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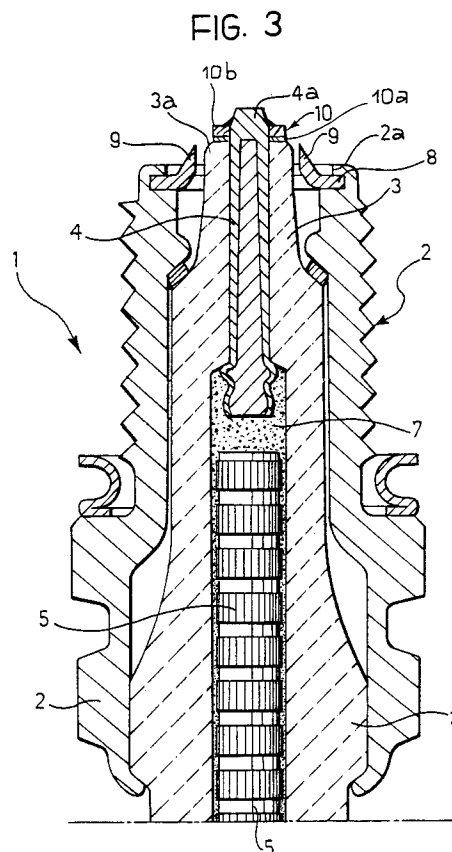
71 Applicant: **INDUSTRIE MAGNETI MARELLI**
S.p.A.
Via Griziotti, 4
I-20145 Milano (IT)

72 Inventor: **Rossi, Roberto**
Via Lambrate, 15
I-20131 Milano (IT)

74 Representative: **Serra, Francesco et al**
c/o **JACOBACCI & PERANI S.p.A.**
Corso Regio Parco, 27
I-10152 Torino (IT)

⑤4 **A spark plug.**

57) An annular element (10) constituted by a bimetal laminate having a first layer (10a) of a noble material and a second layer (10b) of a non-noble metal such as nickel or an alloy thereof is disposed, in an electrically conductive relationship with the central electrode (4), around the portion of the central electrode (4) which projects from the insulating element (3a, 3) so that, in operation, the spark or sparks are struck between the annular element (10) and the earth electrode or electrodes (9).



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The present invention relates to spark plugs for internal combustion engines with controlled ignition.

More specifically, the invention relates to a spark plug of the type comprising:

an outer, tubular metal body,

a tubular insulating element disposed in the body,

a central electrode which extends through the insulating element and projects axially beyond the end of the insulating element which faces the combustion chamber in use,

at least one earth electrode which extends from the outer metal body towards the side surface of the portion of the central electrode which projects from the insulator, and

an annular element disposed around the projecting portion of the central electrode in an electrically conductive relationship with the central electrode so that, in operation, the spark or sparks are struck between the annular element and the earth electrode.

An object of the invention is to provide a spark plug of this type which is suitable for very much prolonged operation (a "long-life" plug).

"Long-life" plugs are known, the earth electrodes of which extend from the outer metal body of the plug to face the end surface or face of the central electrode according to a well-known geometrical arrangement. Layers of noble metal, typically platinum or an alloy thereof, are welded to this end surface of the central electrode and to the portion of the earth electrode which faces it, and, in use, the spark is struck between these layers.

However, the use of "long-life" plugs of this type has shown some disadvantages; when these plugs are used, in particular, in engines having four valves per cylinder, the vibrations to which they are subject in operation, may cause the plugs to lose their entire earth electrodes which, typically, are welded to the outer metal bodies of the plugs.

In order to eliminate this problem, it was proposed in the Applicant's European patent application No. EP-A-0 480 886 to dispose an annular element constituted by a noble metal or by an alloy thereof around the projecting portion of the central electrode in an electrically conductive relationship with the central electrode so that, in operation, the spark or sparks were struck between the annular element and the earth electrode.

Although a solution such as that just described is optimal from a functional point of view, it has the disadvantage of a high cost because of the noble material used, which is a serious drawback for mass production.

The object of the present invention is to provide a "long-life" plug the cost of which is considerably reduced thus maintaining functionality and endurance characteristics just described.

According to the invention, this object is achieved by a spark plug having the specific characteristics recited in the claims which follow.

Further characteristics and advantages of the invention will become clear from the detailed description which follows, given with reference to the appended drawings, provided purely by way of non-limiting example, in which:

Figure 1 is a perspective view of a spark plug according to the invention,

Figure 2 is a partial axial section taken on the line II-II of Figure 1,

Figure 3 is a sectioned view similar to that of Figure 2, showing a variant of the spark plug according to the invention, and

Figures 4 to 6 are partial axial sections of further variants of the spark plug according to the invention.

In Figure 1, a spark plug according to the invention for an internal combustion engine is generally indicated 1. The plug comprises, in known manner, an outer, tubular metal body 2, a portion of which is threaded externally.

A substantially tubular element 3 of electrically insulating material, typically of ceramic material, (Figure 2) is disposed in the body 2 in known manner. An end portion 3a of the insulating element projects axially beyond the end of the metal body 2 which faces the combustion chamber in use.

A central electrode, indicated 4, extends through a portion of the insulating element 3 and projects axially beyond the end 3a of the insulating element.

A conductive core 5 is also disposed in the insulating element 3; one end of this core projects from the insulating element 3 axially and forms an electrical connection terminal 6.

A conductive or resistive sealing mastic, indicated 7 in Figure 2, is interposed between the central electrode 4 and the conductive core 5 within the insulating element 3.

An annular element of metallic material, onto which a rim 2a of the metal body 2 is turned over, is indicated 8 (Figure 2). The annular element 8 which is made, for example, of a nickel- or copper-based alloy, has a plurality of integral appendages 9 which extend from its inner edge towards the end portion 3a of the insulator in equiangularly spaced positions. These appendages constitute the earth electrodes of the plug.

As an alternative to the solution shown in Figure 2, the annular element 8 with the integral appendages 9 which act as electrodes may be welded to the end of the outer metal body 2 of the plug, for example, by laser welding.

In the embodiment shown by way of example in Figures 1 and 2, the central electrode 4 has a

substantially disc-shaped end head 4a.

An annular element constituted by a bimetal laminate formed by a first layer 10a of noble metal and a second, thicker, layer 10b of less expensive metal, typically of the group comprising nickel and/or its alloys with chrome, for example, Inconel, is indicated 10.

The annular element 10 is disposed around the central electrode 4 between the head 4a thereof and the end 3a of the insulating element 3 (Figure 2). This annular element 10 may simply be fitted around the electrode and then clamped between the head 4a thereof and the insulator 3 or may be disposed around the stem of the central electrode 4 and then welded to the head 4a thereof.

As can best be seen in Figure 2, the arrangement is such that, in operation, the sparks are struck between the annular element 10 and the earth electrodes 9.

The solution described above with reference to Figures 1 and 2 permits the production of "long-life" plugs suitable for covering 80,000 kilometres or more and requires an extremely slight and simple modification of a plug of an already-known type and of the respective existing production lines.

In the variant of Figure 3, the central electrode 4 is generally cylindrical and does not have a head on its end portion which is intended to face the combustion chamber; in order to fix this central electrode to the insulating element and to enable the plug to have a long operating life, an annular element 10 constituted by a bimetal laminate formed as described above is disposed and welded around the end 4a of the electrode 4 which projects from the insulating element 3.

In the variant described above with reference to Figure 3, the arrangement of the annular element 10 is also such that, in operation, the sparks are struck between the annular element and the earth electrodes 9.

Figure 4 shows a variant in which the plug 1 comprises one (or more) substantially arcuate earth electrodes 19 connected (for example, by welding) to the annular end surface of the metal body 2 with their ends facing the annular bimetal laminate element 10 which is welded to the central electrode 4.

In the variant of Figure 4, the end surfaces of the earth electrodes 19 also partially face the ceramic insulating element 3 so that the plug is of the partial-surface discharge type.

In the embodiments of Figures 1 to 4, the annular bimetal laminate element 10 has a smaller diameter than the end 3a of the ceramic insulating element 3.

Figures 5 and 6 show two embodiments similar to those shown in Figure 3 and Figure 4, respectively, but with the bimetal laminate element 10 projecting radially from the end 3a of the insulating

element 3.

These solutions provide better thermal protection for the end or tip 3a of the insulator 3 and eliminate the formation of carbon deposits on the insulating element during cold starting of the engine.

The annular element 10 may be formed by the hot or cold blanking of a bimetal laminate; the layer of noble material 10a is, for example, from 0.1 to 0.2 mm thick and the layer 10b of less expensive material is, for example, between 0.4 and 1 mm thick.

The layer 10a may be made of platinum, platinum-iridium, gold, gold-palladium, silver, or an alloy thereof.

The layer 10b may be made of nickel, or nickel-chrome, or of alloys thereof, for example, Inconel.

In a further embodiment, not shown, the annular element 10 may be replaced by portions of a ring or by a surfacing, also of bimetal laminate, as already described, thus achieving a considerable saving of material.

Clearly, moreover, the formation of the annular element 10 as first described also allows the total thickness to be increased without greatly affecting costs, simply by increasing the thickness of the portion 10b which is of relatively less expensive material. Such an increase in the thickness of the element 10 permits better and safer welding (for example, by laser) of the element 10 to the central electrode 4, at the same time improving the heat dissipation of the central electrode 4.

Naturally, the principle of the invention remaining the same, the forms of embodiment and details of construction may be varied widely with respect to those described and illustrated purely by way of non-limiting example, without thereby departing from the scope of the present invention.

Claims

1. A spark plug comprising:
 - an outer, tubular metal body (2),
 - a tubular insulating element (3) disposed in the body (2),
 - a central electrode (4) which extends through the insulating element (3) and projects axially beyond the end (3a) of the insulating element (3) which faces the combustion chamber in use,
 - at least one earth electrode (9) which extends from the outer metal body (2) towards the side surface of the portion of the central electrode (4) which projects from the insulator (3), and
 - an annular element (10) disposed around the projecting portion of the central electrode (4) in an electrically conductive relationship with the

central electrode (4), so that, in operation, the spark or sparks are struck between the annular element (10) and the at least one earth electrode (9),

characterized in that the annular element (10) is a bimetal laminate, constituted by a first layer (10a) of noble metallic material and by a second layer (10b) of non-noble metallic material, the arrangement being such that the first layer (10a) is nearer than the second layer (10b) to the at least one earth electrode (9).

2. A spark plug according to Claim 1, characterized in that the first layer (10a) of noble material is constituted by gold, platinum, silver, or an alloy thereof.
3. A spark plug according to Claim 1 or Claim 2, characterized in that the second layer (10b) is constituted by nickel or an alloy thereof.
4. A spark plug according to Claim 3, characterized in that the second layer (10b) is constituted by a nickel-chrome alloy, particularly Inconel.
5. A spark plug according to Claim 3 or Claim 4, characterized in that the second layer (10b) is between 0.4 and 1 mm thick.
6. A spark plug according to Claim 1 or Claim 2, characterized in that the first layer (10a) is between 0.1 and 0.2 mm thick.
7. A spark plug according to Claim 1, characterized in that the annular element (10) is formed by discontinuous portions of a bimetal laminate ring.
8. A spark plug according to Claim 1, characterized in that the annular element (10) is formed by a bimetal laminate surfacing.

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FIG. 1

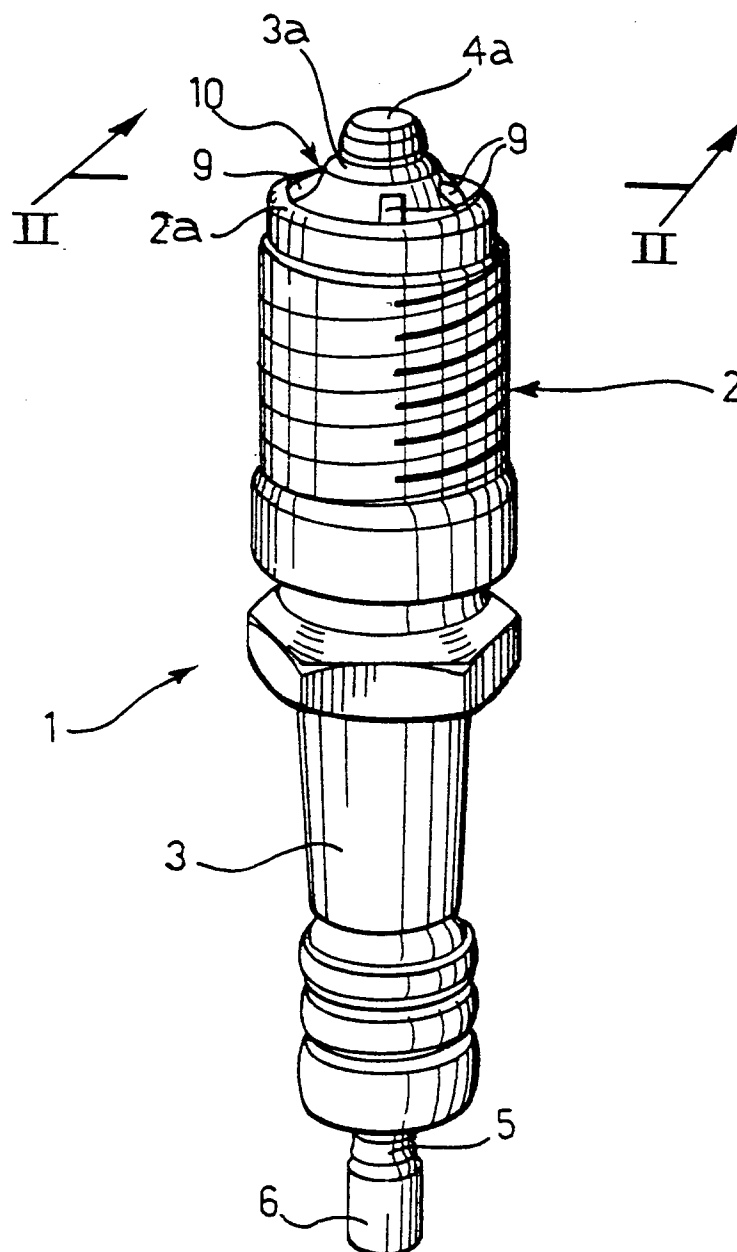


FIG. 2

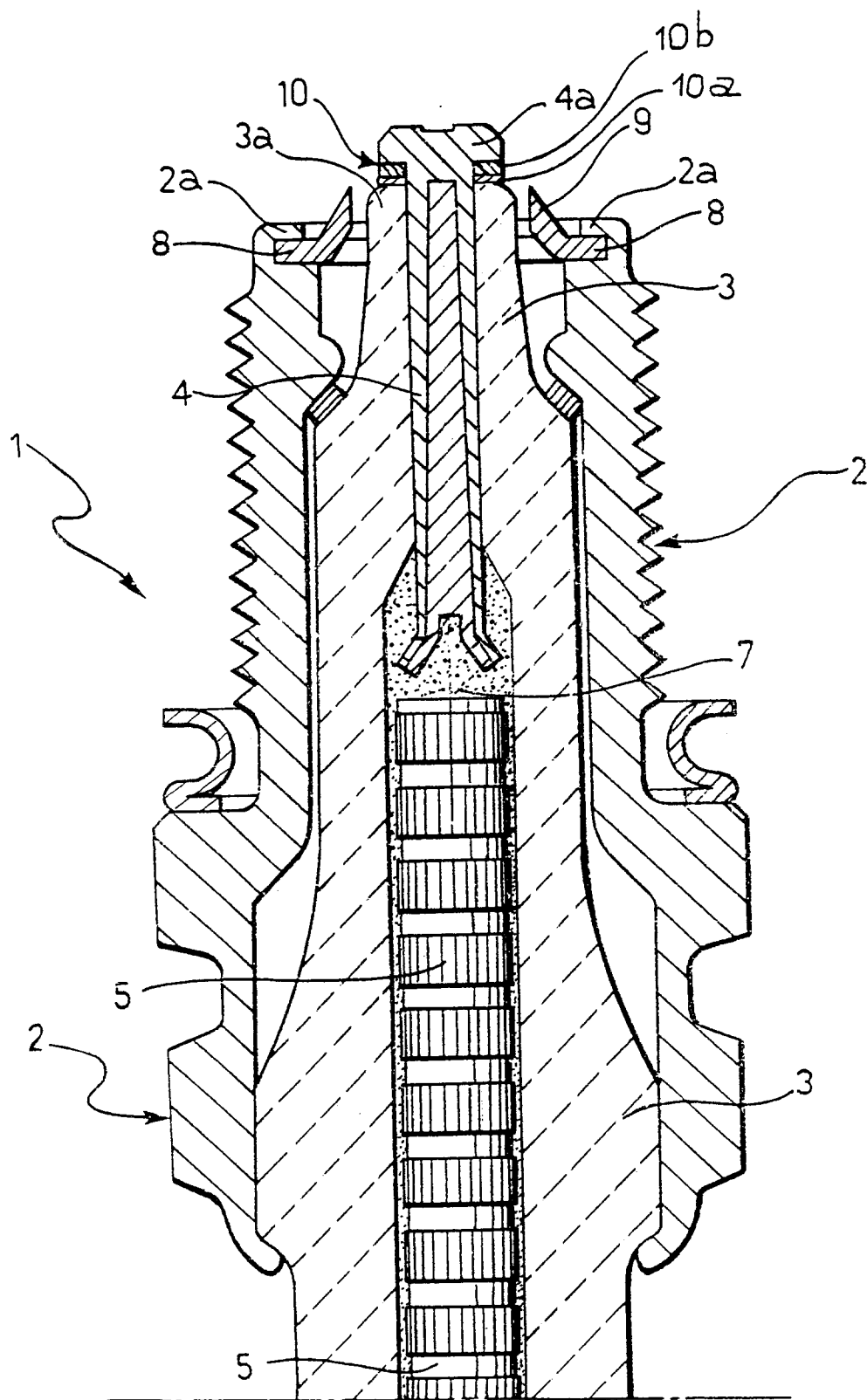
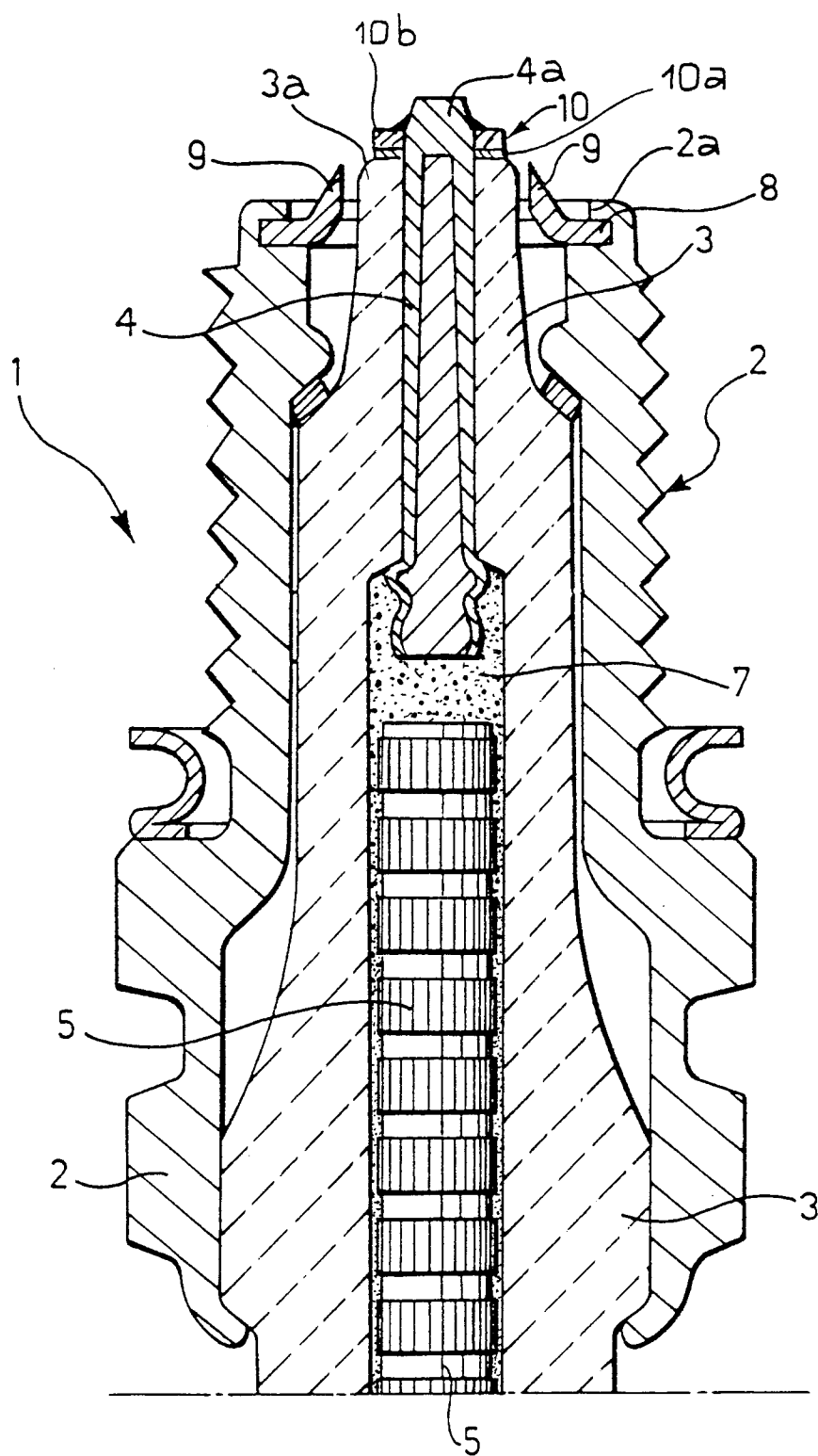
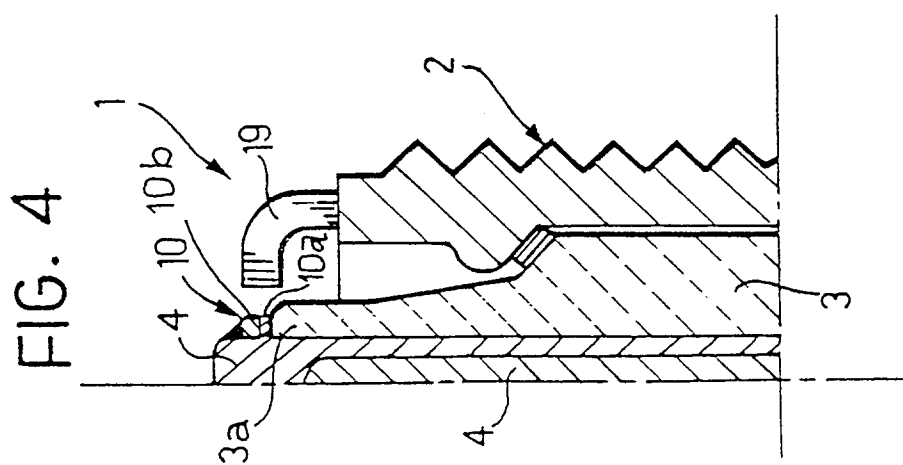
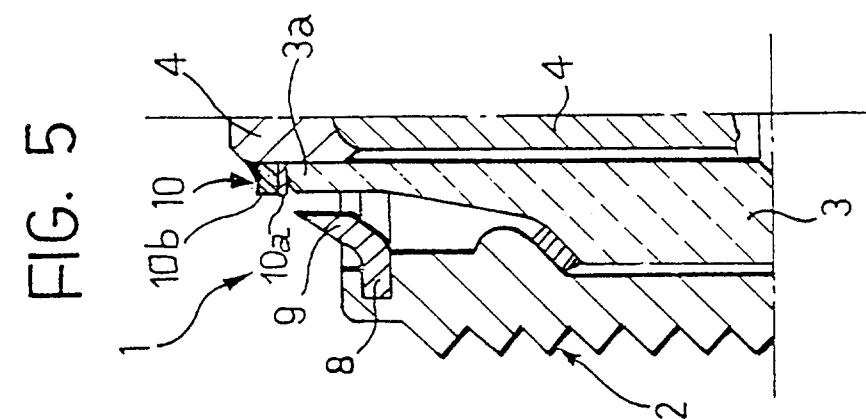
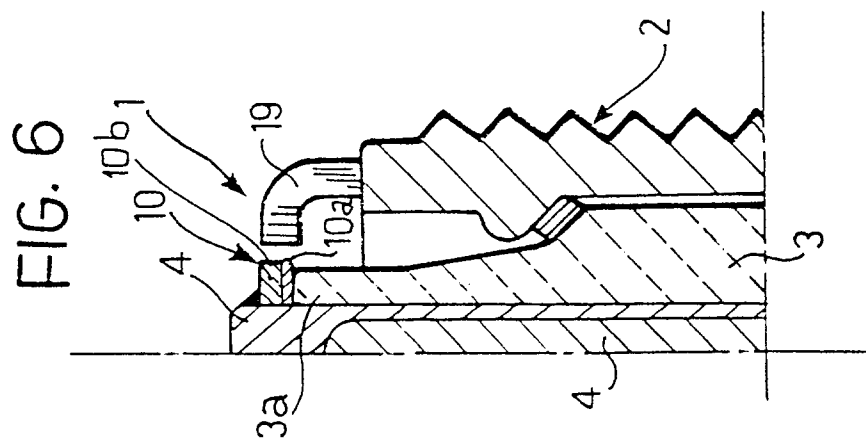


FIG. 3







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EUROPEAN SEARCH REPORT

Application Number
EP 94 10 6786

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.5)
D,A	EP-A-0 480 886 (IND. MAGNETI MARELLI.) * the whole document * ---	1	H01T13/39 H01T13/46
A	FR-A-497 769 (SOC. IND. D'USSEL) * page 1, line 36 - line 47; figure 1 * ---	1	
A	GB-A-578 430 (MALLORY METALLURGICAL PRODUCTS) * page 2, line 24 - line 30; figure 4 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			H01T
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 1 August 1994	Examiner Bijn, E
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	