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(54) Spark plug

(57) A spark plug mainly includes a spark-plug body (1) and a spark-plug bonding cap (2) connected to a front end of the spark-plug body, and can be widely used on internal combustion engines for cars, motorcycles, vessels, power generators, mowing machines, etc. The bonding cap (2) functions like a pre-combustion chamber (3) to enable enhanced ignition and explosion of mixture in the engine combustion chamber to produce strong flames, so that the mixture is completely burned to enable upgraded engine horsepower and torque output, reduced amount of accumulated carbon in the engine combustion chamber, and reduced amounts of CO, HC, NOx, etc. contained in the exhaust of the engine. The requirements of environmental protection and lowered fuel consumption of the engine can therefore be met.

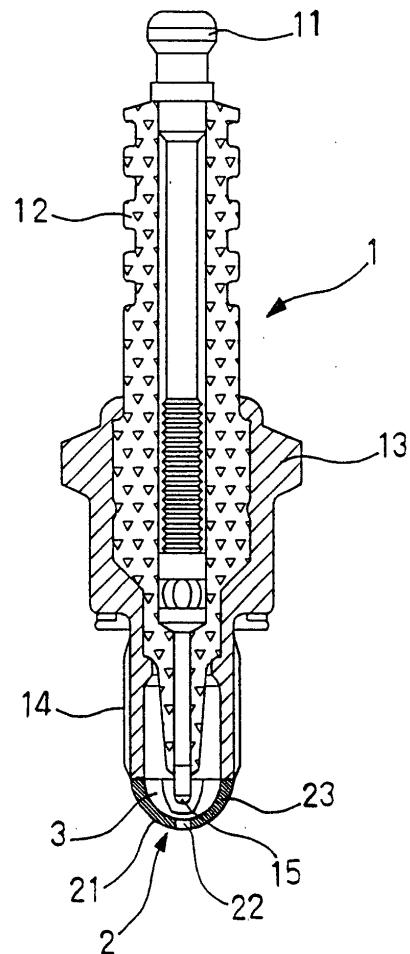


FIG. 3

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a novel spark plug for widely using on internal combustion engines for cars, motorcycles, vessels, power generators, mowing machines, etc., and more particularly to a spark plug that provides the function of a pre-combustion chamber to enhance ignition and explosion of mixture in an engine combustion chamber while provides good heat radiating effect and extended usable life thereof.

BACKGROUND OF THE INVENTION

[0002] There are various types of spark plugs available in the markets for use on general vehicle engines. Figs. 1A to 1D show some examples of the conventional spark plugs.

[0003] In a standard type of conventional spark plugs, there is only one single bonding corresponding to a central tip of the spark plug. The bonding is frequently damaged or burned out due to a high-temperature working environment, and therefore results in undesirable changes in a spark-ignition gap between the central tip and the bonding. That is, an original ignition contact on the spark plug is no longer a point best for ignition now.

[0004] In many other improved types of conventional spark plugs, there are provided two-pole, three-pole, and four-pole bonding, V-shaped bonding, 360-degree all-directional igniter, and hood-type bonding.

[0005] However, all the two-pole, three-pole, and four-pole bonding, V-shaped bonding, the 360-degree all-directional igniter, as well as the so-called platinum igniter and iridium-alloy igniter for the conventional spark plugs do not provide the function of a pre-combustion chamber and produce lightning-like sparks during ignition. The lightning-like sparks only serve as an ignition and explosion medium for burning the mixture in the engine. Though the conventional spark plug with the hood-type bonding has the function of a pre-combustion chamber, the hood thereof is so closed that it causes poor heat dissipation of the spark plug, resulting in increased compression ratio, less smooth flows of air into and out of the engine combustion chamber, and easy occurrence of engine knock and/or unstable engine idling speed to directly affect the functions and quality of the engines having the spark plug mounted thereon.

[0006] It is therefore tried by the inventor to develop an improved and durable spark plug to eliminate the drawbacks existed in the conventional spark plugs.

SUMMARY OF THE INVENTION

[0007] A primary object of the present invention is to provide a novel and durable spark plug that has the function of a pre-combustion chamber to enhance ignition

and explosion of mixture in an engine combustion chamber while provides good heat radiating effect and extended usable life of the spark plug.

[0008] Another object of the present invention is to provide a spark plug in which a spark-ignition gap between a central tip and a bonding cap of the spark plug is always maintained at a fixed point, so that an ignition with the spark plug can be more easily done and a usable life of the spark plug is much longer than that of the conventional spark plugs.

[0009] To achieve the above and other objects, the spark plug of the present invention mainly includes a spark-plug body and a spark-plug bonding cap connected to a front end of the spark-plug body. The spark-plug body includes, from a rear end to a front end thereof, a nipple, a porcelain insulator, a middle hexagonal body nut, a diameter-reduced threaded portion, and a central tip enclosed in the porcelain insulator to forward project from a center of the threaded portion. The spark-plug bonding cap includes a top portion having a tip release hole formed at a center thereof, a plurality of fixing legs radially spaced along an outer periphery of the top portion for connecting to the spark-plug body, and a plurality of pointed-tipped discharge contacts provided at an inner wall of the bonding cap around the tip release hole to enable concentrated discharge. With the fixing legs connected to the front end of the spark-plug body, the bonding cap is located over the central tip of the spark-plug body to together with the fixing legs enclose a space that functions like a pre-combustion chamber. Spaces between any two adjacent fixing legs enable good heat radiation and smooth flows of air into and out of the pre-combustion chamber.

[0010] The spark plug of the present invention has extended service life and is able to maintain stable ignition in the engine combustion chamber, so that flames produced at explosion in the bonding cap could instantly propagate to reach as far as possible in the engine combustion chamber, enabling the mixture therein to stably burn and therefore provides an enhanced thermal efficiency, which in turn upgrades the engine horsepower and torque output, and reduces the amount of CO, HC, NOx, etc. contained in the exhaust of the engine.

45 BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The structure and the technical means adopted by the present invention to achieve the above and other objects can be best understood by referring to the following detailed description of the preferred embodiments and the accompanying drawings, wherein

55 Figs. 1A to 1D show some examples of conventional spark plugs;

Fig. 2 is an exploded perspective view of a spark plug according to an embodiment of the present invention;

Fig. 3 is an assembled sectional view of the spark plug of Fig. 2;

Fig. 4 is a three-view drawing showing a first embodiment of the bonding cap included in the spark plug of the present invention;

Fig. 5 is a three-view drawing showing a second embodiment of the bonding cap included in the spark plug of the present invention; and

Fig. 6 shows the application of the spark plug of the present invention in an engine combustion chamber.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Please refer to Figs. 2 and 3 that are exploded perspective and assembled sectional views, respectively, of a spark plug according to an embodiment of the present invention. As shown, the spark plug mainly includes a spark-plug body 1 and a spark-plug bonding cap 2 connected to a front end of the spark-plug body 1.

[0013] The spark-plug body 1 includes, from a rear end to a front end thereof, a nipple 11, a porcelain insulator 12, a middle hexagonal body nut 13, a diameter-reduced 'threaded portion 14, and a central tip 15 forward projected from a center of the threaded portion 14.

[0014] The spark-plug bonding cap 2 includes a top portion 21 having a tip release hole 22 formed at a center thereof, and a plurality of fixing legs 23 radially spaced along an outer periphery of the top portion 21 for connecting to the spark-plug body 1.

[0015] Please refer to Fig. 4 that is a three-view drawing showing a first embodiment of the bonding cap 2. The fixing leg 23 may be a curved rectangle or a curved trapezoid, and may be three or more in number. In a most preferred embodiment of the bonding cap 2, three fixing legs 23 radially equally spaced from each other by 120 degrees are integrally extended from the outer periphery of the top portion 21. The bonding cap 2 may have a rounded top portion 21 to look like a dome, as shown in Figs. 2 and 3, or have a flat-topped top portion 21, as shown in Figs. 4 and 5. Since the bonding cap 2 is connected to the front end of the spark-plug body 1 by means of welding or bonding, each of the fixing legs 23 is provided at a free end with a centered triangle-sectioned or round-sectioned strip of pre-connection material 24. A plurality of pointed-topped discharge dots 26 are provided at an inner wall surface of the top portion 21 around the tip release hole 22 and are coated with a special metal material to enable concentrated discharge and improved discharge effect.

[0016] Fig. 5 is a three-view drawing showing another embodiment of the bonding cap 2 for the spark plug of the present invention. The bonding cap 2 of this second embodiment is generally structurally similar to the first

embodiment shown in Fig. 4, except that the fixing legs 23 are provided along an inner lower edge of their respective free ends with an axially extended flange 25 adapted to wedge into the front end of the spark-plug body 1, so that the bonding cap 2 can be well fixed to the spark-plug body 1 by way of welding or bonding.

[0017] After the bonding cap 2 is assembled to the spark-plug body 1, the top portion 21 of the bonding cap 2 is located over the central tip 15 of the spark-plug body 1, and together with the spaced fixing legs 23 enclose a small room that functions like a small and opened pre-combustion chamber 3. Meanwhile, spaces 31 between any two adjacent fixing legs 23 provide good heat radiating effect and allow smooth flows of air into and out of the pre-combustion chamber 3.

[0018] The spark plug of the present invention is characterized in the generally arched bonding cap 2. This structure enables the domed or flat-topped top portion 21 and the central tip 15 of the spark-plug body 1 to maintain a fixed and required spark-ignition gap between them. The fixed spark-ignition gap together with the pointed discharge dots 26 around the tip release hole 15 and the spaces 31 between adjacent fixing legs 23 enable the spark plug of the present invention to have the following advantages:

1. The spark-plug body 1 and the fixing legs 23 of the bonding cap 2 over the spark-plug central tip 15, which may be made of a zirconium alloy, are tightly connected to each other to form the small pre-combustion chamber 3. When the spark plug of the present invention is mounted onto an engine combustion chamber 4, as shown in Fig. 6, the spark-plug body 1 starts igniting in the engine combustion chamber 4 when an engine piston 41 has been compressed to an upper dead center in its travel. Flames of ignited and exploded mixture in the engine combustion chamber 4 propagate from the room enclosed by the bonding cap 2 into the whole engine combustion chamber 4 via the spaces 31 between adjacent fixing legs 23 to enable complete combustion of the mixture in the engine combustion chamber 4.

2. The bonding cap 2 and the central tip 15 of the spark-plug body 1 always maintain between them a gap best for spark ignition, so that the flames of the ignited mixture are more stable to enable an upgraded thermal efficiency of the engine and an extended usable life of the spark-plug body 1.

3. The bonding cap 2 connected to the front end of the spark-plug body 1 does not have any negative influence on the engine combustion chamber 4 to which the spark plug is mounted. As a matter of fact, since the bonding cap 2 has the pre-ignition function and provides good heat radiating effect, it fully meets an original design requirement of the engine

combustion chamber 4 for the same to breath more smoothly and thereby enable complete combustion of mixture therein to meet the environmental protection requirement. Moreover, the engine combustion chamber 4 shall have an increased compression ratio to provide an enhanced engine performance.

4. The spaced fixing legs 23 of the bonding cap 2 enable the bonding cap 2 to provide the functions of a turbulence stimulator and a turbulence combustion chamber for the air taken into the engine, so that the mixture in the engine combustion chamber 4 produces turbulent flows to enable good combustion, upgraded engine horsepower and torque output, reduced exhaust pollution, and reduced fuel consumption of the engine.

5. The bonding cap 2 functions like an opened pre-combustion chamber 3 to enable easy ignition of sparks from the a plurality of discharge dots 26 surrounding the tip release hole 22, so that mixture in the opened pre-combustion chamber 3 explodes beforehand for the flames to propagate via the spaces 31 between the fixing legs 23 of the bonding cap 2 into the engine combustion chamber 4 to completely burn the mixture therein, and thereby enables good combustion, upgraded engine horsepower and torque output, reduced exhaust pollution, and reduced fuel consumption of the engine. Moreover, amounts of CO, HC, NOx, etc. contained in the exhaust of the engine are reduced.

[0019] The spark plug of the present invention has been proven in vehicle engine durability tests conducted over a long period for more than eighty thousand kilometers to have a usable life much longer than that of a conventional spark plug. This fact together with the above-mentioned advantages, including good combustion, upgraded engine horsepower and torque output, reduced exhaust pollution, and reduced fuel consumption of the engine, make the present invention superior to the conventional spark plugs and more practical for use.

[0020] The present invention has been described with some preferred embodiments thereof and it is understood that many changes and modifications in the described embodiments can be carried out without departing from the scope and the spirit of the invention as defined by the appended claims.

Claims

1. A spark plug, comprising a spark-plug body (1) and a spark-plug bonding cap (2) connected to a front end of said spark-plug body; said spark-plug body (1) including, from a rear end

5 to a front end thereof, a nipple (11), a porcelain insulator (12), a middle hexagonal body nut (13), a diameter-reduced threaded portion (14), and a central tip (15) enclosed in said porcelain insulator to forward project from a center of the threaded portion; and

10 said spark-plug bonding cap (2) including a top portion (21) having a tip release hole (22) formed at a center thereof, a plurality of fixing legs (23) radially spaced along an outer periphery of said top portion for connecting to said spark-plug body, and a plurality of pointed-topped discharge dots (26) provided at an inner wall surface of said top portion around said tip release hole to enable concentrated discharge; and

15 said bonding cap (2) being located over said central tip (15) of said spark-plug body (1) to together with said fixing legs (23) enclose a room that functions like a pre-combustion chamber (3), and spaces (31) between any two adjacent ones of said fixing legs enabling good heat radiation and smooth flows of air into and out of said pre-combustion chamber.

2. The spark plug as claimed in claim 1, wherein said 25 fixing legs (23) of said bonding cap (2) are in the shape of a curved rectangle or trapezoid, and are three in number to extend from an outer periphery of said top portion (21) and radially equally space from one another by 120 degrees, and wherein said fixing legs are provided at respective free ends with a centered strip (24) of pre-connection material that may have a triangular or a round cross section.

3. The spark plug as claimed in claim 1, wherein said 35 fixing legs (23) of said bonding cap (2) are in the shape of a curved rectangle or trapezoid, and are three in number to extend from an outer periphery of said top portion (21) and radially equally space from one another by 120 degrees, and wherein said fixing legs (23) are provided at respective free ends with a centered strip (24) of pre-connection material that may have a triangular or a round cross section.

40 3. The spark plug as claimed in claim 1, wherein said fixing legs (23) of said bonding cap (2) are in the shape of a curved rectangle or trapezoid, and are three in number to extend from an outer periphery of said top portion (21) and radially equally space from one another by 120 degrees, and wherein said fixing legs (23) are provided along an inner lower edge of respective free ends with an axially extended flange (25) adapted to wedge into the front end of said spark-plug body (1), so that said bonding cap (2) can be well fixed to said spark-plug body (1) by 45 way of welding or bonding.

4. The spark plug as claimed in claim 1, wherein said bonding cap (2) is an arched member.

50 5. The spark plug as claimed in claim 1, wherein said top portion (21) of said bonding cap (2) has a domed top.

55 6. The spark plug as claimed in claim 1, wherein said top portion (21) of said bonding cap (2) has a flat top.

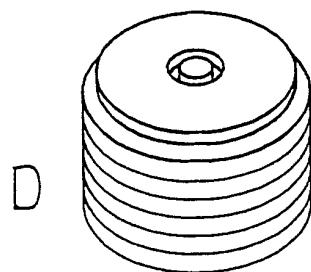
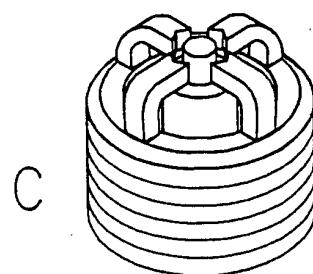
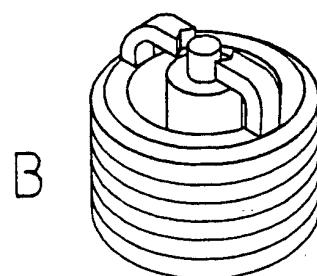
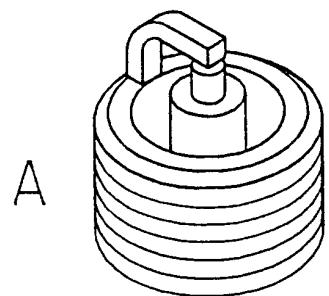


FIG.1
Prior Art

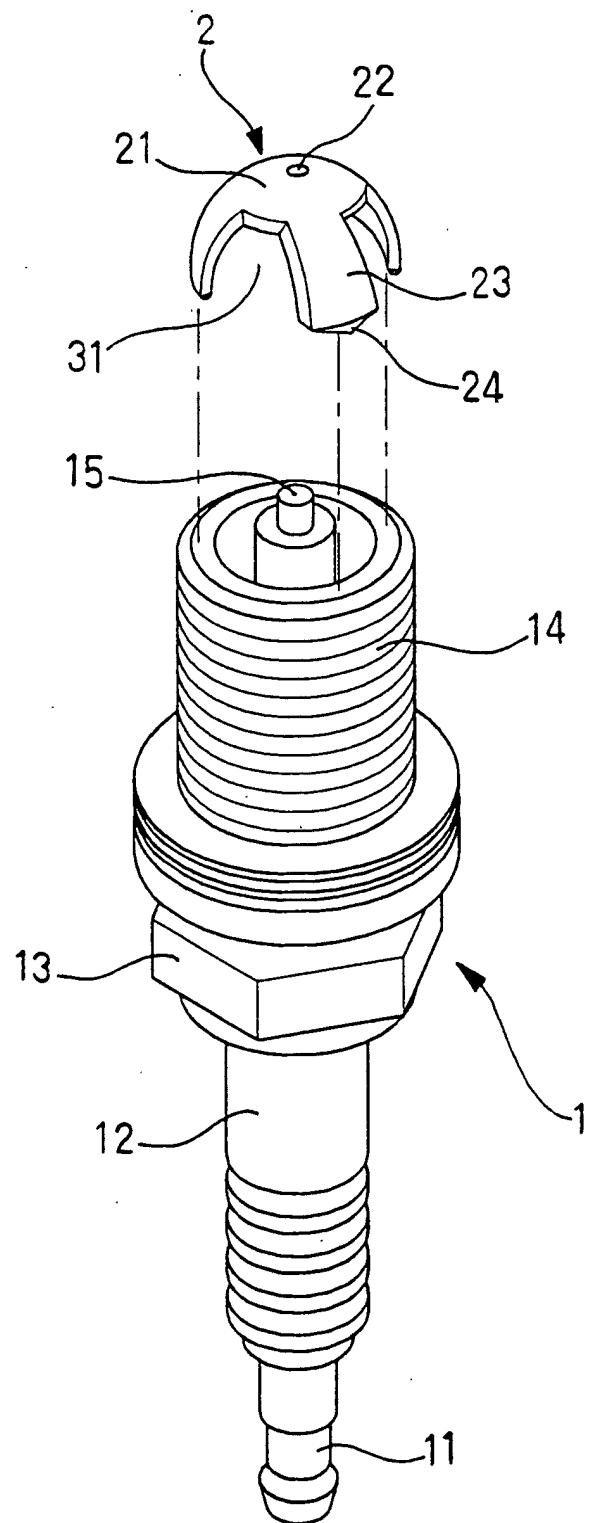


FIG. 2

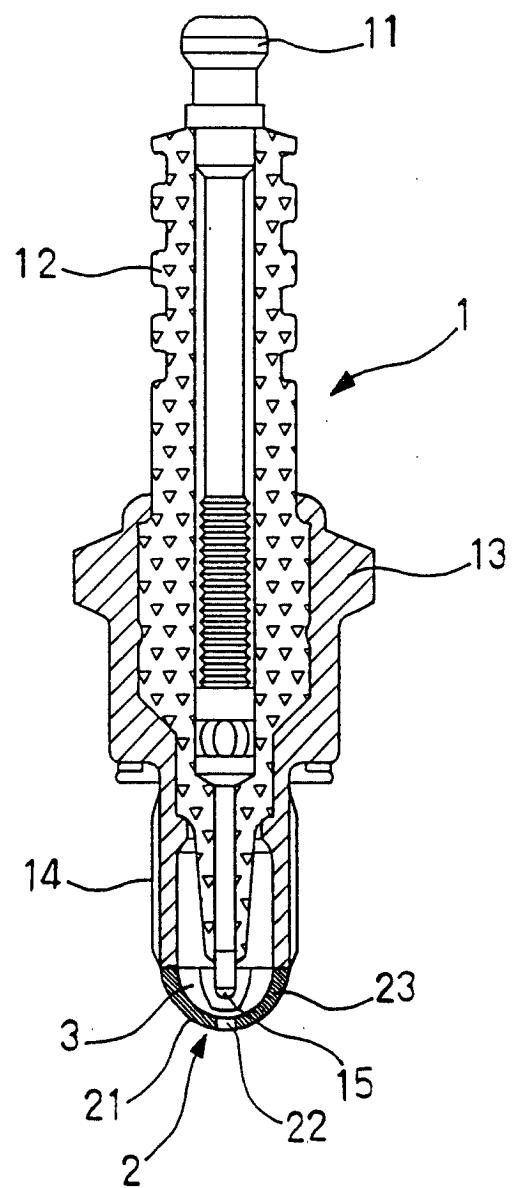


FIG. 3

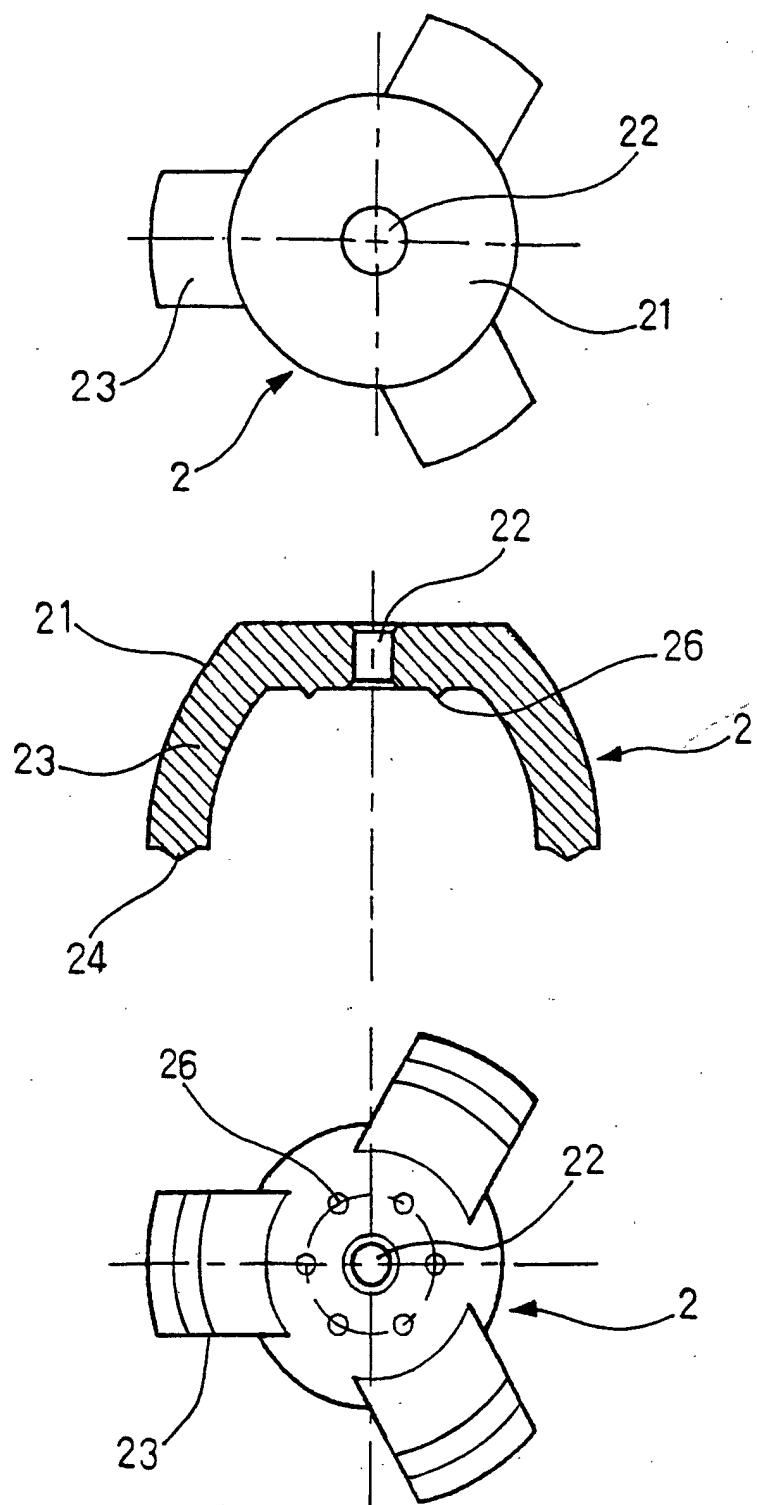


FIG. 4

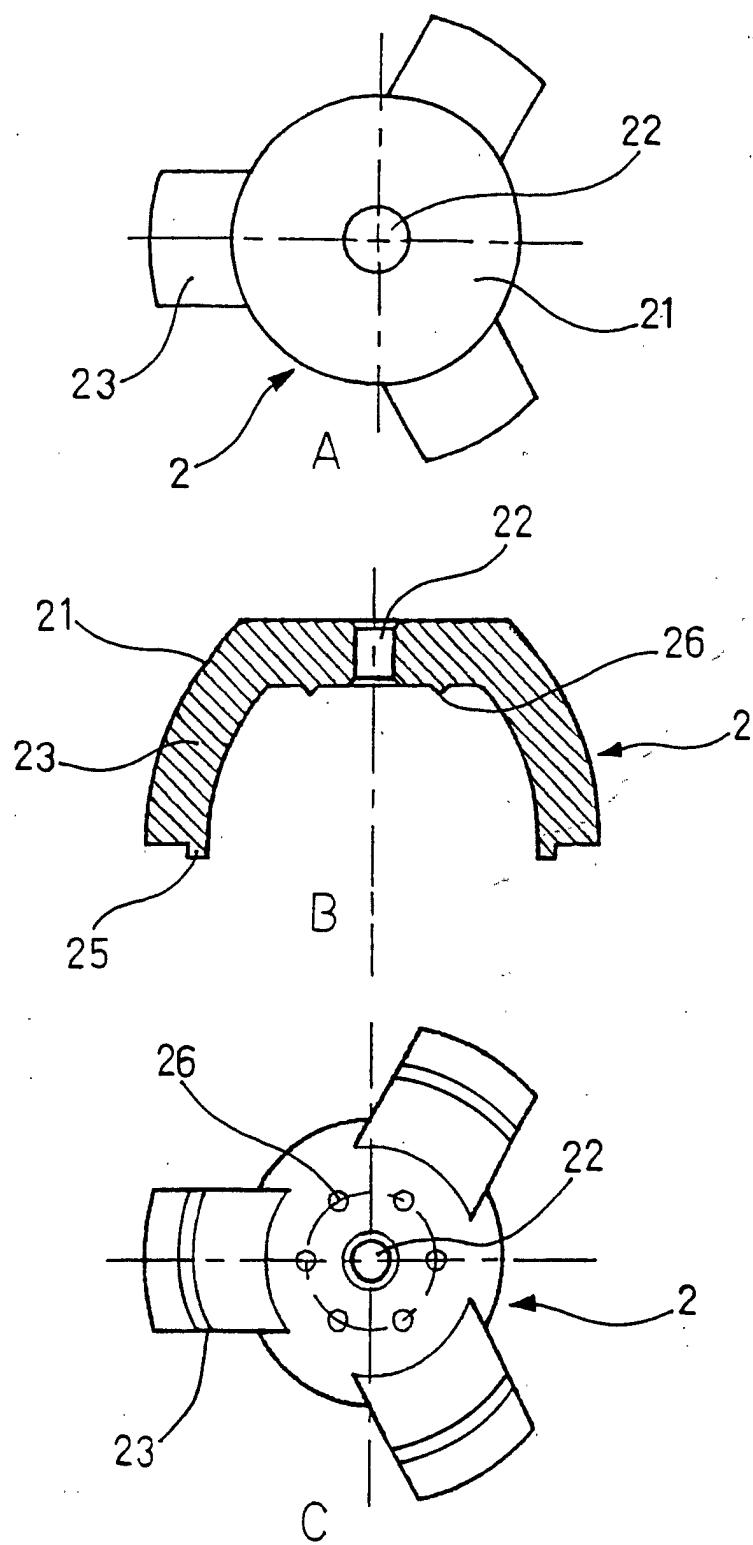


FIG. 5

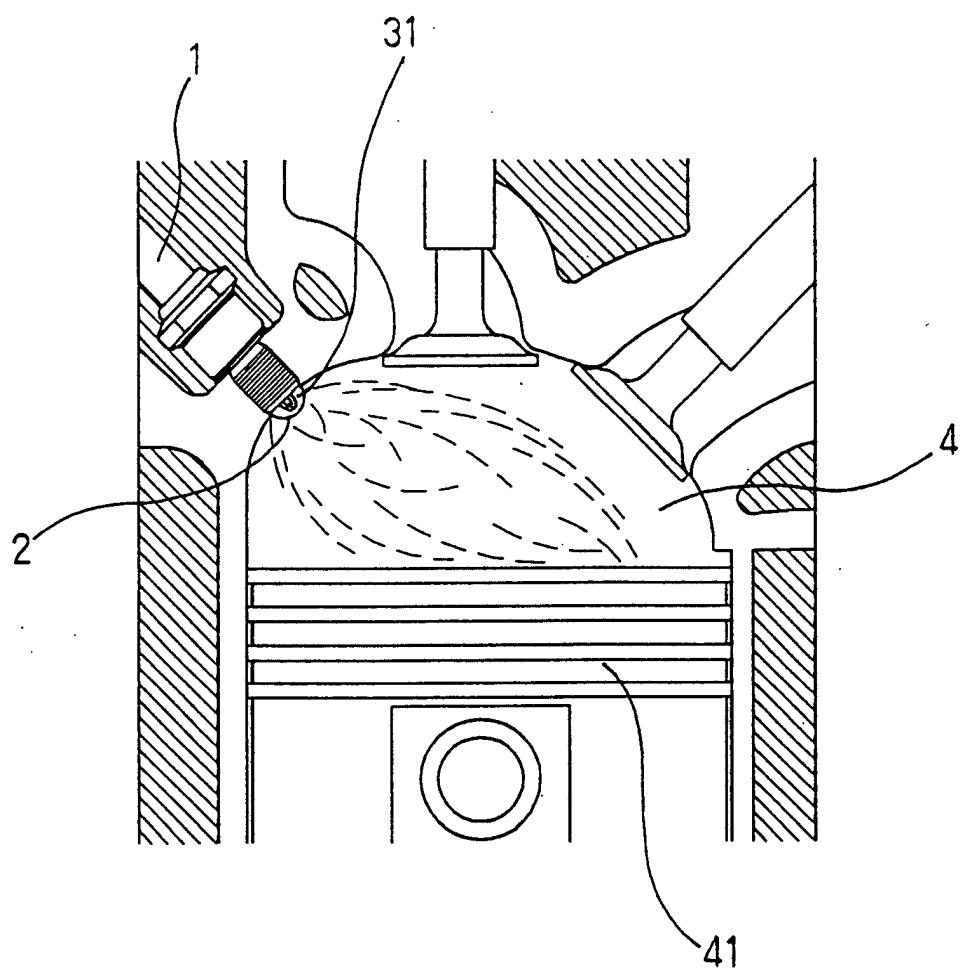


FIG. 6



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 4 808 878 A (KASHIWARA TAKEAKI ET AL) 28 February 1989 (1989-02-28) * column 2, line 20 - column 3, line 49; figures 1,3 * * column 3, line 64 - column 4, line 2; figure 6 *	1	H01T13/54 H01T13/46
A	US 1 360 294 A (HILL) 30 November 1920 (1920-11-30) ---		
A	FR 1 013 076 A (LANDON FRANCOIS) 22 July 1952 (1952-07-22) -----		
TECHNICAL FIELDS SEARCHED (Int.Cl.7)			
H01T			
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search		Examiner
THE HAGUE	27 January 2003		Bijn, E
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FR 1013076	A	22-07-1952		NONE		

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