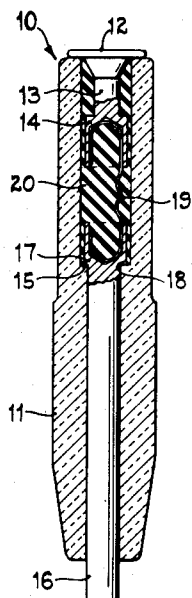


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SPARK PLUG CONSTRUCTION

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SPARK PLUG CONSTRUCTION

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This invention relates to spark plug construction and particularly concerns a center electrode assembly of improved type that is adapted to be assembled as a unit in a spark plug.

In co-pending application, Serial No. 668,202, filed May 8, 1946, there is disclosed a new type of spark plug having particularly desirable characteristics. That construction is still regarded as superior to the constructions of the prior art, but it involves the use of carbon connectors that are rigid and must be formed in rather accurate sizes, and require considerable care in assembling the spark plug.

It is an object of this invention to connect the two main parts of the center conductor by a novel connector that is adapted to withstand the treatments to which the center electrode assembly is subjected.

A particular object of the invention is to substitute a novel wire or metallic connection for the carbon connection described in the said application, whereby leakage of gases is prevented at all operating temperatures and under all operating conditions.

The objects of the invention were attained, generally speaking, by the employment of a novel form of connector, in novel combination with a sealing compound and other elements of the center electrode.

The above and further objects and novel features of the present invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawing. It is to be expressly understood, however, that the drawing is for the purpose of illustration only and does not constitute a limitation of the invention, reference for that latter purpose being had primarily to the appended claims.

In the figure of the accompanying drawing, the numeral 10 indicates generally a center electrode assembly comprised of a tubular insulator 11 and a terminal 12 having a shank 13 and a socketed end 14, which is of less size than the tube of the insulator. The head of the terminal 12 extends over the end of the insulator and is adapted to assist in sealing the contents thereof therewithin. The insulator is provided with an internal shoulder 15 at the boundary between the larger upper part of the bore and the smaller lower part. A center electrode spindle 16 fits the lower end of the bore and has a socketed end 17 provided with a shoulder 18 that is adapted to rest upon the shoulder 15 and to aid in sealing that portion of the assembly. In this case also

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the socketed part of the electrode spindle 16 is of less size than the larger part of the bore. The sockets of the terminal and the electrode open toward each other and are adapted to receive in their ends a connector 19 of resilient material, such as molybdenum, having hooked ends and a mid section bent or curved to provide resilience and expansibility.

The terminal and the electrode may be of any satisfactory construction. The terminal and the spindle are both made of metal that is capable of withstanding the temperatures to which the assembly is subjected. Nichrome steel has satisfactory conduction and wearing qualities in this use.

In making the connector 19, it is preferred to employ molybdenum, by which is meant molybdenum in a major percentage and preferably containing only minor amounts of other constituents. Pure molybdenum may be used, but there is no necessity to employ it in a pure state. Molybdenum has sufficient inherent springiness to perform the functions that are required of it in the construction. Other suitable metals may be used.

In assembling the construction the electrode spindle is seated within the bore of the insulator with the shoulder 18 abutting the shoulder 15. The connector 19 is seated in the socket 17 before the electrode is put into the insulator or afterwards. The space about and within the socketed end 17 of the spindle, and the bore of the insulator is filled with a mixture of lead oxide and borosilicate glass 20 all preferably in powdered form. This mixture may cover or partially cover the upper hooked portion of connector 19 or may leave the hook exposed. The socket in terminal 12 is forced over the hooked end of the wire 19. The dimensions of the hook are such that a firm contact is established by the compression of the hook as it is forced into the spindle. The curved midsection of the spring permits the spring to be compressed sufficiently to insure proper seating of the parts. The sockets have conical ends which provide the curve of the hook with four places of contact: two upon the sides of the socket and two against the sides of the cone.

The insulator is heated, before or after the terminal is emplaced, in the region of the borosilicate fill until the fill becomes plastic. The heating may be carried out satisfactorily by directing three flames from gas jets against the outside of the insulator 120 degrees apart. After the parts are assembled with contact established

as illustrated, the flames are extinguished and the socket is allowed to cool while maintaining sufficient pressure upon the terminal 12 to keep the spring 19 in bent position until the glass has solidified. Spring action of the wire 19 is not too important when the hot socket is made to shrink upon the hooked connection, then being held by force of shrinkage rather than by resiliency of the wire. Once the glass has solidified, the spring can no longer straighten itself, being set in the rigid glassy insulation. The glassy insulation may fill the entire space within the upper end of the insulator and, if permitted, may find its way between the spindle 16 and the smaller portion of the insulator bore to the extent that it is not already filled by the spindle itself to vary the operating characteristics, or it may fill a lesser space. In this way there is provided a positive seal against the escape of compressed gases from within the engine that is served by the spark plug.

A valuable invention not herein claimed involves the partial filling of the sockets with solder before heating. The solder melts during the melting of the lead boro-silicate glass and aids in establishing good contact between the spring and the sockets. Thus, the spring may be set in solder in the terminal or electrode socket before being assembled with the other parts.

The spring may be of any desired shape, round wire or flat wire with a rounded side conforming to the curvature of the socket being preferred, but it is to be understood that flat springs having edge contact with the round sockets may also be employed.

Lead boro-silicate glass, the proportions for and method of making which are set forth in the aforesaid co-pending application, is preferably used because of its insulating characteristics and its coefficient of expansion, but other types of setting insulation may be employed. For instance, a mixture of aluminum oxide and lead oxide has been employed. It is also to be noted that the thermal characteristics of lead boro-silicate glass are satisfactory. A satisfactory composition for the lead boro-silicate glass contains 20 to 60% lead oxide and 80 to 40% of glass, the glass composition itself being illustrated by but not limited to proportions of 80.5 parts by weight of silicon dioxide, 12.3 parts of sodium tetraborate, 7.8 parts of boric acid, 2.2 parts of aluminum oxide, and .6 part of potassium carbonate. The temperatures employed are on the order of 1400 to 1800 degrees F. within the insulator. The coefficient of expansion of the molybdenum connector differs but little from that of the sealing mixture or compound so that possible gas leakage along the connection is obviated.

An advantage of the invention is in the construction of a center electrode assembly for a spark plug that provides a seal against the escape of gases under pressure through the bore of a spark plug, that provides excellent conductivity between the terminal and the electrode, and that connects the spindle and the electrode by means, compressible to size, that can be set in position when once seated. Other advantages of the invention will be in part apparent and in part derived from the structure itself.

Although only a single embodiment of the present invention is herein illustrated and described, it is to be expressly understood that the invention is not limited thereto. Various changes may be made in the design and arrangement of the parts and in the materials used without departing

from the spirit and scope of the invention, as will now be apparent to those skilled in the art. For a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. Spark plug construction comprising a tubular insulator, a terminal having a socket, a center electrode having a socket, and a molybdenum spring connector rigidly held in the sockets, said connector having bent opposite end portions contacting the surrounding wall of each of said sockets.

2. Spark plug construction comprising a tubular insulator, a terminal, an interfitting center electrode, and a wire connector connecting said terminal and electrode, a U-shaped hooked portion of said connector being adapted to have spring contact with the surrounding wall of a recess in said terminal during assembly.

3. Spark plug construction comprising a tubular insulator, a terminal, an interfitting center electrode, a wire connector connecting said terminal and electrode, and rigid insulation encasing the connector, said connector having a U-shaped hooked end portion engaging the top and side walls of a recess in said terminal.

4. Spark plug construction comprising a tubular insulator, a terminal, an interfitting center electrode, sockets on the electrode and terminal, a molybdenum connector having bent opposite ends seated in and contacting the surrounding walls of the sockets, and rigid insulation encasing the connector.

5. Spark plug construction comprising a tubular insulator and an interfitting center electrode, a socketed part on the electrode, a terminal having a socketed part within the tube, a molybdenum connector having U-shaped opposite ends seated in and contacting the surrounding walls of the sockets, and rigid insulation encasing the connector and filling the space within said sockets.

6. Spark plug construction comprising a tubular insulator and an interfitting center electrode, a socketed part on the electrode, a terminal having within the tube a socketed part, and a conductive connector having a U-shaped bent end compressed in one of the sockets.

7. Spark plug construction comprising a tubular insulator and an interfitting center electrode with cooperating abutments, a socketed part on the electrode of size less than the tube, a terminal having with the tube a socketed part of less size than the tube, a conductive spring having U-shaped ends disposed within and compressed by the sockets, and rigid insulation filling the space between the terminal and insulator and encasing the spring.

8. Spark plug construction comprising a tubular insulator and an interfitting center electrode with cooperating abutments, a socketed part on the electrode of size less than the tube, a terminal having within the tube a socketed part of less size than the tube, a conductive spring having U-shaped ends disposed within and compressed by the sockets, and insulating glass filling the space between the terminal and insulator and encasing the spring.

9. Spark plug construction comprising a tubular insulator and an interfitting center electrode with cooperating abutments, a socketed part on the electrode of size less than the tube, a terminal having within the tube a socketed part of less

size than the tube, a conductive spring having U-shaped hooked spring ends compressed in the sockets and a bent midsection, and insulating glass filling the space between the terminal and insulator and encasing the spring.

10. Spark plug construction comprising a tubular insulator and an interfitted center electrode with cooperating abutments, a socketed part on the electrode of size less than the tube, a terminal having within the tube a socketed part of size less than the tube, a conductive spring having U-shaped hooked spring ends compressed in the sockets and a corrugated midsection adapted for shortening and elongation, and a lead boro-silicate glass filling the space between the terminal and insulator and encasing the spring.

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