Jan. 9, 1923. 1,441,444.

P. MITCHELL.

SPARK PLUG.

FILED JAN. 20, 1919.

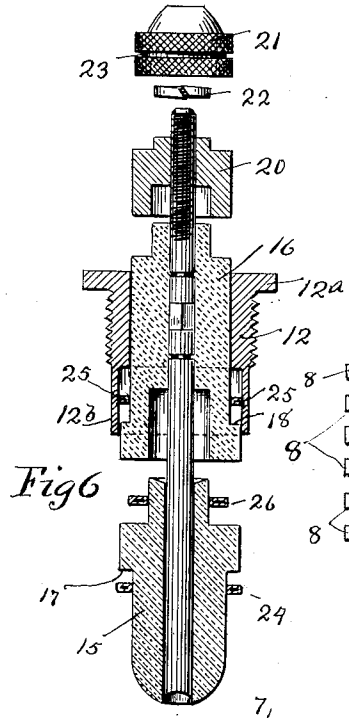


Fig 6

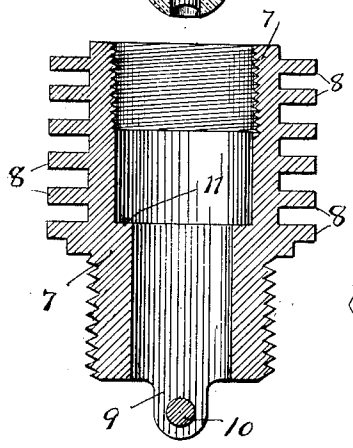


Fig 1

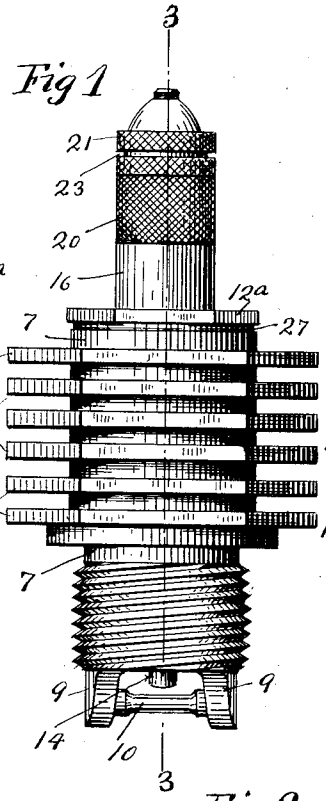


Fig 3

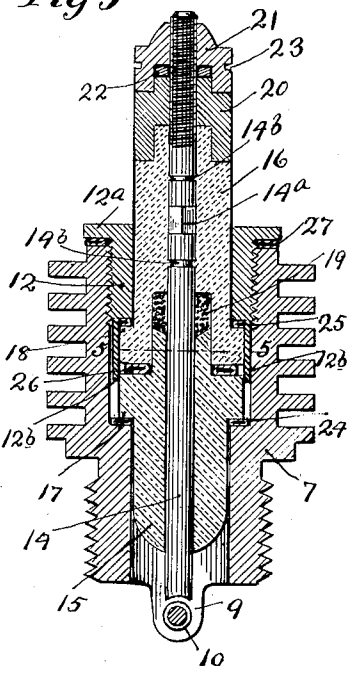


Fig 2

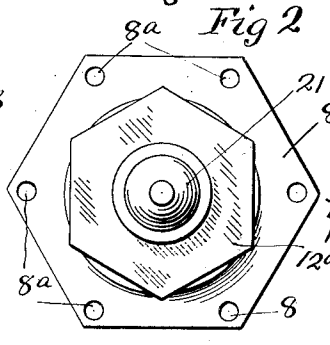


Fig 4

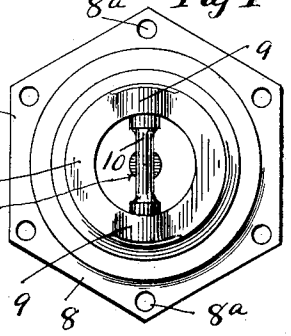
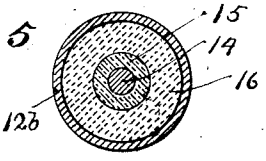


Fig 5



Witnesses.
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UNITED STATES PATENT OFFICE.

PARKER MITCHELL, OF ST. PAUL, MINNESOTA.

SPARK PLUG.

Application filed January 20, 1919. Serial No. 272,009.

To all whom it may concern:

Be it known that I, PARKER MITCHELL, a citizen of the United States, residing at St. Paul, in the county of Ramsey and State of Minnesota, have invented certain new and useful Improvements in Spark Plugs; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention has for its object to provide a greatly improved and more highly efficient spark plug for internal combustion engines and to such ends, generally stated, consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

This improved spark plug has been especially designed to meet the requirements of, and in fact has been found highly efficient in practice when used in connection with the well known "Liberty motor", wherein very high tension ignition current is employed and certainty in the ignition action is required. Obviously, a spark plug that will meet the requirements of a motor such as a "Liberty motor", as used in the aeroplane service, will also meet the requirements of other internal combustion engines.

This improved spark plug, of course, is capable of modification, but will now be described in its preferred construction, towit, the construction actually employed, as above stated.

The improved spark plug is illustrated in the accompanying drawings wherein like characters indicate like parts throughout the several views. Referring to the drawings,

Fig. 1 is a side elevation showing the improved plug;

Fig. 2 is a plan view of the plug;

Fig. 3 is a vertical section taken on the line 3—3 of Fig. 1;

Fig. 4 is a bottom plan view of the plug;

Fig. 5 is a detail in horizontal section on the line 5—5 of Fig. 3; and

Fig. 6 is a view corresponding to Fig. 3 but with the parts of the plug pulled apart or strung out axially, some parts being in full.

The bowl 7 of the plug is preferably made of brass, but may be made of other material, and at its inner end, is threaded to fit the customary seats provided for plugs in cylinder heads. The exterior of the bowl is provided with spaced radiating fins 8 rigidly secured thereon and preferably made integral therewith. As a feature of this invention, the perimeters of these fins 8 are made hexagonal, or other angular form so that they serve as a head for the application of a wrench to turn the plug tightly to its seat. At its inner end, said bowl is formed with diametrically opposite ears 9 to which a diametrically extended electrode 10 is rigidly attached at its ends. The electrode 10 is cylindrical and preferably of a high grade steel, such as a "vanadium" steel. Moreover the bowl is formed with an internal shoulder 11 and is internally threaded at its outer end to receive an externally threaded hold-down bushing 12 which, at its outer end, has an outstanding flange 12^a preferably of hexagonal form for the application of a wrench.

The inleading electrode 14, which is preferably of high grade steel, such as vanadium steel, is extended axially through the bowl and through an insulator, which, in accordance with my invention, is made in two sections, towit, an inner section or so-called floating insulator 15 and an outer section or so-called insulator shield 16. These two insulator sections 15 and 16 are provided within the upper portion of the bowl, respectively, with enlargements which afford clamping shoulders 17 and 18; and moreover, the insulator section 16, at its inner end, is formed with cylindrical cavity that is filled with suitable packing material, such as asbestos tape 19, and the lower insulator section 16, has a reduced cylindrical end that is telescoped into the said packing containing cavity.

The inner or floating insulator 15, preferably and in practice, is made of high grade quartz glass capable of standing 1700 degrees centigrade of heat. The outer or so-called insulator protector 16, preferably, and in practice, has been made of what is well known to the trade as "bakelite." Bakelite, as is well known, is capable of being molded to form, the finished product being an electrical insulator of high efficiency, capable of standing approximately 1650 degrees Fahrenheit of heat, and being tough and capable of standing high compression and general rough usage without breaking. This bakelite section or insulator protector

16 is molded rigidly onto the electrode 14 and the said electrode, to further insure positive rigid connection with the said section, is shown as made square at 14[a], and as having annular grooves 14[b].

The upper end of the said insulator protector 16 is reduced and telescoped into a cylindrical terminal nut 20 that is screwed onto the threaded outer end of the electrode 14. An outer clamping nut 21 is also screwed onto the threaded end of the electrode 14 and, as shown, has a concave lower face that receives a reduced upper end portion of the nut 20. An ordinary lock washer 22 is interposed between the clamping nuts 20 and 21, and the nut 20 is preferably formed with an annular groove 23 to receive the usual forked coupling of the lead wire, not shown.

The numerals 24, 25 and 26 indicate gaskets of any suitable form, but preferably of the copper covered asbestos type applied as follows:

The gasket 24 is clamped between the shoulder 11 of the bowl 7 and the shoulder 17 of the floating insulator 15; the gasket 25 is clamped between the inner end of the bushing 12 and the shoulder 18 of the insulator protector 16; and the gasket 26 is clamped between the enlarged inner ends of the said insulator elements 15 and 16. The latter noted bushing 26, might well be dispensed with in view of the packing 19, but the gaskets 24 and 25 are highly important. A similar gasket 27 is clamped between the flange 12[a] of the bushing 12 and the outer end of the bowl 7.

The inner portion of the floating insulator 15 should loosely fit within the bowl, and the electrode 14 should loosely fit the axial passage of said floating insulator, so as to thereby prevent breaking of the said insulator by expansion and contraction of the metallic parts of the plug. The electrodes 10 and 14 are of large diameter, but the electrode 14 is preferably of considerably greater diameter than the electrode 10. The hold down bushing 12, at its inner end, is provided with a thin annular centering flange 12[b] that extends around and beyond the enlarged inner end of the outer insulator 16 and telescopes the upper portion of the enlarged end of the floating insulator 15, thereby positively centering both of the insulator sections 15 and 16, in respect to the bowl and the one in respect to the other.

The diametrical electrode 10 is subject to more intense heat than the axial electrode 14, and hence, its central portion is preferably made of less diameter than the axial electrode 14 but the ends of said electrode 10 are made large, and by the integral ears 9 are connected to the body of the plug so that there will be a good conduction of heat from the said electrode 10. In fact, I have found that I obtain the best results by making the central or sparking portion of the electrode 10 of materially less diameter than the electrode 14. It is highly important, however, to note that the inner end of the axial electrode 14 is cut cylindrically concave so that it is concentric to the opposing surfaces of the electrode 10 and at all points equidistant therefrom. This spacing and arrangement assists in producing the desired flash or heavy well distributed spark which is required for certainty of ignition. Also, I have found that the best sparking action can be produced by making both of the electrodes 10 and 14 of large diameter. For example, in a small plug, such as used in plugs that have been designed especially for the "Liberty motor", the axial electrode 14 has been made about $\frac{3}{16}$ of an inch in diameter, while the central portion of the diameter of the electrode 10 has been made about $\frac{1}{8}$ of an inch in diameter. Of course, these dimensions can be varied.

To increase the heat radiating efficiency of the fins 8, they are provided with perforations 8[a] preferably located near the apexes of the angles. These perforations permit circulation of air through the fins, and moreover, increase the exposed radiating surfaces thereof.

With the two-part electrode insulator, as described or constructed on the general plan stated, it is possible to make the inner portion, which is protected from breaking by the bowl but is subjected to very intense heat of a high grade electrical insulating material that is capable of withstanding very high temperatures, and to make the outer and exposed section of the insulator of an insulating material that is tougher than the inner section, and will stand knocks and rough handling and resist breaking under general use, even though it is of a material that will stand a less degree of temperature than the inner section of the insulator. The materials described for the two sections of the insulator are, however, the best at present known to me, for the respective functions performed.

In practice, I have further found that where small electrodes are employed, oil dropping or accumulating thereon, will have a considerable cooling effect, so that the oil will be carbonized rather than burned, but that if the electrodes be of larger cross section, and being hot, oil dropping or accumulating thereon will have but very slight cooling effect, and hence, that the oil will be burned rather than carbonized, and thus that large electrodes are very much less liable to accumulate carbon than small electrodes.

What I claim is:

1. In a spark plug, the combination with a bowl and a diametrically extended cylindrical inner electrode connected to the inner

end thereof, an axial electrode extended through said bowl, an insulator for said axial electrode, and means for securing said insulator within said bowl, the inner end of said axial electrode being formed cylindrically concave and extended concentric to the co-operating surface of said diametrical electrode.

2. In a spark plug, the combination with a bowl and a diametrically extended cylindrical inner electrode connected to the inner end thereof, an axial electrode extended through said bowl, an insulator for said axial electrode, and means for securing said insulator within said bowl, the inner end of said axial electrode being formed cylindrically concave and extended concentric to the co-operating surface of said diametrical electrode, the central sparking portion of said diametrical electrode being of less diameter than said axial electrode.

3. In a spark plug, the combination with a bowl and a diametrically extending inner electrode connected to the inner end thereof, an axial electrode extended through said bowl, an insulator for said axial electrode, and means for securing said insulator within said bowl, the inner end of said axial electrode being formed concave about an axis extending in substantially the same direction as the axis of said inner electrode.

In testimony whereof I affix my signature in presence of two witnesses.

PARKER MITCHELL.

Witnesses:
CLARA DEMAREST,
F. D. MERCHANT.