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Description

The present invention relates to a method of manufacturing a voltage controlling discharge tube, and more particularly to a method of manufacturing a gas sealed discharge tube for a series gap in an ignition device for an automotive engine, for example.

A method of manufacturing gas sealed discharge tubes is disclosed in Soviet Inventions Illustrated; Section EI, week 8446, January 2, 1985, DERWENT PUBLICATION LTD., London, V05 : Su-1 081-702.

An ignition device for an automotive engine or the like is designed to apply a high voltage to a spark plug and thereby generate a spark. To prevent the generation of misfire and precisely control an ignition timing, there has been proposed a so-called series gap ignition device having a discharge gap formed in series with the spark plug. It is known to use a discharge tube for the formation of such a series gap which discharge tube is provided with a pair of discharge electrodes mounted on opposite ends of a cylindrical body and filled with an inert gas.

In precisely controlling an ignition timing of the spark plug with use of such a discharge tube for a series gap, a discharge starting voltage in the discharge tube is required to be high to some extent as compared with that of the ignition plug. It is also known to increase a pressure of the inert gas to be filled, so as to increase the discharge starting voltage with the discharge tube maintained compact.

In assembling such a discharge tube, there has been conventionally adopted a melt-bonding method using a glass frit or metal solder to hermetically connect a cylindrical body formed of an electrical insulating material capable of enduring a high voltage such as glass or ceramics to electrode terminals formed of metal. It has been considered to be preferable that such a bonding process should be carried out in a vacuum electric furnace, so as to ensure a quality of the discharge tube. In assembling a gas sealed discharge tube, it is necessary to change the atmosphere in the electric furnace from a vacuum condition to a gas atmosphere. However, to fill a high pressure gas in the discharge tube, the electric furnace is required to endure a high pressure. As a result, an apparatus for assembling the discharge tube becomes large and complicated, and the number of assembling steps is also increased to cause a disadvantage from an economical viewpoint.

In view of the foregoing, it is an object of the present invention to provide a method of economically manufacturing a high-pressure gas sealed discharge tube having a uniform performance suitable for the series gap.

The above object can be achieved by the following construction of the discharge tube. That is, according to the present application, there is provided a method of manufacturing a gas sealed discharge

tube including an electrical insulating cylindrical body and a pair of electrodes attached to opposite ends of said electrical insulating cylindrical body, said method comprising the steps of inserting a heat melting sealing material into a gas introducing pipe mounted to at least one of said electrodes so as to communicate the inside space of said cylindrical body to the outside thereof, said heat melting sealing material being a solid having an outer diameter smaller than an inner diameter of said gas introducing pipe; introducing a gas through said gas introducing pipe into said cylindrical body; heating said gas introducing pipe together with said heat melting sealing material under pressure at a sealing position where said gas introducing pipe is intended to be sealed to thereby press said gas introducing pipe and simultaneously melt said heat melting sealing material; and cutting said gas introducing pipe at said sealing position together with said heat melting sealing material after solidified.

The gas introducing pipe to be mounted to the discharge tube in the present invention is required to be pressed by heating under pressure. Furthermore, it is necessary to hermetically mount the gas introducing pipe to at least one of the electrodes by any bonding means such as welding or brazing. Moreover, the gas introducing pipe is preferably formed of an electrical conductive material such as metal, preferably, a copper material.

The heat melting sealing material to be inserted into the gas introducing pipe has a melting point lower than that of the gas introducing pipe, and preferably has an affinity to the material of the gas introducing pipe and a good wettability. For example, the sealing material is selected from silver solder, solder or high-molecular adhesive. However, the sealing material is not limited to these materials. Furthermore, the heat melting sealing material is required to be a solid having an outer diameter smaller than an inner diameter of the gas introducing pipe. For example, the sealing material is in the form of rod, wire or granule. Particularly, a wire form of the sealing material is preferable since an insert position of the sealing material in the gas introducing pipe can be easily controlled and adjusted.

According to the method of manufacturing a gas sealed discharge tube of the present invention, a composition and pressure of a gas to be sealed can be greatly easily adjusted, and a manufacturing equipment and its operation are simple. Therefore, mass production of a gas sealed discharge tube having a high quality can be economically carried out.

Other objects and features of the invention will be more fully understood from the following detailed description and appended claims when taken with the accompanying drawings.

Fig. 1 is a schematic illustration of a device embodying the method of manufacturing a gas

sealed discharge tube according to the present invention;

Fig. 2 is a sectional view of a discharge tube assembly to be suitably used for embodying the manufacturing method of the present invention; and

Fig. 3 is a sectional view of a gas sealed discharge tube manufactured by the manufacturing method of the present invention.

There will now be described a preferred embodiment of the method of manufacturing a gas sealed discharge tube according to the present invention with reference to the drawings.

Referring to Fig. 2 which is a sectional view of a discharge tube assembly A before applying the method of the present invention, reference numeral 1 designates an electrical insulating cylindrical body formed of glass or ceramics, and reference numerals 2 and 3 designate discharge electrodes bonded to opposite ends of the cylindrical body 1. The electrode 2 is formed with a through-hole 2'. A gas introducing pipe 4 is engaged with the through-hole 2', and is brazed to the electrode 2. Such an assembly A can be formed under vacuum or in the atmosphere of air or inert gas, for example.

The assembly A is mounted to a device as shown in Fig. 1, so as to form a gas sealed discharge tube B as shown in Fig. 3. This device is constructed of a jig 6 and a press including a pair of heating electrodes 7a and 7b. The jig 6 is constructed of a piping system including a joint portion 6a adapted to be hermetically connected to a free end of the gas introducing pipe 4, a wire inserting portion 6b adapted to hermetically insert a silver solder wire 5, a connecting portion 6c connected to a vacuum device (not shown) for evacuating the inside of the assembly A, a gas introducing portion 6d for supplying an inert gas into the assembly A, and a manometer 6e.

In manufacturing the gas sealed discharge tube B by using the above device, the free end of the gas introducing pipe 4 of the assembly A is first connected to the joint portion 6a, and then the silver solder wire 5 is inserted through the wire inserting portion 6b into the gas introducing pipe 4 as far as a sealing position where the gas introducing pipe 4 is intended to be sealed. Then, the wire inserting portion 6b and the gas introducing portion 6d are closed, and the inside of the assembly A is evacuated through the connecting portion 6c by the vacuum device. Then, the connecting portion 6c is closed, and an inert gas is introduced from the gas introducing portion 6d until a predetermined pressure is reached. Then, the gas introducing pipe 4 is pressed by the heating electrodes 7a and 7b, and simultaneously the silver solder wire 5 is molten by the heating electrodes 7a and 7b. Then, the heating electrodes 7a and 7b are moved away from each other to solidify the silver solder of the wire 5, thus completing the sealing operation of the assembly A.

Then, the assembly A containing the sealed gas is removed from the joint portion 6a, and the gas introducing pipe 4 is cut at a sealing portion 4' as shown in Fig. 3. Thus, the gas sealed discharge tube B sealed by a solidified silver solder 5' as shown in Fig. 3 is obtained.

Claims

1. A method of manufacturing a gas sealed discharge tube (B) including an electrical insulating cylindrical body (1) and a pair of electrodes (2,3) attached to opposite ends of said electrical insulating cylindrical body (1), said method comprising the steps of inserting a heat melting sealing material (5) into a gas introducing pipe (4) mounted to at least one of said electrodes (2,3) so as to communicate the inside space of said cylindrical body (1) to the outside thereof, said heat melting sealing material (5) being a solid having an outer diameter smaller than an inner diameter of said gas introducing pipe (4); introducing a gas through said gas introducing pipe into said cylindrical body; heating said gas introducing pipe (4) together with said heat melting sealing material (5) under pressure at a sealing position where said gas introducing pipe (4) is intended to be sealed to thereby press said gas introducing pipe and simultaneously melt said heat melting sealing material; and cutting said gas introducing pipe (4) at said sealing position together with said heat melting sealing material (5) after solidified.
2. The method as defined in claim 1, wherein said gas introducing pipe (4) is hermetically mounted to at least one of said electrodes (2,3).
3. The method as defined in claim 2, wherein said gas introducing pipe (4) is welded to at least one of said electrodes (2,3).
4. The method as defined in claim 2, wherein said gas introducing pipe (4) is brazed to at least one of said electrodes (2,3).
5. The method as defined in claim 1, wherein said gas introducing pipe (4) is formed of an electrical conductive material.
6. The method as defined in claim 5, wherein said electrical conductive material comprises metal.
7. The method as defined in claim 6, wherein said metal comprises a copper material.
8. The method as defined in claim 1, wherein said heat melting sealing material has a melting point

lower than that of said gas introducing pipe (4).

9. The method as defined in claim 8, wherein said heat melting sealing material (5) has an affinity to a material forming said gas introducing pipe (4) and has a good wettability.
10. The method as defined in claim 9, wherein said heat melting sealing material (5) is selected from the group consisting of silver solder, solder and high-molecular adhesive.
11. The method as defined in claim 1, wherein said heat melting sealing material (5) is in the form of wire.
12. The method as defined in claim 1 further comprising the step of evacuating the inside space of said cylindrical body (1) before said gas introducing step.
13. The method as defined in claim 1, wherein said heating step is carried out by a press device (7) including a pair of heating electrodes (7A, 7B).

Patentansprüche

1. Verfahren zur Herstellung einer gasverschmolzenen Entladungsröhre (B) umfassend einen elektrisch isolierenden zylindrischen Körper (1) und ein Paar an den gegenüberliegenden Enden des elektrisch isolierenden Zylinders angebrachte Elektroden (2, 3), wobei das Verfahren die Schritte des Einsetzens eines heißschmelzenden Dichtungsmaterials (5) in ein Gaseinfüllrohr, das wenigstens an einer der Elektroden (2, 3) so befestigt ist, daß der Innenraum des zylindrischen Körpers (2, 3) mit der Außenseite desselben in Verbindung steht, wobei das heißschmelzende Material (5) in festem Zustand einen Außendurchmesser aufweist, der kleiner ist als der Innendurchmesser des Gaseinfüllrohres (4); des Einfüllens eines Gases durch das Gaseinfüllrohr in den zylindrischen Körper; des Aufheizens des Gaseinfüllrohres (4) zusammen mit dem heißschmelzenden Material (5) unter Pressung in einer Dichtungsposition, bei der das Gaseinfüllrohr abgedichtet werden soll, so daß dadurch das Gaseinfüllrohr gepreßt und gleichzeitig das heißschmelzende Material erhitzt wird; und des Schneidens des Gaseinfüllrohres (4) bei der Dichtungsposition zusammen mit dem heißschmelzenden Material (5) nach dessen Verfestigung.
2. Verfahren nach Anspruch 1, wobei das Gaseinfüllrohr (4) hermetisch an wenigstens einer der

Elektroden (2, 3) befestigt ist.

3. Verfahren nach Anspruch 2, wobei das Gaseinfüllrohr (4) mit wenigstens einer der Elektroden (2, 3) verschweißt ist.
4. Verfahren nach Anspruch 2, wobei das Gaseinfüllrohr (4) mit wenigstens einer der Elektroden (2, 3) verlötet ist.
5. Verfahren nach Anspruch 1, wobei das Gaseinfüllrohr (4) aus elektrisch leitfähigem Material gebildet ist.
6. Verfahren nach Anspruch 5, wobei das elektrisch leitfähige Material Metall umfaßt.
7. Verfahren nach Anspruch 6, wobei das Metall Kupfer umfaßt.
8. Verfahren nach Anspruch 1, wobei das heißschmelzende Material einen Schmelzpunkt aufweist, der niedriger als der des Gaseinfüllrohres ist.
9. Verfahren nach Anspruch 8, wobei das heißschmelzende Material (5) eine Affinität zu einem das Gaseinfüllrohr bildenden Material aufweist und eine gute Benetzbarkeit hat.
10. Verfahren nach Anspruch 9, wobei das heißschmelzende Material (5) aus einer Gruppe ausgewählt ist, die aus Silberlot, Lot und hochschmelzendem Kunststoff besteht.
11. Verfahren nach Anspruch 1, wobei das heißschmelzende Material (5) drahtförmig ausgebildet ist.
12. Verfahren nach Anspruch 1, des weiteren umfassend den Schritt des Evakuierens des Innenraums des zylindrischen Körpers (1) vor dem Schritt des Gaseinfüllens.
13. Verfahren nach Anspruch 1, wobei der Schritt des Aufheizens durch eine Preßvorrichtung (7) durchgeführt wird, die ein Paar Heizelektroden (7A, 7B) umfaßt.

Revendications

1. Méthode de fabrication d'un tube à décharge (B) dans un gaz, scellé, comprenant un corps cylindrique diélectrique (1) et une paire d'électrodes (2, 3) fixées aux extrémités opposées dudit corps cylindrique diélectrique (1), ladite méthode comprenant les étapes consistant à introduire un

- matériau thermofusible de scellement (5) dans un tube (4) d'introduction de gaz monté sur au moins une desdites électrodes (2, 3) de manière à faire communiquer l'espace intérieur dudit corps cylindrique (1) avec l'extérieur de celui-ci, ledit matériau thermofusible de scellement (5) étant un solide ayant un diamètre extérieur inférieur au diamètre intérieur dudit tube (4) d'introduction de gaz ; introduire un gaz par ledit tube d'introduction de gaz dans ledit corps cylindrique ; chauffer ledit tube (4) d'introduction de gaz en même temps que ledit matériau thermofusible de scellement (5) sous pression à un endroit de scellement où ledit tube (4) d'introduction de gaz est destiné à être scellé de manière à comprimer ainsi ledit tube d'introduction de gaz et à faire fondre simultanément ledit matériau thermofusible de scellement ; et à couper ledit tube (4) d'introduction de gaz au niveau dudit endroit de scellement en même temps que ledit matériau thermofusible de scellement (5) après solidification.
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- 5
- ledit matériau thermofusible de scellement (5) est sélectionné parmi le groupe comprenant l'argent d'apport de brasage, un métal d'apport de brasage et un adhésif à haute densité moléculaire.
11. Méthode selon la revendication 1 dans laquelle ledit matériau thermofusible de scellement (5) se présente sous la forme d'un fil.
12. Méthode selon la revendication 1 comprenant en outre l'étape consistant à évacuer l'espace intérieur dudit corps cylindrique (1) avant ladite étape d'introduction de gaz.
13. Méthode selon la revendication 1 dans laquelle ladite étape de chauffage est effectuée par un dispositif de pression (7) comprenant une paire d'électrodes chauffantes (7A, 7B).
2. Méthode selon la revendication 1 dans laquelle ledit tube (4) d'introduction de gaz est monté de façon hermétique sur au moins une desdites électrodes (2, 3).
3. Méthode selon la revendication 2 dans laquelle ledit tube (4) d'introduction de gaz est soudé à au moins une desdites électrodes (2, 3).
4. Méthode selon la revendication 2 dans laquelle ledit tube (4) d'introduction de gaz est brase à au moins une desdites électrodes (2, 3).
5. Méthode selon la revendication 1 dans laquelle ledit tube (4) d'introduction de gaz est formé d'un matériau électroconducteur.
6. Méthode selon la revendication 5 dans laquelle ledit matériau électroconducteur comprend du métal.
7. Méthode selon la revendication 6 dans laquelle ledit métal comprend du cuivre.
8. Méthode selon la revendication 1 dans laquelle ledit matériau thermofusible de scellement a un point de fusion inférieur à celui dudit tube (4) d'introduction de gaz.
9. Méthode selon la revendication 8 dans laquelle ledit matériau thermofusible de scellement (5) a une affinité pour le matériau formant ledit tube (4) d'introduction de gaz et a une bonne mouillabilité.
10. Méthode selon la revendication 9 dans laquelle

FIG. 1

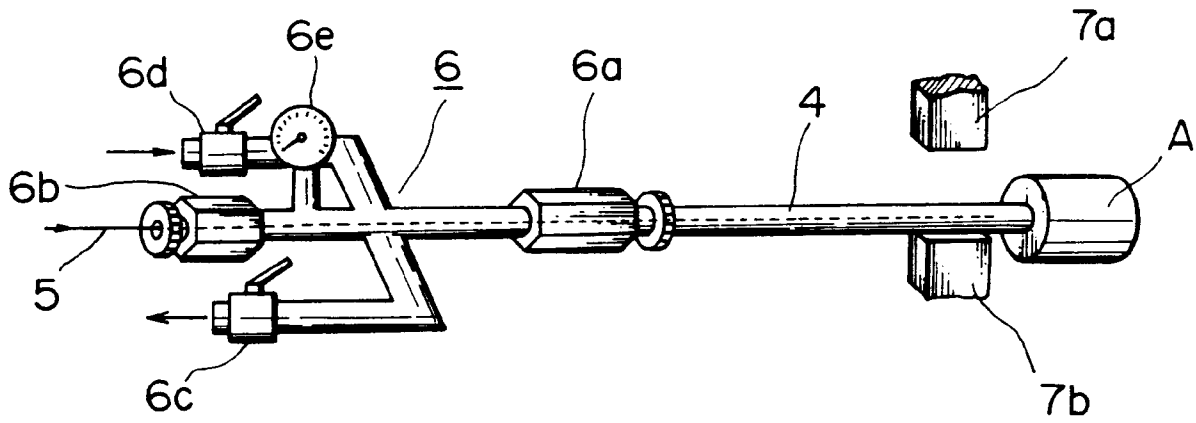


FIG. 2

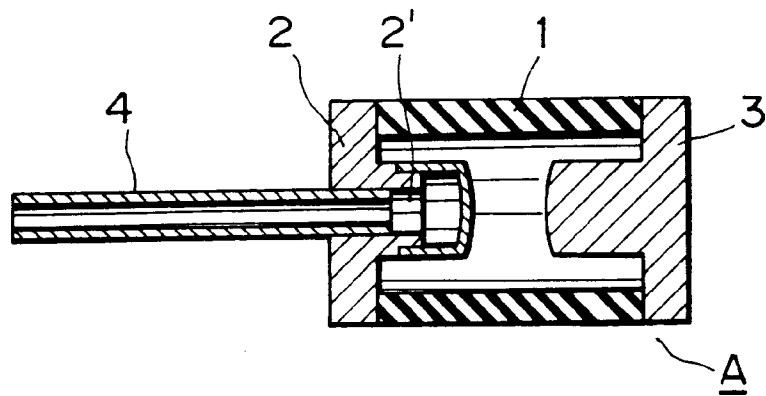


FIG. 3

