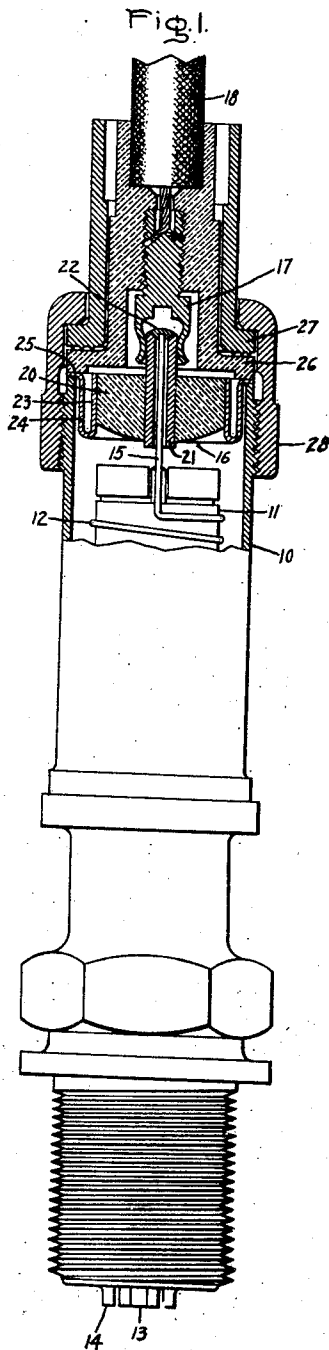
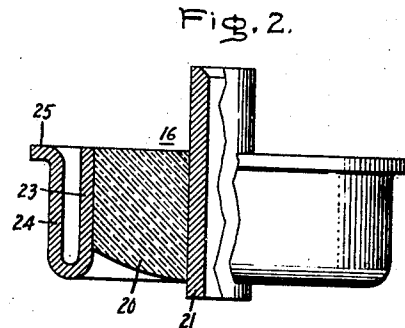
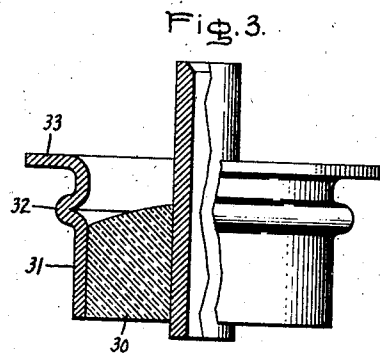
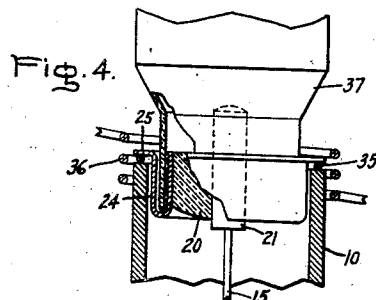


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SPARK PLUG CONSTRUCTION

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SPARK PLUG CONSTRUCTION

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Application January 22, 1943, Serial No. 473,155

1 Claim. (Cl. 315—57)

My invention relates to a spark plug particularly suitable for high altitudes, and to a bushing which may provide a substantially gas-tight seal between a conductor and the casing of an electric apparatus.

Heretofore it has been customary to provide seals between conductors and enclosing casings of electric apparatus by providing a ceramic body with a metallic member having a portion sealed into the ceramic body. Constructions have also been employed including an idler or shield ring which cooperates with the metallic member for preventing a portion of the metallic member from sticking to the outside surface of the ceramic, as is described and claimed in Patent 2,299,750 Hull et al., and which is assigned to the same assignee as this present invention.

It is an object of my invention to provide an improved spark plug construction with a bushing which will minimize the possibility of breakage when a relatively high pressure exists between the inside and the outside surfaces of the seal.

Another object of my invention is to provide a bushing seal construction between a conductor and a casing of an electric apparatus which will be simple in construction, easy to manufacture, and which will withstand a very large pressure differential between opposite sides.

Further objects and advantages of my invention will become apparent from the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claim annexed to and forming a part of this specification.

In the drawing Fig. 1 is a side elevation in partial section of an electric ignition apparatus which is provided with an embodiment of my bushing seal construction; Fig. 2 is a side elevation in partial section of the bushing seal construction employed in Fig. 1; Fig. 3 is a side elevation in partial section of a bushing seal construction illustrating a modification of my invention; and Fig. 4 illustrates a method of attaching my improved bushing to a tubular member.

Referring to the drawing, in Fig. 1 I have illustrated my invention as applied to an electric ignition device such as a spark plug but it is to be understood that my invention may be applied to any other suitable electric apparatus where a bushing with a relatively gas-tight construction is desired. In Fig. 1 the ignition apparatus includes a casing or barrel 10 within which is placed a transformer 11 having a low voltage winding 12

which is electromagnetically coupled with a high voltage winding, not shown, the high voltage winding being connected to a high voltage electrode 13 at the base of the plug. A conventional low voltage electrode 14 is provided which is grounded through the casing 10. One end of the low voltage winding connects through a conductor 15 which passes through my improved bushing construction 16 which will be described below. The conductor in turn connects through a connector 17 to a conductor 18 which forms a part of the harness of the ignition system. Such ignition systems which employ a step-up transformer allow the large percentage of the distribution system including the conductor 18 to have a relatively low voltage so that the system is designed for relatively high altitudes or low pressure operation. In order to maintain the pressure at the desired amount inside the barrel 10 there is provided an improved spark plug including a sealed construction with bushing 16 which will withstand relatively high pressure differentials so that the plug is suitable for high altitudes. Other details of the ignition system are more completely described and claimed in a copending application Serial No. 466,608 Harkness and Robinson, filed November 23, 1942, and assigned to the same assignee as this present invention.

In order to provide a spark plug construction which will be substantially gas-tight and which will seal a relatively large pressure differential without the danger of cracking of the seal, I provide a bushing construction including a body of suitable ceramic material 20, such as glass or porcelain, having a tube 21 for accommodating the conductor 15. The tube 21 is suitably sealed to the cooperating surface of the ceramic material 20 and the conductor 15 is electrically connected to the end of the metallic tube 21 in any suitable manner such as by soldering or brazing as indicated by the numeral 22. The solder 22 also suitably seals the end of the hollow tube 21. Connection is made between the body of ceramic material 20 and the surrounding surface of the barrel 10 of the ignition system by a metallic member including a first portion or band 23 which has a relatively large area suitably sealed to a cooperating surface of the ceramic material. The seal between the glass body and the tube 21 and the band 23 may be made in any suitable manner, such as by placing a bead of glass within the band 23 which bead has an opening to accommodate the tube 21. This assembly is then heated until the glass softens and upon cooling the glass will be sealed or united with a tube 21 and band 23.

It is customary to make a glass metal seal by embedding an end of a metallic member into the glass. However, I have found that a higher pressure may be sealed by my improved construction including a relatively large portion of cooperating flat surfaces which form the seal between the glass and metal. The metallic member 23 also includes a portion 24 which is bent to form a springlike portion so the metallic member forms a resilient connection between the ceramic material and the support. It will be seen that in Figs. 1 and 2 that the portions 23 and 24 are so formed that the metallic member has a U-shaped cross section. The member 24 is provided with a shoulder 25 which, as will be seen in Fig. 1, cooperates with an end of the barrel 10 for supporting the bushing construction. A relatively tight seal between the shoulder 25 and the cooperating surface of the barrel 10 is formed by relatively tightly forcing members 26 and 27 against the end of the barrel member 10 through a nut member 28. Also, the shoulder 25 may be attached to the supporting member 10 in any other suitable manner, such as by brazing, as will be described below in relation to Fig. 4. I have found that when my improved bushing is attached to a support it will withstand a pressure differential of at least about 600 pounds per square inch without breaking the seal between a band 23 which has about one-fourth of an inch in height and is sealed to the adjacent surface of the glass bushing. Also, the bushing has been heated from room temperature to 200° F. without damage.

In Fig. 3 I have illustrated another arrangement for obtaining a flexible connection between a body 30 of suitable ceramic material by providing a metallic member having a portion or band 31 with a relatively large surface sealed to the ceramic portion and a second portion 32 which is bent to provide a springlike portion. A shoulder 33 is provided so that the bushing may be relatively solidly attached to a support.

In Fig. 4 I have illustrated a method of assembling my improved spark plug by attaching my improved bushing construction as is illustrated in Fig. 2 to the end of the barrel member 10. A small ring shape member 35 of suitable soldering or brazing material is placed between the shoulder 25 and the end of the barrel member 10 and the member 35 may be heated in any suitable member so as to melt and attach the shoulder 25 to the end of the barrel member 10. A convenient way of forming the brazed connection is to provide a coil 36 around the metallic members which may conduct a high frequency current so as to suitably heat the metallic member by electromag-

netic conduction. However, when so attaching my improved bushing to a support, it is desirable to prevent the current from being induced into the band portion 23 which may cause sufficient heating to break the seal between the band 23 and the adjacent surface of the ceramic 20. Since the metallic members 24 and 25 have a corrugation or a U-shape it will be seen that a tubular member 37 may be placed between the members 23 and 24 so as to suitably screen the member 23 and prevent current from being induced in the member by the coil 36 during the brazing operation. Furthermore the metallic member, since it rests on the bottom of the corrugation, will help to absorb any heat which tends to flow from the portion 24 to the portion 23.

In view of the above, it will be seen that I have provided a spark plug particularly suitable for high altitudes and including a bushing construction which is strain-free, which may withstand differences in expansion characteristics due to temperature of the supporting member 10 and the metallic member 24, which provides a minimum height in an axial direction, and which also due to its corrugated construction allows the insertion of a metallic shield for preventing currents from being induced into the band member 23 while the seal is being made between the shoulder 25 and the end of the barrel member 10.

Although I have shown and described particular embodiments of my invention, I do not desire to be limited to the particular embodiments described, and I intend in the appended claim to cover all modifications which do not depart from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

In a spark plug for internal combustion engine ignition systems which are adapted for high altitude operation, an elongated generally cylindrical metal casing having a high tension spark gap at one end and a low tension terminal at the other end, a voltage step-up transformer in said casing connected to said low tension terminal, means for both insulating said low tension terminal and sealing said transformer against low pressure high altitude operating conditions comprising an annular ceramic insulating member surrounding the said low tension terminal and fused thereto, an annular axially resilient shock absorbing supporting member surrounding said ceramic member and fused thereto, and air-tight means for fastening the outside of said supporting member to the walls of said casing.

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