relative to firing timing of another ignition means.
- 10 16. A method of controlling noise and harshness in an engine having a cylinder provided with a plurality of ignition means comprising, during operation of an engine in transition from part load to full load:
- a) measuring rate of rise of combustion pressure in said cylinder; and
 - b) retarding firing of an ignition means in said cylinder by controlled degree if
- 15 measured rate of rise of combustion pressure exceeds a predetermined value; wherein degree of retardation of firing of said ignition means is controlled dependent on sensed engine speed and load conditions.
17. The method of any one of the preceding claims when implemented in a small bore engine.
- 20 18. An ignition control system comprising:
- a plurality of spark ignition means (15, 16); and
 - a control unit (4) for controlling operation of each ignition means (15, 16) wherein said control unit (4) is programmed to receive combustion noise associated parameter data and operate each ignition means (15, 16) in accordance with said data to control noise and
- 25 harshness.
19. The ignition control system of claim 18 wherein the control unit is programmed with maps providing ignition firing timing as a function of measured combustion noise associated parameter data under particular engine operating conditions.
20. The ignition control system of claim 19 wherein the maps provide ignition firing
- 30 timing as a function of at least one parameter selected from the group consisting of engine

1/8

17

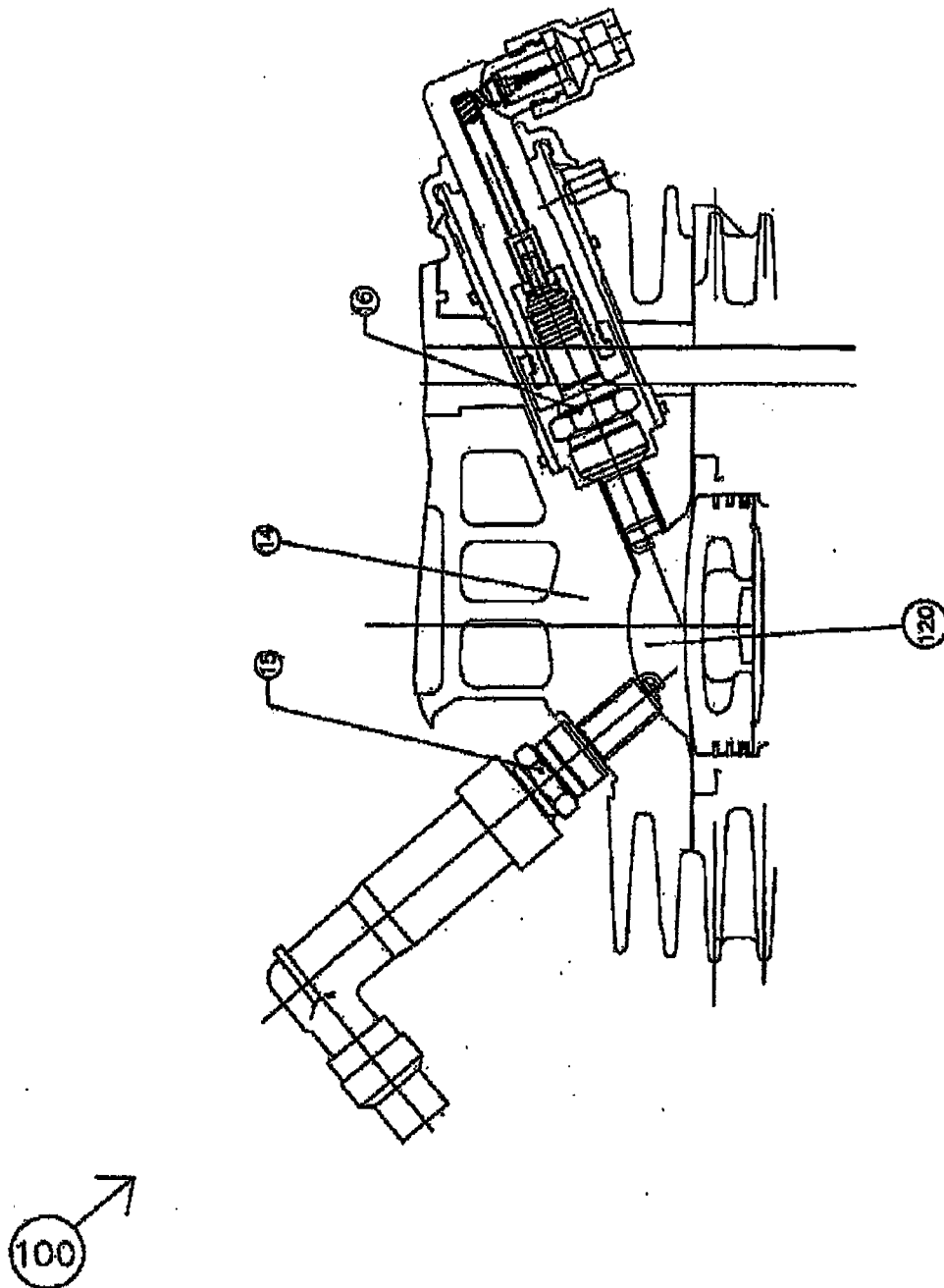


Figure 1

16

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ENG. RPM V/S IGN. TIMING

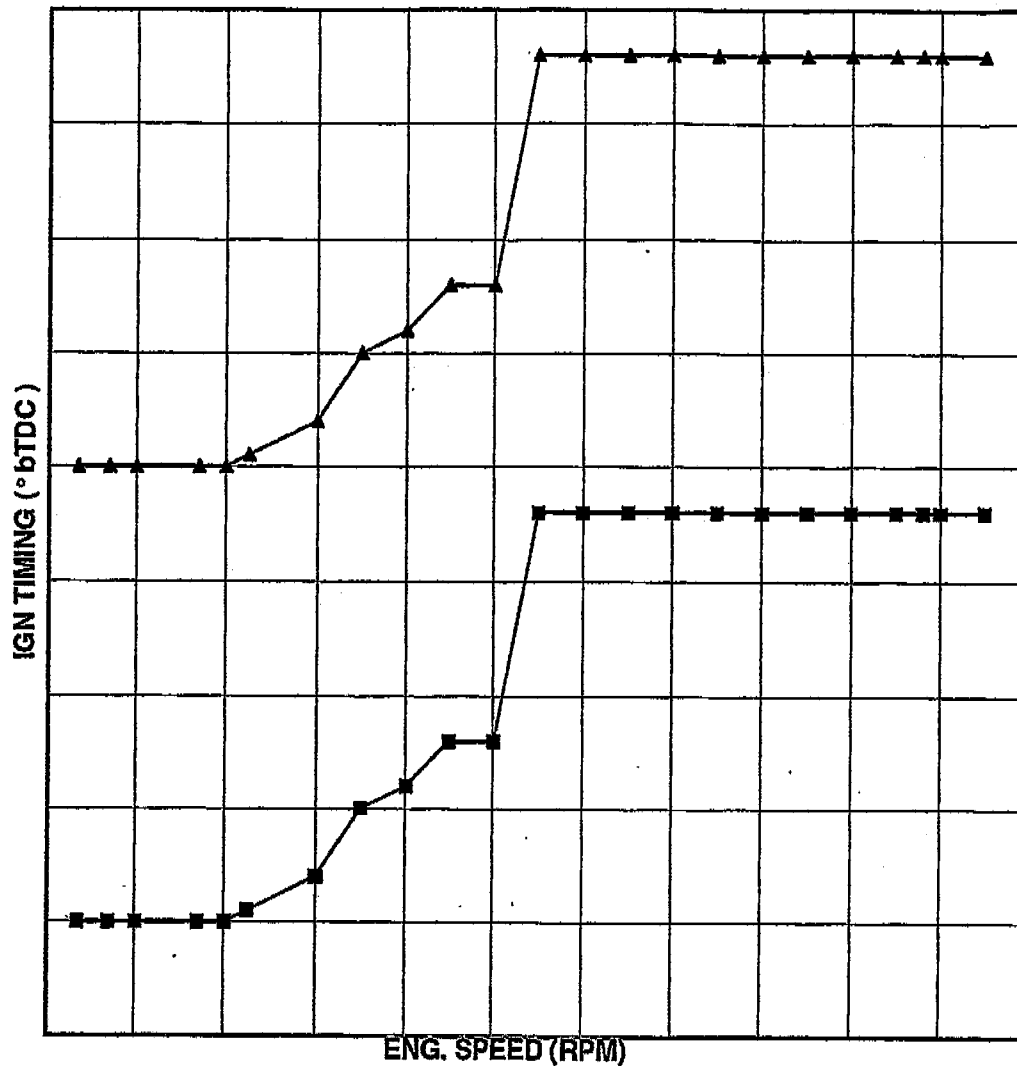


FIGURE 2

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ENG. RPM V/S IGN. TIMING

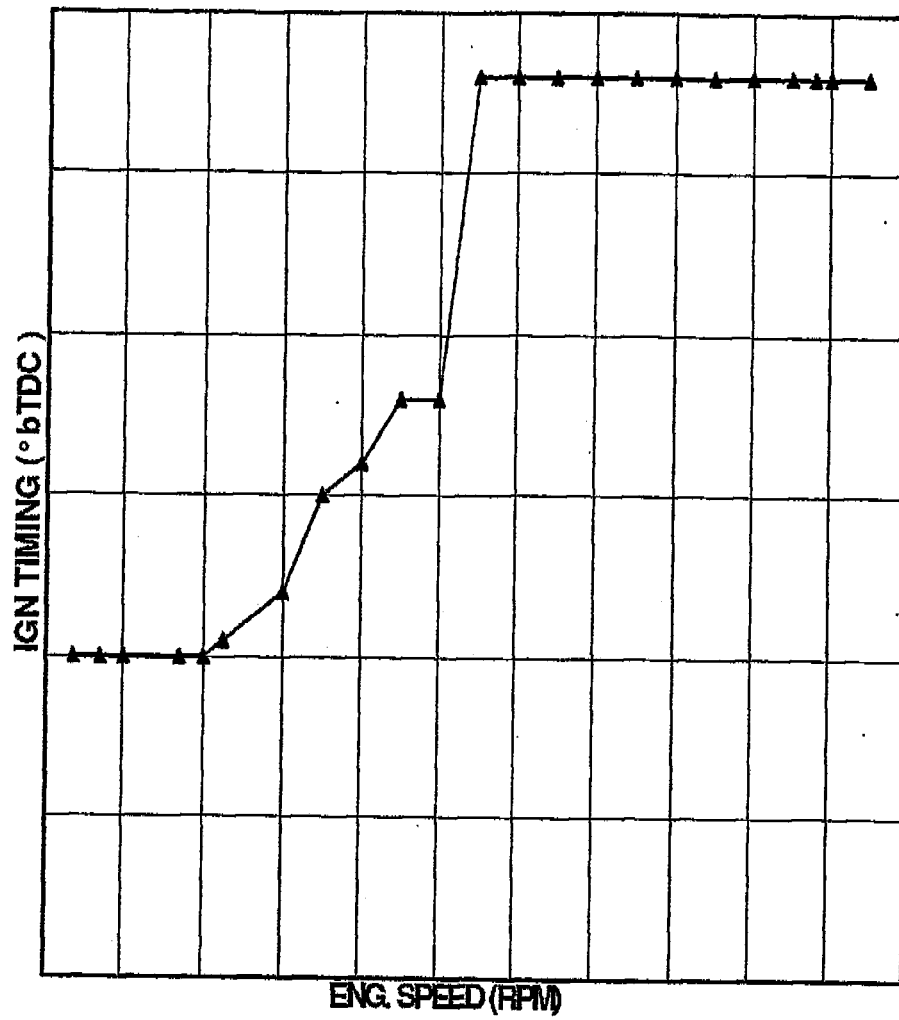
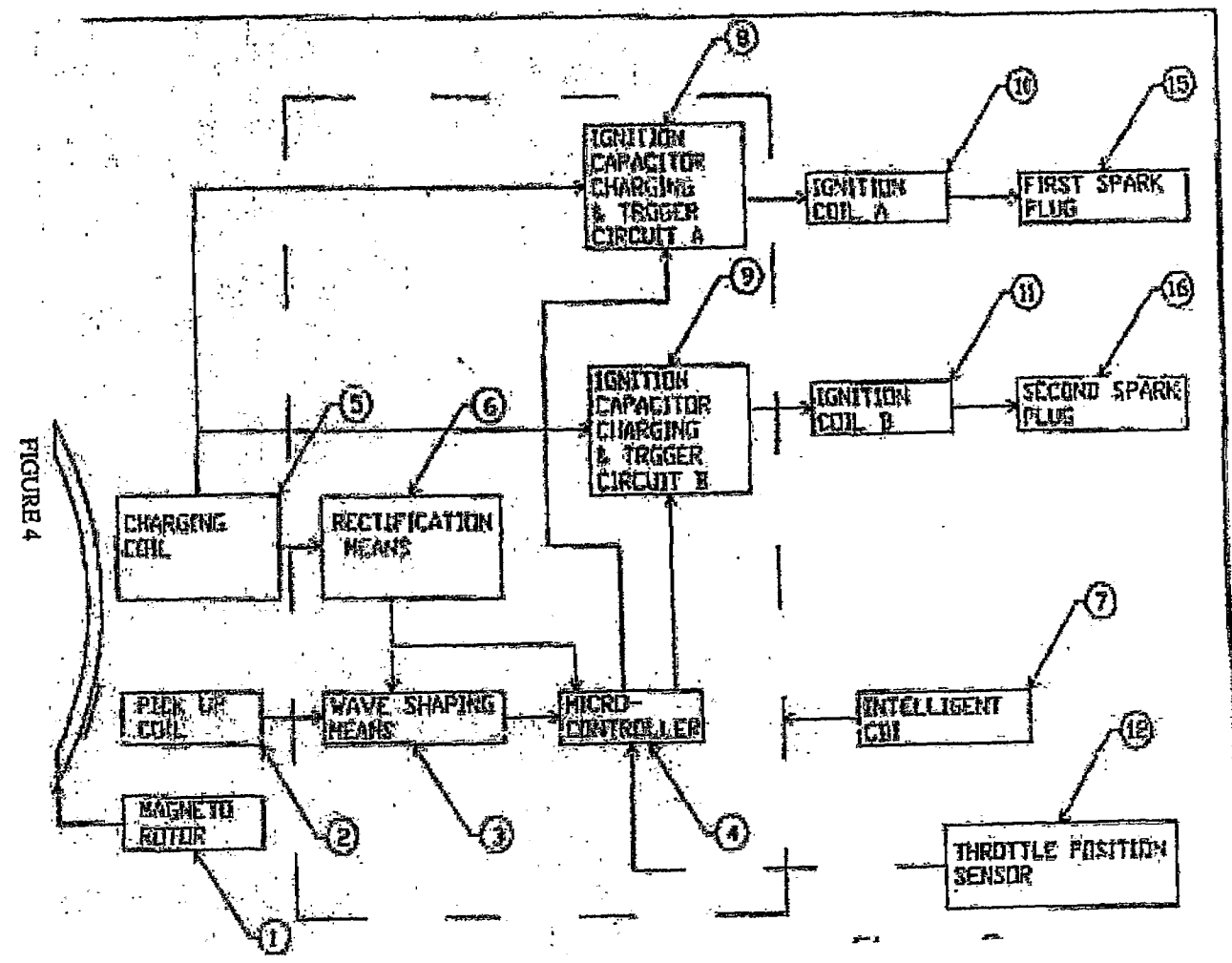


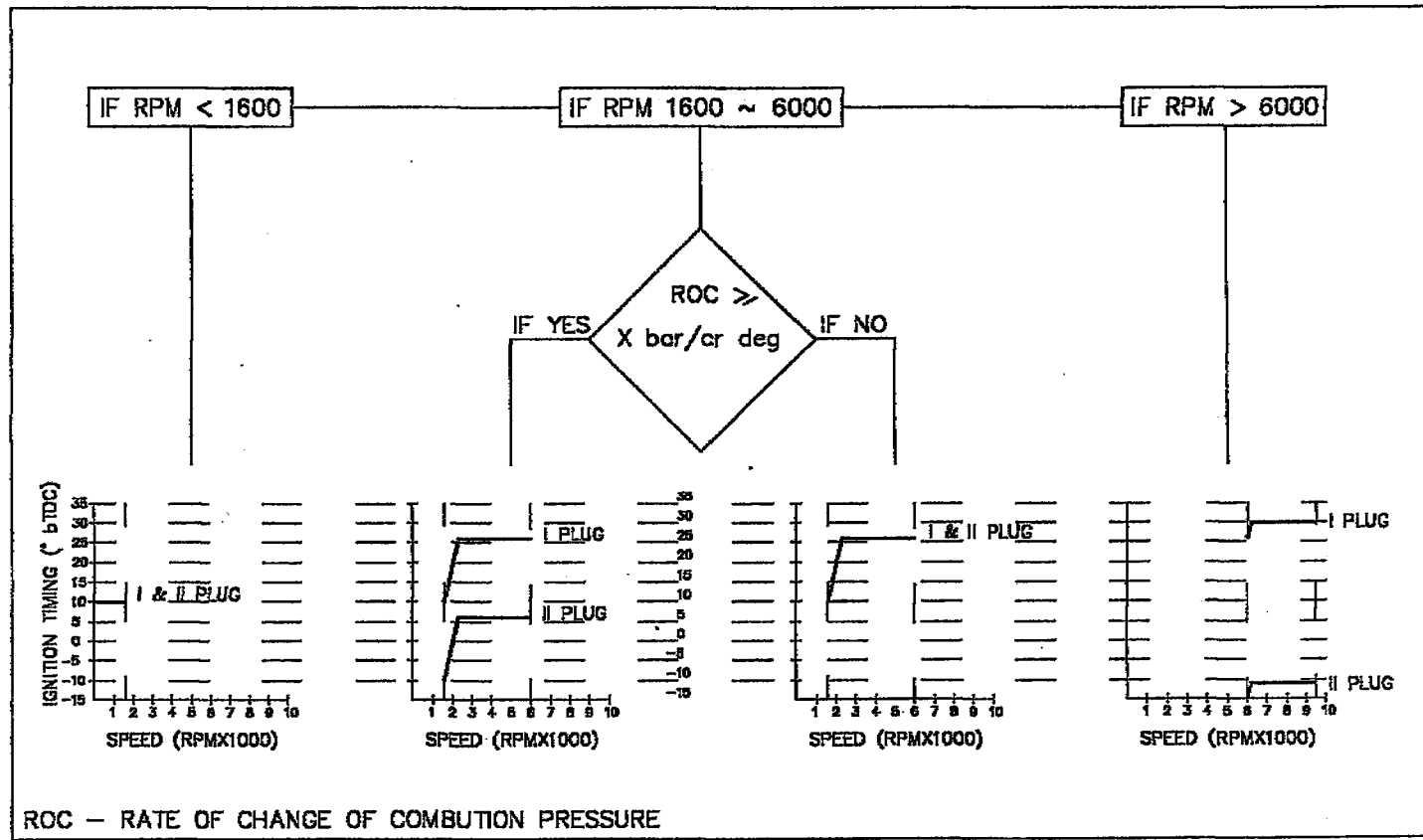
FIGURE 3

20



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Figure 5



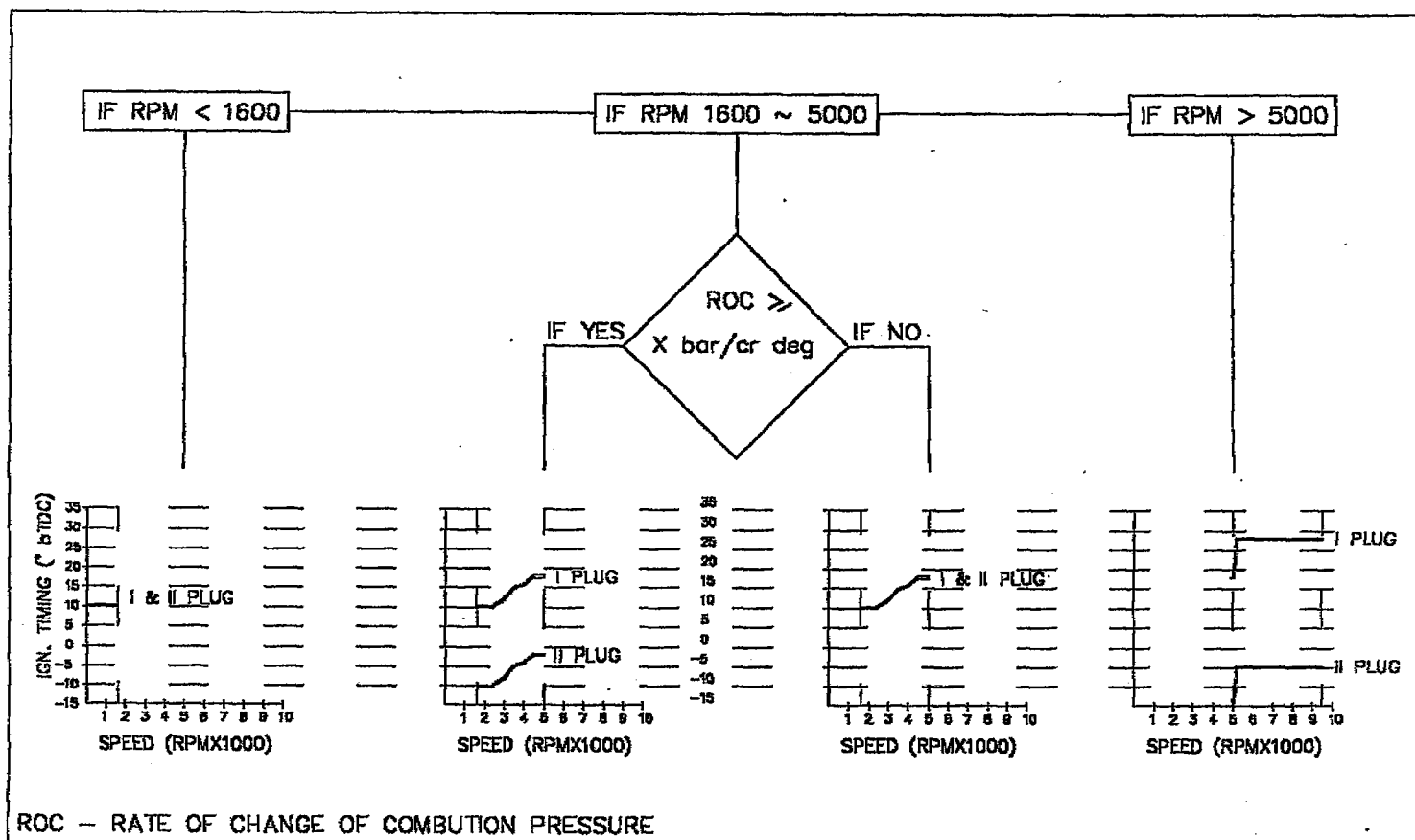


Figure 6

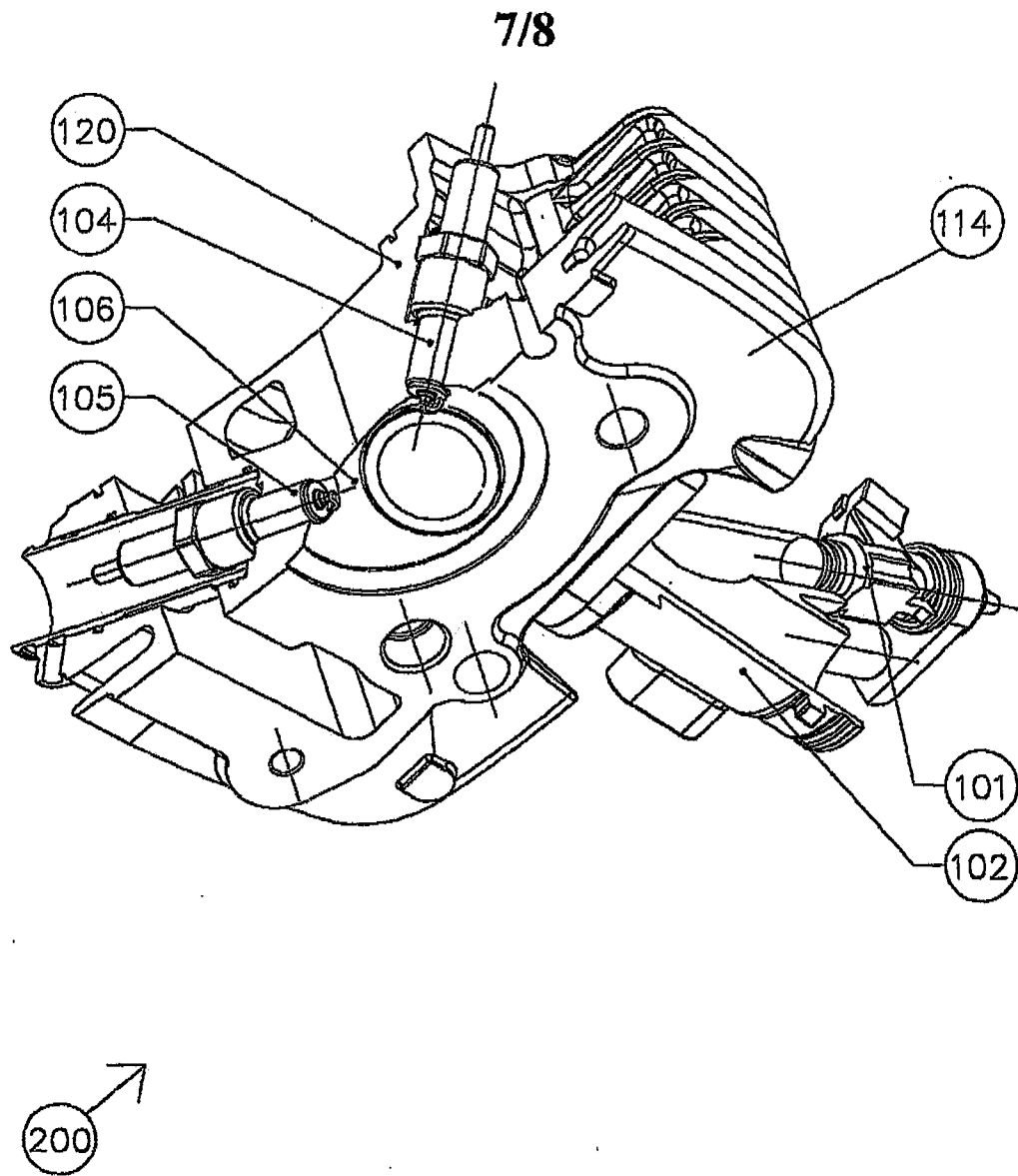
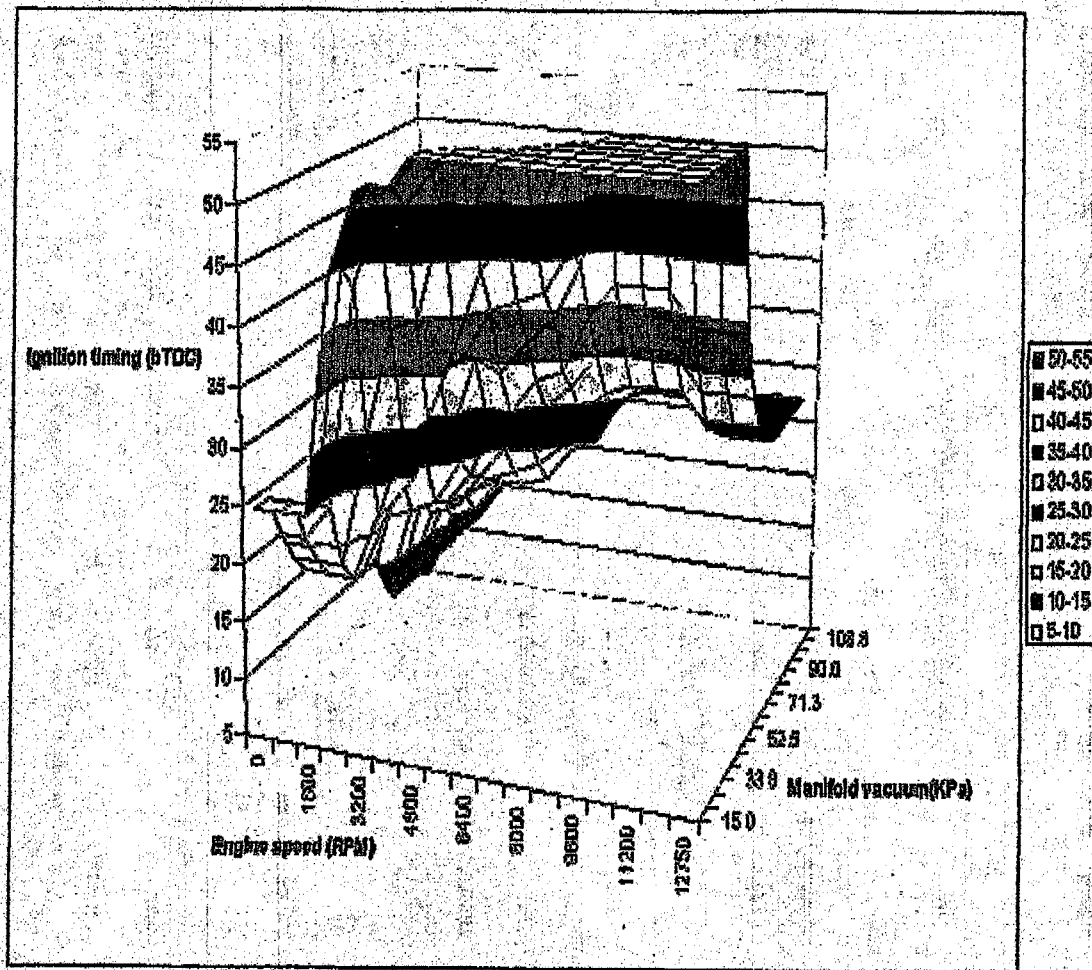


Figure 7

8/8

Ignition map for a DTGSI system



MÉTODO Y SISTEMA PARA CONTROLAR RUIDO DE MOTOR

CAMPO DE LA INVENCION

Esta invención se refiere a un método y a un
5 sistema para controlar ruido de motor, particularmente
ruido asociado con la combustión.

Se ha inventado un motor que tiene una pluralidad
de medios de ignición para cada cámara de combustión. Un
motor de desplazamiento pequeño o de calibre pequeño, como
10 se describe la Patente India concedida al Solicitante
195905 fechada el 16 de julio de 2002, de la cual el
contenido se incorpora por este medio en la presente para
referencia, permite una quema eficiente de mezclas pobres
de aire-combustible. Particularmente aplicable a motores
15 pequeños de desplazamiento, la disposición de varios o dos
medios de ignición permite que dos bujías sean energizadas
simultáneamente en un momento predeterminado por debajo del
centro muerto superior para quemar una mezcla pobre de
aire-combustible en una forma eficiente. Tales vehículos se
20 han recibido bien pero el Solicitante deseó mejorar los
niveles de ruido que, mientras están dentro de los límites
estatutarios, eran ligeramente elevados.

ANTECEDENTES DE LA INVENCION

25 Parece que la energización simultánea de las

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bujías puede llevar a niveles de ruido incómodos o a
severidad acústica cuando un motor se acelera u opera
rápidamente en regímenes de operación de un motor de más
alta velocidad. Este ruido debe ser distinguido del ruido
5 generado como resultado del fenómeno de "detonación" bien
conocido ya que no necesariamente provoca daño mecánico al
motor.

Cuando un vehículo que emplea el motor se está
desplazando a una velocidad constante, es decir, entre 15 a
10 60 km/h, un motor puede quemar una mezcla pobre de aire-
combustible a una proporción muy rápida para lograr una
combustión eficiente sin ruido incómodo y severidad
acústica. En tal condición, la proporción de elevación de
la presión de combustión es lo suficientemente buena para
15 lograr una combustión eficiente. Sin embargo, cuando el
motor se acelera rápidamente, el cilindro se llena
instantáneamente con una mayor cantidad de mezcla de aire-
combustible que se comprime a presiones más altas que
llevan a una proporción de elevación más alta de la presión
20 de combustión. En este instante, en motores conocidos, la
ignición doble de la bujía provoca que la proporción de
elevación más alta de la presión de combustión se
incrementa, llevando a niveles de ruido incómodos y a
severidad acústica. Una elevación tan rápida en la presión
25 de combustión también lleva a una rápida aceleración de las

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partes móviles ocupando los huelgos entre las mismas rápidamente durante la carrera de un pistón. Esto incrementa el problema del ruido y la severidad. Se ha observado que si la proporción de elevación de presión de combustión es más que un valor de umbral, aproximadamente 3.5 bares por grado de rotación del cigüeñal, lleva a niveles de ruido incómodos o severidad acústica.

También se ha observado que, cuando el motor funciona a una velocidad de motor más alta, es decir, más de 6000 rpm, se producen niveles de ruido incómodos o severidad acústica. A estas velocidades, la velocidad de flujo más alta de la mezcla de aire-combustible crea turbulencia en el cilindro del motor. La relación de aire-combustible también es más rica para tener cuidado de la durabilidad de los elementos del motor. Estos factores, es decir: la turbulencia en el cilindro y la mayor cantidad de una carga más rica conlleva a una proporción más alta de elevación de presión de combustión en los motores conocidos debido a la ignición doble de la bujía que de este modo provoca niveles de ruido incómodos o severidad acústica.

SUMARIO DE LA INVENCION

Es un objeto de la presente invención dirigir el problema de ruido y severidad asociados con la combustión en motores que tienen cámaras de combustión ajustadas con

una pluralidad de medios de ignición por chispa.

Con este objeto en mente, la presente invención proporciona un método para controlar el ruido y la severidad provocados por la combustión en un motor encendido por chispa que tiene una cámara de combustión; un medio de distribución de combustible para distribuir una carga de combustible a la cámara de combustión; una pluralidad de medios de ignición por chispa situados en la cámara de combustión para encender la carga de combustible y una unidad de control en donde la unidad de control controla la operación de cada medio de ignición de la pluralidad de medios de ignición en respuesta al valor medido de un parámetro asociado del ruido de combustión. Tal control se puede implementar en respuesta al valor medido de un parámetro asociado del ruido de combustión que viola un límite de umbral predeterminado.

De preferencia, el medio de distribución de combustible es un inyector de combustible situado en un colector para el motor. El medio de distribución de combustible puede comprender un carburador.

De preferencia, la carga de combustible es una mezcla de aire-combustible. La carga de combustible puede tener una relación de aire-combustible en el margen pobre o en el margen rico. La ignición doble por chispa puede evitarse cuando la relación de aire-combustible está en el

margen rico.

El parámetro asociado del ruido de combustión se puede seleccionar de un grupo de condiciones posibles de operación de motor. La proporción de elevación de presión de combustión en una cámara de combustión se asocia fuertemente con ruido y severidad de la combustión como se describe en lo anterior y es el parámetro preferido o primario para el control. De hecho, el método se puede implementar para mantener la proporción de elevación de presión de combustión por debajo de un valor de umbral predeterminado en el cual sean aceptables los niveles de ruido. La proporción de elevación de presión de combustión se puede expresar como elevación de la presión por grado de rotación del cigüeñal y, por consiguiente, el umbral predeterminado puede ser de 3.5 bares por grado de rotación del cigüeñal. La proporción de elevación de presión de combustión también se puede expresar como elevación de presión por unidad de tiempo.

La elevación en presión de combustión ha asociado parámetros tales como velocidad, aceleración, carga del motor, posición del acelerador, relación de aire-combustible y presión o variación de vacío del colector, de los cuales cada uno de estos parámetros asociados del ruido secundario se pueden detectar o medir para un motor de medio de ignición doble probable o variado dado y

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utilizarse como un parámetro de control en combinación con la proporción de elevación de presión de combustión o particularmente a altas velocidades de motor, posiblemente solas, por ejemplo mayores que 5000 rpm. Ventajosamente, el control sobre el medio de ignición y combustión procede basándose en la proporción medida de elevación de presión de combustión y por lo menos en otro parámetro, particularmente velocidad del motor o aceleración, violando los valores de umbral predeterminados particularmente bajo condiciones medianas de velocidad del motor, por ejemplo 1600 a 5000 rpm.

En otro aspecto, la invención proporciona un sistema de control de ignición de un vehículo que comprende:

15 una pluralidad de medios de ignición por chispa;
y

una unidad de control para controlar la operación de cada medio de ignición, en donde la unidad de control se programa para recibir datos de parámetros asociados del ruido de combustión y para operar cada medio de ignición de acuerdo con los datos de parámetros asociados del ruido de combustión.

El método y sistema son particularmente aplicables a la situación en la cual el motor está en una transición de carga, normalmente desde la carga parcial

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hasta la carga completa. La naturaleza del control de tiempos del medio de ignición de acuerdo con el método puede variarse dependiendo de las condiciones de carga del motor.

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5 La detección de velocidad y aceleración del motor proporciona una forma conveniente para proporcionar datos a la unidad de control. La unidad de control, la cual puede ser un microcontrolador, entonces puede operar el medio de ignición para controlar el nivel de ruido a través del control sobre el tiempo de disparo para uno o ambos medios

10 de ignición. El disparo de un medio de ignición se puede suspender, si es necesario, para lograr el control de ruido deseado. El retardo del tiempo de disparo de un medio de ignición con relación al tiempo de disparo de otro medio de

15 ignición es un modo preferido del control también. Tal retardo puede variar como una función de las condiciones de operación del motor.

 Bajo condiciones "normales", donde el ruido es poco probable que sea problemático, ambos medios de

20 ignición o bujías pueden encenderse al mismo tiempo, especialmente si se requiere combustión de mezclas pobres, aunque las bujías se podrían encender en cierto desplazamiento de tiempo fijo. Si la velocidad y/o aceleración del motor, por ejemplo, exceden un valor

25 predeterminado, la unidad de control puede retardarse o

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demorarse en energizar el evento de encendido de uno de los medios de ignición por chispa o bujías. Bajo tales condiciones, incluso una mezcla pobre puede no requerir promoción de ignición por varios medios de ignición.

5 Si la velocidad y/o aceleración del motor está por debajo del valor predeterminado, por ejemplo, 1600 rpm para la velocidad del motor, las bujías se pueden energizar simultáneamente con el énfasis sobre la salida de energía del motor. La unidad de control puede implementar tales partes en respuesta a los datos de parámetros asociados del ruido de combustión con excepción de la velocidad del motor y los datos de aceleración. La unidad de control se puede programar con mapas de discontinuación del tiempo de disparo de ignición/medios de ignición para varias condiciones de operación del motor, por ejemplo velocidad del motor. Tales mapas pueden corresponder con condiciones del acelerador abierto parcialmente o acelerador abierto totalmente.

Además, el control sobre la operación del medio de ignición, por ejemplo en términos de retardar el evento de disparo o el tiempo de un de las bujías, con respecto al evento de disparo o al tiempo de otra bujía puede presentarse en respuesta a una combinación propensa a ruido de datos de parámetros asociados de ruido de combustión medidos o detectados. Por ejemplo, el retardo sobre el

tiempo del evento de disparo puede presentarse en respuesta a la proporción de elevación de presión de combustión y a la velocidad o aceleración del motor que está por arriba de los valores de umbral para la implementación del control.

5 El tiempo de ignición para las bujías se puede retardar por partes bajo condiciones de operación cuando se requiere el control de ruido. Esto requiere menos capacidad para la unidad de control. Sin embargo, se puede preferir una transición moderada del tiempo de evento de disparo de
10 ignición, el grado de retardo que se determina como una función del parámetro de control asociado de ruido de combustión seleccionado. El grado de retardo del disparo o suspensión del disparo de una de las bujías se puede determinar a partir de los mapas de velocidad del
15 motor/tiempo de ignición que pueden corresponder con condiciones del acelerador abierto parcialmente o acelerador abierto totalmente. También se pueden emplear mapas que utilizan parámetros asociados de ruido de combustión con excepción de la velocidad del motor.

20 El motor controlado de acuerdo con el método o implementar los aspectos del sistema de control de ignición de la invención puede ser un motor con carburador, un motor inyectado por colector o un motor de inyección directa. El uso del método y sistema de control con relación a un motor
25 inyectado con combustible es una modalidad particularmente

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ventajosa de la invención. El motor puede ser un motor de dos carreras o de cuatro carreras y puede ser particularmente ventajoso aplicar un motor de desplazamiento pequeño o de calibre pequeño.

5 En un aspecto adicional, la presente invención proporciona un método para controlar ruido y severidad en un motor que tiene un cilindro proporcionado con una pluralidad de medios de ignición que comprende, durante la operación de un motor en transición desde la carga parcial
10 hasta la carga completa:

a) medir la proporción de elevación de presión de combustión en el cilindro; y

b) retardar la energización o disparo de un medio de ignición en el cilindro por el grado controlado si la
15 proporción de elevación medida de presión de combustión excede un valor predeterminado, en donde el grado de retardo del disparo del medio de ignición se controla dependiendo de las condiciones detectadas de velocidad y carga del motor.

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BREVE DESCRIPCIÓN DE LAS FIGURAS

La presente invención ahora se describirá en detalle con referencia a modalidades preferidas no limitantes como se ilustra en los dibujos anexos, en donde:

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La Figura 1 ilustra una sección de una culata del

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Con referencia ahora a la Figura 1, se muestra la culata 14 del cilindro de un motor 100 de combustión interna de calibre pequeño. El motor 100 funciona sobre el principio de cuatro carreras. Las características típicas de un motor de calibre tan pequeño incluyen un volumen de cilindro barrido que varía de 70 cc a 200 cc y el calibre del diámetro del cilindro es de 45 mm a 70 mm, empleado como motores principales para la operación de vehículos de dos o tres ruedas u otros vehículos motorizados, por ejemplo, como aquí, motocicletas.

La culata 14 del cilindro define la parte superior de una cámara 120 de combustión, de construcción de techo cerrado, y se ajusta con dos bujías 15 y 16, de fabricación convencional, permitiendo que el motor 100 opere en un modo de combustión pobre para mejorar la economía de combustible.

Las bujías 15 y 16 forman parte de un sistema 7 de ignición de descarga capacitiva (sistema de CDI). El sistema 7 de CDI se muestra esquemáticamente en la Figura 4 y comprende una medio 3 de conformación de ondas, un medio de detección o una unidad 4 de control del microcontrolador, una bobina 5 de carga, un medio 6 de rectificación de fuente de alimentación, un circuito A 8 de carga y activador de un condensador de ignición, y un circuito B 9 de carga y activador de un condensador de

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ignición. El sistema 7 de CDI controla la manera y tiempo de disparo de las bujías 15 y 16 a través de la unidad 4 de control del microcontrolador.

El rotor 1 magnético genera los impulsos en la bobina 2 de captación que se ingresan en el microcontrolador 4 a través del medio 3 de conformación de ondas. El suministro de energía para el microcontrolador 4 se proporciona por la bobina 5 de carga convencional 5 a través del medio 6 de rectificación del suministro de energía. Dos salidas del microcontrolador 4 están conectadas al circuito A 8 de carga y activador del condensador de ignición y al circuito B 9 de carga y activador del condensador de ignición. El circuito A 8 de carga y activador del condensador de ignición está conectado a la bujía 15 a través de la bobina A de baja ignición y el circuito B 9 de carga y activador del condensador de ignición está conectado a la bujía 16 a través de la bobina B 11 de ignición. El vehículo ajustado con este sistema también se puede ajustar con un sensor 12 de posición del acelerador. El sensor 12 puede ser de una construcción que identifica los dos estados del acelerador: abierto totalmente y acelerador abierto parcialmente. Un sensor que proporcionaba datos más detallados para la posición del acelerador también podría emplearse.

25 Cuando un conductor de la motocicleta incrementa

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la velocidad del vehículo al operar el acelerador, la proporción de elevación de presión de combustión, un parámetro fuerte asociado de ruido de combustión, es detectada por el microcontrolador 4 de captación a través de la bobina 2. Además, la proporción de incremento de la velocidad del motor se puede ingresar al microcontrolador 4. En la modalidad preferida, son estos dos parámetros de ruido de combustión asociados, uno primario y uno secundario, los que se utilizan en una estrategia para controlar el ruido de combustión a niveles aceptables. Estos niveles aceptables pueden establecerse y probarse en un ambiente de fábrica. Parámetros adicionales, tales como el vacío o presión del colector, también se pueden ingresar en la estrategia de control.

Bajo condiciones de baja velocidad del motor, ilustrativamente por debajo de 1600 rpm, ambas bujías 15 y 16 se dispararán, con la instrucción del microcontrolador 4, para promover la ignición de una carga de mezcla pobre de aire-combustible proporcionada al motor 100, el microcontrolador 4 se programa con los mapas de tiempos de ignición requeridos como una función de la velocidad del motor y la proporción de elevación de presión de combustión.

A una velocidad de umbral del motor, ilustrativamente por arriba de 1600 rpm, y una proporción

de elevación medida de presión de combustión sobre un valor de umbral, es decir 3.5 bares por grado de rotación del cigüeñal, el microcontrolador 4 retarda o discontinúa el disparo de una de las bujías 16 por un valor predeterminado. Tal control se implementa, en la modalidad ilustrada, por una maniobra por etapas, el valor o grado de la etapa de retardo es dependiente de la velocidad del motor medida. Es decir, sobre un mediano margen de velocidad, supongamos 1600 rpm a 5000 rpm, el grado de retardo variará dependiendo del valor de velocidad del motor. El grado de retardo también puede variar con la proporción de elevación medida de presión de combustión. El tiempo de ignición de la otra bujía 15 permanece sin cambio.

15 Cuando la velocidad del motor incrementa más allá de un cierto valor, digamos 5000 rpm, en el margen de alta velocidad, particularmente en condiciones de aceleración del acelerador abierto totalmente, donde una carga de combustible del margen rico de relación de aire-combustible se distribuye a la cámara 14 de combustión, el encender de la bujía (16) se continúa como innecesario y se discontinúa el disparo de la bujía (16) cuando es innecesario y el motor 100 funciona solamente con una bujía energizada.

Los mapas ejemplares del tiempo de disparo de bujía contra la velocidad del motor o curvas de tiempos de

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ignición de conformidad con qué control de ruido y
severidad se implementa de acuerdo con la invención como se
describe en lo anterior se muestran en la Figura 2. La
Figura 2 ilustra las curvas de tiempos de ignición para el
5 motor 100 que tiene dos bujías 15 y 16 por cilindro para la
estrategia de control de la presente invención, en donde el
eje x muestra la velocidad del motor (rpm) y el eje y
muestra el tiempo de ignición. Cuando la velocidad del
motor incrementa rápidamente, el tiempo de disparo de
10 ignición de una de las bujías 16 se retarda por un valor
predeterminado como se indica por D que mantiene el tiempo
de ignición de la bujía 15 sin cambio como se indica por C
en la figura. Esto logra la reducción del ruido y
severidad.

15 En contraste, la Figura 3 ilustra las curvas de
tiempos de ignición para motores de acuerdo con la técnica
anterior, en donde el eje x muestra la velocidad del motor
(rpm) y el eje y muestra el tiempo de ignición en grados
antes del Centro Muerto Superior. Cuando la velocidad del
20 motor incrementa, el tiempo de ignición también varía y es
aplicable para ambas bujías, que se energizan
simultáneamente. Esta operación simultánea de las bujías da
lugar a una sobre-promoción de la combustión y ruido
potencialmente excesivo y severidad. No se proporciona
25 ninguna estrategia de control para que los medios de

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ignición reduzcan tales niveles de ruido.

La comparación de las Figuras 2 y 3 demuestra que, utilizando la estrategia de control de ignición de la presente invención bajo condiciones de velocidad mediana y alta, el progreso de ignición y combustión pueden controlarse con beneficios consecuentes en términos de reducción de ruido y severidad. El retardo controlado o la operación discontinuada de la bujía cuando se dictan condiciones de operación del motor en términos de parámetros asociados de ruido de combustión calculados, dan lugar a menos ruido puesto que no se implementa necesariamente el disparo simultáneo de las bujías 15 y 16.

El grado de control en términos de grado de retardo, los tiempos de ignición, las condiciones bajo las cuales se discontinúa el disparo de una bujía y los tiempos de desplazamiento de disparo de la bujía son dependientes de si el motor 100 se opera en modo de acelerador abierto parcialmente o acelerador abierto totalmente y la velocidad del motor. Los diagramas de flujo que corresponden con los algoritmos de control para los dos modos de posición del acelerador se presentan en las Figuras 5 y 6.

En tal forma, los beneficios de un sistema de ignición doble de bujía para la combustión de mezclas pobres de aire-combustible se pueden mantener sin el costo o desventaja de ruido y severidad de la ignición doble

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cuando se requiere que se distribuyan cargas ricas de combustible de relación de aire-combustible al motor 100. Otros beneficios también pueden acumularse ya que se puede esperar que las bujías 15 y 16 se desgasten en una
5 proporción más lenta ya que los tiempos de disparo se optimizan a las condiciones de operación del motor.

Sin embargo, cuando el conductor termina una fase de aceleración al mantener una posición constante del acelerador, como detectada por la bobina 2 de captación, el
10 tiempo de ignición simultáneo de ambas bujías 15 y 16 se restablece siendo ventajoso para el buen rendimiento de operación de combustión del motor.

Los valores mapeados de la proporción de incremento de la velocidad del motor durante la fase de
15 aceleración, la variación en el tiempo requerido de ignición que va a hacerse para un bujía y a cuál de las dos bujías se aplicará y la velocidad del motor en la cual tiene lugar la desconexión de una de las bujías dependen del diseño del motor. Los parámetros de diseño del motor
20 tales como el volumen de barrido del cilindro, la energía máxima del motor y el esfuerzo cortante máximo y en qué velocidad del motor se presentan éstos, la velocidad máxima del vehículo, las relaciones de engranaje de transmisión, el radio dinámico de rodadura de los neumáticos, etc.,
25 afectan tales decisiones. Los mapas serán programados con

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respecto a estos parámetros.

La descripción anterior se refiere a un sistema en donde la entrada de velocidad del motor se ha tomado de la bobina del impulsor, basándose en qué microcontrolador 4 se controla el tiempo de ignición de una de las dos bujías. Las entradas también se pueden tomar basándose en parámetros tales como presión de vacío del colector (Figura 8), el sensor de posición instantáneo del acelerador u otros parámetros que pueden indicar o conducir a la indicación de una proporción más alta de presión de combustión y de este modo mayor ruido y severidad. Cuando se requiere explicar la carga en el motor también, es necesario tomar la entrada desde lugares tales como el vacío del colector y/o el sensor de posición del acelerador. Tales variaciones en las entradas tomadas se encuentran bien dentro del alcance de esta invención.

Modificaciones y variaciones en el método y sistema de control de ignición de la presente invención pueden ser aparentes para el lector con experiencia en esta descripción. Tales modificaciones y variaciones se consideran dentro del alcance de la presente invención.

Por ejemplo, el método y sistema de control se pueden aplicar ventajosamente a un motor inyectado con combustible como se muestra en la Figura 7. Aquí, la culata 114 del cilindro del motor 200 define la parte superior de

una cámara 120 de combustión que es ajustada con dos bujías 104 y 105, de fabricación convencional, permitiendo que el motor 200 opere en un modo de combustión pobre para mejorar la economía de combustible.

5 El motor 200 es un motor inyectado con combustible del colector en el cual un inyector de combustible de colector 101 distribuye una carga de combustible al colector 102 de aire que distribuye aire a la cámara de combustión del motor 120. Se logra el control
10 del ruido de combustión utilizando la misma estrategia general que se describe en lo anterior.

Específicamente, durante el funcionamiento de velocidad constante, dependiendo de la presión del colector y la velocidad del motor, una unidad electrónica de control
15 de motor (ECU, no mostrado) activa el disparo de ignición en el tiempo requerido para ambas bujías 104 y 105. Tales tiempos pueden ser simultáneos o diferentes, por ejemplo, el disparo en cierta relación de tiempo que puede ser una relación fija de tiempos.

20 Durante la aceleración, el disparo de la segunda bujía 105 se retarda con respecto a la primera bujía 104 por un ángulo de cigüeñal funcionalmente dependiente de la velocidad del motor. La aceleración se puede detectar de dos maneras. Por ejemplo, la aceleración puede ser
25 detectada si (1) la proporción de cambio de posición del

NOVEDAD DE LA INVENCION

Habiendo descrito la presente invención se considera como novedad y por lo tanto se reclama como propiedad lo descrito en las siguientes reivindicaciones.

5

REIVINDICACIONES

1. Un método para controlar el ruido y severidad provocados por la combustión en un motor encendido por chispa que tiene una cámara de combustión; un medio de
10 distribución de combustible para distribuir una carga de combustible a la cámara de combustión; una pluralidad de medios de ignición por chispa situados en la cámara de combustión para encender la carga de combustible; y una
15 unidad de control, caracterizado porque la unidad de control controla la operación de cada medio de ignición de dicha pluralidad de medios de ignición en respuesta al valor medido de por lo menos un parámetro asociado con el ruido de combustión.

2. El método de conformidad con la reivindicación
20 1, caracterizado porque el control es implementado cuando el valor medido de dicho parámetro asociado con el ruido de combustión viola un valor de umbral predeterminado.

3. El método de conformidad con la reivindicación
1 o 2, caracterizado porque un parámetro primario asociado
25 con el ruido de combustión es la proporción de elevación de

presión de combustión.

4. El método de conformidad con la reivindicación 3, caracterizado porque un parámetro secundario asociado con el ruido de combustión es por lo menos un parámetro asociado con la proporción de elevación de presión de combustión seleccionado del grupo que consiste de velocidad de motor, carga de motor, posición del acelerador, proporción de aire combustible y la presión del colector y la variación en éstos.

5. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque el disparo de un medio de ignición se retarda si la proporción de elevación de presión de combustión excede un valor de umbral.

6. El método de conformidad con la reivindicación 5, caracterizado porque el tiempo de disparo de un medio de ignición se retarda si la velocidad del motor o la aceleración también excede un valor de umbral.

7. El método de conformidad con la reivindicación 6, caracterizado porque el tiempo se retarda en un cambio de paso.

8. El método de conformidad con la reivindicación 7, caracterizado porque una transición moderada desde un tiempo de disparo hasta un tiempo de disparo retardado se efectúa por la unidad de control.

9. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque el disparo de un medio de ignición se descontinúa si por lo menos un parámetro asociado con el ruido de combustión
5 viola el valor de umbral.

10. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque el motor se inyecta con dicha carga de combustible.

11. El método de conformidad con cualquiera de
10 las reivindicaciones 1 a 10, caracterizado porque el colector del motor se inyecta con combustible.

12. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque la relación de aire-combustible de la carga de combustible
15 está en un margen pobre.

13. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque el motor se opera en el modo de combustión pobre.

14. El método de conformidad con cualquiera de
20 las reivindicaciones precedentes, caracterizado porque el control se implementa durante una transición de carga del motor.

15. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque el
25 control se implementa al retardar el tiempo de disparo de

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uno de los medios de ignición con relación al tiempo de disparo de otro medio de ignición.

16. El método para controlar el ruido y severidad en un motor que tiene un cilindro suministrado con una pluralidad de medios de ignición, caracterizado porque comprende, durante la operación de un motor en transición desde la carga parcial hasta la carga completa:

a) medir la proporción de elevación de presión de combustión en el cilindro; y

10 b) retardar el disparo de un medio de ignición en el cilindro por medio del grado controlado si la proporción de elevación de presión de combustión medida excede un valor predeterminado; en donde el grado de retardación de disparo del medio de ignición es controlado dependiendo de
15 la velocidad de motor medida y las condiciones de carga.

17. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque se implementa en un motor de calibre pequeño.

18. Un sistema de control de ignición
20 caracterizado porque comprende:

una pluralidad de medios (15, 16) de ignición por chispa; y

una unidad de control (4) para controlar la operación de cada medio (15, 16) de ignición, en donde la
25 unidad de control (4) se programa para recibir datos de

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parámetros asociados de ruido de combustión y para operar cada medio (15, 16) de ignición de acuerdo con los datos para controlar el ruido y severidad.

19. El sistema de control de ignición de conformidad con la reivindicación 18, caracterizado porque la unidad de control se programa con los mapas que proporcionan el tiempo de disparo de ignición como una función de datos de parámetros asociados de ruido de combustión medidos bajo condiciones de operación particulares del motor.

20. El sistema de control de ignición de conformidad con la reivindicación 19, caracterizado porque los mapas proporcionan el tiempo de disparo de ignición como una función de por lo menos un parámetro seleccionado del grupo que consiste de velocidad del motor, carga del motor, aceleración, proporción de distribución de combustible, y presión de vacío del colector y variación en éstos.

21. El sistema de control de ignición de conformidad con cualquiera de las reivindicaciones 18 a 20, caracterizado porque los mapas se proporcionan para las condiciones de operación del motor de acelerador abierto parcialmente o acelerador abierto totalmente.

22. El sistema de control de ignición de conformidad con cualquiera de las reivindicaciones 18 a 21,

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RESUMEN DE LA INVENCIÓN

La presente invención proporciona un método para controlar el ruido y la severidad provocados por la combustión en un motor encendido por chispa que tiene una cámara de combustión; un medio de distribución de combustible para distribuir una carga de combustible a la cámara de combustión; una pluralidad de medios de ignición por chispa situados en la cámara de combustión para encender la carga de combustible y una unidad de control. La unidad de control controla la operación de cada medio de ignición en respuesta al valor medido de por lo menos un parámetro asociado del ruido de combustión, que es una condición de operación del motor. El control puede ser una respuesta al parámetro asociado de ruido de combustión que viola un valor de umbral. El parámetro asociado de ruido de combustión puede ser la proporción de elevación de presión de combustión en la cámara de combustión. Sin embargo, el método puede implementarse en respuesta a la proporción de elevación de presión de combustión y uno o más parámetros adicionales, tales como la velocidad del motor, la aceleración y/o la carga del motor que violan los valores de umbral. Un sistema de control de ignición para implementar el método en un vehículo forma otro aspecto de la invención. El método y el sistema de control de ignición pueden implementarse en motores inyectados con combustible o motores con carburador pero es particularmente ventajoso para motores inyectados con combustible.

1/8

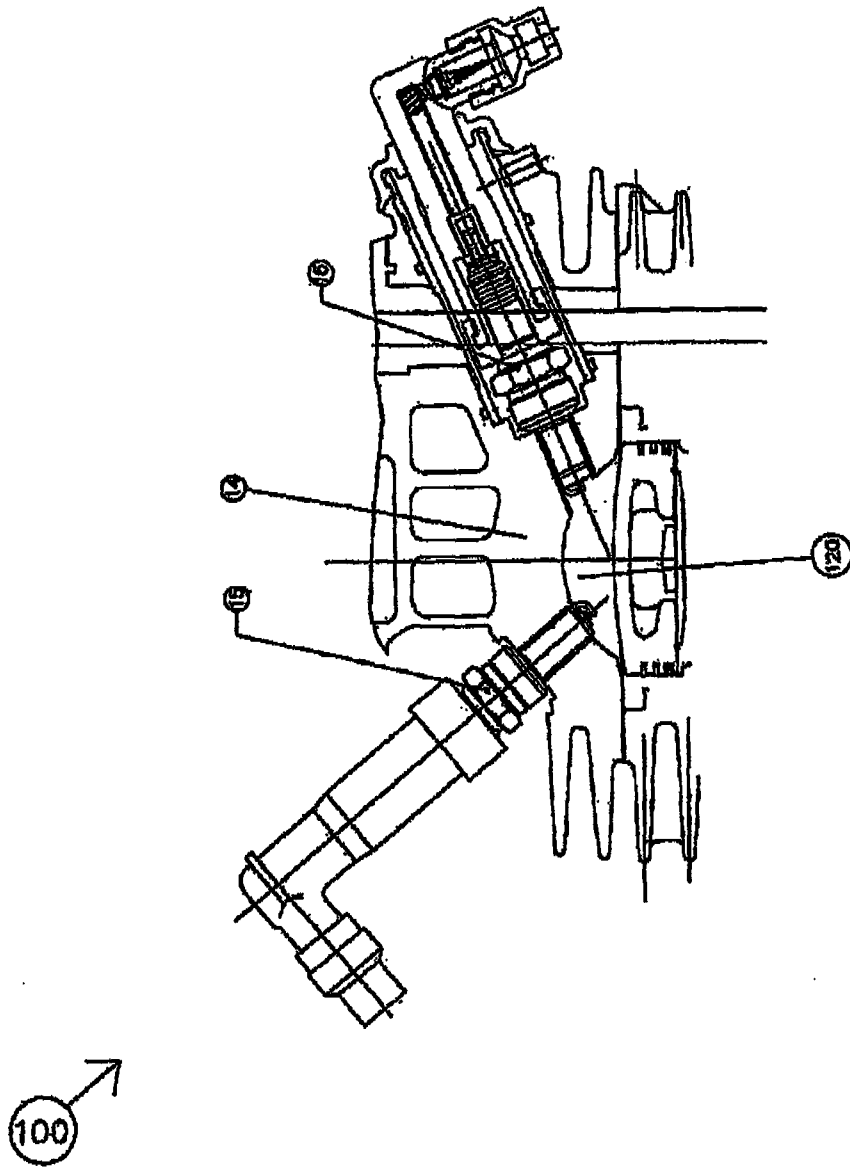


FIGURA 1

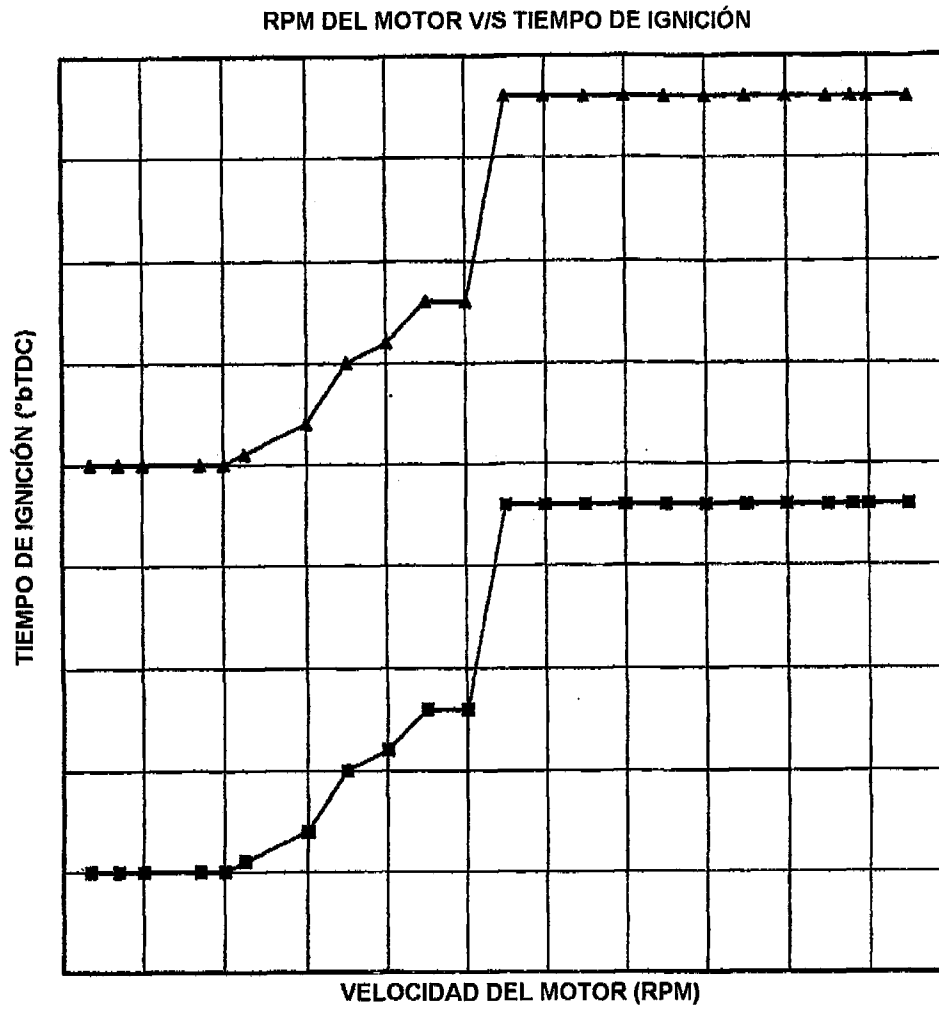


FIGURA 2

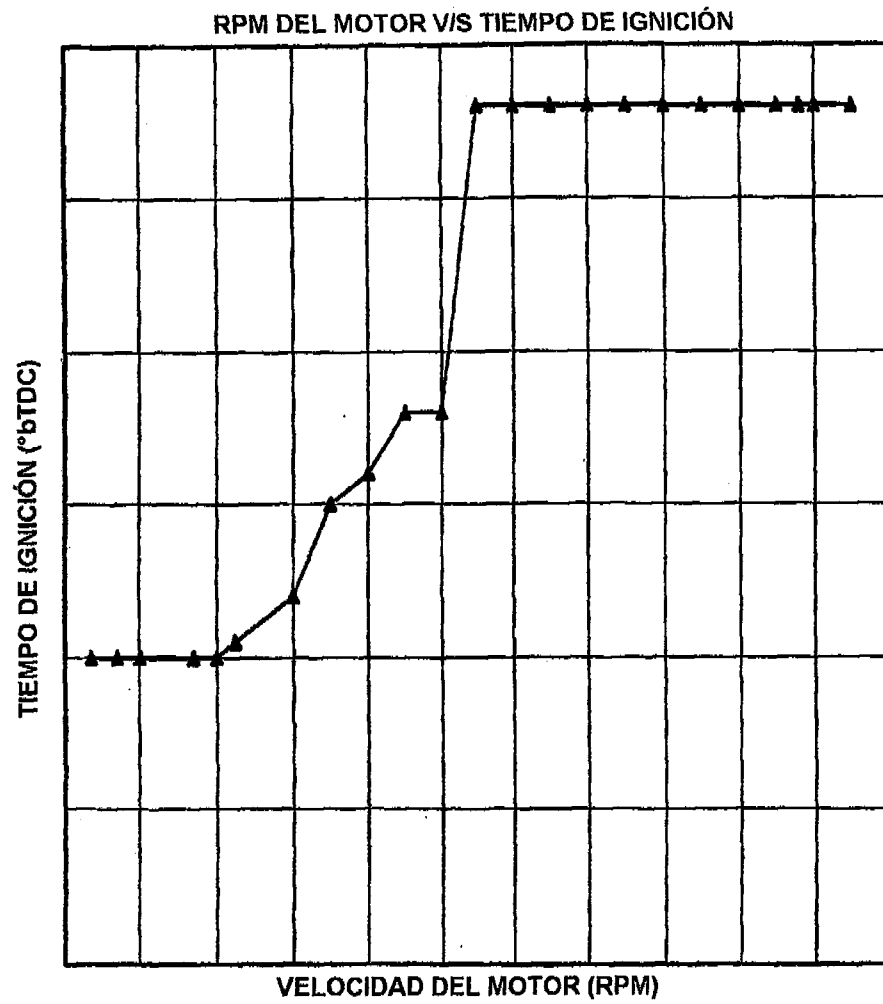
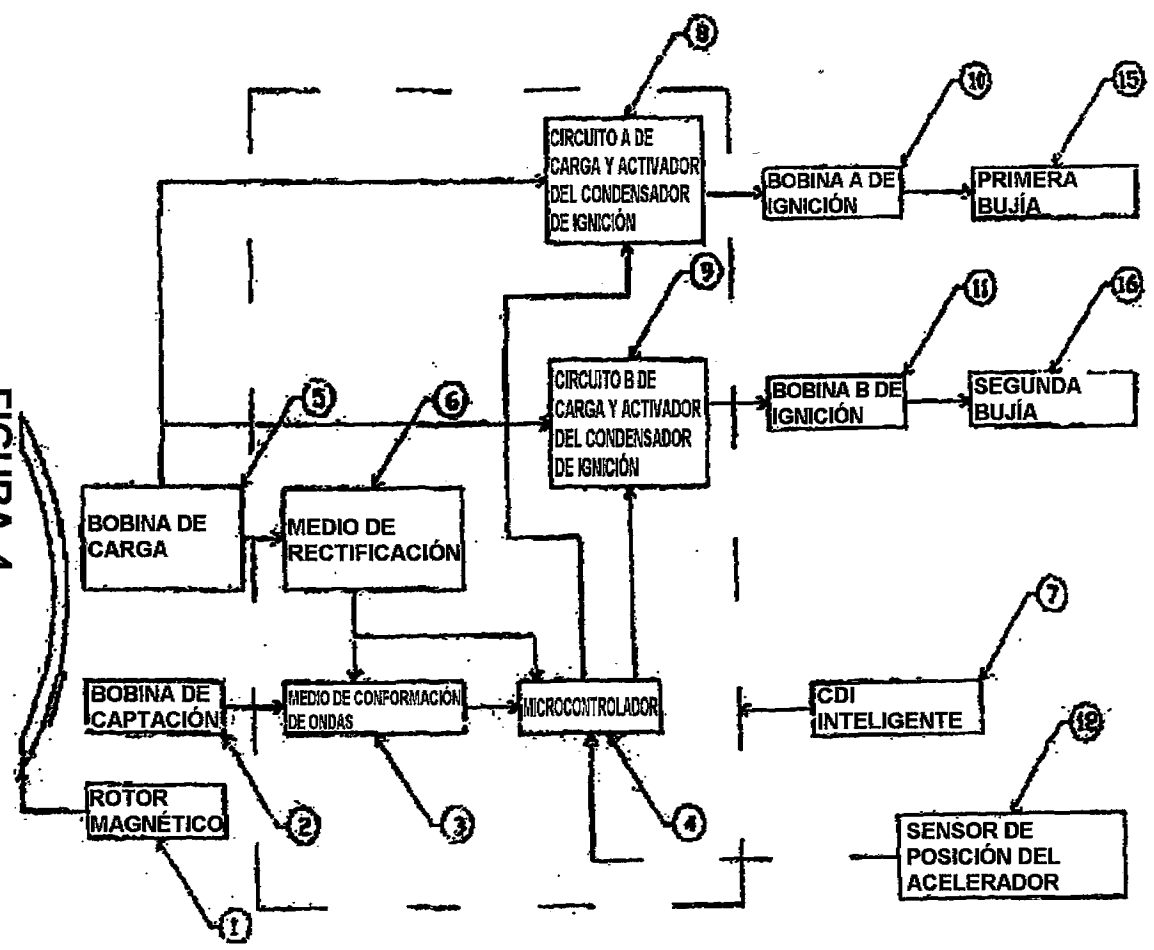


FIGURA 3

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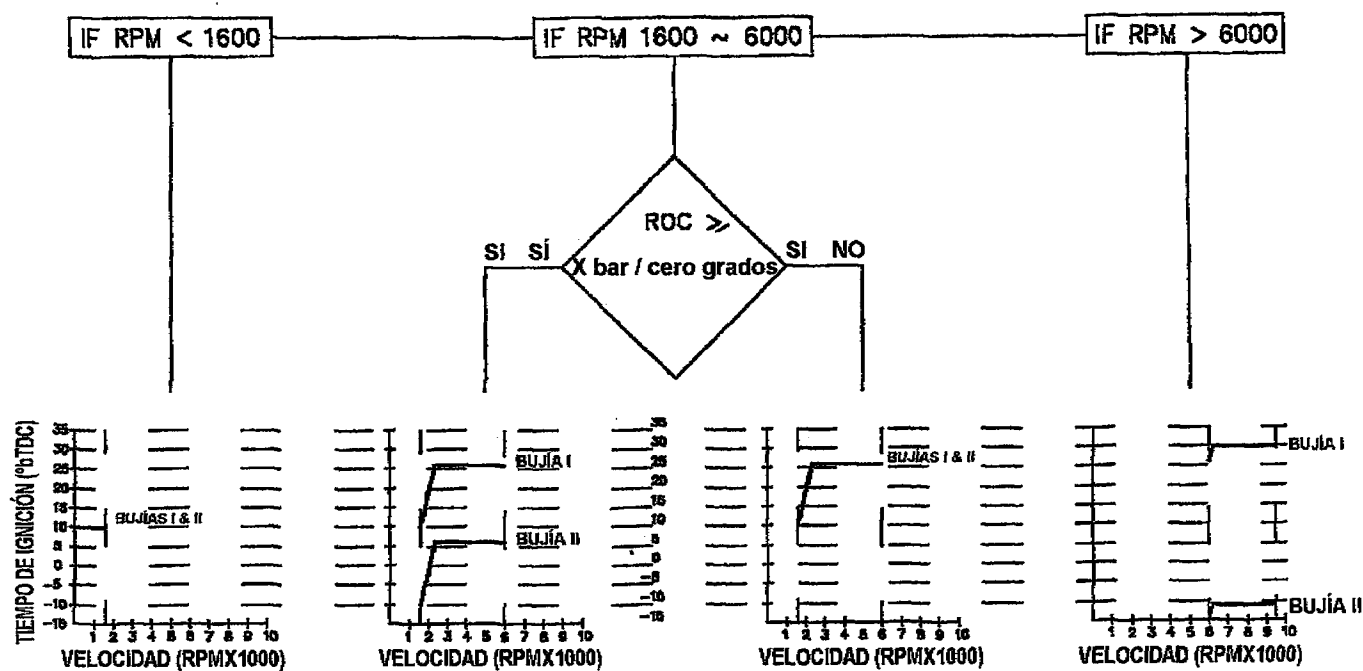
FIGURA 4



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FIGURA 5

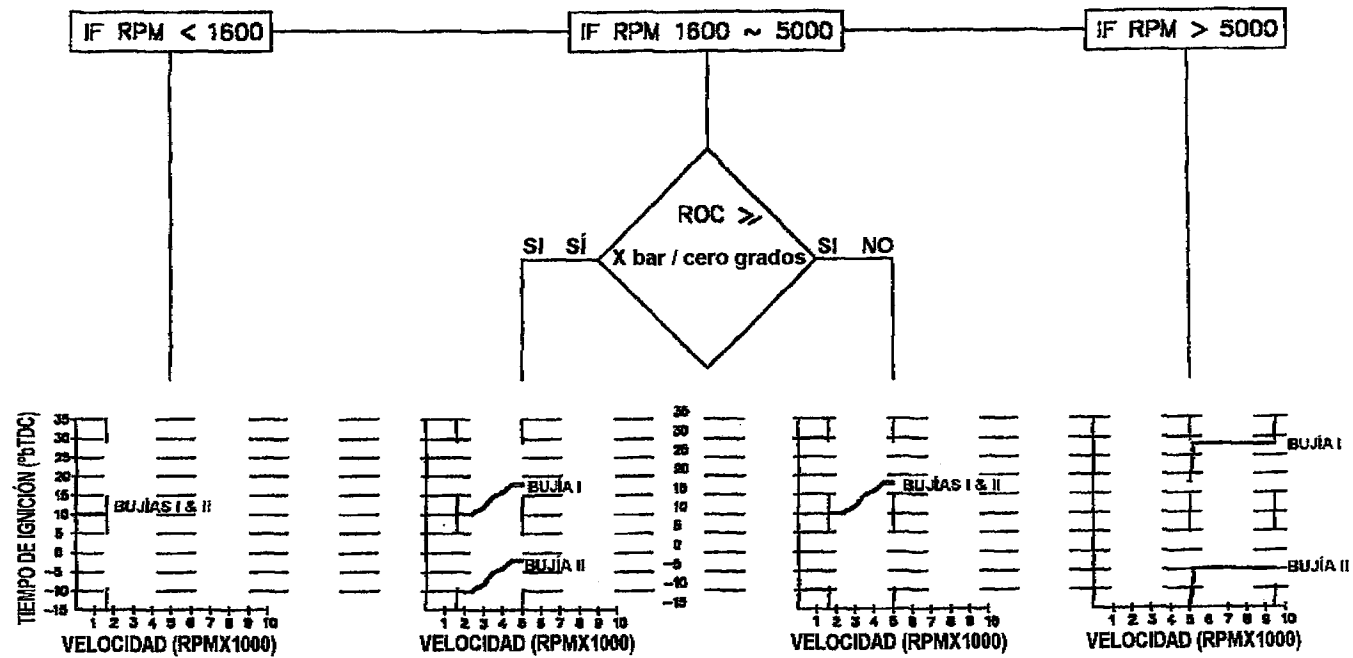


ROC - PROPORCIÓN DE POSIBILIDAD DE PRESIÓN DE COMBUSTIÓN

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FIGURA 6



ROC - PROPORCIÓN DE POSIBILIDAD DE PRESIÓN DE COMBUSTIÓN

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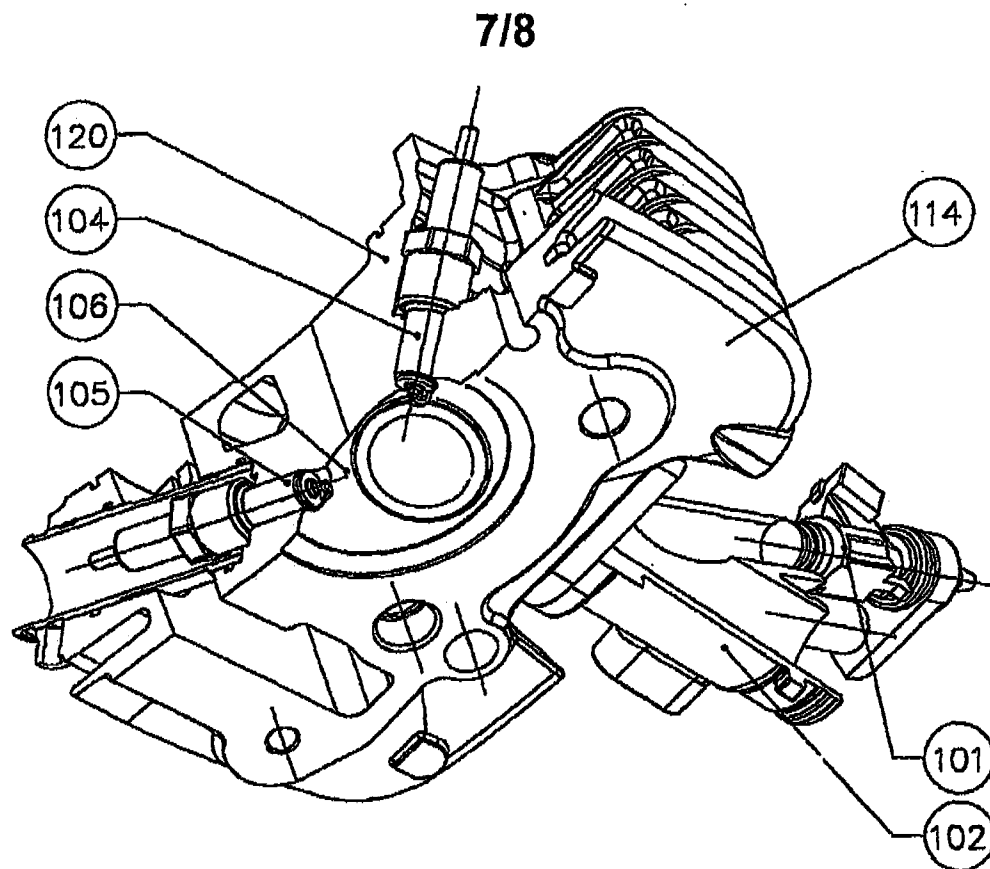


FIGURA 7

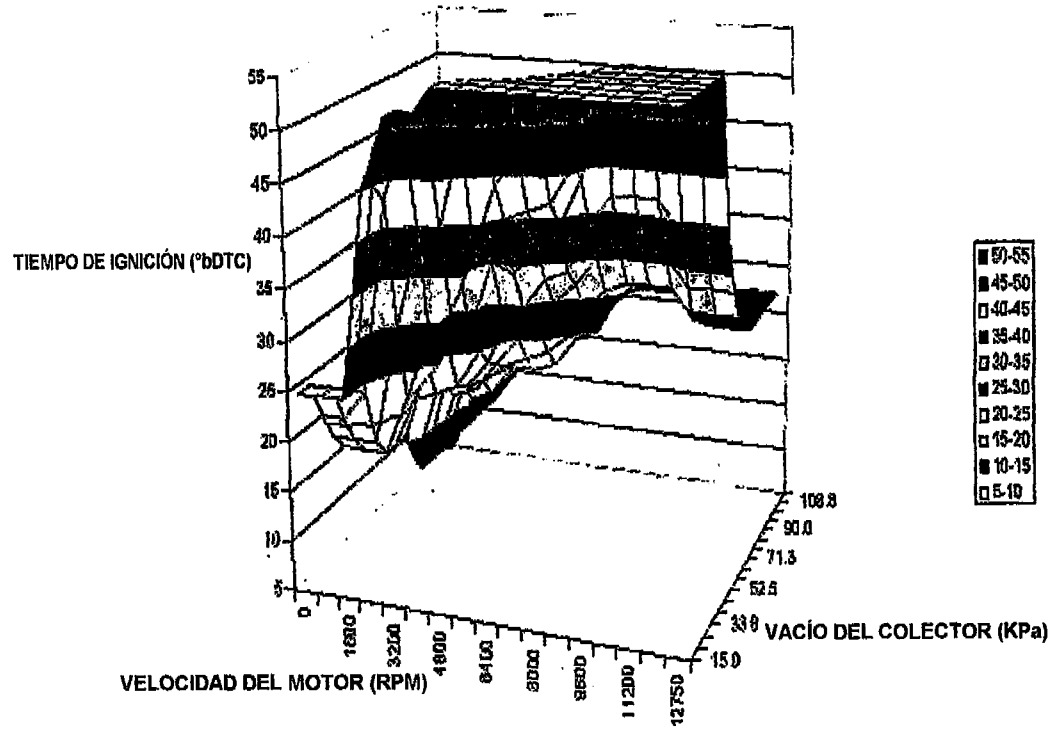


FIGURA 8

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) KM-028

Box No. I TITLE OF INVENTION METHOD AND SYSTEM FOR CONTROLLING ENGINE NOISE	
Box No. II APPLICANT ☐ This person is also inventor	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.) Bajaj Auto Limited Akurdi Pune 411 035 Maharashtra, India	
Telephone No. (91) (020) 27472851	
Facsimile No. (91) (020) 27407387	
Teleprinter No.	
Applicant's registration No. with the Office	
State (that is, country) of nationality: IN	State (that is, country) of residence: IN
This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box	
Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.) Joseph Abraham of Bajaj Auto Limited, Akurdi, Pune, 411 035, Maharashtra, India	
This person is: ☐ applicant only ☒ applicant and inventor ☐ inventor only (if this check-box is marked, do not fill in below.)	
Applicant's registration No. with the Office	
State (that is, country) of nationality: IN	State (that is, country) of residence: IN
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box	
☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.	
Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE	
The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☐ agent ☐ common representative	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) Madan Jose A, Jhunjhunwala Ram N, Grover Vivek, Dwarkadas Vinay D, Dr Gharve Shilpa, Jhunjhunwala Rabindranath and Madan Prita, all of Khaitan & Co, Advocates, Notaries, Patent & Trade Mark Attorneys, Meher Chambers, 4th & 5th Floors, R K Marg, Ballard Estate, Mumbai 400038, Maharashtra, India	
Telephone No. 91) (22) 66365000	
Facsimile No. (91) (22) 66365050	
Teleprinter No.	
Agent's registration No. with the Office	
☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.	

Box No. V DESIGNATIONS

The filing of this request constitutes under Rule 4.9(a), the designation of all Contracting States bound by the PCT on the international filing date, for the grant of every kind of protection available and, where applicable, for the grant of both regional and national patents.

However,

- ☐ DE Germany is not designated for any kind of national protection
- ☐ KR Republic of Korea is not designated for any kind of national protection
- ☐ RU Russian Federation is not designated for any kind of national protection

(The check-boxes above may be used to exclude (irrevocably) the designations concerned in order to avoid the ceasing of the effect, under the national law, of an earlier national application from which priority is claimed. See the Notes to Box No. V as to the consequences of such national law provisions in these and certain other States.)

Box No. VI PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country or Member of WTO	regional application: regional Office	international application: receiving Office
item (1) 1st July 2005	784/MUM/2005	India	Mumbai	India
item (2)				
item (3)				

- ☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office) identified above as:

- ☐ all items ☒ item (1) ☐ item (2) ☐ item (3) ☐ other, see Supplemental Box

* Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii)).

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA / AU

Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):

Date (day/month/year) Number Country (or regional Office)

Box No. VIII DECLARATIONS

The following declarations are contained in Boxes Nos. VIII (i) to (v) (mark the applicable check-boxes below and indicate in the right column the number of each type of declaration):

- | | | |
|---|--|---|
| ☐ Box No. VIII (i) | Declaration as to the identity of the inventor | : |
| ☒ Box No. VIII (ii) | Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent | : |
| ☐ Box No. VIII (iii) | Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application | : |
| ☒ Box No. VIII (iv) | Declaration of inventorship (only for the purposes of the designation of the United States of America) | : |
| ☐ Box No. VIII (v) | Declaration as to non-prejudicial disclosures or exceptions to lack of novelty | : |

Number of
declarations

Box No. VIII (ii) DECLARATION: ENTITLEMENT TO APPLY FOR AND BE GRANTED A PATENT

The declaration must conform to the standardized wording provided for in Section 212: see Notes to Boxes Nos. VII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (ii). If this Box is not used, this sheet should not be included in the request.

Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent (Rules 4.17(ii) and 51bis.1(a)(ii)), in a case where the declaration under Rule 4.17(iv) is not appropriate:

In relation to this International Application, Bajaj Auto Limited, is entitled to apply for and be granted a patent by virtue of the following:

(i) an Assignment from Joseph Abraham to Bajaj Auto Limited dated 28th June 2006

(ii) this Declaration is made for purpose of all designations except the designation of the United States of America)

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (ii)".

Box No. VIII (iv) DECLARATION: INVENTORSHIP (only for the purposes of the designation of the United States of America)
The declaration must conform to the following standardized wording provided for in Section 214; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (iv). If this Box is not used, this sheet should not be included in the request.

**Declaration of inventorship (Rules 4.17(iv) and 51bis.1(a)(iv))
 for the purposes of the designation of the United States of America:**

I hereby declare that I believe I am the original, first and sole (if only one inventor is listed below) or joint (if more than one inventor is listed below) inventor of the subject matter which is claimed and for which a patent is sought.

This declaration is directed to the international application of which it forms a part (if filing declaration with application).

This declaration is directed to international application No. PCT/..... (if furnishing declaration pursuant to Rule 26ter).

I hereby declare that my residence, mailing address, and citizenship are as stated next to my name.

I hereby state that I have reviewed and understand the contents of the above-identified international application, including the claims of said application. I have identified in the request of said application, in compliance with PCT Rule 4.10, any claim to foreign priority, and I have identified below, under the heading "Prior Applications," by application number, country or Member of the World Trade Organization, day, month and year of filing, any application for a patent or inventor's certificate filed in a country other than the United States of America, including any PCT international application designating at least one country other than the United States of America, having a filing date before that of the application on which foreign priority is claimed.

Prior Applications:

I hereby acknowledge the duty to disclose information that is known by me to be material to patentability as defined by 37 C.F.R. § 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the PCT international filing date of the continuation-in-part application.

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.

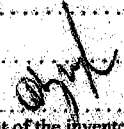
Name: Joseph Abraham

Residence: India

(city and either US state, if applicable, or country)

Mailing Address: Bajaj Auto Limited, Akurdi, Pune 411 035, Maharashtra, India

Citizenship: Indian

Inventor's Signature: 

(The signature must be that of the inventor, not that of the agent)

Date: 29/06/2006

Name:

Residence:

(city and either US state, if applicable, or country)

Mailing Address:

Citizenship:

Inventor's Signature:

(The signature must be that of the inventor, not that of the agent)

Date:

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (iv)".

Box No. IX CHECK LIST; LANGUAGE OF FILING

This international application contains:

(a) on paper, the following number of sheets:

request (including declaration sheets) : 5
 description (excluding sequence listing and/or tables related thereto) : 9
 claims : 3
 abstract : 1
 drawings : 8

Sub-total number of sheets : 26

sequence listing :
 tables related thereto :

(for both, actual number of sheets if filed on paper, whether or not also filed in electronic form; see (c) below)

Total number of sheets : 26

(b) ☐ only in electronic form (Section 801(a)(i))

(i) ☐ sequence listing
 (ii) ☐ tables related thereto

(c) ☐ also in electronic form (Section 801(a)(ii))

(i) ☐ sequence listing
 (ii) ☐ tables related thereto

Type and number of carriers (diskette, CD-ROM, CD-R or other) on which are contained the

☐ sequence listing :
☐ tables related thereto :

(additional copies to be indicated under items 9(ii) and/or 10(ii), in right column)

This international application is accompanied by the following item(s) (mark the applicable check-boxes below and indicate in right column the number of each item):

1. ☐ fee calculation sheet
2. ☐ original separate power of attorney
3. ☐ original general power of attorney
4. ☐ copy of general power of attorney; reference number, if any:
5. ☐ statement explaining lack of signature
6. ☐ priority document(s) identified in Box No. VI as item(s):
7. ☐ translation of international application into (language):
8. ☐ separate indications concerning deposited microorganism or other biological material
9. ☐ sequence listing in electronic form (indicate type and number of carriers)
 - (i) ☐ copy submitted for the purposes of international search under Rule 13ter only (and not as part of the international application) :
 - (ii) ☐ (only where check-box (b)(i) or (c)(i) is marked in left column) additional copies including, where applicable, the copy for the purposes of international search under Rule 13ter
 - (iii) ☐ together with relevant statement as to the identity of the copy or copies with the sequence listing mentioned in left column
10. ☐ tables in electronic form related to sequence listing (indicate type and number of carriers)
 - (i) ☐ copy submitted for the purposes of international search under Section 802(b-quater) only (and not as part of the international application)
 - (ii) ☐ (only where check-box (b)(ii) or (c)(ii) is marked in left column) additional copies including, where applicable, the copy for the purposes of international search under Section 802(b-quater)
 - (iii) ☐ together with relevant statement as to the identity of the copy or copies with the tables mentioned in left column
11. ☐ other (specify):

Number of items

Figure of the drawings which should accompany the abstract:

Language of filing of the international application:

English

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Joseph Abraham

For Bayer AG Ltd.
 SRINIVASAN RAVIKUMAR
 VICE PRESIDENT (B.D.)

For receiving Office use only

1. Date of actual receipt of the purported international application:	2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA /	6. ☐ Transmittal of search copy delayed until search fee is paid

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

Form PCT/RO/101 (last sheet) (October 2005)

See Notes to the request form

01 July 2005 (01.07.2005)

784/MUM/2005

IN

05 March 2007 (05.03.2007)

The International Bureau of WIPO
 34, chemin des Colombettes
 1211 Geneva 20, Switzerland

Authorized officer

Dorothee Mülhausen

Facsimile No. +41 22 338 82 70

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Facsimile No. +41 22 338 82 70

Form PCT/IB/304 (October 2005)

1/C7BI20DB0

PCT
INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)
(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference KM-028	FOR FURTHER ACTION	See Form PCT/IPEA/416
International application No. PCT/IN2006/000227	International filing date (day/month/year) 30 June 2006	Priority date (day/month/year) 1 July 2005
International Patent Classification (IPC) or national classification and IPC Int. Cl. F02P 15/02 (2006.01) F02P 5/153 (2006.01)		
Applicant BAJAJ AUTO LIMITED et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36. 2. This REPORT consists of a total of 3 sheets, including this cover sheet. 3. This report is also accompanied by ANNEXES, comprising: a. ☒ (sent to the applicant and to the International Bureau) a total of 3 sheets, as follows: ☒ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions). ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box. b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).	
4. This report contains indications relating to the following items: ☒ Box No. I Basis of the report ☐ 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 Article 35(2) 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	

Date of submission of the demand 11 June 2007	Date of completion of this report 28 September 2007
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer C. NGUYEN-KIM AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. (02) 6283 2121

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69

B No. I Basis of the report1. With regard to the **language**, this report is based on:☒ 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 (under Rules 12.3(a) and 23.1 (b))☐ publication of the international application (under Rule 12.4(a))☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):☐ the international application as originally filed/furnished☒ the description:pages **1 – 9** as originally filed/furnished

pages* received by this Authority on _____ with the letter of

pages* received by this Authority on _____ with the letter of

☒ the claims:

pages as originally filed/furnished

pages* as amended (together with any statement) under Article 19

pages* **10 – 12** received by this Authority on **7 August 2007** with the letter of **7 August 2007**

pages* received by this Authority on _____ with the letter of

☒ the drawings:pages **1 – 8** as originally filed/furnished

pages* received by this Authority on _____ with the letter of

pages* received by this Authority on _____ with the letter of

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.3. ☐ The amendments have resulted in the cancellation of:☐ the description, pages☐ the claims, Nos.☐ the drawings, sheets/figs☐ the sequence listing (*specify*):☐ any table(s) related to the sequence listing (*specify*):4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).☐ the description, pages☐ the claims, Nos.☐ the drawings, sheets/figs☐ the sequence listing (*specify*):☐ any table(s) related to the sequence listing (*specify*):5. ☐ This report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to the Authority under Rule 91 (Rule 70.2(e)).

* If item 4 applies, some or all of those sheets may be marked "superseded."

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R No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	YES
	Claims 1 – 24	NO
Inventive step (IS)	Claims	YES
	Claims 1 – 24	NO
Industrial applicability (IA)	Claims 1 – 24	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

The following international search report citations have been considered for the purpose of this statement:

D1: US 6499460 B	D2: US 5259357 A	D3: US 4920944 A	D4: US 4517952 A
D5: US 4243005 A	D6: US 4198942 A	D7: US 3964454 A	
D8: US 5474045 A	D9: US 5107813 A	D10: US 5069183 A	D11: EP 451462 A
D12: US 4991554 A	D13: GB 2213876 A	D14: EP 284054 A	D15: US 4690116 A

Novelty (N) Claims 1 – 24

The claims are not novel in the light of D1 – D7 which disclose all the essential features of the claims, namely a method of controlling engine noise during acceleration or at high speed operation by retarding one of the spark ignition means relatively to the other spark ignition means.

In response to the previous opinions, the attorney submits that none of D1 – D5 is concerned with the problem solved by the invention, that is the control of noise and harshness during acceleration for high speed operation. However, the citations do disclose the features of the claims, for example, D1 discloses a method and an ignition control system for controlling engine noise during acceleration or high speed operation (eg. between 1500 – 4500 rpm) wherein the engine having a combustion chamber (see Fig. 1), a fuel injection means (9), a plurality of spark ignition means (8I1, 8E1), and a control unit (ECU 11) for retarding/discontinuing one ignition means in response to the engine speed (NE) and/or acceleration (see Figs. 5, 6, 7). The citation also discloses the engine operated at a lean air/fuel ratio (see column 6, lines 21 – 22). D2 – D5 disclose similar features.

The attorney also submits that D6 discloses a mechanical switch for controlling the ignition retardation based on the measurement of manifold pressure and hence with less precision than present invention. However, the present claims do not exclude mechanical switches as part of the control unit (in fact the claims do not define what the control unit consists of), and claims 7, 8, 22 allow the manifold pressure to be measured to determine the engine acceleration/speed.

The attorney also submits that D7 solves the engine problem during acceleration by advancing the ignition of one of the spark plugs instead of retarding as in present invention. However, D7 does disclose the ignition of one of the spark plugs is delayed relatively to the ignition of the other spark plug during engine acceleration (see Fig. 4), only the degree of delay (i.e. retardation) varies with speed. The present claims do not define any degree of retardation at all.

Inventive Step (IS) Claims 1 – 24

The claims do not involve an inventive step in the light of D1 – D7 for the same reasons as above.

The claims also do not involve an inventive step in the light of D8 – D15 all of which disclose an ignition control system / method thereof, wherein the firing of the spark ignition means is retarded in response to the value of one or more engine parameters, such as combustion pressure, engine speed, engine load, etc. Although D8 – D15 do not disclose a plurality of spark ignition means in each combustion chamber, it is obvious to a person skilled in the art to combine any one of D8 – D15 with any one of D1 – D7 to reach the same solution as claimed.

Industrial Applicability (IA) Claims 1 – 24

The claims satisfy the requirements for industrial applicability.

From the INTERNATIONAL BUREAU

PCTNOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

MADAN, Jose
KhaiTan & Co
Advocates, Notaries, Patent & Trade Mark Attorneys
Meher Chambers, 4th & 5th Floors
R K Marg, Ballard Estate
Mumbai 400 038, Maharashtra
INDE

Date of mailing (day/month/year) 02 April 2007 (02.04.2007)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference KM-028	
International application No. PCT/IN2006/000227	International filing date (day/month/year) 30 June 2006 (30.06.2006)
International publication date (day/month/year) 22 March 2007 (22.03.2007)	Priority date (day/month/year) 01 July 2005 (01.07.2005)
Applicant BAJAJ AUTO LIMITED et al	

- By means of this Form, which replaces any previously issued notification concerning submission or transmittal of priority documents, the applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to a date of receipt, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
- (If applicable)* The letters "NR" appearing in the right-hand column denote a priority document which, on the date of mailing of this Form, had not yet been received by the International Bureau under Rule 17.1(a) or (b). Where, under Rule 17.1(a), the priority document must be submitted by the applicant to the receiving Office or the International Bureau, but the applicant fails to submit the priority document within the applicable time limit under that Rule, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
- (If applicable)* An asterisk (*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b) (the priority document was received after the time limit prescribed in Rule 17.1(a) or the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b)). Even though the priority document was not furnished in compliance with Rule 17.1(a) or (b), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as the priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
01 July 2005 (01.07.2005)	784/MUM/2005	IN	05 March 2007 (05.03.2007)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer

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14 OCT 2007

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PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (Chapter II of the Patent Cooperation Treaty)

(PCT Rule 71.1)

Date of mailing
(day/month/year)

02 OCT 2007

Applicant's or agent's file reference

KM-028

P 26446 PCIN

IMPORTANT NOTIFICATION

International application No.

PCT/IN2006/000227

International filing date (day/month/year)

30 June 2006

Priority date (day/month/year)

1 July 2005

Applicant

BAJAJ AUTO LIMITED et al

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translations to those Offices.
4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the *PCT Applicant's Guide*.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed invention is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the IPEA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaaustralia.gov.au
Facsimile No. (02) 6285 3929

Authorized officer

C. NGUYEN-KIM
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
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PCT
INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference KM-028	FOR FURTHER ACTION	See Form PCT/IPEA/416
International application No. PCT/IN2006/000227	International filing date (day/month/year) 30 June 2006	Priority date (day/month/year) 1 July 2005
International Patent Classification (IPC) or national classification and IPC Int. Cl. F02P 15/02 (2006.01) F02P 5/153 (2006.01)		
Applicant BAJAJ AUTO LIMITED et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36. 2. This REPORT consists of a total of 3 sheets, including this cover sheet. 3. This report is also accompanied by ANNEXES, comprising: a. ☒ (sent to the applicant and to the International Bureau) a total of 3 sheets, as follows: ☒ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions). ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box. b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).	
4. This report contains indications relating to the following items: ☒ Box No. I Basis of the report ☐ 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 Article 35(2) 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	

Date of submission of the demand 11 June 2007	Date of completion of this report 28 September 2007
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer C. NGUYEN-KIM AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. (02) 6283 2121

Br No. 1 Basis of the report

1. With regard to the language, this report is based on:

- ☒ 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 (under Rules 12.3(a) and 23.1 (b))
- ☐ publication of the international application (under Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

☐ the international application as originally filed/furnished

☒ the description:

pages 1 – 9 as originally filed/furnished

pages* received by this Authority on _____ with the letter of

pages* received by this Authority on _____ with the letter of

☒ the claims:

pages as originally filed/furnished

pages* as amended (together with any statement) under Article 19

pages* 10 – 12 received by this Authority on 7 August 2007 with the letter of 7 August 2007

pages* received by this Authority on _____ with the letter of

☒ the drawings:

pages 1 – 8 as originally filed/furnished

pages* received by this Authority on _____ with the letter of

pages* received by this Authority on _____ with the letter of

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/figs

☐ the sequence listing (*specify*):

☐ any table(s) related to the sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/figs

☐ the sequence listing (*specify*):

☐ any table(s) related to the sequence listing (*specify*):

5. ☐ This report has been established taking into account the rectification of an obvious mistake authorized by or notified to the Authority under Rule 91 (Rule 70.2(e)).

* If item 4 applies, some or all of those sheets may be marked "superseded."

B. 10. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	YES
	Claims 1 – 24	NO
Inventive step (IS)	Claims	YES
	Claims 1 – 24	NO
Industrial applicability (IA)	Claims 1 – 24	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

The following international search report citations have been considered for the purpose of this statement:

D1: US 6499460 B	D2: US 5259357 A	D3: US 4920944 A	D4: US 4517952 A
D5: US 4243005 A	D6: US 4198942 A	D7: US 3964454 A	
D8: US 5474045 A	D9: US 5107813 A	D10: US 5069183 A	D11: EP 451462 A
D12: US 4991554 A	D13: GB 2213876 A	D14: EP 284054 A	D15: US 4690116 A

Novelty (N) Claims 1 – 24

The claims are not novel in the light of D1 – D7 which disclose all the essential features of the claims, namely a method of controlling engine noise during acceleration or at high speed operation by retarding one of the spark ignition means relatively to the other spark ignition means.

In response to the previous opinions, the attorney submits that none of D1 – D5 is concerned with the problem solved by the invention, that is the control of noise and harshness during acceleration for high speed operation. However, the citations do disclose the features of the claims, for example, D1 discloses a method and an ignition control system for controlling engine noise during acceleration or high speed operation (eg. between 1500 – 4500 rpm) wherein the engine having a combustion chamber (see Fig. 1), a fuel injection means (9), a plurality of spark ignition means (811, 8E1), and a control unit (ECU 11) for retarding/discontinuing one ignition means in response to the engine speed (NE) and/or acceleration (see Figs. 5, 6, 7). The citation also discloses the engine operated at a lean air/fuel ratio (see column 6, lines 21 – 22). D2 – D5 disclose similar features.

The attorney also submits that D6 discloses a mechanical switch for controlling the ignition retardation based on the measurement of manifold pressure and hence with less precision than present invention. However, the present claims do not exclude mechanical switches as part of the control unit (in fact the claims do not define what the control unit consists of), and claims 7, 8, 22 allow the manifold pressure to be measured to determine the engine acceleration/speed.

The attorney also submits that D7 solves the engine problem during acceleration by advancing the ignition of one of the spark plugs instead of retarding as in present invention. However, D7 does disclose the ignition of one of the spark plugs is delayed relatively to the ignition of the other spark plug during engine acceleration (see Fig. 4), only the degree of delay (i.e. retardation) varies with speed. The present claims do not define any degree of retardation at all.

Inventive Step (IS) Claims 1 – 24

The claims do not involve an inventive step in the light of D1 – D7 for the same reasons as above.

The claims also do not involve an inventive step in the light of D8 – D15 all of which disclose an ignition control system / method thereof, wherein the firing of the spark ignition means is retarded in response to the value of one or more engine parameters, such as combustion pressure, engine speed, engine load, etc. Although D8 – D15 do not disclose a plurality of spark ignition means in each combustion chamber, it is obvious to a person skilled in the art to combine any one of D8 – D15 with any one of D1 – D7 to reach the same solution as claimed.

Industrial Applicability (IA) Claims 1 – 24

The claims satisfy the requirements for industrial applicability.

CLAIMS:

1. A method of controlling noise and harshness caused by combustion in a spark ignited engine during acceleration or high speed operation, the engine having a combustion chamber; a fuel delivery means for delivering a fuel charge to the combustion chamber; a plurality of spark ignition means located in the combustion chamber for igniting said fuel charge; and a control unit, wherein said control unit retards operation of at least one ignition means in response to at least one of engine speed and acceleration of the engine.
2. The method of claim 1 wherein operation of said at least one spark ignition means is retarded in response to engine acceleration exceeding a predetermined engine acceleration rate.
3. The method of claim 1 wherein operation of said at least one spark ignition means is retarded in response to engine speed exceeding a predetermined engine speed threshold level.
4. The method of claim 2 wherein the engine acceleration rate is a high acceleration rate.
5. The method of claim 3 wherein the engine speed threshold level is a high engine speed.
6. The method of claims 1, 2 or 4 wherein acceleration of the engine is determined by measuring the rate of change of engine speed.
7. The method of claims 1, 2 or 4 wherein acceleration of the engine is determined by measuring throttle position, fuel delivery per combustion cycle or manifold pressure and variation in these.
8. The method of claims 1, 2 or 4 wherein acceleration of the engine is determined by measuring at least two of engine speed, throttle position, fuel delivery per combustion cycle or manifold pressure and variation in these.

9. The method of any one of the preceding claims wherein operation of at least one ignition means is retarded if determined rate of rise of combustion pressure exceeds a threshold value.
10. The method of any one of the preceding claims wherein operation of the at least one ignition means is retarded in a step change.
11. The method of any one of claims 1 to 9 wherein a smooth transition from one ignition means operation timing to a retarded operation timing is effected by the control unit.
12. The method of any one of the preceding claims wherein firing of an ignition means is discontinued if at least one combustion noise associated parameter breaches a threshold value.
13. The method of any one of the preceding claims wherein the engine is injected with said fuel charge.
14. The method of any one of the preceding claims wherein the manifold of the engine is injected with fuel.
15. The method of anyone of the preceding claims wherein air fuel ratio of the fuel charge is in a lean range.
16. The method of any one of the preceding claims wherein the engine is operated in lean combustion mode.
17. The method of claim 16 wherein the engine is a single cylinder engine having a swept cylinder volume of between 70cc and 200cc.
18. A method of any one of the preceding claims wherein control is implemented by retarding firing timing of one of ignition means relative to firing timing of another ignition means.

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19. The method of any one of the preceding claims when implemented in a small bore engine.
20. An ignition control system for an engine comprising:
a plurality of spark ignition means (15, 16); and
5 a control unit (4) for controlling operation of each ignition means (15, 16)
wherein said control unit (4) is programmed to receive combustion noise associated parameter data and to operate each ignition means (15, 16) in accordance with said data to control noise and harshness when engine speed is accelerating or is at a high level.
- 10 21. The ignition control system of claim 20 wherein the control unit is programmed with maps providing ignition firing timing as a function of measured combustion noise associated parameter data under particular engine operating conditions.
- 15 22. The ignition control system of claim 21 wherein the maps provide ignition firing timing as a function of at least one parameter selected from the group consisting of engine speed, throttle position, fuelling rate and manifold vacuum pressure and variation in these.
23. The ignition control system of claim 21 or 22 wherein the maps are provided for part open throttle and wide open throttle engine operating conditions.
- 20 24. The ignition control system of anyone of claims 21 to 23 wherein the maps provide ignition firing timings for said ignition means such that the firing timing of one ignition means is retarded relative to firing timing of another ignition means.

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REIVINDICACIONES

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1. Un método para controlar el ruido y severidad provocados por la combustión en un motor encendido por chispa durante la aceleración u operación a alta velocidad, el motor tiene una cámara de combustión; un medio de distribución de combustible para distribuir una carga de combustible a la cámara de combustión; una pluralidad de medios de ignición por chispa situados en la cámara de combustión para encender la carga de combustible; y una unidad de control, caracterizado porque la unidad de control retarda la operación de por lo menos un medio de ignición en respuesta por lo menos a una de velocidad del motor y aceleración del motor.

2. El método de conformidad con la reivindicación 1, caracterizado porque la operación de al menos un medio de ignición por chispa se retarda en respuesta a la aceleración del motor que excede una proporción de aceleración predeterminada del motor.

3. El método de conformidad con la reivindicación 1, caracterizado porque la operación de al menos un medio de ignición por chispa se retarda en respuesta a la velocidad del motor que excede un nivel de umbral de velocidad predeterminado del motor.

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reivindicaciones precedentes, caracterizado porque la operación de al menos un medio de ignición se retarda si se determina que la proporción de elevación de presión de combustión excede un valor de umbral.

10. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque la operación de al menos un medio de ignición se retarda en un cambio de etapa.

11. El método de conformidad con cualquiera de las reivindicaciones 1 a 9, caracterizado porque una transición moderada desde un tiempo de operación del medio de ignición hasta un tiempo de operación retardada se efectúa por la unidad de control.

12. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque el disparo de un medio de ignición se discontinúa si al menos un parámetro asociado de ruido de combustión viola un valor de umbral.

13. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque el motor se inyecta con carga de combustible.

14. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque el

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colector del motor se inyecta con combustible.

15. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque la relación de aire-combustible de la carga de combustible está en un margen pobre.

16. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque el motor se opera en el modo de combustión pobre.

17. El método de conformidad con la reivindicación 16, caracterizado porque el motor es un motor de cilindro sencillo que tiene un volumen de cilindro barrido de entre 70 cc a 200 cc.

18. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque el control se implementa al retardar el tiempo de disparo de uno de los medios de ignición con relación al tiempo de disparo de otro medio de ignición.

19. El método de conformidad con cualquiera de las reivindicaciones precedentes, caracterizado porque se implementa en un motor de calibre pequeño.

20. Un sistema de control de ignición para un motor caracterizado porque comprende:

una pluralidad de medios de ignición por chispa; y

una unidad de control para controlar la operación de cada medio de ignición, en donde la unidad de control se programa para recibir datos de parámetros asociados de ruido de combustión y para operar cada medio de ignición de acuerdo con los datos para controlar el ruido y severidad cuando la velocidad del motor está acelerando o está en un nivel elevado.

21. El sistema de control de ignición de conformidad con la reivindicación 20, caracterizado porque la unidad de control se programa con los mapas que proporcionan el tiempo de disparo de ignición como una función de datos de parámetros asociados de ruido de combustión medidos bajo condiciones de operación particulares del motor.

22. El sistema de control de ignición de conformidad con la reivindicación 21 ó 22, caracterizado porque los mapas proporcionan el tiempo de disparo de ignición como una función de por lo menos un parámetro seleccionado del grupo que consiste de velocidad del motor, posición del acelerador, proporción de distribución de combustible, y proporción de vacío del colector y variación en éstos.

23. El sistema de control de ignición de conformidad con la reivindicación 21 ó 22, caracterizado



No. 07-134104-00000-0000

Fecha: 2007-12-19 15:51:47 Dep. 2020 NUECREACIONE
 Tra: 11 PATENTEIYII Eje: 379 FASENACIONALII
 Act: 411 PRESENTACION Folios: 81

Industria y Comercio SUPERINTENDENCIA

REQUISITOS MINIMOS PARA ADMISION A TRAMITE PCT

PATENTE DE INVENCION

☒MODELO DE UTILIDAD ☐

- ◆ Indicación de que se solicita la concesión de una patente ☒
- ◆ Datos de identificación del solicitante o de la persona que presenta la solicitud ☒
- ◆ Descripción de la invención ☒
- ◆ Dibujos de ser estos pertinentes ☒
- ◆ Comprobante de pago de las tasas establecidas ☒

COMPLETA ☒INCOMPLETA ☐DISEÑO INDUSTRIAL ☐

- ◆ Indicación de que se solicita el registro de Diseño Industrial ☐
- ◆ Datos de identificación del solicitante o de la persona que presenta la solicitud ☐
- ◆ Representación gráfica y fotográfica del Diseño Industrial o muestra del material que incorpora el diseño ☐
- ◆ Comprobante de pago de las tasas establecidas ☐

COMPLETA ☐INCOMPLETA ☐ESQUEMA DE TRAZADO ☐

- ◆ Indicación de que se solicita el registro de un Esquema de Trazado ☐
- ◆ Datos de identificación del solicitante o de la persona que presenta la solicitud ☐
- ◆ Representación gráfica del esquema trazado ☐
- ◆ Comprobante de pago de las tasas establecidas ☐

COMPLETA ☐INCOMPLETA ☐

Firma Responsable

Fecha

Carrera 13 No. 27-00 Piso 5, 7 y 10

Conmutador: 3 82 08 40

Fax: 350 52 20

E-mail: info@slb.gov.cowww.slb.gov.co

Bogotá, D.C., Colombia

84

REPUBLICA DE COLOMBIA
SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

Folio 76

2020

Bogotá D.C.,

Doctor(a)

RODRIGUEZ D ALEMAN DILIA MARIA

Apoderado(a) y/o Representante de

BAJAJ AUTO LIMITED

REFERENCIA	Radicación No.	7 134104
	Solicitud internacional	PCT/IN2006/000227
	Fecha inicio fase nacional	01/02/2008
	Trámite	11
	Evento	379
	Actuación	416
	Oficio No.	5709
	Folios	1

Teniendo en cuenta que la solicitud de privilegio de patente que se tramita bajo el expediente indicado en la referencia, reúne los requisitos de forma establecidos en la Decisión 485 de la Comisión de la Comunidad Andina, el Tratado de Cooperación en Materia de Patentes (PCT), el Reglamento y la Circular Única de la Superintendencia de Industria y Comercio, se envía el extracto de la solicitud a la Oficina de Comunicaciones para efecto de su publicación en la Gaceta de Propiedad Industrial.

Cúmplase

Dado en Bogotá DC,

12 MAR. 2008

ALIX CARMENZA CESPEDES DE VERGEL

Jefe de la división de Nuevas Creaciones

jfernand

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