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H. D. SEEKAMP

ELECTRICALLY HEATED SPARK PLUG

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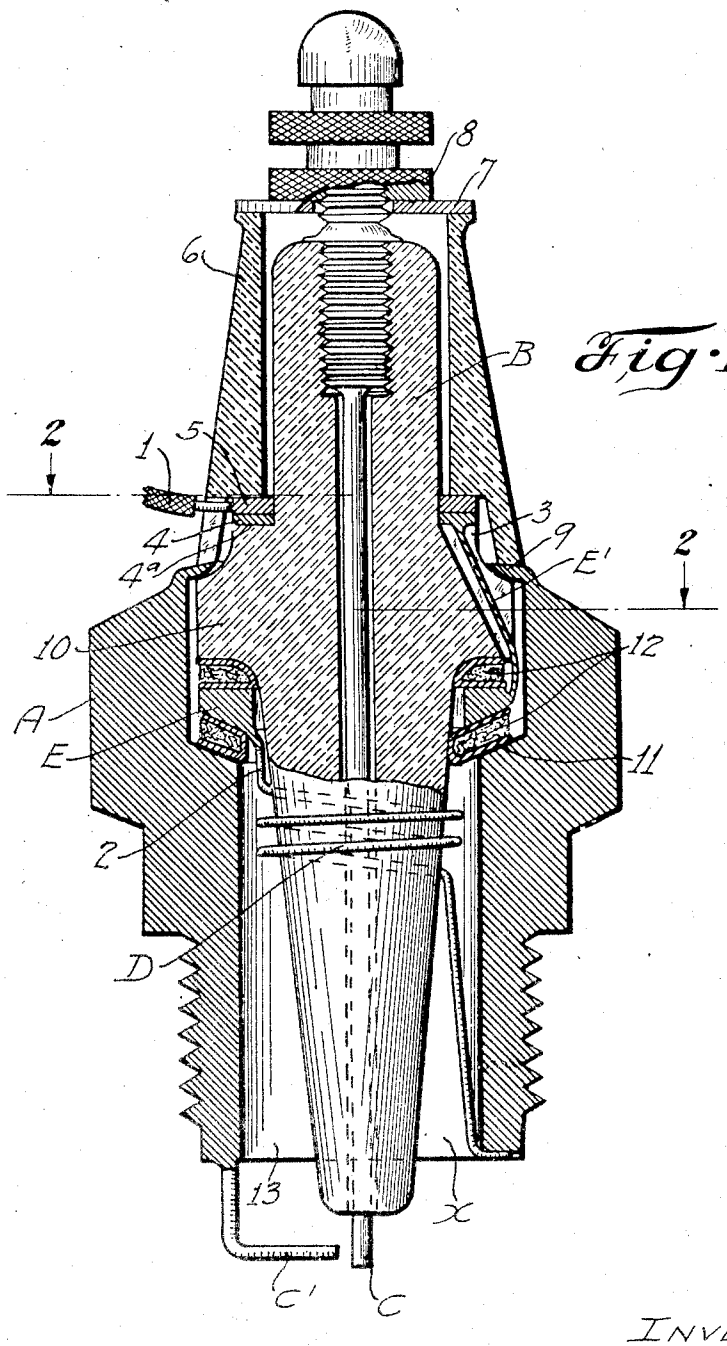

Fig. 1.

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Fig. 2.

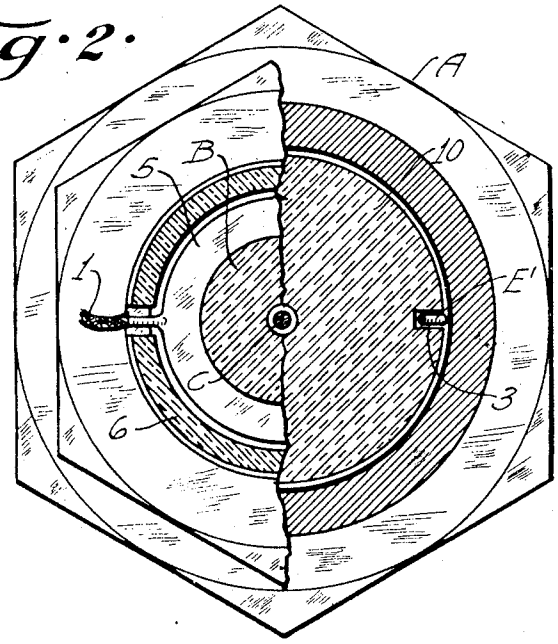
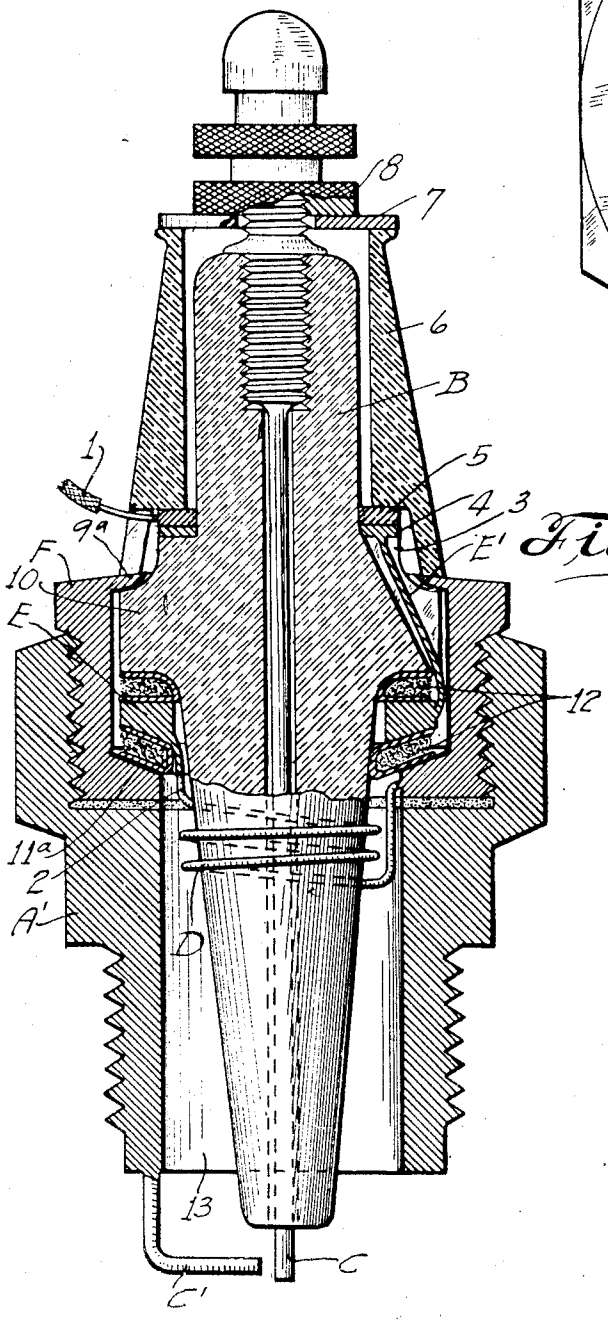


Fig. 3.



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UNITED STATES PATENT OFFICE.

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ELECTRICALLY-HEATED SPARK PLUG.

Application filed November 14, 1924. Serial No. 749,900.

This invention relates to spark plugs of the type that comprise an electric heating element for heating the plug so as to facilitate the starting of the motor on which the plug is used and to burn off carbon that collects on the plug.

One object of my invention is to provide an electrically-heated spark plug which is constructed in such a manner that compression leaks will not develop in the plug at high speed or under heavy compression.

Another object is to provide an electrically-heated spark plug in which the heating element is so arranged that it in no wise affects the normal operation of the plug and will not cause short-circuiting of the current, resulting from the heating element of the plug becoming excessively heated by reason of its close proximity to the electrodes.

Another object is to provide an electrically-heated spark plug in which short-circuiting of the electric current from the heating element to the metallic shell or body portion of the shell is effectively prevented in a novel manner. Other objects and desirable features of my invention will be hereinafter pointed out.

To this end I have devised an electrically heated spark plug in which the heating element is arranged on the insulator of the plug at a point remote from the electrodes of the plug and is electrically connected with the supply wire of the energizing circuit by a conducting means on the exterior of the insulator that tends to maintain a gas-tight joint at all times between the insulator and the metallic shell of the plug. By constructing the plug in this manner I eliminate the possibility of the heating element becoming overheated by the spark produced by the electrodes and I overcome the necessity of forming a hole in the insulator for the conductor that establishes electrical connection between the supply wire and the heating element. In view of the fact that the insulator is not provided with a hole other than the hole which receives the center electrode of the plug, there is no possibility of compression leaks developing in the plug at high speed or under heavy compression, by reason of the plug being equipped with an electrically-operated heating element. Still another advantage of such a construction is that compression leaks between the insulator and the metallic shell of the plug are reduced to a minimum by reason of the fact that the conducting means on the exterior of the insulator that leads from the supply wire to the heating element comprises a part that has a higher coefficient of expansion than the shell of the plug and which is so arranged that a rise in the temperature of same increases the efficiency of the gasket or packing means that is used to produce a gas-tight joint between the insulator and the metallic shell of the plug.

Figure 1 of the drawings is a vertical sectional view of an electrically-heated spark plug constructed in accordance with my invention.

Figure 2 is a cross-sectional view, taken on the line 2—2 of Figure 1; and

Figure 3 is a vertical sectional view illustrating a spark plug constructed in accordance with my invention in which the insulator is removably mounted in the body of the plug.

In the drawings which illustrate the preferred form of my invention, A designates the metallic shell or body portion of the plug, B designates the insulator, C designates the center electrode. C′ designates the side electrode on the shell which is spaced away from the center electrode so as to form a spark gap, and D designates an electrically-operated heating element mounted on the insulator B adjacent the upper end of the chamber x of the plug formed by the annular space between the shell A and the lower end portion of the insulator. By arranging the heating element in this position, namely, at a point remote from the electrodes C and C′ of the plug, I eliminate short-circuiting at a high speed, resulting from the heating element becoming excessively heated by the spark produced by the electrodes. In practice the heating element D is formed from a piece of nicrome wire or other suitable material bent to form a few coils of sufficient diameter to receive the portion of the insulator positioned in the chamber x and having one of its ends connected to a conducting means on the exterior of the insulator that leads to the supply wire 1 of the energizing circuit and having its opposite end grounded on a metallic portion of the plug, such, for example, as on the lower end portion of the shell A, as shown in Figure 1, or on the removable bushing in the upper end portion of the shell that carries the insu-

lator, as shown in Figure 3. Preferably the coils of the heating element D are made large enough so that they will not bear upon the insulator, and thus have a tendency to crack the insulator when the heating element is in use.

As previously stated, the means that establishes electrical connection between the supply wire 1 and the heating element D is arranged on the exterior of the insulator B so as to overcome the necessity of forming a hole in the insulator for said conducting means, as it is difficult to prevent the gases from leaking through such a hole at high speed or under heavy compression. The particular shape, form or style of the conducting means between the supply wire and heating element is immaterial, so far as my broad idea is concerned, but I prefer to use a conducting means composed of an annular member E that surrounds the insulator and which is constructed of brass or some other suitable material that has a relatively higher co-efficient of expansion than the shell A of the plug, the heating element D being brazed or permanently connected to the conducting member E at 2 or any other suitable point and the member E being provided with a conductor E′ that extends upwardly through an open-ended channel 3 in the exterior of the insulator B and which is connected at its upper end to an annular contact member 4 arranged above the shell A of the plug and adapted to have the supply wire 1 connected to same. Any suitable means can be used for connecting the supply wire 1 to the annular conductor terminal 4, but I prefer to connect the supply wire 1 to a washer-shaped contact 5 that is superimposed upon the member 4 and which is pressed tightly against the same by a clamping device 6 of any suitable type or kind. The insulator B is provided with a shoulder 4^a on which the annular member 4 of the conducting means rests, and accordingly, when the clamping device 6 is forced downwardly towards said shoulder, the contact 5 will be pressed tightly against the annular member 4. In the form of my invention herein illustrated the clamping device 6 is formed by a sleeve surrounding the upper end portion of the insulator and retained in position by a clamping washer 7 arranged under an adjustable element 8 on the center electrode that is adapted to be screwed downwardly so as to cause the clamping device 6 to press the annular terminal 5 of the supply wire tightly against the annular member 4 of the means that conducts the current to the heating element D.

In the plug shown in Figure 1 the insulator B is permanently mounted in the shell A of the plug, said insulator being retained in the shell by a flange 9 on the upper end portion of the shell that is bent inwardly over a shoulder on the insulator after the insulator has been positioned in the shell. The insulator is provided with the usual laterally-projecting portion 10 that laps over a shoulder 11 on the interior of the shell located at the upper end of the chamber x of the plug, but instead of packing the joint between said laterally-projecting portion and shoulder by a single copper gasket, as is the usual practice in spark plugs, I pack said joint by means of a plurality of copper asbestos gaskets 12 which are combined with the electrical conducting member E previously described in such a way that an increase in the temperature of said member E increases the efficiency of the gaskets 12. Preferably, the member E is arranged between the gaskets 12, as shown in Figure 1, and the underside of said member that bears against the bottom gasket 12 is slightly tapered or inclined. When the plug becomes heated the member E will expand, and as it is interposed between the gaskets 12, it will exert downward pressure on the bottom gasket, thus causing it to be clamped tightly against the shoulder 11 on the shell of the plug and it will exert upward pressure on the top gasket 12, thus causing said gasket to be tightly clamped against the underside of the laterally-projecting portion 10 on the insulator. Accordingly, even though the shell of the plug becomes abnormally heated, there is no possibility of the shell pulling away from the insulator and thus causing a compression leak to develop between the insulator and the shell because the conducting member E will expand a greater degree than the shell A, and thus always hold the gaskets 12 pressed tightly against the shell and the insulator.

In electrically-heated spark plugs it is essential that some means be employed to eliminate the possibility of the current short circuiting from the heating element to the shell of the plug. In prior plugs of this general type expensive insulating elements of complicated design have been used to prevent such short-circuiting, but I have discovered that short circuiting of the current from the heating element D to the shell A of the plug can be effectively prevented by placing a coating of enamel 13 on the center bore of the sell A through which the insulator passes.

In Figure 1 I have illustrated the insulator as being permanently mounted in the shell of the plug, but this is not essential, for if desired, the insulator can be carried by a bushing F that constitutes a removable portion of the body part A′, as shown in Figure 3, said bushing having a shoulder 11^a that co-operates with the bottom gasket 12 of the means that is used to produce a tight joint between the insulator and the metallic part of the plug and being pro-

vided with a flange 9ª that is adapted to be bent over a shoulder on the insulator after the insulator has been positioned in the bushing F. When the plug is constructed in this manner the lower end of the heating element D is grounded on the bushing F, as shown in Figure 3, so as to permit the insulator and the heating element to be removed as a single unit from the metallic shell of the plug. From the foregoing it will be understood that my improved plug has many features which make it a decided improvement upon prior electrically-heated spark plugs. For example, the heating element is arranged on the insulator in such a way that it in no wise affects the normal operation of the plug and has no tendency to produce a sort-circuit, thus causing the cylinder to miss firing. Another desirable characteristic of my plug is that compression leaks will not develop in the insulator or between the insulator and the metallic shell of the plug at high speed or under heavy compression, this being due to the fact that the conducting means between the heating element and the supply wire of the energizing circuit is arranged on the exterior of the insulator, instead of in a hole formed in the insulator, and due to the fact that the annular member E of said conducting means has a higher co-efficient of expansion than the shell of the plug and is so arranged that a rise in the temperature of the plug increases the clamping pressure of the gaskets 12 that are employed to produce a tight joint between the insulator and the shell of the plug. The enamel coating 13 on the bore of the shell through which the insulator passes forms an inexpensive and highly efficient means to prevent short circuiting of the current from the heating element to the shell, and still another very desirable feature of my plug is the ease with which a supply wire can be connected with or disconnected from the heating element D of the plug, this being effected by attaching the supply wire to an annular terminal 5 that can be arranged on the upper end portion of the insulator above the annular contact member 4 and then compressed tightly against said member by a clamping device 6 of any suitable form.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An electrically heated spark plug, comprising a metallic body part provided with a center bore that is enlarged at its upper end to form a shoulder, an insulator in said body part provided with a laterally-projecting portion that overhangs said shoulder, an electrode projecting downwardly through said insulator, an electrically-operated heating element composed of a few coils of wire surrounding said insulator and arranged in the center bore of the body part at a point far enough away from the end of said electrode to prevent said heating element from becoming excessively heated by the spark produced by the plug, a gasket arranged between the shoulder on the body part and the laterally-projecting portion of the insulator, an annular conducting member formed from a metal that has a higher co-efficient of expansion than the body part of the plug connected to said heating element and arranged in engagement with said gasket, and an electrical conductor leading upwardly from said conducting member through a groove on the exterior of the insulator and connected at its upper end to a contact or terminal mounted on the insulator above the metallic body part of the plug.

2. An electrically heated spark plug, comprising a metallic body part provided with a center bore that is enlarged at its upper end so as to form a shoulder, an insulator in said bore provided with a laterally-projecting portion that overhangs said shoulder, a plurality of gaskets interposed between said shoulder and laterally-projecting portion, an annular conducting member interposed between said gaskets and formed from a metal that has a higher co-efficient of expansion than the body part of the plug, a heating element formed from a few coils of wire arranged between said insulator and the body part of the plug and positioned in the bore of said body part at a point remote from the electrodes of the plug, said heating element being grounded to a metallic part of the plug and also connected to said annular conducting member, an electrical conductor leading upwardly from said conducting member through a groove formed in the exterior of the insulator, an annular contact or terminal connected to said conductor and mounted on a shoulder on said insulator at a point above the metallic body part of the plug, and means for connecting the supply wire of an energizing circuit to said contact.

3. An electrically heated spark plug, comprising a metallic body part provided with a center bore that is enlarged at its upper end so as to form a shoulder, an insulator in said bore provided with a laterally-projecting portion that overhangs said shoulder, a plurality of gaskets interposed between said shoulder and laterally-projecting portion, an annular conducting member interposed between said gaskets and formed from a metal that has a higher co-efficient of expansion than the body part of the plug, a heating element formed from a few coils of wire arranged between said insulator and the body part of the plug and positioned in the bore of said body part at a point remote from the electrodes of the plug, said heating element being grounded to a metallic

part of the plug and also connected to said annular conducting member, an electrical conductor leading upwardly from said conducting member through a groove formed in the exterior of the insulator, an annular contact or terminal connected to said conductor and mounted on a shoulder on said insulator at a point above the metallic body part of the plug, a co-operating contact connected to the supply wire of an energizing circuit, and a clamping member surrounding the upper end portion of the insulator for pressing said contacts together.

HERMAN D. SEEKAMP.