

Sept. 15, 1942.

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2,296,045

SPARK PLUG ELECTRODE

Filed Sept. 29, 1941

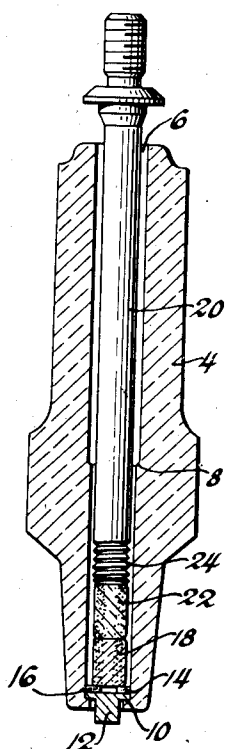


Fig. 1

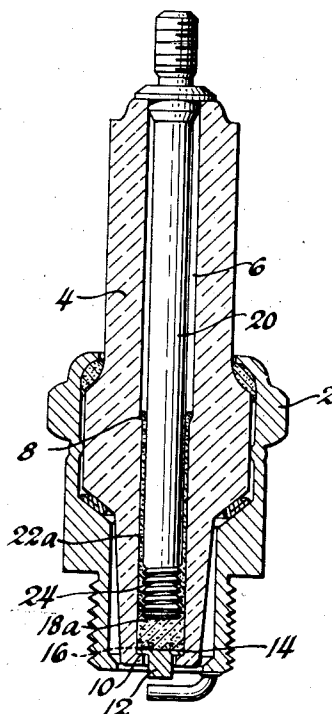


Fig. 2

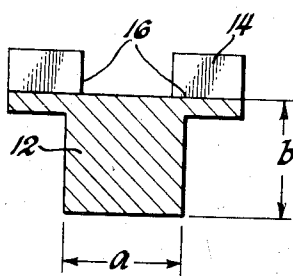


Fig. 3

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UNITED STATES PATENT OFFICE

2,296,045

SPARK PLUG ELECTRODE

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Application September 29, 1941, Serial No. 412,746

11 Claims. (Cl. 123-169)

This invention relates to a spark plug, especially a spark plug having a two piece conductor joined by a plastic seal, in which the heat conductivity is controlled by the shape of the conductor and its construction as assembled in the insulator bore.

Engineers in the spark plug industry have constantly been confronted with the problem of making a spark plug with an electrode having the desirable resistance to the high temperature to which it is exposed and at the same time having suitable heat conductivity to carry away the heat from the firing tip. Most alloys will generally be found to be poor heat conductors. One solution to the problem is to make the conductor in two pieces comprising a lower electrode and an upper terminal screw joined by a conducting seal, the electrode being very short and of a material having the desired high temperature resistance, and the terminal screw having the desired heat conductivity.

It is the object of this invention to provide a spark plug having a conductor made up of a very short heat-resisting electrode exposed to the hot gases, and a long terminal having good heat conductivity out of contact with the hot gases and electrically connected to the electrode by a plastic seal which bonds to the insulator and the electrode. More specifically, the electrode in this invention has a length which is of the order of magnitude of its transverse dimension, which in most cases will be the diameter. Preferably the ratio of length to transverse dimension should not be greater than one.

Figure 1 is a longitudinal sectional view showing an insulator and conductor in the process of assembly according to this invention.

Figure 2 is a longitudinal sectional view showing a completed spark plug made according to this invention, and

Figure 3 is a detail view of the electrode.

A conductor shell 2 is shown having secured therein an insulator 4 which may be of any suitable material. Spark plug insulators are commonly made of porcelain but they may be made of sintered oxides or mixtures of oxides and silicates. A longitudinal bore 6 is provided through the insulator. If desired, this bore may be provided with a shoulder 8 intermediate its ends and a lower shoulder 10 at the firing or sparking end of the insulator, but either or both of these shoulders may be omitted. The shoulder 10 serves to reduce the diameter of bore 6 at the firing end of the insulator. Through this reduced diameter opening projects an electrode 12 having a collar 14 which engages lower shoulder 10. Electrode

12 may be made of any suitable alloy having the desired high temperature resistance properties, such as a nickel alloy. If desired, this electrode may be made with a copper core, as disclosed in application Serial No. 375,002, of Walter F. Heller, filed January 18, 1941. The upper face of electrode 12 may be provided with two slots 16 at right angles to each other, as shown, or only one slot may be provided if preferred. Slots 16 are provided so that the sealing material of pellet 18 may more readily grip the electrode to prevent its rotating in bore 6. Pellet 18, which in the completed plug forms seal 18a, is preferably made of a hard glass such as a borosilicate glass, which is available commercially under the name Pyrex, mixed with an electrically conductive powder. Powdered copper is preferred because of its good thermal and electrical conductivity, although graphite could also be used. If the included substance is copper, 50% glass and 50% copper will be found to give satisfactory results. If graphite is used, 70% glass and 30% graphite is a good proportion.

The upper portion of the conductor is terminal 20 which is preferably made of a material having a good thermal conductivity, such as copper. If it is desired to make the upper portion of terminal 20 of a material having a low heat conductivity to prevent damage to the lead wires attached thereto, this member may be made of two pieces welded together. A second pellet 22 may, if desired, be provided to form an additional, or holding, seal 22a. Pellet 22 preferably comprises a soft glass, such as a lead borosilicate glass mixed with copper powder in the same proportions as discussed above for pellet 18.

In the preferred method of practicing this invention, electrode 12 is dropped into place in bore 6. Pellet 18 is dropped into bore 6 so that it rests on electrode 12. Pellet 22 is dropped in on top of pellet 18. Terminal screw 20 is then inserted in bore 6 with its end in contact with the top of pellet 22. With the members thus assembled, as shown in Figure 1, the assembly is heated to a temperature sufficient to soften the glass pellets. Pellet 22 is made of a softer glass and will be more plastic for a given temperature than pellet 18. When the desired degree of plasticity is reached, as by heating to a temperature of 1650° F. or higher, pressure is applied to screw 20, causing the pellets 18 and 22 to flow outward to fill the bore as shown at 18a and 22a respectively of Figure 2. Since pellet 22 is of a softer glass than pellet 18, terminal 20 will push downward through this pellet quite easily, forcing the

glass to fill up the annular space between terminal screw 20 and bore 6. Pellet 22 is sufficiently large to cause some of the glass to be forced up in the bore above shoulder 8. Pellet 18, although not so soft as pellet 22, is likewise rendered plastic by heating to the stated temperature. The pressure exerted by screw 20 on pellet 18 squeezes it down and outward into intimate contact with electrode 12 and the sides of bore 6. The glass forming this pellet bonds to the insulator, making a gas tight seal. The size of pellet 18 and the length of screw 20 are preferably so chosen that screw 20 comes into contact with the lower glass seal 18a in the final assembly as shown in Figure 2. If it should happen, however, that screw 20 be too short to make contact with the Pyrex glass seal in the final assembly, the electrical properties of the plug will not be affected, because the holding seal 22a is also an electrical conductor. Terminal 20 may be provided with threads 24 to give the holding seal 22a a better gripping action.

Figure 3 is a detail view of the electrode. It has been found that the best results of this invention are obtained if the ratio of b to a does not exceed unity. As shown in Figure 3 the dimension b is from the bottom of slot 16 to the firing end of the electrode. The bottom of the slot is taken as a reference because the effective length of the electrode so far as heat transfer is concerned depends to a considerable extent on the depth of the slot. This is particularly true where the slot is wide, and where there are two slots at right angles to each other, because in these cases the slots occupy a considerable proportion of the head. In the usual practice of this invention, the inventors contemplate the use of two wide slots at right angles, although of course the invention can be practiced with unslotted electrodes. If the electrodes are unslotted, the length, b , will be measured from the firing tip to the upper face of collar 14. It is desirable that the dimension b be kept as small as possible since the material of which the electrode is composed and the dimensions of the latter influence and therefore may be made to control the temperature which the electrode attains in operating service. It is further desirable that the distance between the terminal screw and electrode be held to a minimum. The dimension b may conveniently be called the length of the electrode and the dimension a the transverse dimension.

It is evident from the foregoing that this invention provides a spark plug having properties hitherto unknown to the art. The conductor is a two part member comprising an electrode having the desired properties of resistance to high temperature and a terminal screw having the desired high heat conductivity. The electrode and terminal screw are joined electrically by a gas tight seal which keeps the high temperature gases from contacting the terminal screw and which is itself a good heat conductor. The invention therefore provides a conductor having excellent resistance to high temperature and being at the same time a good conductor of heat.

We claim:

1. In a spark plug, an insulator having a longitudinal bore therethrough, a shoulder in said bore at the firing end of the insulator, an electrode in the firing end of the insulator bore, a collar on

the electrode in engagement with said shoulder, a glass seal in said bore above the electrode, and a terminal in said bore above said glass seal and in contact therewith.

2. The combination of claim 1, in which the glass seal contains powdered metal to improve its electrical and heat conductivity.

3. In combination, an insulator having a bore, a shoulder at the firing end of said bore reducing the diameter of the bore, an electrode in the reduced diameter of said bore, a collar on said electrode in engagement with said shoulder, a glass seal in said bore above the electrode, said seal being bonded to the insulator, a terminal in the bore above said glass seal and in contact therewith, and a second glass seal to secure the terminal in said bore.

4. The combination of claim 3, said terminal being roughened at its lower end to better grip the glass seal.

5. The combination of claim 3, in which the transverse dimension of the electrode is at least as great as its length.

6. A spark plug conductor comprising a terminal, an electrode the length of which is the same order of magnitude as its transverse dimension, and means to join the terminal and the electrode electrically.

7. A spark plug conductor comprising a terminal having good heat conductivity, a heat resistant electrode the length of which is the same order of magnitude as the transverse dimension, and an electrically conductive glass seal joining the terminal and electrode.

8. The combination of claim 7, in which the seal is composed of a mixture of hard glass and finely divided copper, in approximately equal quantities.

9. In combination, an insulator having a bore, a shoulder at the firing end of said bore reducing the diameter of the bore, an electrode in the reduced diameter of said bore, a collar on said electrode in engagement with said shoulder, a hard glass seal in said bore above the electrode, said seal being bonded to the insulator, a terminal in the bore above said glass seal and in contact therewith, and a soft glass seal to secure the terminal in said bore.

10. A spark plug comprising an insulator having a bore therein, and a composite electrode in said bore comprising a tip of heat resisting material secured in said bore at the firing end of the plug, a body portion comprising good heat conducting material extending throughout the major portion of the bore, and means for sealing the bore against the passage of gases, the length of said tip portion being substantially no greater than its transverse dimension.

11. In a spark plug, an insulator having a longitudinal bore therethrough, a terminal in said bore extending throughout substantially the length of the bore, an electrode in the extreme firing end of the insulator, and a seal joining the terminal and the electrode, said seal being a good conductor of heat and electricity and cooperating with the electrode and insulator to shield the terminal against contact with gases in the firing chamber.

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