United States Patent [19]

Yamaguchi et al.

[11] **3,857,145**

[45] **Dec. 31, 1974**

[54] **METHOD OF PRODUCING SPARK PLUG CENTER ELECTRODE**

[75] Inventors: **Terumoto Yamaguchi**, Anjo; **Kanemichi Izumi**, Oobu, both of Japan

[73] Assignee: **Nippondenso Co., Ltd.**, Kariya-shi, Aichi-ken, Japan

[22] Filed: **Aug. 1, 1972**

[21] Appl. No.: **277,044**

[30] **Foreign Application Priority Data**

Apr. 14, 1972 Japan 47-38172

[52] **U.S. Cl.** **29/25.12**, 313/136, 313/141

[51] **Int. Cl.** **F23q 3/70**, H01t 13/00

[58] **Field of Search** 29/25.12, 520; 313/136, 313/141, 144

[56] **References Cited**

UNITED STATES PATENTS

2,955,222	10/1960	Beesch	313/141
3,144,576	8/1964	Hagmaier	313/141
3,548,472	12/1970	Urushiwara et al	313/136 X

FOREIGN PATENTS OR APPLICATIONS

838,682	6/1960	Great Britain	29/25.12

Primary Examiner—Roy Lake
Assistant Examiner—James W. Davie
Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] **ABSTRACT**

A method for the production of a spark plug center electrode comprising steps of forming a good heat conducting metal piece into a convex or protrudent shape and a corrosion-resistant metal piece into a concave or cup-shaped shape, preparing an extrusion material by fitting the protruding portion of the convex-shaped good heat conducting metal piece into the recessed portion of the concave-shaped corrosion-resistant metal piece, and cold-extruding and extrusion material into a rod form such that the corrosion-resistant metal covers the good heat conducting metal.

5 Claims, 12 Drawing Figures

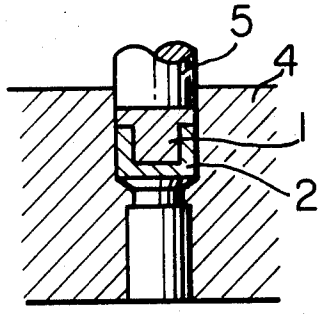


FIG. 1
PRIOR ART

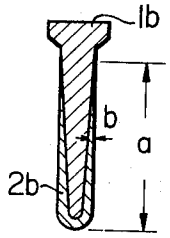


FIG. 2

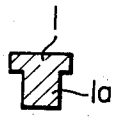


FIG. 3

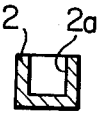


FIG. 4

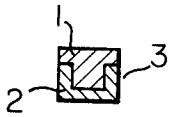


FIG. 5

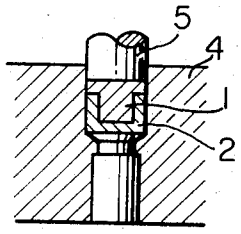


FIG. 6

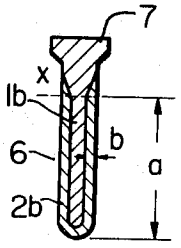


FIG. 7

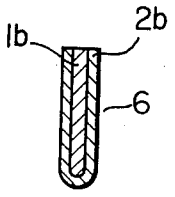


FIG. 8

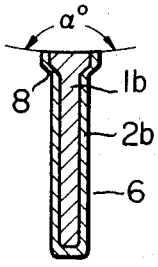


FIG. 9

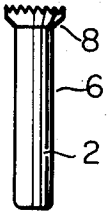


FIG. 10

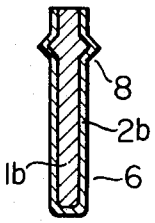


FIG. 11

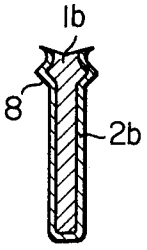
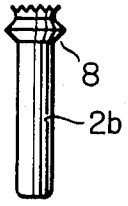


FIG. 12



METHOD OF PRODUCING SPARK PLUG CENTER ELECTRODE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method for the production of a spark plug center electrode of the type in which the core member consisting of a good heat conducting metal such as copper is inserted into the central part of the covering member consisting of a corrosion-resistant metal such as nickel.

2. Description of the Prior Art

Methods of producing spark plug center electrodes are known in the art in which the covering member is formed by boring out a rod of corrosion-resistant metal such as nickel and the core member consisting of a good heat conducting metal such as copper is then inserted into the bore of the covering member and soldered thereto, or alternatively two cylindrical metal pieces of corrosion-resistant metal and good heat conducting metal, respectively, are put one upon another so that when they are extruded and shaped into a rod form in a cold extrusion die, the core member of good heat conducting metal is covered by the covering member of corrosion-resistant metal by virtue of the flowing effect of the metal. A disadvantage of the former method is that the bore of the corrosion-resistant metal covering member for receiving the core member made of good heat conducting metal is formed by a cutting process and thus this method is not satisfactory from the standpoint of mass production efficiency. The latter method is also disadvantageous in that since the center electrode is made using two cylindrical metal pieces, as shown in FIG. **1**, there is a limit to the length *a* of the corrosion-resistant metal covering member **2***b* covering the core member and moreover the covering member **2***b* increases toward its end at the sparking side and decreases toward the opposite end in its thickness *b* thereby making it impossible to ensure a uniform heat radiation.

SUMMARY OF THE INVENTION

It is the object of the present invention to solve these difficulties. In accordance with the present invention therefore, there is provided a method of producing a spark plug center electrode which comprises a first step of forming a metal piece of good heat conductivity into a convex shape and a corrosion-resistant metal piece into a concave shape, a second step of preparing an extrusion material by fitting the protruding portion of the convex-shaped good heat conducting metal piece into the recessed portion of the concave-shaped corrosion-resistant metal piece, a third step of cold-extruding the extrusion material into a rod form with the corrosion-resistant metal covering the good heat conducting metal, a fourth step of cutting the cold extruded material at that portion thereof where the corrosion resistant metal no longer covers the good heat conducting metal, and a fifth step of subjecting the center electrode composed of the core member consisting of the good heat conducting metal and the corrosion-resistant metal covering member to a heading operation to form thereon a collar for assembling it into a spark plug, whereby the length of coverage of the corrosion-resistant metal covering member can be selected as desired with its thickness being relatively uniform, and the core member can be covered with the covering member without any cutting operation thus making the present method well suited for mass production.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a longitudinal sectional view of a center electrode produced according to a conventional method of producing a spark plug center electrode.

FIG. **2** is a longitudinal sectional view of a good heat conducting metal piece employed in the method for the production of a spark plug center electrode according to the present invention.

FIG. **3** is a longitudinal sectional view of a corrosion-resistant metal piece employed in the method for the production of a spark plug center electrode according to the present invention.

FIG. **4** is a longitudinal sectional view of an extrusion material prepared by assembling the good heat conducting metal piece of FIG. **2** and the corrosion-resistant metal piece of FIG. **3**.

FIG. **5** is a partial longitudinal sectional view of a cold extrusion die in which the extrusion material of FIG. **4** is placed.

FIG. **6** is a longitudinal sectional view of a center electrode with a head, which is produced by the cold extrusion die of FIG. **5**.

FIG. **7** is a longitudinal sectional view of the center electrode of FIG. **6** with its head cut off.

FIG. **8** is a longitudinal sectional view showing a first embodiment of the center electrode of the invention produced by subjecting the center electrode of FIG. **7** to a heading operation to form a collar thereon.

FIG. **9** is a side view of the center electrode shown in FIG. **8**.

FIG. **10** is a longitudinal sectional view showing a second embodiment of the center electrode of the invention produced by subjecting the center electrode of FIG. **7** to a heading operation to form a collar thereon.

FIG. **11** is a longitudinal sectional view of the center electrode of FIG. **10** subjected to an expanding operation.

FIG. **12** is a side view of the center electrode shown in FIG. **11**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be explained with reference to a first embodiment shown in the accompanying drawings. According to this first embodiment, the first step consists of plastic-working a metal piece **1** of good heat conductivity such as copper into a convex shape having a protruding portion **1***a* as shown in FIG. **2** and a metal piece **2** of corrosion-resistant material such as nickel into a concave shape having a recessed portion **2***a* as shown in FIG. **3**. In the second step, the good heat conducting metal piece **1** and the corrosion-resistant metal piece **2** worked plastically in the first step are assembled in such a manner that the protruding portion **1***a* of the former is fitted into the recessed portion **2***a* of the latter to produce an extrusion material **3**. The two metal pieces **1** and **2** can be bonded together, if required, by means of soldering, welding, thermal diffusion, pressure fitting and caulking, etc., so that the resultant extrusion material **3** may be conveniently placed in a cold extrusion die in a subsequent step. In the third step, the extrusion material **3** prepared in the second step is placed in a cold extrusion

die 4 and it is then shaped into a rod form in cold extrusion under the pressure applied by a punch 5, producing a cold extruded product comprising a covering member 2*b* consisting of the cup-shaped corrosion-resistant metal piece 2 and a core member 1*b* consisting of the good heat conducting metal piece 1 covered by the covering member 2*b*. A center electrode 6 is thus obtained in which, as shown in FIG. 6, the covering member 2*b* consisting of the corrosion-resistant metal 2 is uniform in its thickness *b* and its length *a* covering the core member 1*b* is also long. In the fourth step, the center electrode 6 extruded as shown in FIG. 6 by the cold extrusion die is cut at that portion thereof where the corrosion-resistant metal of the center electrode 6 no longer covers the good heat conducting metal, i.e., at a dotted line X by means of a lathe or the like, cutting off a head portion 7 of the center electrode 6 and thus shaping it into a form shown in FIG. 7. The fifth and final step consists of subjecting the center electrode 6 to a heading operation to form thereon a collar portion 8 as shown in FIGS. 8 and 9 which is necessary for assembling the center electrode 6 into a spark plug.

In this heading operation, the center electrode 8 is worked to have a point angle α at its end face and it is also worked by a punch having its end face formed with radial V-grooves.

In accordance with a second embodiment of the present invention, in the heading operation the collar portion 8 may be formed on the center electrode 6 at a place slightly below its end face as shown in FIG. 10 and thereafter the end face may be subjected to an expanding operation by the aforesaid punch as shown in FIG. 11 or 12.

It will thus be seen that since the method according to the present invention comprises the first step of forming a good heat conducting metal piece into a convex shape and a corrosion-resistant metal piece into a concave shape, the second step of preparing an extrusion material by fitting the protruding portion of the convex-shaped good heat conducting metal piece into the recessed portion of the concave-shaped corrosion-resistant metal piece, the third step of shaping the extrusion material into a rod form by the process of cold extruding, the fourth step of cutting off the thus cold-extruded product at that portion thereof where the corrosion-resistant metal no longer covers the good heat conducting metal, and the fifth step of subjecting the resultant center electrode comprising the core member made of the good heat conducting metal and the covering member made of the corrosion-resistant metal to a heading operation to form thereon a collar portion for assemblying the center electrode into a spark plug, there is a remarkable effect in that the dimensions of the protruding portion of the good heat conducting metal piece and the recessed portion of the corrosion-resistant metal piece can be chosen as desired and that the thickness of the covering member consisting of the corrosion-resistant metal below the mounting collar portion of the center electrode can also be selected as desired and made relatively uniform and more specifically the thickness of the covering member on the end face at the sparking side can also be adjusted as desired. There is another remarkable effect in that by subjecting the center electrode to a heading operation, a sufficient amount of the good heat conducting metal of the center electrode can be exposed, thereby ensuring an adequate transmission of heat to the glass sealing material and also a sufficient mechanical sustaining strength. There is a further remarkable effect in that with the use of a heading punch which is required to operate in the vertical direction only, the operating method of the punch can be extremely simplified thus permitting the production of center electrodes with inexpensive equipment. There is a still further remarkable effect in that the core member can be covered with the covering member without any cutting operation, thereby ensuring an improved mass production efficiency.

We claim:

1. A method of producing a spark plug center electrode of the type which comprises a core member consisting of a good heat conducting metal having a corrosion-resistant metal enclosing the sparking end portion and the side portions thereof, said method comprising the steps of:

forming said good heat conducting metal into a protrudent shape by only one plastic-working step, the protrudent portion of the shaped good heat conducting metal being at least as great as one-half the height of said shaped good heat conducting metal,

forming a corrosion-resistant metal piece into a cup shape by only one plastic working step, the depth of the cavity of said cup-shaped metal being at least as great as one-half the height of said cup-shaped metal,

preparing an extrusion metal by fitting the protruding portion of said protrudent shaped good heat conducting metal piece into the recess portion of said cup-shaped corrosion resistant metal piece, and

shaping said extrusion metal into a rod formed by the process of cold extrusion, wherein said good heat conducting metal is covered by said corrosion resistant metal.

2. A method according to claim 1 including a further step of cutting said cold-extruded product at that portion thereof where the length of said corrosion-resistant metal covering said good heat conducting metal terminates.

3. A method according to claim 2 including a further step of subjecting the center electrode comprising the core member consisting of said good heat conducting metal and the covering member covering said core member and consisting of said corrosion-resistant metal to a heading operation to form thereon a collar portion for assemblying said center electrode into a spark plug.

4. A method according to claim 3, wherein said good heat conducting metal consists of copper and said corrosion-resistant metal consists of nickel.

5. A method of producing a spark plug center electrode of the type which comprises a core member consisting of a good heat conducting metal having a corrosion-resistant metal enclosing the sparking end portion and the side portions thereof, said method comprising the steps of:

forming said good heat conducting metal into a protrudent shape by only one plastic-working step wherein the protruding portion of said good heat conducting metal is at least as great as one-half the length of the shaped good heat conducting metal,

forming a corrosion-resistant metal piece into a complementary shape having a cavity therein for receiving said protruding portion of said good heat conducting metal, the depth of said cavity being at least as great as one-half the height of said complementary-shaped metal piece,

preparing an extrusion metal by fitting the protruding portion of said protrudent-shaped good heat conducting metal piece into the cavity portion of said complementary-shaped corrosion-resistant metal piece, and

shaping said extrusion metal into a rod formed by the process of cold extrusion, wherein said good heat conducting metal is substantially uniformly covered by said corrosion-resistant metal.

* * * * *