

V. G. APPLE.
 SPARK PLUG FOR INTERNAL COMBUSTION ENGINES.
 APPLICATION FILED AUG. 3, 1906.

1,025,232.

Patented May 7, 1912.

Fig. 1

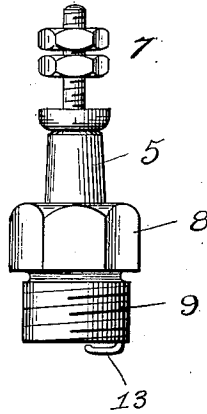
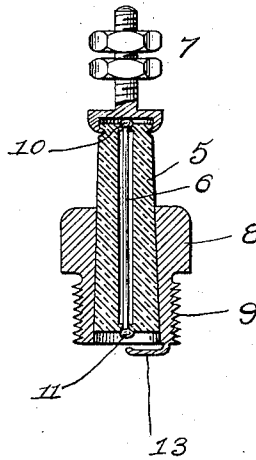


Fig. 2



Witnesses
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UNITED STATES PATENT OFFICE.

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SPARK-PLUG FOR INTERNAL-COMBUSTION ENGINES.

1,025,232.

Specification of Letters Patent.

Patented May 7, 1912.

Application filed August 3, 1906. Serial No. 329,031.

To all whom it may concern:

Be it known that I, VINCENT G. APPLE, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Spark-Plugs for Internal-Combustion Engines, of which the following is a specification.

My invention relates to improvements in spark plugs for internal combustion engines.

One of the objects of my invention is to produce a new and useful element of a spark plug, consisting of a self-contained conductor and surrounding insulating medium, which is highly refractory to the effects of excessive temperatures such as are produced within the cylinders of gas engines.

Another object of my invention is to produce an element of the character described, in which the insulating medium is composed of melted quartz; a substance possessing high specific resistance to the passage of the electric current, although hot, and which yields to manipulation only when submitted to temperature much higher than that ever attained within the cylinder of an internal combustion engine.

Other and further objects of my invention will become apparent to those persons who are skilled in the art from the description hereinafter.

In the drawings, Figure 1 is a representation of an elevation of my spark plug complete. Fig. 2 is a representation of a central vertical section of the same.

In all of the views the same reference characters are used to indicate similar parts.

One element of my new spark plug comprises the cylinder 5, of insulating material, preferably of melted quartz, containing the central electric conductor 6, preferably of platinum, and the terminal generally indicated by 7. This element of the structure is self-contained, and may be viewed as a separate entity from that part of the structure used to hold the former in place, with relation to the cylinder of the engine. The cylinder 5 is preferably tapered upon its outside surface, as shown in Fig. 2.

A thimble 8, screw threaded as at 9, is adapted to be secured in one of the walls of the engine cylinder, and is provided

with a central perforation corresponding in taper with that of the cylinder 5. When the plug is placed in an operating engine the force of the pressure, due to the rapid combustion or explosions, tends to more intimately and firmly seat the part 5 within the coacting part 8.

The means employed for holding the part 5 in place presents several advantages; the material 5 is very refractory and is difficult to manipulate for the purpose of fashioning into more complex or fantastic forms; the tapering plug-like form 5 is more firmly seated and held in position by the effect of the operation of the engine and the relatively large surfaces of the parts 5 and 8, in substantial intimate contact, produces a practically gas tight joint.

One of the important features of my invention consists in the use and manner of constructing the insulating medium 5 in the construction of a new article of manufacture. The part 5 is composed of melted quartz, or substantially pure silica or silicon (SiO_2) which is so highly refractory that it is infusible before the blow pipe. Melted quartz possesses entirely different characteristics from glass, to which it seems so nearly related. It requires a much higher temperature to originally melt the former, and after having been melted or "flecked" into a homogeneous mass, it is practically impossible to remelt it. It is an electric insulator under all conditions of temperature. Glass is composed of sand (quartz in a finely divided state) and metal oxids, usually those of potassium or sodium, and calcium or lead, and initially melts at a relatively low temperature. It becomes an electric conductor when hot and is brittle and friable when under stress.

The part 5, the melted quartz insulating medium, may be made in the following manner: Sand, finely divided quartz or pure silicon, may be placed in a hollow carbon tube. Electric terminals are fixed to the ends of the tube and a heavy current of electricity, sufficient to render the tube highly incandescent, is passed through the tube. To protect the tube against the disintegrating effect of the oxygen in the air, the tube is buried in a large body of pulverized charcoal. After the current has been passed through the tube for a sufficient period of time to melt the quartz contained therein, the current is withdrawn and the tube and

surrounding mass is allowed to cool. If it is desirable to produce a hollow cylinder of melted quartz, a small stick of carbon may be longitudinally fixed and maintained at the axis of the tube, and subsequently drilled out or otherwise removed from the cylinder of melted quartz. While the melted quartz can not be again melted by any known means it becomes relatively soft when again heated to a high temperature, not so high as that required to originally melt it, and while hot it may be changed in form by the application of pressure, as lead or other soft substances.

15 In the production of the insulating medium 5, of my improved spark plug, after the quartz has been melted it is again heated and molded into the shape 5, or other suitable form, by the application of pressure.

20 By this means the diameter may be increased or diminished; the mass may be made relatively longer or shorter, and the general form and proportion may be entirely changed.

25 After the part 5 has been molded into suitable shape, such for example as that shown, a central electric conductor 6, preferably of platinum, is fused at its ends, into the body part of the quartz, preferably by means of an electric arc, thereby forming enlargements 10 and 11, embedded into the body part of the quartz and to some extent softening the immediately surrounding quartz, by the intense heat of the arc, producing a complete seal at each end of the structure. The enlargement 10 is electrically connected to terminal cap 7 by any suitable means, by pressure, welding or otherwise; the former means being shown in the drawing. The enlargement 11 answers for a terminal of the spark gap in coöperative relation with the terminal 13.

Melted quartz is strong, tough, homogeneous, a good electric insulator under all con-

ditions of temperature; can not be materially affected by any temperature prevailing at any time or for any period of time within the cylinder of a gas engine; is not affected by moisture or sudden changes of temperature. Porcelain, the material usually used in spark plug construction, soon loses its electric insulating qualities when in use, is easily fractured by unequal or excessive strain and by sudden change of temperature, while mica, by continuous use, becomes dehydrated and is thereby rendered friable, disintegrates and breaks down as an electric insulator and is structurally destroyed.

Any other means than that described may be employed for melting and forming the quartz into proper shape and condition, my invention not being limited to the precise means set forth.

Having thus described my invention, what I claim and desire to secure by Letters Patent, of the United States, is:

In a device of the character described, an insulated-conductor unit, consisting of an insulating part, 5, having therein a longitudinal central bore of reduced diameter at its ends and larger diameter between its ends, and a central conductor of substantially the diameter of the reduced portion of the bore, having at each end an integral enlargement, the reduced ends of the bore and the conductor enlargements being fused together with said enlargements partially embedded intimately within the body of the insulating part, thereby permanently to unite said conductor and insulating part, and completely to close the bore of said insulating part.

In testimony whereof I hereunto set my hand in the presence of two witnesses.

VINCENT G. APPLE.

In the presence of—

W. D. BROWN,

H. F. APPLE.