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SPARK PLUG.

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This invention relates to spark plugs for use in connection with internal combustion motors.

It is an object of the invention to provide a self-cleaning plug which is extremely simple in construction, economical to fabricate, which can be easily assembled and disassembled, which is positive in its action, which will not readily get out of order, and which is extremely durable and highly efficient in operation.

It is a special object to provide a plug of this character having a bodily removable tubular electrode made of a non-corrodible material so coordinated with the main body of the plug that it will be securely anchored in position upon the assembly of the several parts with a free annular space disposed both at the exterior and interior of the electrode and between the main body and insulating body of the inner central electrode, respectively.

Another special object is to provide a plug having a bodily removable tubular electrode whereby by constructing said electrode in a variety of lengths and selecting the most appropriate length of electrode, the plug can be efficiently accommodated to different makes and types of motors, and one in which a defective electrode may be quickly and easily replaced with a new one, should occasion demand.

Heretofore, great difficulty has been experienced with plugs commonly found upon the market due to the fouling thereof brought about by the accumulation of soot, carbon and other foreign matter, resulting from the combustion within the firing chamber, between the porcelain body encircling the inner electrode and the main body of the plug. Such effect is particularly harmful when these foreign substances collect around the said porcelain body adjacent the region at which it is seated within the main body. This accumulation is most pronounced in engines or motors of the so-called "oil-pumper" type, or those in which an excessive quantity of lubricant finds its way into the combustion chambers. In fact, with plugs now in common use, it is practically impossible to operate such motors any substantial length of time without fouling the plugs to a point where they become utterly unfit for practical service.

It is a further special object of the invention to provide a plug especially adapted for long continued service without fouling in motors of the "oil-pumper" class, by coordinating the parts whereby to divide the entire space disposed between the encircling insulating body of the usual central electrode and the main body of the plug into a pair of concentrically arranged compartments or chambers by means of a tubular removable outer electrode, and to so construct the same that a cleaning blast will be automatically directed through both of these compartments and throughout substantially their entire extents during the firing of the motor, whereby to remove foreign substances which would otherwise collect therein, and ultimately result in the fouling of the plug.

A still further object is to provide a plug including a removable tubular electrode having an unbroken free lower end and unbroken portions extending throughout the entire length of its tubular wall whereby to effectively withstand without danger of injury not only to blows of sufficient strength to remove the electrode, even in cases of sticking, but which will positively guard the sparking points of the plug against damage if roughly handled or accidentally dropped.

An additional special object is to so position the sparking portions of the tubular electrode that they will serve to partially momentarily confine the combustible gases within the interior of the electrode at the time of the firing of the charge for the purpose of initiating a flow outwardly through arcuate conducting slits provided in the wall of the electrode towards the compartment surrounding the same whereby to cause a swirling action therein, and at the same time serve as a means for catching and retaining parts of the insulating porcelain body surrounding the inner electrode should it become broken.

These and other objects of the invention will more fully appear when taken in conjunction with the following description and the appended claims.

In the accompanying drawings, forming a part of the application, Fig. 1 is a view, partially in elevation and partially in vertical section, illustrating the preferred em-

bodiment of the invention; Fig. 2 an elevational view of the outer tubular electrode; and Fig. 3 a bottom plan view of the tubular electrode showing how the sparking points or portions are formed thereon.

Referring to the drawings, 1 designates the main body of the plug which is tubular in form, having a bore extending completely therethrough. The lower end of the body is slightly reduced in size and exteriorly threaded at 2 for threading into the usual openings provided for this purpose in the motor casting. The bore of the main body is interiorly threaded adjacent its upper end as at 3, and is provided at a point intermediate its length with a rib 4 which projects radially inwards, the upper face of the rib providing a tapered shoulder or seat 5 upon which the outer tubular electrode, to be subsequently described, rests and which serves as an abutment for positioning the inner electrode relatively to the remaining parts. The lower face of the rib 4 is under-cut in the fashion clearly indicated in Fig. 1, providing an over-hanging tapered ledge which assists in deflecting the flow of gases employed for cleaning purposes in the desired direction.

The inner, or centrally disposed electrode corresponds to a type now commonly found in various plugs upon the market and includes an encircling body of insulating material 7, preferably porcelain, having an enlarged intermediate portion 7' and a lower tapered extremity 7'', the latter terminating short of the protruding lower end 8 of the electrode proper.

The remaining, or outer electrode, is designated generally at 9, and is in the form of a bodily removable tubular element of substantially cylindrical shape with its upper extremity 10 flared outwardly in the form of a bell. The lower end of the tubular electrode 9 is plain, having an unbroken or uninterrupted end face 11, while its tubular wall is also equipped with unbroken or uninterrupted portions which extend completely from the lower end face 11 to its upper flared extremity 10. The tubular wall of the electrode 9 is provided with slits 12, 12' at points spaced from the end face 11, and the metal thereof immediately below and adjacent these slits is turned inwardly in the fashion clearly shown in Fig. 3 to provide the sparking points or portions 13, 13', respectively. The tubular wall of the electrode 9 is also equipped with a pair of arcuate-shaped slits 14, 14', both ends of which terminate short of the extremities of the electrode, and are so disposed relatively to the remaining parts thereof as to leave the unbroken portions extending throughout the entire length of the electrode, as previously described.

The outer diameter of the tubular elec-

trode throughout its cylindrical portion, immediately below the flared extremity 10, corresponds substantially with the diameter of the reduced opening defined by the rib 4, whereby to provide a neat fit of the electrode 9 therein when placed in operative position with the parts of the plug assembled, as illustrated in Fig. 2. Although the electrode 9 may be made of any metal suitable for the purpose, it is contemplated making the same of a highly conductive non-corrodible metal such as copper or Monel metal.

The over-all length of the electrode 9 is preferably slightly greater than the distance from the shoulder 5 to the lower open end of the main body of the plug, so that it projects slightly below the said main body.

In assembling the several parts, the electrode 9 is inserted within the bore of the main body with the cylindrical portion thereof projecting downwardly through the restricted opening formed by the rib 4, and with its upper flared extremity 10 seating directly upon the shoulder 5. The inner electrode is then positioned with its enlarged portion 7' superposed upon the upper extremity of the tubular electrode preferably with a washer 15 interposed therebetween, and is locked into gripping relation therewith by means of a gland nut 16 threadedly engaging the portion 3 of the main body, and adapted to engage the upper part of the enlarged portion 7'.

With the parts thus assembled, the snug engagement of the cylindrical wall of the electrode 9 with the opening formed by the rib 4, together with the intimate engagement of the washer and the insulating body of the inner central electrode, the several parts are held rigidly in the fixed relative positions shown in Fig. 2 of the application drawings.

With the several parts positioned relatively, as described, the tubular electrode 9 provides a space between the insulating body of the inner electrode and the main body of the plug into two concentrically arranged chambers or compartments 16, 16', the compartment 16 being located around the lower tapered portion 7'' of the inner electrode, and extending from a point adjacent the flared extremity 10 of the outer electrode while the compartment 16' extends from an overhanging ledge 6 to the lower end of the main body of the plug. It is noted that the arcuate fluid conducting slits or passages 14, 14' extend to a region adjacent the upper portions of both of these compartments. It is also pointed out that due to the bending of the metal radially inwards to form the sparking points or portions 13, 13', at the same time effects a partial closure of the lower end of the tubular electrode which is adapted to function

not only as a means for partially and momentarily restricting the flow of gases downwardly through the lower end of the electrode during the firing of the motor, but functions also as a means for catching and retaining portions of the insulating body of the inner electrode should the same become broken, thus preventing such broken portions falling directly into the firing chamber and giving rise to trouble from this source. The bending inwardly of the metal immediately below the slits 12, 12', in addition, serves as an effective guard against injury to the lower extremity 8 of the inner electrode, due to rough handling or accidental dropping of the plug.

In use, with the several parts assembled as shown in Fig. 2 of the drawings, the plug is bodily screwed into the threaded apertures provided on the motor casting for this purpose, as is the usual practice. During the intake and compression strokes of the motor, a portion of the combustible charge finds its way into the chambers or compartments 16, 16'. Upon the firing of the motor, the sparking gap being located between the projecting portion 8 of the inner electrode and the apexes of the portions 13, 13', as is obvious, due to the partial restriction afforded by the inwardly bent portions at the lower end of the tubular electrode, a flow of the gases is initiated radially outwards through the arcuate passages or slits 14, 14', from the compartment 16 towards the compartment 16'. Such flow of gases is produced periodically during each of the firing strokes of the motor. By extending the passages 14, 14' to a point adjacent the upper regions of the compartments 16, 16', all soot, burnt carbon, and other foreign substances, are effectively removed from these spaces, and the several parts maintained in a clean condition conducive to the proper firing of the plug. The provision of the overhanging ledge 6 enhances the beneficial effect incident to the flow of gases thus initiated, in that the inclined face thereof serves to deflect the gases towards the body of the plug and to assist in ultimately diverting the path of travel thereof downwardly through the compartment 16'.

Attention is directed to the fact that the entire outer tubular electrode 9 is an integral unitary construction providing an extremely sturdy and rugged structure. Because of this, the plug is capable of withstanding severe usage without danger of derangement of the sparking points 13, 13', and the continuous end face 11 together with the unbroken portions of the side wall extending completely throughout its length afford a means of forcibly removing the electrode by tapping upon its lower free end with a suitable tool, should such recourse become necessary. The desirability of the

plug in these respects is also enhanced due to the total absence of all sharp edges or points which may be easily bent out of shape.

As previously noted, the outer tubular electrode being bodily removable, by fabricating such electrodes in a variety of lengths, the plug can be readily fitted with one which will best accommodate it for the motor with which it is to be used, as well as enabling replacement of burned out electrodes with new ones from time to time, if required.

Normally the terminal 8 of the inner electrode is disposed immediately opposite the portions 13, 13' of the outer electrode, as shown in Fig. 2. Should the tip 8 become shortened due to prolonged use, it may be easily repositioned so as to assume a proper relative position with respect to remaining parts by merely removing the washer 15 and seating the portion 7' directly upon the flared terminal 10.

I claim:

1. A spark plug for internal combustion motors comprising a main body provided with a bore open at its lower end, an inner electrode having an encircling body of insulating material anchored within the main body and projecting downwardly into said bore thereof, an outer removable tubular electrode interposed between the said insulating body and said main body dividing the space therebetween into two annular compartments, the wall of said tubular electrode having fluid conducting passages formed therein said passages extending to a point adjacent the upper region of the said compartments.

2. A spark plug for internal combustion motors comprising a main body provided with a bore open at its lower end, an inner electrode having an encircling body of insulating material anchored within the main body and projecting downwardly into said bore thereof, an outer removable tubular electrode interposed between the said insulating body and said main body dividing the space therebetween into two annular compartments, the wall of said tubular electrode having fluid conducting slits formed therein, the said slits stopping short of the lower extremity of the tubular electrode and extending to a point adjacent the upper region of the said compartments.

3. A spark plug for internal combustion motors comprising a main body provided with a bore open at its lower end, an inner electrode having an encircling body of insulating material anchored within the main body and projecting downwardly into said bore thereof, an outer removable tubular electrode interposed between the said insulating body and said main body dividing the space therebetween into two annular

compartments, the wall of said tubular electrode having fluid conducting slits formed therein, said slits being of arcuate shape whereby to produce a swirling of the fluid passing therethrough, and extending to a point adjacent the upper region of the said compartments.

4. A spark plug for internal combustion motors comprising a main body provided with a central bore, said body having an inwardly extending rib forming a seat at one side thereof, an inner electrode having an encircling body of insulating material projecting downwardly towards the lower open end of the bore of the main body, an outer tubular electrode gripped between the said insulating body and the said seat and extending downwardly towards the lower open end of the bore of the main body, said tubular electrode being spaced below the said seat from the said insulating body and below the said rib from the said main body, the wall of the said tubular electrode having fluid conducting passages formed therein co-extensive with the space between the electrode and said main body for conducting fluid from the space within the interior of

the electrode to the space surrounding the same.

5. A spark plug for internal combustion motors comprising a main tubular body, a centrally disposed inner electrode having an encircling body of insulating material anchored in the main body and projecting downwardly therein towards its lower open end, the said insulating body terminating short of the lower extremity of the inner electrode, an outer tubular electrode interposed between said insulating and main bodies dividing the space therebetween into a pair of compartments and extending below the said insulating body, said tubular electrode being slit at a point spaced from its lower extremity and bent radially inwards adjacent thereto to form sparking tips, and being further provided with fluid conducting passages establishing communication between the said compartments, said passages being coextensive with the outer compartment and adapted to discharge gases adjacent the upper regions of the said compartments.

In testimony whereof, I sign my name.

EMIL J. RUBERT.