O. H. H. HEINS.

SPARK PLUG.

APPLICATION FILED JUNE 16, 1909.

1,003,740. Patented Sept. 19, 1911.

Fig 1

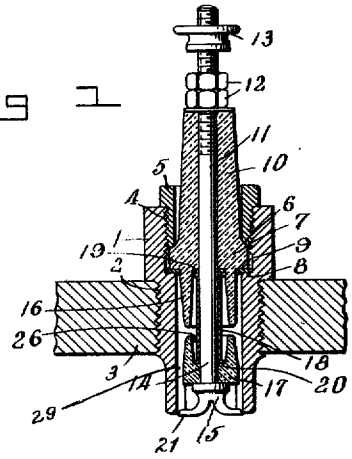
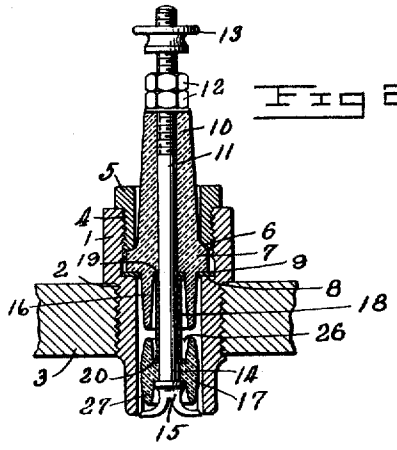


Fig 2



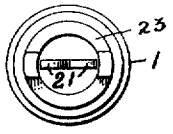


Fig 3

Fig 4

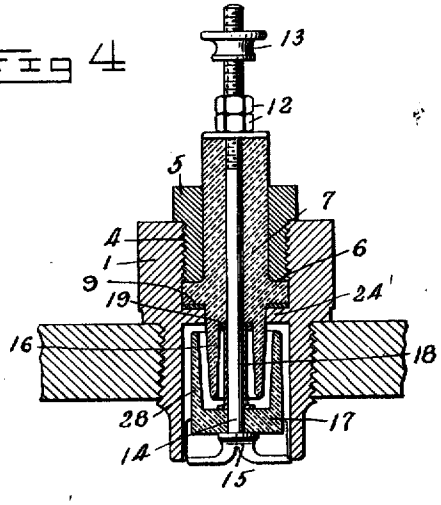
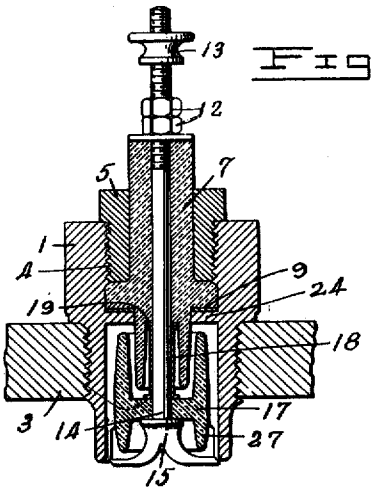


Fig 5



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SPARK-PLUG.

1,003,740. Specification of Letters Patent. Patented Sept. 19, 1911.

Application filed June 16, 1909. Serial No. 502,491.

To all whom it may concern:

Be it known that I, OTTO H. H. HEINS, a citizen of the German Empire, residing at Valley Place, Edgewater-on-the-Hudson, New Jersey, have invented certain new and useful Improvements in Spark-Plugs, of which the following is a specification.

This invention relates to spark plugs; and it comprises a chambered tubular spark plug having an open end and a closed end and adapted for threaded engagement through the wall of an explosion chamber, a shaped body of heat-resistant insulating material in said closed end, a pole piece supported, spaced and carried by said insulating material and extending through the inner chamber of the plug to a terminal electrode at the mouth of said plug and in spark-producing relationship to such mouth, and a shaped blocking-out body carried upon the pole piece behind said electrode and near the mouth of the plug chamber whereby a circumferential channel is formed about the blocking-out body establishing communication between a chamber for cushioning gases therebehind and the open mouth of the spark plug; all as more fully hereinafter set forth and as claimed.

A desirable type of electric igniter for use with high tension currents in explosion engines is afforded by a threaded tubular plug adapted to pass through a wall of the explosion chamber and form one pole piece for the sparking circuit, the other pole piece being formed by a rod within the tubular plug and spaced away from its walls a suitable distance. A crown or series of spark points or electrodes may terminate the inner end of this rod opposite the open inner mouth of the plug, which forms the coöperating electrode for the production of sparks. The outer end of the plug is closed and sealed by a spacing insulator of heat-resistant insulating material, such as porcelain, which carries and supports the inner pole piece. This form of igniter has a number of important advantages. The outer end of the plug being closed while the inner is open to the explosion chamber of the engine and there being an annular chamber between the included pole piece and the walls of the plug tube, in use a cushioning body of inert gases accumulates in such annular chamber. The annular chamber forms a sort of "dead end" for the gases within the explosion chamber proper and neither the explosive mixture nor the products of explosion penetrate therein against the cushioning gases to any great extent. Diffusion of gases is a relatively slow phenomenon and no sufficient time is afforded during the compression or the explosion stroke of the piston to permit any substantial mixture of the gases of the cushion chamber with the gases of the engine chamber. When the gases of the engine chamber are under pressure they press their way into the annular chamber against the resistance of the cushioning gases for a short distance, such cushioning gases acting as a sort of fluid piston, but upon relief of the pressure the engine gases are again expelled. This to-and-fro movement of the engine gases penetrates but a short distance within the cushion chamber. For practical reasons, this cushioning body of inert gases is very desirable. It is desirable to relieve the insulation, which must form some part of the wall of the explosion chamber, of the direct shock and jar of the explosion and it is undesirable furthermore that any part of the explosion should take place in direct contact therewith, both because of the heat developed and because of the possibility of short-circuiting by the deposition of a layer of soot upon the insulation. Soot is more or less oily and it has a tendency to cling to exposed surfaces in the well-known way, bridging across the insulation and causing short-circuiting with consequent "engine troubles."

While the described arrangement is efficient in cushioning the insulation against shock and jar and preventing to a great extent the commingling of engine gases with the inert gases within the plug chamber and consequent development or deposition of soot within the latter, it does not altogether prevent the accumulation of preformed soot therein though it does retard its access. The engine soot has a tendency to drift, like other very finely-divided suspended dusts, and with the described freely-open plug mouth sufficient soot may gain access after a time to cause trouble. In the present invention, I have devised a cheap, simple and efficient means of preventing sooting-up and other troubles while preserving and enhancing the advantages of the gas cushion by

providing the inner end of the included pole piece within but near the mouth of the plug chamber with a blocking-out body of heat-resistant insulating material spaced away somewhat from the insulator at the rear of the plug chamber so as to afford a cushion chamber therebetween and also spaced away from the side walls of the plug chamber so as to afford a narrow or restricted channel of communication between the engine chamber and the cushion chamber of the plug. Preferably, this blocking-out body or the insulator body, or both, is so shaped as to provide certain sub-chambers for purposes later appearing.

By causing the communication between the explosion chamber and the gas cushion to be through a relatively narrow passage or channel, a number of desirable results are attained while increasing the advantages of such gas cushion. The blow delivered by the explosion is still further cushioned, thereby protecting the porcelain or other insulation at the back of the plug chamber. This porcelain being an insulation must of course span a space between metal and metal and being also a seal, no room can be given for expansion and contraction. But the expanding gas striving to force its way inward through this restricted passageway to reach the comparatively larger gas chamber has its force and speed so restricted during the comparatively short time afforded by the compression and power strokes that it does not itself reach such cushion gas chamber nor do the jar and heat of the explosion reach the insulation. Upon relief of the pressure within the engine chamber, the compressed body of gas within the cushion chamber expands outward through the contracted passageway, effectually sweeping out the residual engine gases therein as well as entrained soot. The cross-section of the areas of the two gas bodies in face contact being much reduced, there is still less danger of commingling than exists in the recited structure in which the contacting areas are substantially full width while the drifting inward of soot and dust is also concomitantly reduced, preserving a clean surface on the insulation at the back of the cushion chamber.

In this structure, deposition of soot upon the outer face of the blocking-out body, which is preferably of porcelain or similar ceramic material, is not injurious since it is carried wholly by the inner pole piece and is spaced away from the inner walls of the tubular plug at all points so that bridging across and short-circuiting cannot occur. Any soot which may deposit on such blocking-out body is harmless. And this blocking-out piece being wholly carried by the inner pole piece and spaced away from all other metal elements by gas bodies cannot be affected by the shock or jar of the explosions in the same way that the porcelain insulation proper can be affected.

Preferably, as stated, the blocking-out body is so shaped or recessed as to afford certain sub-chambers, either at its inner or its outer face, or at both.

In the accompanying illustration I have shown, more or less diagrammatically, certain embodiments of the described invention.

In this showing, Figure 1 is a vertical section of a complete spark plug; Fig. 2 is a similar view of a spark plug carrying a modified form of blocking-out body; Fig. 3 is an end view of the structures of Figs. 1 and 2; Fig. 4 is a vertical section showing another modified form; and Fig. 5 shows still another modification.

In the showing of Fig. 1, a tubular spark plug 1 is threaded at 2 to permit its attachment to explosion chamber 3 (shown broken away). Internally the plug is threaded at 4 to engage lock-nut 5 which bears upon the shoulder 6 of an insulator 7, of porcelain or the like. As shown, this insulator is spaced away somewhat from the sleeve to give room for expansion and contraction at its sides, the joint being made at a shoulder 8 of the screw plug by means of an annular disk of mica or like material, 9. By suitable adjustment of the locknut, the insulator may be pressed firmly against this disk or gasket. Upwardly the insulator is prolonged into extension 10, spaced away from the lock nut a safe distance. Within the insulator and firmly held thereby is a pole piece or rod 11, extending upwardly through lock nuts 12 to binding screw 13 and downwardly as pole piece 14 through the chamber of the tubular plug and spaced away from the walls thereof, this pole piece carrying a crown or series 15 of spark poles or electrodes which extend nearly to the edge of the mouth of such plug and are adapted to produce sparks therebetween.

Within the plug chamber is a downward prolongation or sleeve 16 extending from the insulator and surrounding the pole piece but spaced away both from such pole piece and from the inner walls of the plug chamber. At the extremity of the pole piece just behind the crown of electrodes is a blocking-out body, 17, which may be formed of porcelain or any other suitable heat-resisting insulating material. As shown, this blocking-out piece is spaced somewhat away from the insulator proper so as to form a chamber therebetween, spacing as shown being preserved by the use of a sleeve 18, which may be metal or any other material and which engages at either end the insulator and the blocking-out piece through the intermediacy of gaskets 19 and 20, respectively. The crown of electrodes on the

pole piece may, as shown more distinctly in Fig. 3, comprise but two electrodes, 21 and 21, oppositely directed toward the mouth of the plug chamber, which may be appropriately cut away, as at 23.

So far as just described, the structure of the alternative forms shown in Figs. 2, 4 and 5 is the same as that of Fig. 1, though in Figs. 4 and 5 the shoulder of the insulator bears against an annular lug 24 of the hollow plug instead of bearing against a shoulder 8, as in Figs. 1 and 2. The principal difference in the structure of the various forms illustrated is in the particular shape of the blocking-out piece (17). As shown in Fig. 1, this blocking-out body is plane-faced on the fore side behind the crown of electrodes while at its rear it is recessed to form a sub-chamber 26, annularly surrounding the pole piece. This blocking-out piece is of such dimensions as to leave a chamber behind it and before the insulator and as to leave a narrow circumferential channel between its sides and the inner side of the plug chamber, not touching the latter at any point. The blocking-out body of Fig. 2 is similarly shaped but is recessed at the fore side to form an annular prolongation 27 and a sub-chamber within which the base of the electrode-crown is seated. The blocking-out body of Fig. 4, like that of Fig. 1, is plane-faced on the fore side and recessed at the rear, but the annular walls 28 of this recess extend sufficiently far backward to annularly inclose the sleeve extending forward from the insulator. The blocking-out body of Fig. 5 is similarly formed at the rear while at the fore face it is recessed like that of Fig. 2.

In the operation of the structure of Fig. 1, in the compression stroke of the engine, the compressed mixture of explosive gases is forced into the mouth of the tubular plug, forcing before it and backward through the narrow channel 29 the inert gases already present in such mouth. This insures the electrodes being bathed with the explosive mixture while but very little of such mixture reaches 29. Substantially no commingling of live and inert gases takes place in 29, the contacting faces being of such small area that practically no diffusion can occur in the limited time allowed. The friction in this narrow passageway insures that the shock of the piston returning for the compression stroke shall not reach the cushioning gases in the chamber back of the blocking-out piece quickly and that it shall be effectually cushioned before reaching the insulator. As a matter of fact, because of the narrowness of this passageway, the pressure in the cushion chamber lags behind that in the explosion chamber. Upon exploding the mixture of gases for the power stroke, the shock is similarly damped, while any soot which may be produced has little tendency to drift backward through the narrow channel, and particularly so since the current of gases in such channel tends to revert at once as the pressure is relieved by the motion of the piston, causing the compressed gases to pour forward through the channel sweeping out any soot before it has a chance to lodge. In the structure of the blocking out piece and insulator of Fig. 1, practically three reservoirs are provided for the reception of cushioning compressed inert gas, all discharging into the channel.

In the structure of Figs. 2 and 5, the recess in the forward face of the blocking-out piece acts practically as a subchamber for the reception of the explosive gases independent of the narrow channel 29. The explosive mixture enters the subchamber compressing before it the gases present as a cushion and after the explosion is complete, the cupped end of the blocking-out piece is once more filled with inert gas. With this structure it is not necessary that the explosive gases entering the mouth of the plug shall drive the inert gases therein back through the narrow channel, the mouth of the plug tube and the channel being, so to speak, independent. And the length of the narrow channel proper is prolonged by the forward extension of the blocking-out piece by sleeve 27.

The functions of the blocking-out bodies of Figs. 4 and 5 are similar to those just described, but in addition by prolonging the annular sleeve on the rear of the blocking out body around the similar sleeve on the insulator a tortuous channel is created, still further impeding the progress of soot and dust back to the face of the insulator. To reach the inner face of the insulator sleeve in the structure of Fig. 5, soot must travel up the narrow channel 29 against the periodic outward rush of compressed cushioning gases, must then travel downward through the narrow channel between the inner face of the rear sleeve of the blocking out body and the outer face of the insulator sleeve and must then ascend the narrow channel between the inner face of the insulator sleeve and the included pole piece, making two right-angled turns. In order to produce short-circuiting, there must be a layer of soot on the insulator reaching continuously from the top of the outer face down such face and up the inner face to its top. The sleeve-like prolongation therefore makes an extended surface over which, with the structure described, it is practically impossible to produce a short circuit from sooting in any reasonable time.

Another advantageous feature of the cupped blocking-out body of Figs. 2 and 5, with an annular sleeve reaching nearly to the electrodes is that in the violent outward

rush of compressed cushioning gases, the space between the electrodes is swept clear of any bridging soot.

What I claim is:—

1. An igniter comprising a chambered tubular spark plug having an open and a closed end, a pole piece extending through the closed end and suitably insulated therefrom, said pole piece bearing a terminal electrode in spark-producing relationship to said open end, and a blocking-out body of heat-resistant insulating material mounted on the pole piece behind said electrode and spaced away both from the side walls and the rear wall of the chamber within the plug, said blocking-out body being recessed on one or more end faces.

2. An igniter comprising a chambered tubular spark plug having one end open and having a closure at the other comprising a body of heat-resistant insulating material, a pole piece bearing a terminal electrode in spark-producing relationship to the open end and extending through the plug chamber and the rear closure, and a blocking-out body of heat-resistant insulating material mounted on said pole piece behind the electrode near the open end of the plug chamber, said blocking-out body being of such shape and size as to leave a narrow annular channel between itself and the side walls of the plug chamber, to leave a chamber between its rear face and the rear walls of the plug chamber and to form a sub-chamber within the plug chamber at its front face.

3. An igniter comprising a chambered tubular spark plug having an open and a closed end, a pole piece extending through the closed end and suitably insulated therefrom, said pole piece having a terminal electrode in spark-producing relationship to said open end, and a blocking-out body of heat-resistant insulating material mounted on the pole piece behind said electrode and spaced away both from the side walls and the rear walls of the chamber, within the plug, said blocking out body being recessed on its front face to form a sub-chamber for the reception of the electrode.

4. An igniter comprising a chambered tubular spark plug having an open and a closed end, a pole piece extending through the closed end and suitably insulated therefrom, said pole piece having a terminal electrode in spark-producing relationship to said open end, and a blocking-out body of heat-resistant insulating material mounted on the pole piece behind said electrode and spaced away both from the side walls and the rear wall of the chamber within the plug, said blocking out body being recessed on its rear face to form an annular extension surrounding but spaced away from said pole piece.

5. An igniter comprising a chambered tubular spark plug having an open and a closed end, a pole piece extending through the closed end and suitably insulated therefrom, said pole piece having a terminal electrode in spark-producing relationship to said open end, and a blocking-out body of heat-resistant insulating material mounted on the pole piece behind the electrode and spaced away both from the side walls and the rear wall of the chamber within the plug, said blocking out body being recessed on its front face to form a sub-chamber for the reception of the electrode and on its rear face to form an annular extension surrounding but spaced away from said pole piece.

6. An igniter comprising a chambered tubular spark plug having an open end and a rear end closed by a closure comprising a body of heat-resistant insulating material, said body having an inward annular extension spaced away from the chamber walls, a pole piece extending inward through said insulating material and through the annular extension but spaced away from the inner walls of the latter, said pole piece carrying a terminal electrode in spark-producing relationship to the open end of the plug chamber, and a blocking-out body mounted on the pole piece behind the electrode and spaced away both from the side walls and the rear walls of the chamber within the plug, said blocking out body being recessed on its front face to form a sub-chamber for the reception of the electrode.

7. An igniter comprising a chambered tubular spark plug having an open end and a rear end closed by a closure comprising a body of heat-resistant insulating material, said body having an inward annular extension spaced away from the chamber walls, a pole piece extending inward through said insulating material and through the annular extension but spaced away from the inner walls of the latter, said pole piece carrying a terminal electrode in spark-producing relationship to the open end of the plug chamber, and a blocking-out body of heat-resistant insulating material mounted on the pole piece behind the electrode and spaced away both from the side walls and the rear walls of the chamber within the plug, said blocking-out body being recessed on its rear face to form an annular extension surrounding but spaced away from said pole piece, said extension being spaced away from the annular extension of the insulating material of the rear closure.

8. An igniter comprising a chambered tubular spark plug having an open end and a rear end closed by a closure comprising a body of heat-resistant insulating material, said body having an inward annular extension spaced away from the chamber walls, a pole piece extending inward through said insulating material and through the annular

extension but spaced away from the inner walls of the latter, said pole piece carrying a terminal electrode in spark-producing relationship to the open end of the plug chamber, and a blocking-out body of heat-resistant insulating material mounted on the pole piece behind the electrode and spaced away both from the side walls and the rear walls of the chamber within the plug, said blocking-out body being recessed on its rear face to form an annular extension surrounding but spaced away from said pole piece, said annular extension also surrounding but spaced away from the annular inward extension of the insulating material of the rear closure.

9. An igniter comprising a chambered tubular spark plug having an open end and a rear end closed by a closure comprising a body of heat-resistant insulating material, said body having an inward extension spaced away from the chamber walls, a pole piece extending inward through said insulating material and through the annular extension but spaced away from the inner walls of the latter, said pole piece carrying a terminal electrode in spark-producing relationship to the open end of the plug chamber, and a blocking-out body of heat-resistant insulating material mounted on the pole piece behind the electrode and spaced away both from the side walls and the rear walls of the chamber within the plug, said blocking-out body being provided on its front face with a recess for the reception of the electrode and on its rear face with a recess forming an annular extension surrounding but spaced away from said pole piece, said annular extension also surrounding but spaced away from the annular inward extension of the insulating material of the rear closure.

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

OTTO H. H. HEINS.

Witnesses:
H. F. BRINKMANN,
K. M. WILD.