Nov. 23, 1965 H. G. ALLMAN 3,219,864

SPARK PLUG CONNECTION

Filed Sept. 13, 1962

Fig 1

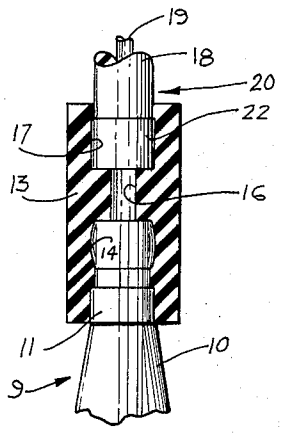


Fig 2

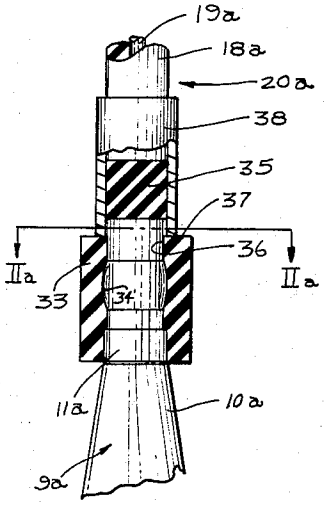
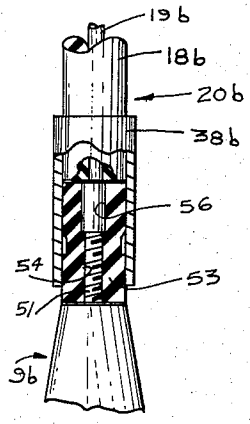


Fig 3



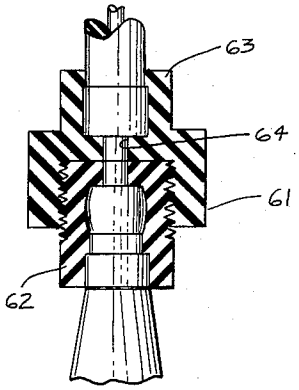


Fig 4

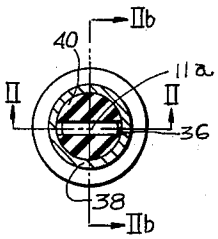


Fig 2a

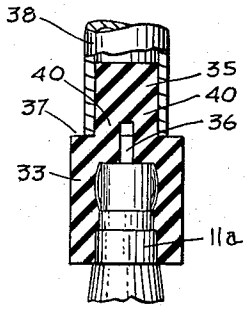


Fig 2b

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SPARK PLUG CONNECTION

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This invention relates to an improved spark plug construction and, more particularly, it relates to improved means for providing a secondary spark gap between the lead-in wire from the distributor and the center electrode of the spark plug in addition to the gap which exists between the firing electrodes of the spark plug.

It is well known in the art that the provision of a secondary spark gap in series with the firing gap of a spark plug makes it possible to achieve a more intense spark in said firing gap. Among the advantages of the more intense spark are easier starting of the engine so equipped, a lesser tendency for the spark plug to become carbon or oil fouled, longer intervals of engine operation between spark plug cleaning or replacement, improved operation at high engine speeds, and smoother and more economical operation of the engine. So-called resistor-type spark plugs are commercially available and are capable of giving the above-mentioned improvements in engine performance, but they are more expensive than conventional-type spark plugs. The art has suggested several mechanisms by which conventional spark plugs can be adapted to provide the secondary spark gap. Some of these have required structural modification of conventional plugs which is undesirable because of the skill, time and expense required to make such modifications. Other mechanisms that have been proposed do not require modification of existing conventional spark plugs and are adapted to be fitted to existing plugs as an accessory. However, such mechanisms generally have been of relatively complex, multipart construction requiring special parts and the use of specialized and relatively complicated tools in their construction. Such mechanisms have in some cases been relatively difficult to install, such installation requiring a number of individual steps and the use of several tools. In some cases, installation has involved modification or replacement of the terminal on the lead-in cable, thus adding to the cost of the installation. Also, such mechanisms have been of relatively large bulk thus accentuating the space problem in an engine compartment which already may be overcrowded. Further, such mechanisms because of their relatively high degree of complexity are often susceptible to damage through vibration or through disturbance by persons conducting repair or other work in the engine compartment. Installation, in some cases, requires the fixing of several parts together in a proper sequence thus increasing the possibility of incorrect installation by unskilled persons. For the above mentioned and other related reasons units for converting conventional spark plugs in order to obtain the advantages of so-called resistor-type spark plugs have been generally unsatisfactory.

Accordingly, the objects of this invention include:

(1) To provide an improved device for placing a secondary spark gap in series with the firing gap of a spark plug.

(2) To provide an improved spark gap device for a conventional spark plug which is of one-piece construction, which can be constructed of a variety of widely available materials and which can be inexpensively and rapidly produced.

(3) T oprovide an improved spark gap device for use on conventional spark plugs which can easily be manufactured to fit a wide variety of plug and lead-in cable configurations.

(4) To provide an improved spark gap device for use with conventional spark plugs which requires no modification of the spark plug or cable with which it is used, which can be rapidly and easily installed by unskilled personnel without the use of tools in a few simple motions, and which requires no adjustments during installation or during use.

(5) To provide an improved spark gap device adaptable to use with conventional spark plugs which will not add significantly to the bulk of either the spark plug or the lead-in cable, which will maintain a spark gap within an optimum range during use, and which will require virtually no maintenance, such maintenance as required consisting primarily of removing a damaged device and replacing same with a new one.

Other objects and purposes of the invention will be apparent to persons acquainted with devices of this general type upon reading the following specification and inspecting the accompanying drawings.

In the drawings:

FIGURE 1 is a central section of the spark gap device of the invention showing its connection to an end of a conventional spark plug and to a cable terminal.

FIGURE 2 is a central section of another embodiment of the invention and corresponds to a view taken along the line II—II of FIGURE 2*a*.

FIGURE 2*a* is a sectional view taken along the line II*a*—II*a* of FIGURE 2.

FIGURE 2*b* is a sectional view taken along the line II*b*—II*b* of FIGURE 2*a*.

FIGURE 3 is a central section of still another embodiment of the invention.

FIGURE 4 is a central section of still another embodiment of the invention.

Referring to the drawings, FIGURE 1 shows the upper fragment of a typical, conventional-type spark plug **9** consisting of an insulating portion **10** and a conductor terminal **11** which is connected by conventional means (not shown) to the firing electrode of said spark plug. The terminal **11** is here shown as being of contoured cylindrical shape. The spark gap device **13** according to the invention is of one-piece, substantially cylindrical shape and is constructed of any suitable insulating material, which preferably is somewhat resiliently expandable, such as rubber. The terminal **11** is snugly received within a suitably contoured opening **14** in the lower end of the device **13**. The opening **14** communicates with a preferably coaxial, circular spark gap chamber **16** in the device **13**. It has been found that the length of said spark chamber **16** should be between about ⅛ of an inch and about ½ of an inch for effective operation and the optimum spark chamber length is about 3/16 of an inch. The upper end of said spark chamber communicates with a cable opening **17** in the upper end of the device **13**. A cable **20**, shown for purposes of illustration as consisting of a conductor **19** surrounded by insulation **18**, is received within the opening **17**, the conductor **19** being connected to a source of voltage, ordinarily the distributor of an automotive engine. Said cable **20** is here shown as having a cap **22** of conductive material which is connected to the current-carrying conductor **19**. The cap **22** is snugly received in the opening **17** in the device **13**. The cap **22** is shown here for purposes of illustration only and may be omitted in which case the end of the cable **20** is snugly received into the opening **17** whereby the uninsulated end of the conductor **19** communicates with the upper end of the spark gap chamber **16**.

FIGURE 2 shows a modified embodiment of the in-

vention which is adapted for use with a different type of cable terminal. The parts of the cable and the spark plug in this embodiment corresponding to those in the embodiment of FIGURE 1 will be designated with the same reference numerals with the suffix *a* added thereto. The spark gap device **33** is of one-piece construction and is made of insulating material, which preferably is resiliently expandable, such as rubber. The device **33** has an opening **34** in its lower end in which the plug terminal **11***a* is snugly received. A spark gap chamber **36** communicates with said opening **34**, said spark gap chamber here being formed by a slot in said device **33**, which slot is closed at its upper end and open at its lateral ends. The device **33** has an upper portion **35** of reduced external diameter which provides a shoulder **37**. The upper portion **35** is joined to the lower portion of the device **33** by the web portions **40**. The upper portion **35** may have the same shape as the upper portion of the terminal **11***a* of the spark plug **9***a*. The cable **20***a* has a cylindrical sleeve **38** thereon which is sleeved over the upper portion **35** of the spark gap device and which preferably abuts against the shoulder **37**. Said sleeve **38** is generally constructed of a rigid conductive material and is electrically connected to the conductor **19***a* of said cable. Cable terminals, such as the sleeve **38**, are well known in the art and commonly connect a spark plug cable, such as the cable **20***a*, to a spark plug terminal, such as the terminal **11***a*, by snug engagement of the inner wall of the sleeve **38** with the spark plug terminal. With the sleeve **38** attached to the device **33**, as shown in FIGURE 2, the lower end of the sleeve is adjacent to and communicating with the lateral ends of the spark chamber **36**.

FIGURE 3 illustrates another modified embodiment of the invention herein disclosed. Parts of the cable and spark plug of FIGURE 3 which are common to the devices described above will be designated with the same reference numerals but with the suffix *b* added thereto.

In this case, the spark plug terminal consists of a threaded post **51** which is connected to and which may be integral with one of the firing electrodes of the spark plug **9***b*. A cylindrical spark gap device **53** constructed of an insulating and preferably somewhat resilient material, as aforesaid, has an opening **54** in its lower end into which said post **51** is snugly receivable. The opening **54** may be tapped to match the threads on the post **51**, or more conveniently and if the spark gap device **53** is of suitably resilient material, said opening may be slightly radially smaller than said post, said post thereby being fixed in said opening by the resilient deformation of the wall of said opening about the threads of said post. The upper end of the post **51** communicates with the spark chamber **56** which opens through the upper face of the device **53**. The opening **54** and the spark chamber **56** may conveniently constitute a straight-sided bore coaxial with the central axis of the device **53**. The radially outer surface of the device **53** may at the upper end thereof duplicate the silhouette of the terminal **11***a* of FIGURE 2 or more conveniently may be straight sided and of radius equal to or slightly greater than the terminal **11***a* of FIGURE 2. A cable **20***b* comprised of a conductor **19***b* and a coaxial surrounding insulator **18***b* is terminated by a conductive sleeve **38***b* which is in electrical contact with the conductor **19***b*.

Because it is rather common in the manufacture of spark plugs to employ means, such as the post **51** shown in FIGURE 3, to fix a terminal such as the terminal **11***a* of FIGURE 2 to a spark plug, it will be seen that the embodiment of FIGURE 3 may advantageously be used in the manufacturing stage to produce spark plugs having the advantages of resistor-type spark plugs in cases where large stocks of partially constructed ordinary plugs, tooling costs, or other problems make undesirable the production of usual types of resistor spark plugs.

It may be desirable to be able to adjust the length of the spark gap chamber. FIGURE 4 discloses one suitable way by which this may be accomplished. Here, the spark gap device **61** consists of two parts **62** and **63** which are threadedly connected so that the effective length of the spark gap chamber **64** can be adjusted.

To install the spark gap device **13** of FIGURE 1, any devices which were previously used to join the cable **20** to the spark plug terminal **11** are removed therefrom. The device **13** is placed over the spark plug terminal **11** so that the opening **14** snugly surrounds the terminal **11**. The cable **20**, which is terminated by the cap **22** or by the terminal end of the conductor **19**, is placed into and is snugly surrounded by the wall of the opening **17** and the installation is complete.

The spark gap device **33** of FIGURE 2 is installed by first removing the sleeve **38** from the spark plug terminal **11***a* so that the opening **34** snugly surrounds the terminal **11***a*. The device **33** is then placed on said terminal **11***a* so that the opening **34** snugly surriunds the terminal **11***a*. The sleeve **38** is then placed around the upper end portion **35** of the device **33** abutting the shoulder **37** so that said sleeve snugly surrounds said upper portion.

The spark gap device **53** (FIGURE 3) may be installed on the spark plug **9***b* by first removing any nuts or terminations which may be affixed to the post **51**. The device **53** is then placed on the post **51** so that the opening **54** snugly surrounds said post. The conductive sleeve **38***b* is then slipped over the device **53** so that the device **53** is snugly retained therein.

In operation, the spark gap devices provide a secondary spark gap between the lead-in wire from the distributor and the central electrode of the spark plug so that the improved operation mentioned above can be achieved. The operation of the spark plug is conventional and need not be detailed.

While certain particular preferred embodiments have herein been utilized to illustrate the invention, it will be recognized that the basic concept of the invention may be embodied in a wide variety of other specific embodiments and accordingly the invention shall be understood as including such variations excepting as expressly stated otherwise in the hereinafter appended claim.

What is claimed is:

In combination with a spark plug having a firing electrode with a terminal at one end of the spark plug body, a spark gap device for providing a secondary spark gap comprising a one-piece, elongated body of insulating material having a tubular portion at one end thereof forming a central opening into which said terminal is snugly received, said tubular portion having an internal abutment at the inner end of said central opening against which said terminal abuts so that it is precisely positioned within said central opening, said body having a cap portion at the other end thereof, said cap portion being of smaller cross-sectional size than said tubular portion and being of substantially the same cross-sectional size as said terminal, an external shoulder at the juncture of said tubular portion and said cap portion, said external shoulder being spaced in a lengthwise direction a predetermined distance from said abutment, a lead-in cable having an electrically conductive sleeve snugly telescoped over said cap portion and abutting against said shoulder, said sleeve being adapted for carrying electric current supplied through said lead-in cable, wall means in said body forming slot means extending lengthwise from the inner end of said central opening through the side wall of said cap portion adjacent said shoulder, said sleeve extending over and substantially covering the radially outer ends of said slot means, said slot means forming an air gap between said sleeve and said terminal so that electrical energy to be supplied to said firing

electrode from said lead-in cable must jump across said air gap.

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