

Feb. 19, 1935.

B. BERGER

1,991,369

ELECTRIC SPARK IGNITION

Filed Jan. 29, 1932

2 Sheets-Sheet 1

Fig. 1.

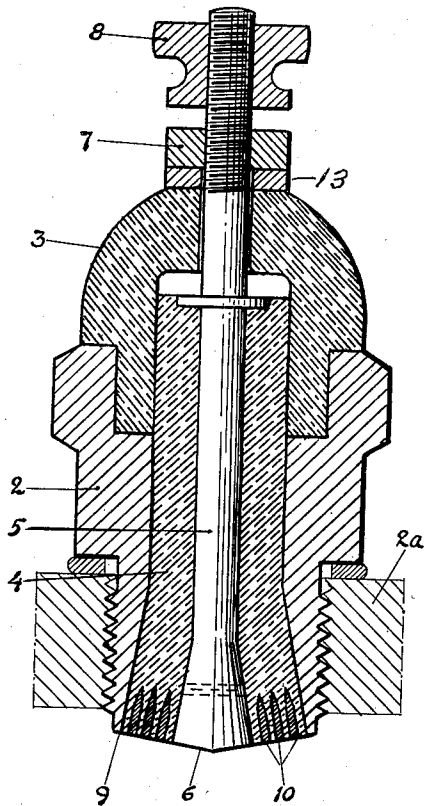


Fig. 2.

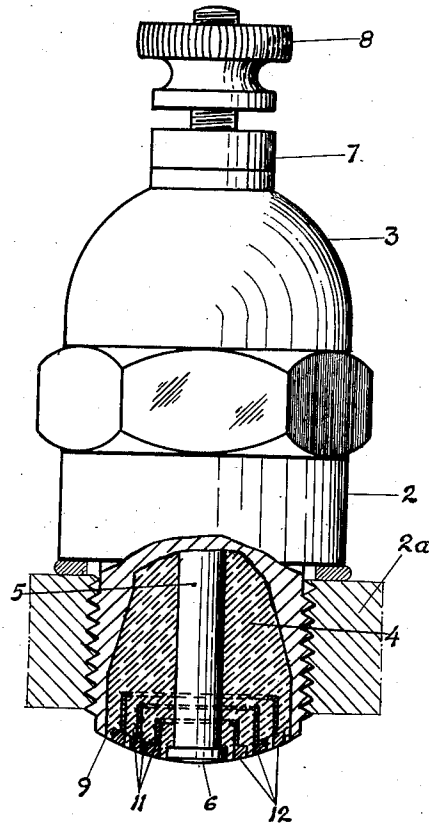
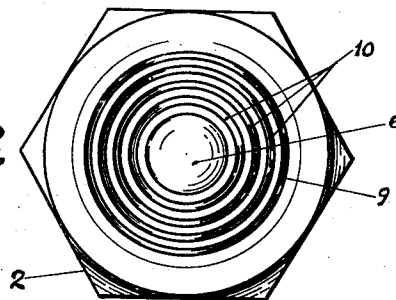


Fig. 3.



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Fig. 4.

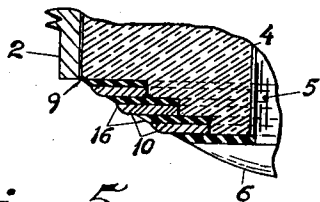
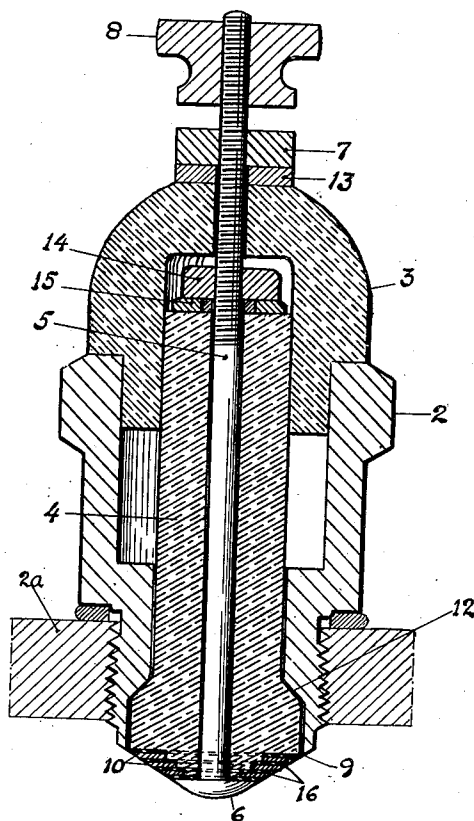


Fig. 5.

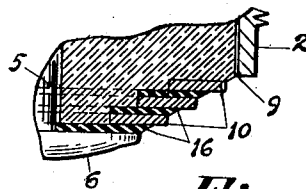


Fig. 6.

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1,991,369

ELECTRIC SPARK IGNITION

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Application January 29, 1932, Serial No. 589,549
In Sweden January 30, 1931

6 Claims. (Cl. 123—169)

The present invention relates to spark ignition apparatus for use, for instance, in connection with combustion engines such as automobile motors or the like and has for its object to provide an improved spark plug providing a multiple spark by means of which the ignition is improved.

Multiple spark plugs are known comprising a plurality of metallic elements arranged in the spark gap between the electrodes of the plug so that when the spark is passing said gap it has to pass from one electrode to the adjacent element and thence over the following elements to the next electrode, thus being divided up in a number of steps resulting in the same number of sparks each time the spark plug is supplied with electric current. Hitherto suggested constructions of spark plugs of said kind have, however, not been so designed that they have found great practical use. The designs have been such that the formation of soot in the gap or over the insulation between said elements has occurred and/or oil has been collected on their operating surfaces thus rendering the same inoperative. The designs suggested have also been such as to project a considerable extent into the cylinder so that a considerable space at the upper part of the cylinder had to be left when the piston is in its uppermost position, which circumstance has had a detrimental influence upon the compression in the engine.

These drawbacks are eliminated by my present invention which provides a spark plug powerful in its action and which has an operating surface of such form as to stay clean during operation and so that the collection of soot and oil thereon is avoided.

The invention will be more fully described below with reference to the embodiments illustrated by way of example in the accompanying drawings in which:—

Figs. 1, 2 and 4 show vertical elevations wholly or partly in section of three differently designed spark plugs according to the invention;

Fig. 3 shows an end view of the operating surface of the spark plug illustrated in Fig. 1;

Figs. 5 and 6 show two modifications of the lower part, that is, of the part forming the operating surface of the spark plug illustrated in Fig. 4.

The spark plugs illustrated in the drawings are, as to their outward dimensions, of standard type and consist mainly of a metallic body or sleeve 2 to be screwed into the cylinder or the cylinder cover 2a of the engine, which body surrounds the parts 3 and 4 made of electrically

non-conducting material and tightly pressed against the body 2 by means of a central core or screw 5 which may be made of steel or iron. At the lower end of this core, a head 6 is formed which serves both as a bolt head for the core and as one of the main electrodes of the plug. The opposite end of the core is threaded and provided with a resilient expanding washer 13 and nuts 7 and 8. The nut 8 serves as terminal nut for connecting the core, and therewith the central main electrode 6, to a conductor for the electric current delivered to the spark plug from, for instance, a battery or the like.

The other main electrode of the plug is as usual formed by the metal body 2, the lower end of which forms the operating surface 9 of this electrode.

As seen from the drawings, the spark plug according to my invention is provided with a plurality of annular elements 10, herein termed auxiliary electrodes, which are arranged to surround the central main electrode 6, the surfaces of the auxiliary electrodes together with the lower surface of the main electrodes 6 and 9 forming a smooth plane or convex surface on which, in operation, no impurities such as soot or oil will adhere.

In the embodiment shown in Figs. 1 and 2, the auxiliary electrodes 10 are arranged concentrically with respect to each other and the central main electrode 6. Said auxiliary electrodes are built into the inner part 4 of the spark plug which, as above stated, is made of some kind of electrically insulating material such as steatite or the like. If the part 4 consists of a material which can be cast, the auxiliary electrodes 10 may in known manner be inserted in the casting form and thus on casting be effectively built into the central part 4. They may, however, also be maintained in their places by some kind of cementitious compositions. In order to facilitate the mounting of the auxiliary electrodes into part 4 when not cast therein, that is, their introduction into the corresponding grooves or slots provided in said part, they may be split up in similar manner as done, for instance, in connection with piston rings. The final finishing, for example by means of grinding of the operating surface of the plug, may be done after the auxiliary electrodes 10 have been mounted into their places. As is apparent from the drawings, the auxiliary electrodes 10, in the plug according to Fig. 1, are given a conical shape preventing their loosening to an extent that they fall out from the places due to vibrations or different ex-

pansion of the material from which they are made relative to that of the central part 4 when the spark plug is getting heated.

In connection with the embodiment illustrated in Fig. 2 the auxiliary electrodes, as apparent from the figure, are formed as cylindrical mantle rings provided at their ends with inwardly or outwardly projecting heads 11 and 12 which serve to maintain the mantle rings in their positions. Heads 12 thereby also form, together with the central part 4, the operating surface of the plug. The mounting of these auxiliary electrodes may be accomplished in accordance with the methods above mentioned in connection with Fig. 1.

A preferred embodiment of my invention is illustrated in Fig. 4. In this embodiment, the auxiliary electrodes 10 consist of flat rings, the outer edges of which form part of the operating surface. The outer as well as the inner diameters of these ring elements are so dimensioned that the diameter of the operating surface successively increases from one auxiliary electrode to the other. The rings forming these electrodes also surround the central core 5, the bottom head of which serves as the one main electrode 6, and are maintained in their places by means of said core and nut 7. For facilitating the mounting, a nut 14 and a washer 15 are arranged on core 5. By means of these parts, the inner part 4 and the core 5, together with the plates 10 and the insulation part 16 forming the operating surface of the plug, may be mounted together and thence built into the spark plug body 2 with part 3 and screwed together by means of nut 7 and washer 13. The auxiliary electrodes 10 are kept apart from each other by means of insulating parts 16 which may be made of glimmer or mica, or any other suitable electrically insulating material. These insulating parts or rings can also, as shown, be given the form of flat rings surrounding the central core.

A good centralization of the auxiliary electrodes 10 and the insulating rings 16 is obtained by giving the inner part 4 a form at its lower end corresponding to the inner diameter of said electrodes and rings as obvious from the drawing.

In the arrangement shown in Figs. 4-6, the outer and inner diameters of the annular auxiliary electrodes 10 are so determined that the shortest length for the spark to pass between two adjacent electrodes is to be found on the operating surface of the plug and thus no sparking can take place between the auxiliary electrodes at other places, that is, particularly not through possible spaces at their inner edges.

In the modification shown in Fig. 5, the outer edges of the electrodes 10 are not cut down so as to coincide with the other parts of the operating surface but only rounded, which in special cases may be of advantage for instance for obtaining an increased support and protection of the insulation 16.

In the further modification shown in Fig. 6 only the insulating washers 16 are bevelled while the auxiliary electrodes 10 have a substantially rectangular section.

What I claim is:—

1. A spark plug comprising a central electrode provided at its inner end with a head forming a main terminal, an insulating member surrounding said central electrode, a metal sleeve surrounding said insulating member and forming a second main terminal, and a plurality of

ring-shaped auxiliary electrodes arranged around the central electrode so as to form a plurality of intermediate ring-shaped spark gaps between said main terminals, said auxiliary electrode being embedded in said insulating member with their terminal faces flush with the inner end surface of said insulating member, the terminal faces of said auxiliary electrodes and said central electrode forming together with the inner end surface of said insulating member a smooth conical surface around the longitudinal axis of the spark plug, the height of the rim of said surface above its base being substantially less than half of the width of said insulating member.

2. A spark plug comprising a central electrode provided at its inner end with a head forming a main terminal, an insulating member surrounding said central electrode, a metal sleeve surrounding said insulating member and forming a second main terminal, and a plurality of ring-shaped auxiliary electrodes arranged around the central electrode so as to form a plurality of intermediate ring-shaped spark gaps between said main terminals, the diameter of the terminal faces of said ring-shaped auxiliary electrodes increasing successively counted from the central electrode towards said metal sleeve, said auxiliary electrodes being embedded in said insulating member with their terminal faces flush with the inner end surface of said insulating member, the terminal faces of the auxiliary electrodes and said central electrode forming together with the inner end surface of the insulating member a smooth conical surface around the longitudinal axis of the spark plug, and the height of the rim of said surface above its base being substantially less than half the width of the insulating member.

3. A spark plug comprising a central electrode provided at its inner end with a head forming a main terminal, an insulating member surrounding said central electrode, a metal sleeve surrounding said insulating member and forming a second main terminal, a plurality of annular disc-shaped auxiliary electrodes extending into said insulating member substantially perpendicularly towards the central electrode and arranged around the central electrode so as to form a plurality of intermediate ring-shaped spark gaps between said main terminals, the terminal faces of the auxiliary electrodes and said central electrode forming with the inner end surface of the insulating member a conical surface around the longitudinal axis of the spark plug, and the height of the rim of said surface above its base being substantially less than half of the width of the insulating member.

4. A spark plug comprising a central electrode provided at its inner end with a head forming a main terminal, an insulating member surrounding said central electrode, a metal sleeve surrounding said insulating member and forming a second main terminal, a plurality of annular disc-shaped auxiliary electrodes extending into said insulating member substantially perpendicularly towards the central electrode and arranged around the central electrode so as to form a plurality of intermediate ring-shaped spark gaps between said main terminals, and annular disc-shaped insulating washers separating said auxiliary electrodes from each other and from the central electrode, the outer diameters of said auxiliary electrodes and said washers increasing successively counted from the central electrode towards said metal sleeve, the terminal faces of the auxiliary electrodes and

said central electrodes forming with the exposed surfaces of said washers a conical surface around the longitudinal axis of the spark plug, the height of the rim of said surface above its base being substantially less than half of the width of the insulating member.

5. A spark plug comprising a central electrode provided at its inner end with a head forming a main terminal, an insulating member surrounding said central electrode, a metal sleeve surrounding said insulating member and forming a second main terminal, a plurality of annular disc-shaped auxiliary electrodes extending into said insulating member substantially perpendicularly to the central electrode, the terminal faces of said auxiliary electrodes forming a plurality of intermediate ring-shaped spark gaps between said main terminals, and insulating washers separating said auxiliary electrodes from each other and from the central electrode, the terminal faces of

said auxiliary electrodes and said central electrode forming together with the inner end surface of said insulating washers a conical surface around the longitudinal axis of the spark plug, the radial dimensions of said electrodes and said washers being such in relation to each other that the shortest path for the spark is formed on the outside of the insulating member.

6. A spark plug comprising a central electrode, a concentric shell forming an outer grounded electrode extending substantially down to the lower level of the central electrode, and insulator disposed around the electrode and between the electrode and the shell, and a series of concentric rings embedded in said insulator of progressively increasing diameters outward from said central electrode with their exposed surfaces substantially flush with the surface of the insulator to provide a series of intermediate electrodes.

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