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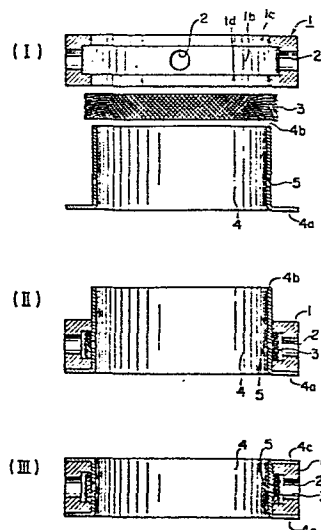
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54 **A fit-on type attachment ring assembly for an engine spark plug unit.**

57 The assembly is positioned on the spark plug between the latter and a cylinder cover of an internal combustion engine and comprises a ring (1) having an internal annular groove (1b) for reception of a dust-preventing fine wire gauze net strip (3) overlapped at its ends and at least one radial air passage (2) extending through the inner wall of the annular groove. The assembly also comprises a hollow cylinder (4) mechanically coupled with the ring and having integral outwardly extending end flanges (4a, 4c) and at least one air passage (5) extending through the cylindrical wall thereof. The ring and hollow cylinder are made of a base metal, e.g. copper, and the ring has a surface layer of a precious metal, e.g. nickel on at least the outer surfaces at both its ends contacting the inside surfaces of the end flanges of the hollow cylinder. The assembly provides a spark spreading electromagnetic effect at spark electrodes of the plug and a small supply of a secondary air from outside and through thread gaps between the spark plug and the engine cylinder cover and towards the spark electrodes at the instance of fuel-air mixture.

FIG. 2



1.

A FIT-ON TYPE ATTACHMENT RING ASSEMBLY FOR
AN ENGINE SPARK PLUG UNIT"

This invention relates to an improved fit-on type attachment ring assembly to be detachably fitted to a conventional engine ignition plug unit.

5 Various attempts have been made among those skilled in the art to improve the fuel consumption efficiency.

It is an object of the invention to provide an ignition plug attachment ring which modifies electrostatically the ignition sparks towards improved fuel combustion efficiency.

10 It is further object of the invention to provide the above kind of plug attachment ring which induces from outside of the engine cylinder a very small amount of secondary air at the very moment of the fuel ignition stage and in proximity to the ignition electrodes for
15 improving the fuel combustion economy.

The invention provides a fit-on type attachment ring assembly for an engine spark plug unit and to be positioned between the latter and a cylinder cover of an internal combustion engine, characterized by a combination of a ring having an internal annular groove for
20 reception of a dust-preventing fine wire gauze net and

at least one radial air passage extending through the inner wall of said annular groove, and a hollow cylinder of a base metal and mechanically coupled with said ring, said hollow cylinder having integral outwardly extending end flanges and at least one air passage extending through the cylindrical wall thereof, said ring having a surface layer of a precious metal formed on at least the outer surfaces at its both ends contacting the inside surfaces of said end flanges of said hollow cylinder, for thereby providing a spark spreading electromagnetic effect at spark electrodes of the plug and a small supply of secondary air from outside and through thread gaps between the spark plug and the engine cylinder cover and towards the spark electrodes at the instance of fuel-air mixture.

Preferably, the precious metal layer is of platinum, gold, silver, nickel, cobalt or nickel-cobalt. However, other similar precious metal or metals may also be used.

Preferably, said base metal is copper, gun-metal or bronze.

Preferably, the net is in the form of a strip overlapped at its ends.

As seen from the foregoing, the attachment ring assembly of the present invention comprises a metal ring, preferably made of copper, gun-metal, bronze or the like, and formed with a precious metal layer applied at least on each of its end surfaces. In practice, however, the whole exposed surfaces of the ring may be coated with the precious metal layer for easier coating technique, as well as, for improved appearance. The attachment ring assembly also comprises a cylinder piece made of a base metal such as copper and formed with radially outwardly extending end flanges which are kept in tight contact with the precious metal layers on the upper and lower end surfaces of the ring thereby forming two electrostatic voltage-

generating couples, copper and nickel as an example. This statical minor voltage generates and maintains electromagnetic fields around the plug male threads and ignition electrodes, so as to spread out the ignition sparks when the these electrodes are periodically discharged. This spark-spreading effect leads effectively the fuel consumption efficiency of the engine according to our knowledge.

Also, the ring assembly according to this invention is formed with at least one secondary air inducing passage leading from outside to the mating thread gaps between the plug male threads and the cylinder cover female threads which fine thread gaps form a kind of air passage. When the fuel-air mixture is ignited with electrical sparks, it is believed that a vacuum is generated around the spark electrodes only instantly. This high vacuum core will induce a very slight amount of secondary air from outside through the said air passages and plug thread gaps towards the spark electrodes. This secondary air acts as a kind of igniton catalyzer according to our belief and accelerates the combustion efficiency. The amount of secondary air induced into the engine cylinder at the very instance of fuel ignition is believed to be 0.01 - 0.03% of the primary combustion air according to our practical measurements.

By attaching the attachment ring in a fit-on manner to a conventional ignition plug, the compression ratio will be reduced. As an example, when the height of the attachment ring amounts to 2.5 - 3 mm, the compression ratio reduction may be in the order of 0.5. Theoretically, this compression ratio reduction may be believed to reduce the fuel consumption rate substantially in corresponding manner.

While internal combustion engines are designed for

best fuel, commercially available gasolines are rather inferior and thus give rise to frequent knockings. With use of the attachment ring, however, these engine knockings may be reduced to a possible minimum. On the other hand, 5 the spark electrodes are always kept in carbonless conditions when the plug is fitted with an attachment ring according to this invention, and on account of best conditions of fuel combustion attainable with use of the attachment ring. By the use of the attachment ring, 10 the fuel consumption efficiency could amount to 7 - 11%. NO_x and the like exhaust gas troubles have in addition been improved substantially.

The invention will now be more particularly described, by way of example, with reference to the 15 accompanying drawings, wherein:-

Figure 1 is an exploded perspective view of three main constituent elements of a preferred embodiment of an attachment ring assembly according to the present invention,

20 Figure 2, (I), (II) and (III), represent three successive steps for assembling these three main constituents elements into a complete ring assembly,

Figure 3 is a perspective view of the completed ring assembly,

25 Figure 4 is an elevational view of a spark plug unit fitted with the ring assembly shown in Figures 1 - 3, and

Figure 5 is an exploded substantially sectional view of the plug ring assembly for the explanation of the generation of static electrical voltages so as to 30 provide a spark spreading-out effect.

In Figure 1, numeral 1 represents a ring made of a base or imperfect metal such as copper, bronze, gun metal or the like and coated with a precious metal

such as platinum, gold, silver, nickel, chromium, or the like. In practice, however, nickel, chromium or nickel-chromium alloy or double layer, may be used for economical reasons. The outer surface is serrated or the like as at 1a, thereby providing a frictional touch to the operator's finger.

On the inside surface of the ring 1, there is provided an annular groove 1b, thereby providing upper and lower, inwardly projecting flanges 1c and 1d.

A plurality of radial openings 2 are drilled through the inner wall of the annular groove 1b, and the openings 2 will serve as secondary air introducing passages from outside, as will be more fully set forth.

There is generally between 2 and 8 of said openings 2, although only one may be provided under certain circumstances.

Numeral 3 represents a fine-mesh, wire gauze net strip which can be introduced into the annular groove 1b in a slightly overlapped manner at its ends. The necessary positioning can be automatically secured by the inherent resilience of the wire gauze net 3 which is made, preferably, of stainless steel.

Numeral 4 represents a flanged cylinder to be coupled with the ring proper 1. This flanged cylinder 4 is also made of base metal, preferably copper. At the bottom end, this cylinder 4 is formed with an outwardly projecting bottom flange 4a. One or more radial openings 5 are drilled through the cylindrical portion of the cylinder 4 at a position between its ends these radial openings serving as part of an air introducing passage in service.

These three elements 1, 3 and 4 are sub-assembled together, as shown in Figure 2 at (I) and (II) and then, the upwardly projecting end portion 4b of the flanged

hollow cylinder 4 is bent under pressure radially and outwardly, so as to form an upper flange 4c, as shown at (III) of Figure 2, as well as in Figure 3, in which, the serrations are shown in parallel line configuration at 1a', while in Figure 1, these serrations are shown in diamond configuration.

In Figure 4, the attachment ring 1 is detachably fitted on a conventional ignition plug 6 comprising an upper connection terminal 6a electrically connected to a centre electrode 7 by a centre electrode, not shown, which is supported by a ceramic sleeve 6b. An opposite spark electrode 8 is arranged with its tip end adjacent to the centre electrode 7.

The spark electrode 8 is integral with a depending male threaded metal sleeve 6c which is integral with a nut-and-ring portion 6d.

The attachment ring 1 is directly coupled with the ignition plug 6 in an tightly contacting way at the lower end portion of the the nut-and-ring portion 6d, and without insertion of a conventional tightening washer.

Figure 5 is an exploded schematic view of several parts of the attachment of the attachment ring, relative to the conventional plug and engine cylinder cover.

In Figure 5, numeral 6 represents an ignition plug as before, while numeral 9 represents a related part of an engine cylinder cover.

When the main constituent parts of the attachment ring 1 are composed of copper and the surface coating is of nickel, there is formed the following series of static electromotive forces:

- (1) between upper copper flange 4c and nickel surface of the ring 1 +1.89 mV
and - 1.48 mV

(2) between nickel surface of the ring 1
and lower copper flange - 1.48 mV
and + 1.89 mV

(3) between lower copper flange and
5 Fe-cylinder cover + 1.89 mV
and + 0.76 mV

In total, the balance will be:

$$\begin{array}{r}
 + 1.89 \\
 - 1.48 \\
 \hline
 + 0.41 \\
 + 0.76 \\
 + 1.89 \\
 \hline
 + 3.06 \text{ mV/100}^\circ\text{C}
 \end{array}$$

When the attachment ring and the cylinder cover
15 are at 200°C under the service conditions of the engine,
the electromotive force will be 6.12 mV. This electro-
motive force will generate electromagnetic fields
around the male screwed lower portion and the ignition
electrodes of the ignition plug, as shown at B in
20 Figure 5. The formation of electromagnetic field B
contributes to spread out the ignition sparks and to
serve for increasing the fuel combustion efficiency.
A and A' shown in Figure 5 represent only schematically
the formation of intermediate electromagnetic fields
25 around the attachment ring.

When the engine operates, a slight amount of
secondary air is introduced from outside through
openings 2 and 5 and through the inside hollow space
of flanged cylinder 4 and further through the screw gaps
30 between the plug screw 6c and corresponding female threads
in the engine cylinder, not shown, and into the space
around the spark electrodes 7 and 8, at the very instance
of fuel combustion initiation stage. In this case, it
is believed that a strong and instantaneous vacuum core

will occur to take place around the spark electrodes at the moment of the fuel ignition. According to our measurements, the intake volume of secondary air amounts in the order of 0.01 - 0.03%, by volume, of the primary air volume. This secondary intake air, although seemingly very small, contributes to accelerate the fuel combustion, because the included oxygen gas acts as a kind of catalyzer in the combustion of the gaseous mixture.

10 The insertion of the inventive attachment in place of the conventional seating washer will naturally reduce the compression ratio of the engine. In contrast to the theory, this will rather increase the combustion efficiency, because, generally speaking, rather inferior
15 gasolines are sold and available on the market. In this case, a higher compression ratio may lead frequently to engine knocking.

1.

CLAIMS:

1. A fit-on type attachment ring assembly for an engine spark plug unit and to be positioned between the latter and a cylinder cover of an internal combustion engine, said ring assembly being characterised by a combination of a ring (1) having an internal annular groove (1b) for reception of a dust-preventing fine wire gauze net (3) and at least one radial air passage (2) extending through the inner wall of said annular groove, and a hollow cylinder (4) made of a base metal and mechanically coupled with said ring, said hollow cylinder having integral outwardly extending end flanges (4a, 4c) and at least one air passage (5) extending through the cylindrical wall thereof, said ring having a surface layer of a precious metal formed on at least the outer surfaces at both its ends contacting the inside surfaces of the end flanges of the hollow cylinder, for thereby providing a spark spreading electromagnetic effect at spark electrodes of the plug and a small supply of a secondary air from outside and through thread gaps between the spark plug and the engine cylinder cover and towards the spark electrodes at the instance of fuel-air mixture.
2. The attachment ring assembly of claim 1, characterised in that said precious metal layer is of platinum, gold, silver, nickel, cobalt or nickel-cobalt.
3. The attachment ring assembly of claim 1 or claim 2, characterised in that said base metal is copper, gun-metal or bronze.
4. The attachment ring assembly of anyone of the preceding claims, characterised in that the net (3) is in the form of a strip overlapped at its ends.

FIG. 1

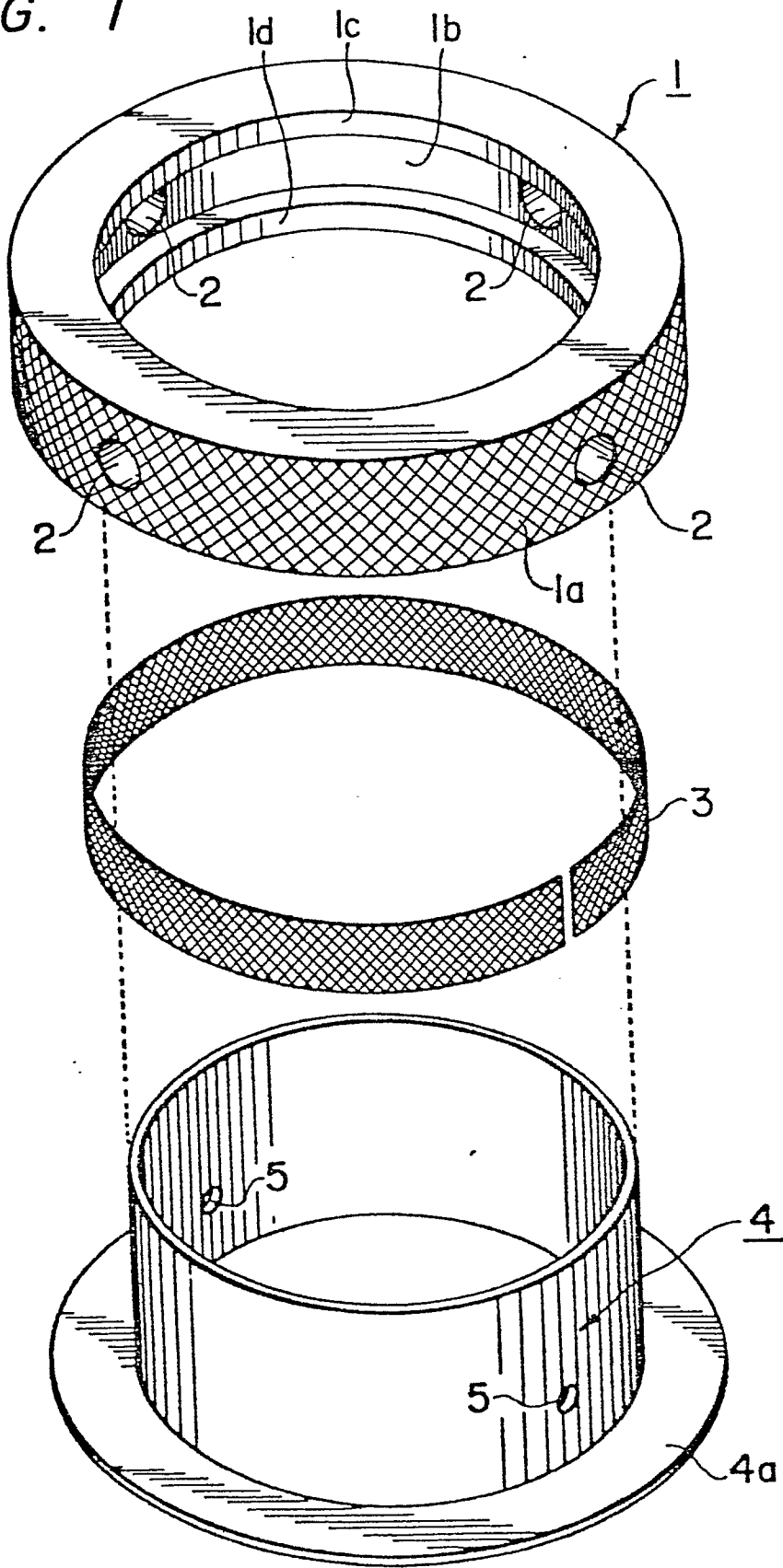


FIG. 2

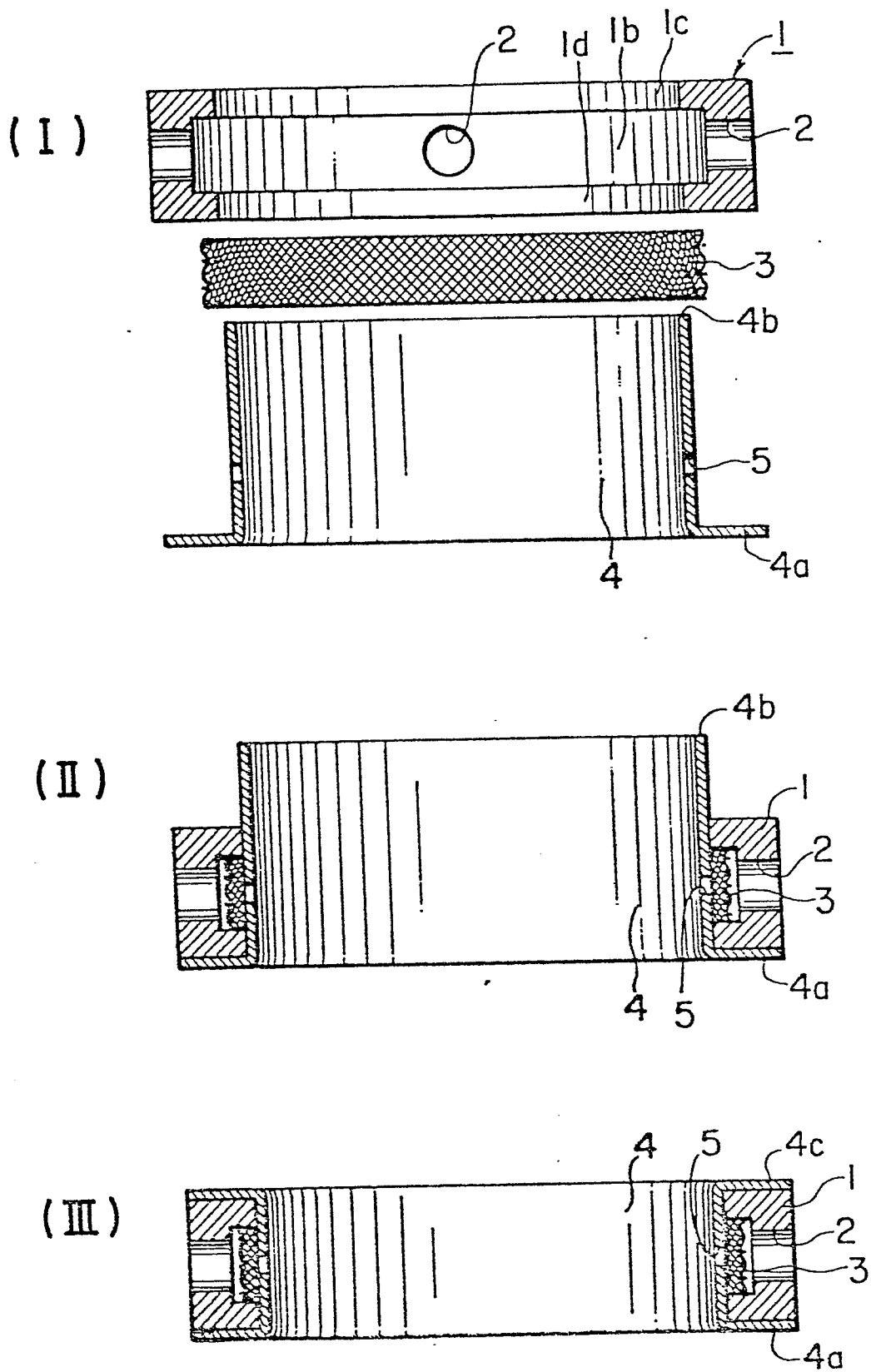


FIG. 3

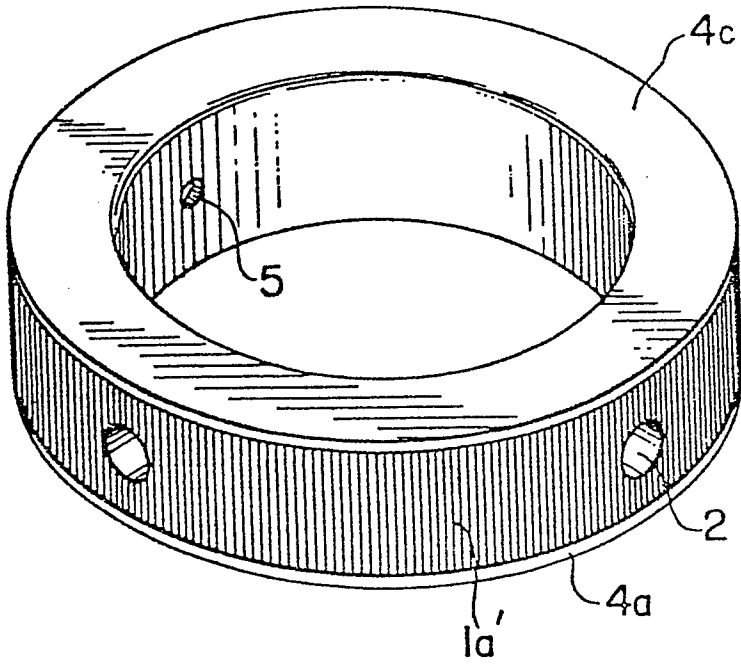


FIG. 4

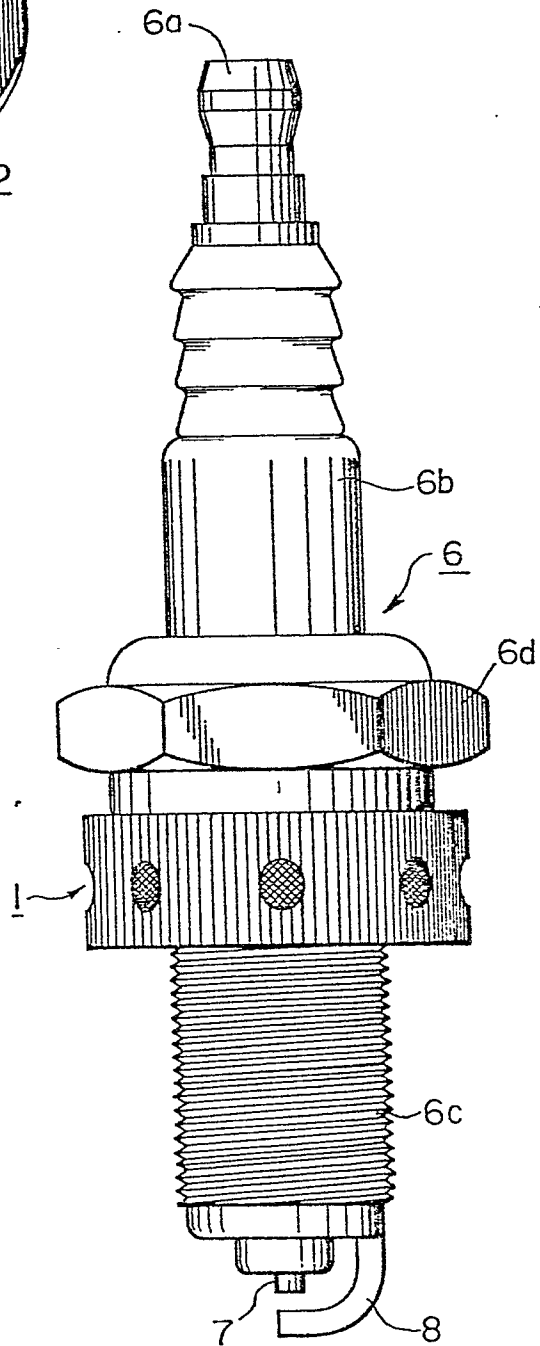
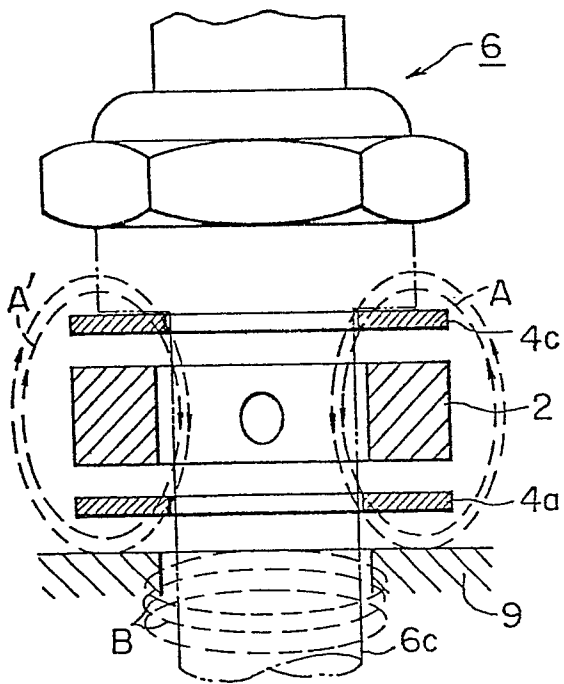


FIG. 5





DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	<u>US - A - 4 214 567</u> (GOTO) * Column 2, line 66 - column 3, line 66; figures 4-6 *	1	H 01 T 13/08
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A	<u>US - A - 4 232 242</u> (HSU) * Column 2, line 15 - column 3, line 20; figure 1 *	1	
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A	<u>GB - A - 2 017 816</u> (IDK) * Page 1, lines 37-70; figures 1,2 *	1	

			TECHNICAL FIELDS SEARCHED (Int Cl.)
			H 01 T 13/08
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family. corresponding document
☒ The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
The Hague	02-12-1981	BIJN	