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SPARK PLUG

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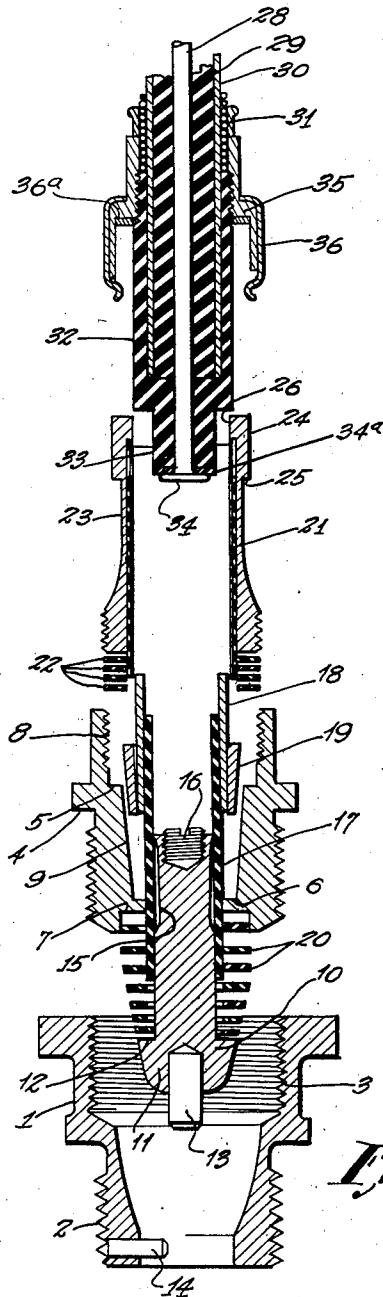


Fig. 1

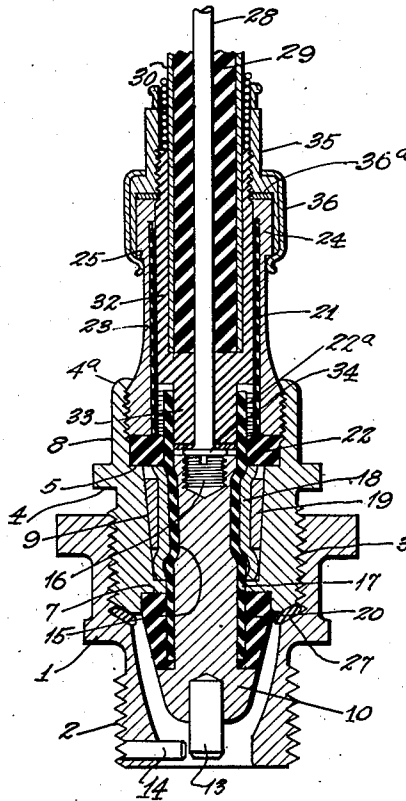


Fig. 2

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SPARK PLUG

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4 Claims. (Cl. 123—169)

This invention is a spark plug adapted to be used in such environs that the operation of an ordinary or conventional plug would interfere with radio reception. This situation may be commonly illustrated as prevalent in aviation where-
in the operation of the conventional ignition system, due more particularly to sparking at the respective plugs of the engine or engines, seriously interferes with the reception of radio messages
by an operator aboard the plane. The reason for such interference is well understood by those skilled in the art, but it may be briefly noted that sparking in the plug produces certain oscillations which are clearly audible in radio reception and not only seriously interfere with the reception of sound, such as voice transmission, but render the reception of code practically unintelligible.

The purpose or object of the present invention is to provide efficient plug construction which will be absolutely reliable for the performance of its intended functions in the ignition system and at the same time equally reliable, and durable and efficient in the elimination of interference with radio reception. So far as I am aware no such structure has heretofore been suggested.

Speaking generally, the principle upon which the present invention operates is the shielding of the oscillations within a metallic casing incorporated in the plug construction and the grounding of such casing with respect to the motor. The shielding to which I have referred directly within the plug construction is of marked practical importance. Spark plugs intended for use in aviation must be reliable. They are generally designed to operate under predetermined conditions and if these conditions are departed from, the plug will not properly operate. For example, questions of heating and cooling, i. e., the operation under predetermined temperatures, is of marked importance in spark plugs and if an attempt is made to employ shielding devices extraneous of the plug construction, it is found that the characteristics of the plug and its operative conditions are so varied as to seriously interfere with the reliability of the plug.

A serious problem incident to the incorporation of shielding in plug construction is the question of proper protection of the insulation and more particularly the insulation employed in the spark plug leads. Such insulation must be absolutely reliable and a breaking down thereof will cause the cessation of the operation of the plug. Heat in the plug is rather a serious factor to be considered in this connection and the proper safe-

guarding of the insulation of the lead to the plug and the connection between the plug and the lead is of marked importance.

The plug of the present invention satisfactorily solves the foregoing problems and provides an absolutely reliable construction from the standpoint of ignition and a thoroughly efficient construction insofar as the elimination of disturbances in radio reception is concerned. Speaking generally, the plug of the present invention embodies a metallic envelope which completely envelops the interior plug parts in such a manner that the current to the insulated electrode is fed to the gap through an uninterrupted metallic shield and those parts which carry the current are so heat insulated as to adequately protect the insulation of the current lead and preclude the breaking down thereof under long continued service.

Features of the invention, other than those specified, will be apparent from the hereinafter detailed description and claims, when read in conjunction with the accompanying drawing.

The accompanying drawing illustrates one practical embodiment of the invention, but the construction therein shown is to be understood as illustrative, only, and not as defining the limits of the invention.

Figure 1 is a central vertical section through a plug embodying the present invention showing the parts in assembled relation.

Figure 2 is also a vertical central section of the parts of the plug, but showing the parts separated from one another in order to more clearly illustrate the parts individually and to show the manner in which they are assembled.

The plug of the present invention embodies the usual metal shell 1 having the exteriorly threaded shank 2 adapted to be screwed into the spark plug hole of an engine cylinder. The upper portion of the shell is interiorly threaded as shown at 3 to receive a carrier bushing 4 on which the central electrode and cooperating insulating parts are supported. The interior of the bushing 4 is stepped to provide the shoulders 5, 6, and 7 positioned respectively one above the other. The two shoulders 5 and 6 face in an upward direction, while the shoulder 7 faces in a downward direction and above the shoulder 5 the interior of the bushing is threaded as indicated at 8. I wish to call attention to the fact that between the seats 5 and 6, the interior of the bushing tapers or converges in a downward direction as indicated by the tapered face 9.

The central electrode designated 10 is in the

form of a metal bar or rod provided at its bottom with an enlarged head 11, the upper face 12 of which constitutes a shoulder or seat opposed to the seat 7 of the bushing. The head 11 is preferably axially bored to receive a sparking point 13 adapted for cooperation with the grounded point 14 of the shell 2. I wish it understood that the particular type of points used in the plug of this invention is immaterial. They may be changed and modified without departing from the invention.

The bar 10 is provided near its upper end with a relatively extensive annular channel 15 which renders a portion of the bar intermediate its ends of reduced cross section, as clearly shown in Fig. 2. The upper end of the bar 2 is preferably tapped to receive an adjusting screw 16, the purpose of which will be hereinafter more fully explained.

17 indicates an insulating sleeve which, in practice, may conveniently be formed from cigarette mica, although any other suitable insulating material may be employed in this connection. This insulating sleeve is adapted to be embraced for a portion of its length by a metallic packing sleeve 18, which in practice may be conveniently made of brass and the sleeve 18 is in turn embraced by an annular wedge 19, the inner face of which wedge is cylindrical, while the outer face is tapered at substantially the same taper as the face 9 of the bushing 4. The reference character 20 designates a series of insulating washers which may be of any suitable material, but may be conveniently formed of mica.

The parts of the plug thus far described are preferably in practice assembled in the following manner. Assuming that the various parts are separate and apart from one another, the insulating sleeve 17 is first applied to the rod 10 and thereafter a sufficient number of washers 20 are assembled about the lower end of the sleeve to give the desired thickness. Thereafter the upper end of the rod 10 is passed upwardly through the metal carrier bushing 4, so that the upper end of the rod and sleeve 17 extend well up into the interior of said bushing. The metallic packing sleeve 18 is then passed downwardly over the sleeve 17 and comes to rest on the seat 6. Next the wedge 19 is passed downwardly over the metal packing sleeve 18 until it comes into engagement with the tapering surface 9 of the bushing. Sufficient axial pressure is thereupon exerted on the bushing 4 and rod 10 in opposite directions to firmly compress the washers 20 between the seats 7 and 12. This having been accomplished, the parts thus assembled are held stationary, while the wedge 19 is forced downwardly with sufficient pressure to force that portion of the sleeve 17 which overlies the annular channel 15 into close conformity with said channel as indicated in Fig. 1. The intermediate metal packing sleeve 18 is simultaneously correspondingly shaped, so that by the time the wedge has been forced to its final position indicated in Fig. 1, both the sleeve 18 and bushing 17 will conform to the adjacent contour of the rod 10 and thus constitute with the rod a lock to permanently secure the rod in position on the bushing 4 and to positively preclude the withdrawal of the rod by downward movement from the bushing. The adjusting screw 16 may thereupon be introduced into the tapped hole in the top of the rod 10.

After the parts have been assembled as described, suitable insulating washers 22 are posi-

tioned on the seat 5 and thereafter a metallic sleeve 23 is screwed into cooperation with the threads 8 of the bushing 4. Previous to the attachment of this sleeve, however, there is formed within the same an insulating sleeve of cigarette mica 24. This may be accomplished by forming the sleeve 24 on a suitable mandrel and thereafter slipping the sleeve 23 over the thus formed sleeve 24.

It will be noted that the upper edge of the sleeve 24 fits into an annular groove in the sleeve 23 and the sleeve 24 is thus maintained intact during the assembly operation. A few additional insulating washers 22a are thereafter introduced between the lower margin of the sleeve 24 and the upper margin of the sleeve 17. After the sleeve 23 has been tightly screwed into place, the upper edge of the bushing 4 is spun in as shown at 4a to render the assembly permanent.

The sleeve 23 while relatively thin for the greater part of its length is provided at its bottom with an enlargement thereon threaded to coact with the interior threads 8 of the bushing 4, and as the metal sleeve 23 is screwed down tight, it clamps the washers 22 to the seat 5 and simultaneously mounts the metal sleeve 23 in position on the bushing. The upper portion of the bushing is slightly enlarged to provide an exterior cylindrical contour 25 at the base of which is a shoulder 26 and said metal sleeve 23 is inwardly flanged at its top as indicated at 26 to overlie the upper end of the insulating sleeve 24.

These parts having been assembled as stated, the threaded shank of the bushing 4 is screwed into the threads 3 of the shell to act upon an intermediate gasket 27 as indicated in Fig. 1 and to mount the bushing on the shell. This completes the assembly operation of the plug.

I will now describe the manner whereby a spark plug lead is associated with the plug as thus far described. The lead wire is indicated by the reference character 28. It is provided with suitable insulation, such as the rubber insulation 29 with the fabric covering 30 and over this fabric covering may be provided a suitable metal armor 31.

The end of the ignition lead is adapted to extend into insulating terminal 32 which may be of bakelite or ceramic composition or of any other suitable insulating substance. This terminal has an over-all exterior diameter substantially equal to the interior diameter of the insulating sleeve 21 and being provided at its bottom with a depending portion 33 of decreased cross section substantially equal to the interior diameter of the insulating sleeve 17. The insulating terminal 32 is cored to two diameters, the upper portion being sufficiently large to receive the wire 28 with the insulation 29 and 30 as indicated in Fig. 2, while the smaller diameter for the remainder of the length of the terminal is of just sufficient size to permit the bare wire 28 to extend therethrough. It is convenient to rivet over or flatten out the end of the wire at the end of the terminal over a metal washer 34a as shown at 34 and if stranded wire is used as usually, the part 34 is preferably silver soldered to the washer to provide a good terminal contact. The shape and proportion of the parts are such that the terminal 32 may be passed downwardly through the insulating sleeve 21 until the contact 34 at the end of the lead wire engages with the adjusting screw 16 in the upper end of the rod 10 which carries the insulated electrode 13. Threaded on to the terminal 32 is a cap 35 which seats on the top of the sleeve 23 and the screw 16 is to provide for such adjust-

ment as will insure proper contact when the cap is substantially seated on said sleeve. In lieu of the screw 16, I may mount a coil spring on the contact 34 to yieldably engage the rod 10.

A clamping member mounted on the cap 35 embodies a plurality of depending spring arms 36 which when the cap is seated on the sleeve 23 will grip beneath the shoulder 25 as shown in Fig. 1 to hold the lead in position. The lower ends of these spring arms are preferably bent inwardly and then outwardly to give the desired grip to hold the lead in position and by so forming these fingers, they may be wired with safety wire to lock them in position if desired. A cushion washer of leather or the like 36a may be interposed between the cap and sleeve to make a weather tight joint.

It will be noted from Fig. 2 that the armor 31 for the cable will extend into the upper end of the cap 35 and may be anchored therein in any suitable manner. The upper end of the cap 35 is preferably so formed that after the armor of the cable has been introduced into the cap as shown, the overlying portion of said cap can be contacted or forced in an inward radial direction to grip the armor tight and produce a weather proof joint.

It may be here noted that the insulating sleeve 21 has a dual function in that it not only insulates the terminal 32 from heat in the sleeve 23, but it also serves as a protectionary electrical insulation in the event that other insulation of the plug breaks down.

It will be noted from the foregoing detailed description that the exterior of the assembly is wholly metallic. In other words, the plug is entirely shielded and all of this shielding is grounded with respect to the shell 1 which is in turn grounded with respect to the motor. The exterior surfaces of the plug embody the outer surfaces of the shell 1, carrier bushing 4, metallic sleeve 23, cap 5 and the armor 31 of the cable. In other words, the entire exterior of the plug constitutes a metal shield grounded on the engine. It will be noted, however, that the insulation is so disposed and proportioned that it will not only properly insulate electrically, but it will properly protect the insulation 29 and 30 of the ignition lead against undue heat. This is a very important fact for unless the insulation of the lead is properly safeguarded against heat, the plug will not function for any appreciable period before this insulation breaks down.

Exhaustive tests have shown, however, that with a plug as described, the insulation 29 may be of rubber, because it is not subjected to seriously high temperatures. The wall of the sleeve 23 is, in the main, relatively thin and much heat which may be conducted upwardly from the shell through the bushing to this part is dissipated at this point without the transmission of this heat to the ignition lead. By thoroughly shielding the plug as stated, the oscillations of the spark are grounded by means incorporated directly in the plug structure and thus the efficiency of the plug from the standpoint of ignition is effectually maintained.

The accompanying drawing shows the invention in its preferred practical form, but the in-

vention is to be understood as fully commensurate with the appended claims.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

1. A spark plug embodying a tubular metallic part, the bore of which has an outwardly flaring wall, a central electrode extending axially through said part and having a reduced cross section for a portion of its length, an insulating sleeve embracing the central electrode, a metal sleeve embracing the insulating sleeve, and a tubular wedge interposed between the flaring wall and the metallic sleeve and engaging said wall with sufficient force to press the metallic and insulating sleeves into conformity with the reduced portion of the central electrode for the purpose of making a gas tight joint and to secure the electrode against relative longitudinal movement with respect to the metallic part of the plug.

2. A spark plug embodying central electrode provided with a coaxial annular channel, a tubular metallic shell embracing said electrode and spaced therefrom, said shell having a frustoconical bore juxtaposed with said channel, an insulating sleeve embracing the electrode, a gripping sleeve embracing the insulating sleeve, and a tubular wedge interposed between the gripping sleeve and the frustoconical bore of the shell and engaging said bore with sufficient force to press the gripping and insulating sleeves into conformity with the channel of the electrode to form a gas tight joint and lock the electrode within the shell.

3. A spark plug embodying a bushing provided therein with a central opening therethrough, a center electrode passing through said opening and having an annular channel arranged within the opening and spaced from the walls of the latter, an insulating sleeve embracing the center electrode within said opening, a gripping sleeve embracing the insulating sleeve within the opening, and tubular wedging means interposed between the gripping sleeve and the wall of the opening and engaging the latter with sufficient force to press the gripping and insulating sleeves into conformity with the channel of the electrode to form a gas tight joint and lock the electrode within the bushing.

4. A spark plug embodying a bushing provided therein with a central opening therethrough, a center electrode passing through said opening and having an annular channel arranged within the opening and spaced from the walls of the latter, an insulating sleeve embracing the center electrode within said opening, a gripping sleeve embracing the insulating sleeve within the opening, and tubular wedging means interposed between the gripping sleeve and the wall of the opening and engaging the latter with sufficient force to press the gripping and insulating sleeves into conformity with the channel of the electrode to form a gas tight joint and lock the electrode within the bushing, said opening in the bushing being formed with a shoulder facing in the direction of the wedging means and on which the lower end of the gripping sleeve is adapted to seat.

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