R. R. HILL.

SPARK PLUG.

APPLICATION FILED APR. 5, 1916.

1,255,880. Patented Feb. 12, 1918.

Fig. 3

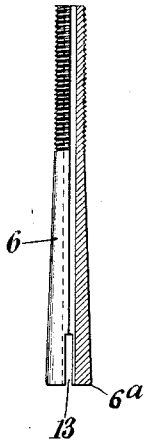


Fig. 1

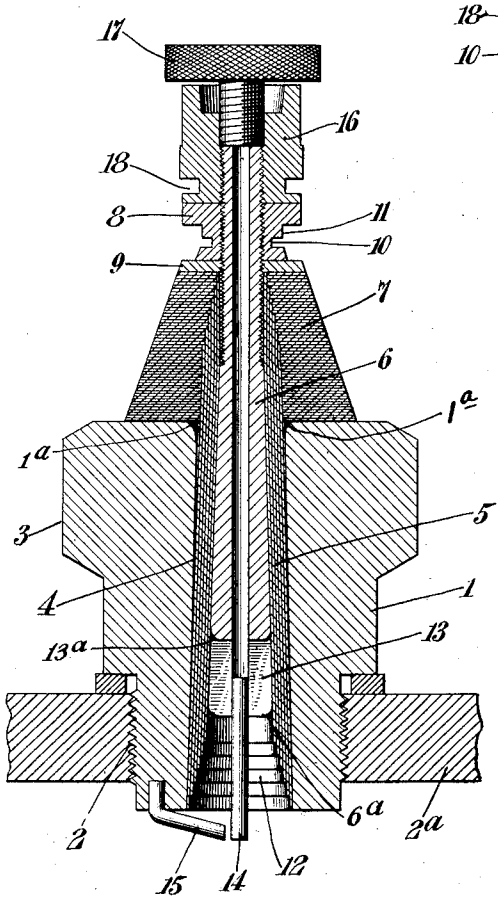
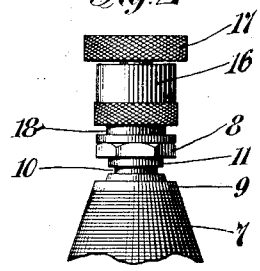


Fig. 2



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SPARK-PLUG.

1,255,880. Specification of Letters Patent. Patented Feb. 12, 1918.

Application filed April 5, 1916. Serial No. 89,036.

To all whom it may concern:

Be it known that I, ROBERT R. HILL, a citizen of the United States, and resident of the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Spark-Plugs, of which the following is a specification.

This invention relates to improvements in spark plugs for internal combustion engines, and particularly to that class of spark plugs provided with means whereby a priming charge of volatile liquid may be introduced into the combustion chamber through the plug.

The main object of this invention is to provide a one-piece spark plug in which the insulated terminal electrode is tapered and forced into a tapered bore under great pressure, the insulation being clamped between the tapered electrode and the tapered bore of the plug, whereby all leakage of gas around the electrode or between the insulation and the body of the plug is prevented. The tapered terminal electrode is forced into the base of the plug under sufficient pressure to permanently seal it therein, whereby the necessity for using clamping or securing nuts is avoided and the terminal will maintain its fixed relation with regard to the body of the spark plug without the necessity of clamping means for that purpose.

Another object of the invention is to provide simple and efficient means whereby a priming charge of volatile liquid may be passed through the insulated terminal into the explosion chamber, said priming charge being caused to flow directly along the said terminal to the sparking point.

Another object of the invention is to form the base of the spark plug of a material having the same coefficient of expansion as the wall of the engine cylinder to which it is to be attached. By this means the binding or freezing of the base in the engine cylinder is avoided, and the base may be readily removed at any time whether the engine cylinder be hot or cold.

There are other objects and advantages of the invention resulting from the details of construction, all of which will fully hereinafter appear.

In the drawing, Figure 1 is a longitudinal central section through the spark plug;

Fig. 2 a detail side elevation partly in section, of the central insulated terminal; and

Fig. 3 a side elevation of a portion of the plug.

Referring to the various parts by numerals, 1 designates the base or body part of the plug which is threaded at 2 to permit of it being screwed into a properly threaded aperture in the wall 2^a of the engine cylinder. The base is hexagonal in form at 3, for the reception of the usual wrench. The base is longitudinally bored at 4, the wall of said bore being tapered from the inner end of the base to the outer end thereof, the bore being largest at its inner end. Arranged in this bore is a tapered sleeve 5 formed of a plurality of layers of mica. When the said tapered mica sleeve is applied to the bore it is slightly larger in diameter than the diameter of the bore and it is considerably longer than the base 1 so that when it is applied it projects beyond both ends of the said base. A tapered central terminal electrode 6 is inserted in the tapered mica sleeve, the surface of the said electrode being at a very slightly increased angle over the angle or taper of the inner surface of the bore of the base. This difference in taper is not very great but is sufficient to insure the proper sliding and adjustment of the various layers of the mica sleeve, when the tapered electrode 6 is forced into the base, as will be hereinafter described. This tapered electrode is forced into the sleeve and into the base under a very heavy pressure, the result of which is that the various layers of the tapered mica sleeve slide on each other as the electrode is forced inward. The tapered terminal acts as a wedge and tightly clamps the mica sleeve in the base. The terminal is forced into the base under such pressure that it is wedged rigidly in place, the mica sleeve being permanently and rigidly gripped by it.

The mica sleeve and the terminal project considerably beyond the outer end of the base, and surrounding the sleeve and resting against the base is an insulation 7 formed of a plurality of disks of mica, said disks being apertured to receive the mica sleeve. The outer end of the terminal is threaded, and screwed thereon is a clamping nut 8 said nut binding a disk 9 against the outer disk of mica. It will, of course, be understood that any suitable form of insulation may be substituted for the disks of mica. The

clamping nut 8 is stepped in diameter at 10 and 11 in order that it may be adapted to receive terminal connectors of different diameters. The outer end of this clamping nut is formed hexagonal to adapt it to receive a wrench. After the tapered central terminal electrode is forced into place that portion of the mica sleeve projecting beyond the inner end of the base piece is cut off so that the said mica insulation will cover the entire surface of the bore in the base. The tapered portion of the central terminal is forced a considerable distance up into the base, leaving a chamber 12 therein between the end of said tapered portion and the inner end of the base piece. The entire wall of this chamber is completely covered by the mica insulation. As the tapered terminal is forced into the bore of the base the several layers of mica forming the mica sleeve will slide on each other so that the layers in the chamber 12 will be in stepped relation, the said insulation being somewhat thinner at the inner end of the base than it is at the end of the tapered terminal. The mica sleeve extends beyond the outer end of the base and throughout the length of the insulation 7, the end of said sleeve being engaged by the clamping disk 9.

By reason of the great pressure applied to the tapered electrode the layers of mica and the tapered portion of the terminal fit tightly together and prevent any leakage of gas through the plug.

The tapered electrode is tubular in form and the inner larger end thereof is cut transversely as at 13, said cut intersecting the longitudinal aperture. To the inner end of the terminal is connected a sparking point 14 which extends inwardly beyond the inner end of the base. This sparking point is preferably screwed into the inner end of the terminal but its secured end is preferably short of the inner end of the aperture in the terminal. The purpose of this is to permit the priming charge to pass through the terminal into the cross-cut and then down along the sparking point. The grounded sparking point 15 is secured to the inner end of the base, its free end extending close to the free end of the sparking point 14.

The outer end of the wall of the bore in the base is rounded or convex, and slightly flared outwardly, as at 1^a, to avoid a sharp corner. The inner end of the terminal plug 6 is also rounded as shown at 6^a, to prevent a sharp corner at that point. At the inner end of the cut 13 the wall is rounded as shown at 13^a, to prevent a sharp corner at that point. I have found that by rounding these surfaces to avoid sharp corners I avoid the breaking down of the insulation at these points, under high voltage. By avoiding the sharp corners I avoid the accumulation of the electricity at one point; that is to say there is no sharp point at which the electricity will accumulate and tend to jump or break down the insulation.

On the end of the insulated terminal is secured a priming cup 16, said cup serving also as a binding screw to enable a terminal wire to be clamped to the terminal. Screwed into this priming cup is a closure device or valve 17, the inner end of said valve seating directly on the outer end of the tubular electrode. When this valve is closed there can be no leakage of gas through the tubular electrode. Of course when it is desired to introduce a priming charge the valve 17 is removed. The priming cup is formed with an annular groove 18 near its inner end to receive a terminal connector, should it be desired to attach a connector of larger diameter than the groove 10 will receive.

The base 1 is preferably formed of cast iron so that it will have the same coefficient of expansion as the wall of the engine cylinder. The advantage of forming the base of the same kind of material as the wall of the engine cylinder, or of some material having the same coefficient of expansion, will be obvious. The expansion of the cylinder will not result in a clamping or binding of the base and the plug may be removed at any time, whether the cylinder be hot or cold. The expansion and contraction of the two parts being equal there is no danger of a gas leakage around the base. This is important; and actual experience has shown that by forming the base of cast iron a gas-tight joint may be readily maintained between the base and the cylinder, and also that the base may be readily unscrewed from the cylinder at any time and without regard to the temperature of the cylinder or the base of the plug.

From the foregoing it will be readily understood that I provide a one-piece spark plug in which the insulated electrode is rigidly wedged in place and in fact becomes a permanent, immovable part of the structure, thereby effectually sealing the electrode in position and preventing any leakage of gas around it or through the insulation. It is also manifest that I provide a priming spark plug whereby the priming charge will flow directly down the insulated sparking point and be delivered into the explosion chamber at the spark gap. It is also clear that I provide means by which practically any form of terminal connector may be attached to the insulated electrode of the plug.

What I claim is:

1. A spark plug comprising a base having a longitudinal bore tapering from the inner end of the base to the outer end thereof, a tapered insulating sleeve extending entirely through the bore and formed of a plurality of nested mica tubes arranged in stepped relation to form an outwardly flaring insu-

lated chamber at the inner end of the bore, a tapered electrode within the insulating sleeve and terminating at its inner end adjacent the inner end of the tapered insulated chamber, a sparking point connected to the electrode and extending through the tapered insulated chamber, and a sparking point carried by the base.

2. A spark plug comprising a base formed with a longitudinal bore tapering from the inner end of the base to the outer end thereof, said bore being flared outwardly at the outer end of the base, an insulating sleeve extending entirely through the base and formed of a plurality of tapered nested tubes arranged in stepped relation to form an outwardly flaring insulated chamber at the inner end of the base, a tapered electrode having a rounded inner end held within said sleeve, a sparking point carried by the inner end of said electrode and extending outwardly through said flaring insulated chamber, and a sparking point carried by the inner end of the base.

3. A spark plug comprising a base formed with a longitudinal bore tapering from the inner end of the base to the outer end thereof, an insulating sleeve extending completely through said bore, said sleeve being formed of a plurality of nested independently slidable tapered tubes, a terminal electrode having a greater taper than said bore wedged in said sleeve with its inner end intermediate the ends of the bore, said electrode causing a relative sliding movement of the tubes when it is forced therethrough, so as to form a completely insulated outwardly flaring chamber at the inner end of the bore and a gas tight packing between the electrode and base, a sparking point secured to the inner end of said electrode and extending outwardly through said tapered insulated chamber, and a sparking point carried by the inner end of the base.

4. A spark plug comprising a base formed with a longitudinal bore tapering from the inner end of the base to the outer end thereof, a tapered insulating sleeve extending entirely through said bore and projecting from the outer end thereof, superposed disks of insulating material surrounding the projecting end of said sleeve, a tapered tubular electrode securing said sleeve in position and extending beyond the projecting end of said sleeve, the inner end of said electrode having a slot therein and terminating intermediate the ends of the bore so as to form an insulated chamber at the end of the bore, a sparking point secured in said slot and extending outwardly through said chamber, a sparking point carried by the base, a nut threaded on the projecting end of the electrode for clamping the insulating disks against the outer end of the base, and a priming cup threaded on said electrode above said clamping nut, said cup being adapted to deliver a priming fluid into the outer end of the tubular electrode and to clamp a wire terminal upon said nut.

5. A spark plug comprising a base formed with a longitudinal bore tapering from the inner end of the base to the outer end thereof, an insulating sleeve extending through said bore and projecting from the outer end thereof, superposed disks of insulating material surrounding the projecting end of said sleeve, a tubular electrode passing through said sleeve, the outer end of said electrode projecting from the outer end of the sleeve, a sparking point carried by the inner end of said electrode, a sparking point carried by the inner end of the base, a nut threaded on the projecting end of the electrode for clamping the insulating disks against the outer end of the base, and a priming cup threaded on said electrode above said nut, said cup being adapted to deliver a priming fluid into the tubular electrode and to clamp a wide terminal upon said nut.

In testimony whereof I hereunto affix my signature.

ROBERT R. HILL.