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- [54] **SPARK PLUG TERMINAL WITH ELLIPTICAL CROSS SECTION BARREL**
11 Claims, 8 Drawing Figs.

- [52] U.S. Cl..... 339/26,
339/213, 339/217, 339/256

- [51] Int. Cl. H01r 11/22.

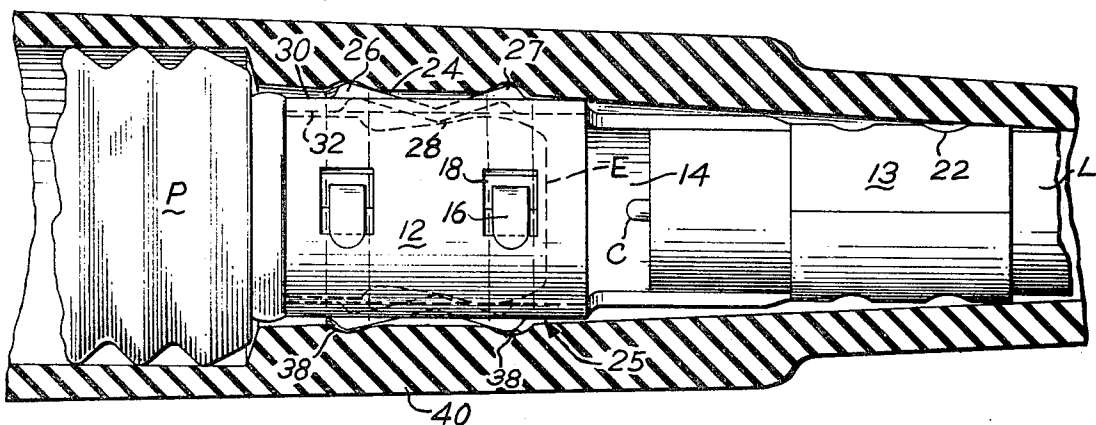
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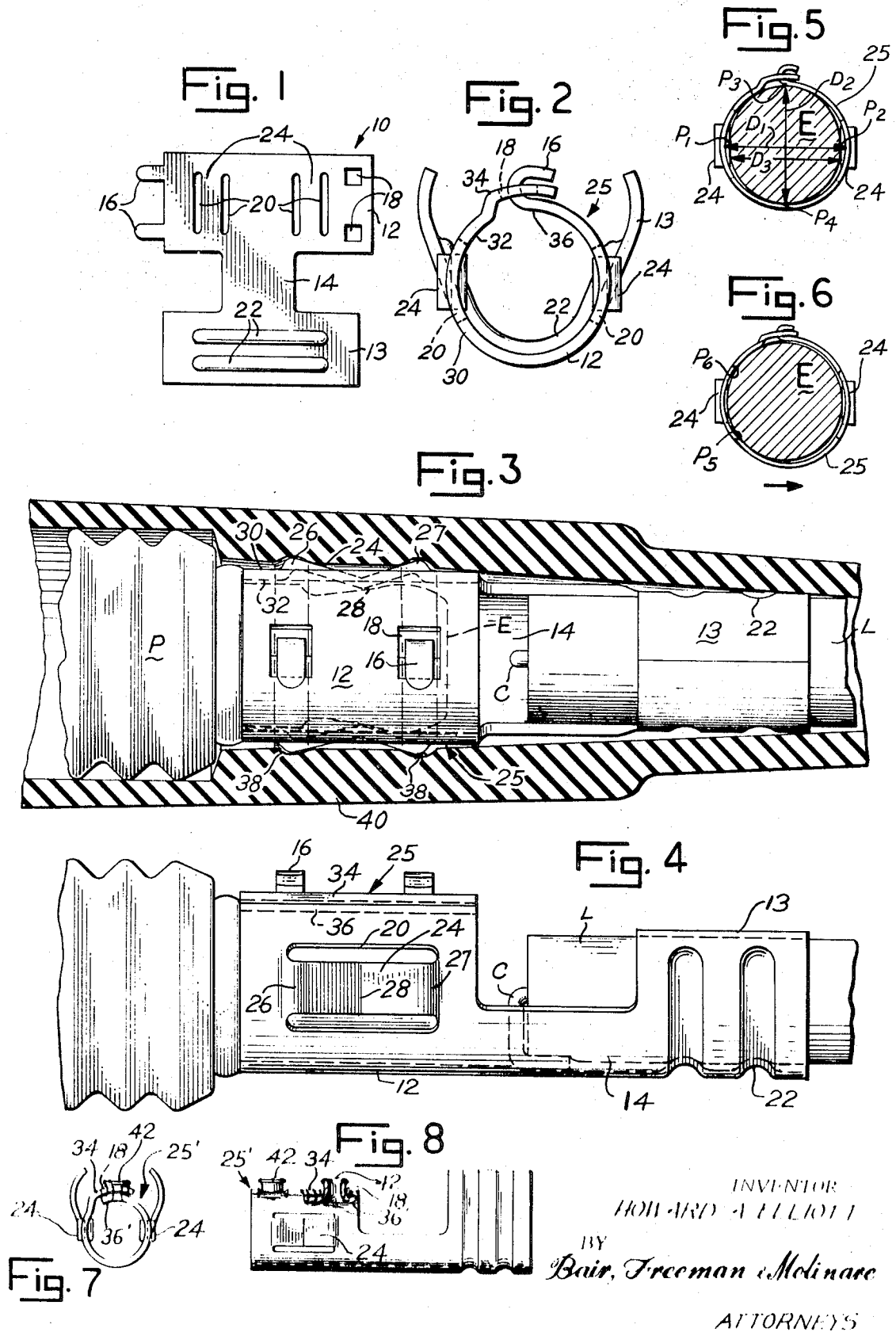
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ABSTRACT: A terminal for a spark plug includes an elongated barrel having an elliptical cross section. A pair of elongated resilient spark plug electrode holding and contact tabs are positioned on the major axis of the barrel and the barrel is split adjacent the minor axis thereof to allow the barrel to flex. The elliptical shape of the barrel prevents overstressing and deformation of the tabs when the barrel is moved in a direction generally perpendicular to its axis, the electrode contacting the internal surface of the barrel in preference to the tabs.





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SPARK PLUG TERMINAL WITH ELLIPTICAL CROSS SECTION BARREL

BACKGROUND OF THE INVENTION

This invention relates to a spark plug terminal.

Spark plug terminals have been provided in the past which are adapted to be slideably fitted over the electrode of the spark plug. The prior terminals and various components thereof are frequently subjected to such deformation that the elastic limit of the material from which they are constructed is exceeded when the terminal is being fitted over the electrode or when the terminal is rocked for the purpose of connecting the terminal to the electrode or for the purpose of checking the connection of the terminal. Such deformation of the terminal or its components beyond their elastic limit will result in a loose fit between the terminal and the spark plug electrode causing poor electrical contact between the electrode and the terminal and, in some instances, the separation of those elements due to vibration encountered during use. Such deformation is particularly likely since the sheet material from which such terminals are constructed is generally thin and insubstantial.

The terminal constructed in accordance with the principles of my invention overcomes these problems. The terminal of my invention is shaped so as to provide for maximum contact of the electrode of the spark plug with the internal surface of the terminal and minimum contact with the resilient electrode holding means of the terminal when the terminal and its electrode holding means is rocked and/or subjected to other sidewise forces. Such preferential contact substantially reduces the exposure of the holding means to excessive forces and substantially reduces the possibility of permanent deformation of the holding means. Moreover, the holding means of the terminal of my invention exert an increased overall holding force with respect to the spark plug electrode and substantial contact wiping is realized. The terminal construction of my invention, while providing for a substantial overall holding force, does so without exceeding the elastic limit of the metal which forms the holding means and the holding means also operates to urge the terminal toward the spark plug to substantially reduce the possibility of separation thereof. The terminal constructed in accordance with the principles of my invention not only provides firm contact in normal operation between the electrode and the holding means, but additional conductive contact of the electrode is made possible with the internal surface of the terminal itself. A locking arrangement is also provided in my terminal which allows limited expansion or flexing of the terminal to prevent overstressing of the terminal during rocking and to accommodate electrodes of varied size, such locking arrangement however preventing flexing beyond the elastic limit of the terminal. Finally, the terminal of my invention may be easily and inexpensively manufactured and may function to also position and hold a spark plug protective boot on the spark plug.

SUMMARY OF THE INVENTION

In a principal aspect, the spark plug terminal constructed in accordance with the principles of my invention includes an elongated barrel which has an internal surface which is substantially of elliptical cross section. Resilient means projects inwardly of the internal surface of the barrel to conductively contact and hold the electrode of the spark plug. The resilient means is positioned with respect to the elliptical internal surface of the barrel such that when the barrel is moved or rocked in a direction perpendicular to its longitudinal axis, the electrode contacts the internal surface of the barrel in preference to the resilient means thereby avoiding excessive deformation of the resilient means.

These and other objects, features and advantages of the present invention will be more clearly understood when considering the following detailed description.

BRIEF DESCRIPTION OF THE DRAWING

In the course of this description, reference will frequently be made to the attached drawing in which:

FIG. 1 is a plan view of a sheet metal blank prior to formation into one of the preferred embodiments of spark plug terminal of my invention;

FIG. 2 is an end elevation view of the terminal of my invention after forming from the blank shown in FIG. 1 and prior to the attachment of the ignition lead;

FIG. 3 is a plan view of a preferred embodiment of terminal in which the spark plug electrode has been inserted and the ignition lead attached and having a cross-sectioned spark plug protective boot positioned thereon;

FIG. 4 is a side elevation view of the terminal and spark plug of FIG. 3 with the protective boot removed;

FIG. 5 is a schematic view showing the terminal and spark plug electrode contact under normal installation conditions;

FIG. 6 is a schematic view showing the terminal and electrode contact when the terminal is rocked or otherwise subjected to a sidewise force;

FIG. 7 is an end elevation view of a second preferred embodiment of terminal constructed in accordance with the principles of my invention; and

FIG. 8 is a side elevation view of the terminal of FIG. 7 having a portion thereof broken away to show the locking structure.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIGS. 1-4 a first preferred embodiment of terminal of my invention is shown. The terminal preferably is formed from a stamped sheet metal blank 10, as shown in FIG. 1. The blank includes pairs of generally rectangular portions 12 and 13 which are connected to each other by a portion 14. Portion 12, which will eventually be adapted to form a barrel which fits over the electrode of the spark plug, includes a pair of tabs 16, a corresponding pair of generally square openings 18, and two pairs of spaced generally rectangular slots 20. Portion 13, which will eventually be adapted to firmly engage and hold the ignition lead, includes a pair of raised ribs 22 which are stamped therein. The function of the various aforementioned elements of each of the blank portions will become clear as the finally constructed terminal of my invention is described hereinafter in detail.

Initially the bridging portions between the elongated slots 20 are rippled so as to provide resilient projection members 24 having the shape as generally shown in FIG. 3 and portion 12 is then rolled upon itself to form a tubular barrel 25. The resilient projections 24 include a pair of outwardly raised crests 26 and 27 which extend outwardly from the external surface 30 of the barrel 25 and an inwardly raised crest 28 which projects inwardly beyond the internal surface 32 of the barrel intermediate crests 26 and 27. The crest 28 is positioned on the barrel so as to receive the outer surface of the electrode E of the spark plug P when the electrode is inserted into the barrel, the projection 24 and its crest 28 providing electric contact between the barrel and the electrode and firmly gripping the electrode E. When viewing FIG. 3, it will be noted that after the crest 28 has slipped beyond the somewhat enlarged distal end of the electrode E, the position and shape of the projection 24 actually operate to urge the barrel 25 toward the main body of the spark plug P.

The tubular barrel 25 is formed by bending portion 12 into a tubular configuration such that the edge 34 containing the openings 18 overlies the edge 36 which carries the tabs 16. The tabs 16 are then bent upwardly through the openings 18 and over into the locking arrangement as shown in FIG. 2. Since the openings 18 are somewhat larger than the tabs 16, relative movement obtains between the two edges 34 and 36 during the rocking of the terminal on the electrode or during insertion of a substantially large electrode in the terminal. The locking arrangement thus enables flexing of the resilient barrel 25 but prevents an amount of flexing which would be such that the elastic limit of the terminal would be exceeded.

Portion 13 is also bent over about a conventional ignition lead L having a conductor of the fold-back variety. The ribs 22 firmly grasp the insulation of the lead L preventing removal thereof and clamping the folded back end of the conductor C against the connecting portion 14 to complete the ignition circuit between the lead L and the barrel 25.

An important feature of the invention resides in the elliptical cross-sectional shape of the barrel 25. Referring to FIGS. 2, 5 and 6 the distance D_1 between opposite points P_1 and P_2 on the major axis of the ellipse and on the internal surface 32 of the barrel is greater than the vertical distance D_2 between points P_3 and P_4 on the barrel's internal surface, and on the minor axis of the ellipse. When the electrode E of the spark plug is inserted into the barrel, the enlarged distal end of the electrode passes crests 28 of the resilient projections 24, which are also positioned on the ellipse major axis, and is firmly locked in the barrel. Although the horizontal distance D_1 between the opposite internal surfaces of the barrel is greater than the distance D_2 , the distance D_3 between the opposed crests 28 of the resilient projection 24 is slightly less than the distance D_2 . Such relationship enables the projections 24 to exert a substantial force through their crests 28 against the sides of the electrode E to securely lock the electrode in the barrel and provide a substantial contact-wiping action at the crests. Also since the barrel 25 is elliptically shaped, the electrode E will also contact the internal surface of the barrel at points P_3 and P_4 at the end of the minor axis of the ellipse. Thus, the elliptical shape of the barrel 25 acts to provide additional electrical contact of the electrode with the barrel over and above that provided at the resilient projections 24.

If the terminal is rocked or other sidewise deflection is experienced by the terminal, the forces exerted on the terminal will in the major part be borne by the barrel internal surface 32 rather than the resilient projections 24. Referring to FIG. 6, the arrow indicates the direction of movement of the barrel with respect to spark plug electrode E. Since the electrode is substantially circular in the cross section and the terminal is elliptical in cross section, the resilient projection 24 will deform only slightly when the barrel 25 is moved to the right as viewed in FIG. 6. Deformation ceases when the surface of the electrode E contacts the internal surface of the barrel at points P_3 and P_4 adjacent the edges of the rectangular slots 20. In fact when the terminal is rocked, the crest 28 forms a fulcrum about which the electrode tends to pivot until it contacts the internal surface of the barrel. Obviously the major portion of the barrel is somewhat stronger than the relatively narrow resilient projection 24 and is thus able to withstand greater stresses. Moreover, if an additional excessive movement is imparted to the barrel, overlying edges 34 and 36 will merely move with respect to each other causing the barrel to flex and increase the perimeter of the elliptical cross section and thus prevent exceeding the elastic limit of the barrel. The movement of the edges 34 and 36 by such amount that the barrel's elastic limit would be exceeded is prevented by the folded back tabs 16 which limit the relative movement of the edges with respect to each other.

Referring again to FIG. 3, the bent over tabs 16 and crests 26 and 27 are arranged in circumferential alignment with each other. Such arrangement enables the positioning of the aligned tabs and crests in annular grooves 38 formed on the internal surface of a flexible spark plug protective boot 40 which is positioned over the terminal and spark plug to protect same. The location of the tabs 16 and crests 26 and 27 within the grooves 38 helps to position and hold the boot 40 in place.

Referring to FIGS. 7 and 8, a second preferred embodiment of terminal of my invention is shown. This embodiment is similar in many respects to the previously described embodiment and thus like reference numerals will be employed to designate like elements. In this embodiment the locking arrangement differs somewhat from the previously described embodiment. The overlying edge 34 of the barrel 25' has one or more openings formed therein as previously described, but the underlying edge 36' is expanded upwardly to form rivet-like studs 42 which extend upwardly through the openings as

shown in FIGS. 7 and 8. The studs 42 are belled at the top to restrain the upward movement of the overlying edge 34. As in the previous embodiment, the openings 18 are somewhat larger than the intermediate portion of the studs 42 to enable limited movement of edges 34 and 36' with respect to each other as previously described such that the movement does not exceed the elastic limit of the barrel 25'.

It is to be understood that the embodiments of the invention which have been described are merely illustrative of a few of the applications of the principles of the invention. Numerous modifications may be made by those skilled in the art without departing from the true spirit and scope of the invention.

I claim:

1. A terminal for a spark plug comprising:

an elongated barrel having an internal surface which is substantially of elliptical cross section;
connector means on said barrel adapted to receive an ignition lead wire in conductive relationship to said barrel; and

resilient projection means projecting inwardly of the internal surface of said barrel for conductively contacting and holding the electrode of the spark plug when the electrode is inserted in the barrel, said resilient projection means being positioned with respect to the elliptical internal surface of said barrel such that when said barrel is moved perpendicular to its longitudinal axis the electrode principally bears against the internal surface of the barrel in preference to the projection means whereby excessive deformation of the projection means is prevented.

2. The terminal of claim 1 wherein the minor axis of the elliptical cross section of the barrel is of a selected length such that the internal surface normally contacts the electrode of the spark plug at at least one point located substantially on said minor axis in addition to the contact afforded by said projection means when the electrode is inserted in the barrel.

3. The terminal of claim 1 wherein said resilient projection means are positioned substantially on the major axis of the elliptical cross section of the barrel.

4. The terminal of claim 3 wherein said resilient projection means comprise a pair of crests positioned opposite each other on said major axis, the distance between said crests being less than the length of the minor axis of the elliptical cross section of the barrel.

5. The terminal of claim 1 wherein said projection means comprise a pair of elongated resilient tabs stamped from said barrel and which extend substantially parallel to the longitudinal axis of said barrel, each of said tabs being positioned adjacent the opposite ends of said major axis of the elliptical cross section of the barrel, the electrode contacting the internal surface of the barrel at points adjacent the tabs when the barrel is moved perpendicular to its axis.

6. The terminal of claim 1 wherein said barrel is split over its longitudinal length in spaced relationship to said resilient projection means for permitting flexing of the barrel to vary the size of the perimeter of the elliptical cross section of said barrel.

7. The terminal of claim 6 wherein said split is located adjacent an end of the minor axis of the elliptical cross section of the barrel.

8. The terminal of claim 6 wherein a portion of the barrel overlies another portion of the barrel adjacent said split, and locking means are carried on one of said portions and cooperate with the other of said portions to enable limited movement of said portions with respect to each other.

9. The terminal of claim 8 wherein a portion of said resilient projection means and a portion of said locking means extend beyond the external surface of said barrel, said extended portions being aligned with each other for mutual entry into positioning grooves of a spark plug protective boot.

10. The terminal of claim 8 wherein said locking means comprise an opening defined in the overlying portion of the barrel, and tab means bent upwardly from the other portion and extending through said opening, said opening being larger than said tab means.

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11. The terminal of claim 8 wherein said locking means comprise an opening defined in the overlying portion of the barrel, and expanded means extending upwardly from the

other portion through said opening, said opening being larger than said expanded means.

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