May 20, 1952 W. HEDIGER 2,597,794

SPARK PLUG

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Fig. 1

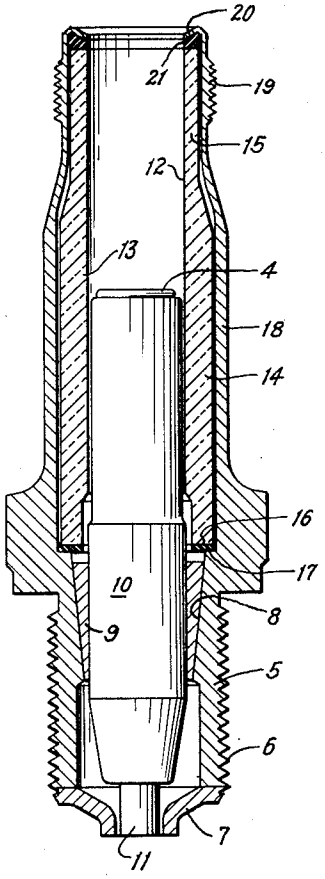
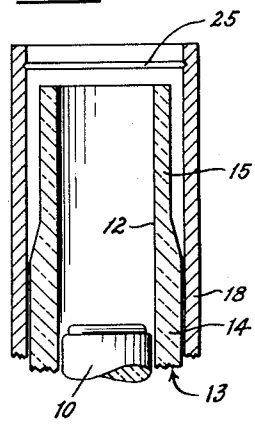


Fig. 2



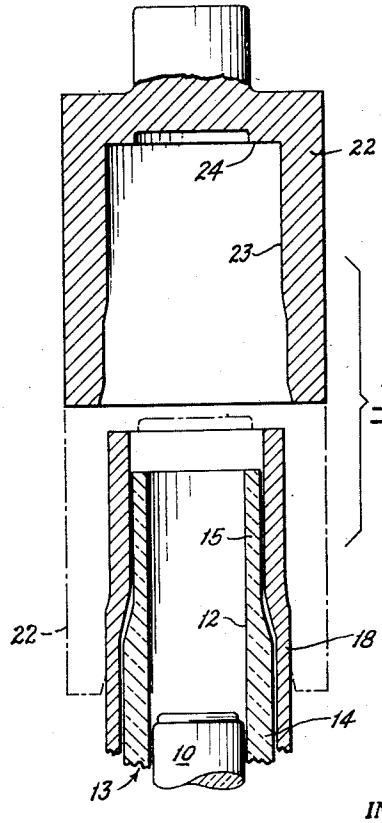


Fig. 3

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SPARK PLUG

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5 Claims. (Cl. 123—169)

1

This invention relates to ignition apparatus and more particularly to spark plugs adapted for use in igniting the combustible charges in the cylinders of internal combustion engines and the like, and to methods of making said spark plugs.

One of the objects of the present invention is to provide a novel spark plug which is simple in construction and inexpensive to manufacture.

Another object of the invention is to provide a novel radio-shielded spark plug having a shell and shielding barrel formed as a single member and a relatively thick insulating tube or sleeve lining said barrel and surrounding the center electrode assembly.

Another object is to provide a novel method of fabricating a radio-shielded spark plug which eliminates the necessity of providing a separate shell and shielding barrel in order to employ a relatively thick insulating tube between said barrel and the center electrode assembly.

Still another object is to provide a novelly constructed spark plug wherein good mechanical qualities are combined with good electrical qualities.

A further object is to provide a novel method of fabricating the shielding barrel of radio-shielded spark plugs whereby said barrel may be formed integral with the spark plug shell and contain a relatively thick insulating lining without necessitating any change in the design of the spark plug and in the design of the shielding harness equipment on present-day and future engines.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended to define the limits of the invention, reference for this latter purpose being had primarily to the appended claims.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is a vertical central section of a radio-shielded spark plug constructed in accordance with the present invention;

Fig. 2 is a fragmentary sectional view of the spark plug in an unfinished stage and showing

2

the shape of the shielding barrel before the latter is conformed to the shape of the pre-formed insulating tube therein; and

Fig. 3 is a view similar to Fig. 2, but showing the shielding barrel after it is shaped to the contour of the insulating tube by the forming die shown in said figure.

Referring to Fig. 1 of the drawings, there is shown a novelly constructed radio-shielded spark plug of the general type universally used in present-day aircraft engines and comprising a tubular metallic shell 5 which is externally threaded at 6 for cooperation with a threaded opening in an engine cylinder (not shown). A ground electrode 7 of any suitable known construction is secured to the lower end of shell 5 by means of silver solder or other suitable means. The bore through shell 5 is provided with a tapered portion 8 for receiving a tapered sleeve 9 of relatively soft metal, such as copper. Sleeve 9 is utilized for centering the ceramic or a like insulator 10 and the center electrode 11 in shell 5 and for securely holding said center electrode assembly in said shell by a wedging action, as is well understood in the art. Center electrode 11 projects beyond the lower end of insulator 10 in spark gap relation with ground electrode 7, and is electrically connected with a metallic terminal 4 which is secured in the upper end of insulator 10 for conducting high tension electric current from a suitable source to said center electrode.

Insulator 10 projects upwardly beyond shell 5 and into the straight bore 12 of a bottle-shaped ceramic or the like insulating tube 13 having a relatively thick walled body portion 14 surrounding the center electrode assembly 10, 11 to improve the insulating qualities of said spark plug, and a relatively thin wall 15 at the upper end thereof for a purpose to more fully appear hereafter. Tube 13 rests at its lower end on a pad 16 of asbestos or other yieldable insulating material, said pad, in turn, resting on an internal annular shoulder 17 within shell 5. Surrounding tube 13 and formed integrally with shell 5 is a metallic shielding barrel 18 which is also bottle-shaped so that the upper end thereof conforms to the external contour of the thin walled neck portion 15 of tube 13 whereby said barrel is of the proper diameter at the upper end thereof to threadedly receive the standard coupling of a shielding har-

ness lead, said end of the barrel being externally threaded at 19 for this purpose. Tube 13 is rigidly held in barrel 18 and in engagement with pad 16 by spinning the upper end of said barrel inwardly to form a retaining flange 20. A cushion 21 of high temperature and oil resisting material, such as, for example, "neoprene" synthetic rubber, is preferably disposed between flange 20 and the end of tube 13 to yieldably clamp the latter and thus prevent chipping or cracking of said tube.

Heretofore, in the manufacture of spark plugs of the type and design described, it has been necessary to make the shell 5 and barrel 18 as two separate members in order to employ the desired insulating tube 13 of variable thickness and to enable assembling of said tube, said barrel being subjected to numerous expensive and time consuming machining operations interiorly and exteriorily thereof to conform the same to the contour of the tube and to adapt the spark plug for use with the standard shielding harness coupling. In accordance with the present invention, a novel method is provided for fabricating the shielding barrel 18 whereby the latter and the shell 5 may be of one-piece construction and contain the desired bottle shaped insulating tube 13 without affecting the design of the spark plug so that the latter is still relatively light in weight and capable of receiving the standard shielding harness coupling, said method reducing the machining operations to a minimum and resulting in a reduction in the manufacturing cost of the spark plug as well as an increase in the production rate.

In making the described spark plug in accordance with the present invention, a piece of solid or tubular metallic stock, such as, for example, high grade steel, is subjected to machining and boring operations, thereby forming the externally threaded shell 5 having the tapered bore 8 and the internal shoulder 17 therein, and a shielding barrel 18 having a straight thin wall extending throughout the length thereof, as shown in Fig. 2, and a central straight bore of a diameter corresponding to the outside diameter of the body portion 14 of tube 13 to receive the latter. The tapered sleeve 9 and the center electrode assembly 10, 11 are then inserted and wedged in the shell 5 in a manner well-known in the art, and thereafter the pad 16 and the pre-formed insulating tube 13 are inserted into the semi-finished barrel 18 and engaged over the center electrode assembly 10, 11 until said pad and tube rest on and are supported by shoulder 17 within shell 5. Thereupon, a die 22 (Fig. 3) having a bore 23 of a predetermined size and contour is engaged with the upper free end of the semi-finished barrel 18 and pressure is applied thereon hydraulically or mechanically by any suitable press, thereby forcing the die downwardly, as indicated in broken lines in Fig. 3, over the upper end of the barrel until an internal shoulder 24 within said die engages the upper end of said barrel, or until the downward movement of the die is interrupted by any other suitable means provided for this purpose. The upper end of the barrel 18 is thus swedged or compressed by die 22, as shown in Fig. 3, in conformity with the external contour of insulating tube or sleeve 13 at the upper reduced neck portion 15 thereof. The size of bore 23 in die 22 is so proportioned that the upper end of the barrel 18 is not swedged into contact with the neck portion 15 of tube 13, but leaves a slight clearance space therebetween, thus avoiding crushing or cracking of said tube.

As a consequence of the swedging operation, the thickness of the wall of the barrel 18 at the upper end thereof is somewhat increased, as shown in Fig. 3, which provides additional and sufficient material for forming a band of the proper diameter and width on the swedged portion to receive the threads 19. Accordingly, after the swedging operation, the swedged portion of the barrel 18 is machined or turned down to the proper band diameter and thereafter further machined or turned down at spaced points to form said band and to also blend the outer surface of the swedged portion into the outer surface of the body of the barrel. If desired, the band may be formed first and thereafter machined to the proper diameter. The band is then threaded, which operation completes the construction of the shell 5 and barrel 18, whereupon the cushion 21 is inserted into said barrel and the upper end of the latter is spun inwardly to form the flange 20 which is then pressed downwardly into firm engagement with said cushion. In order to facilitate spinning of the flange 20, the shielding barrel is provided interiorly and adjacent the upper end thereof with a small, shallow annular groove as indicated at 25 (Fig. 2).

There is thus provided a novel radio-shielded spark plug which, through the provision of a novel method of fabricating the shielding barrel, enables the use of a relatively thick insulating tube between said barrel and the upper exposed end 4 of the center electrode, and the use of a one-piece shell and shielding barrel, without necessitating any change in the design of the spark plug and in the design of the shielding harness associated therewith. The novel method of fabricating the shielding barrel, and the one-piece construction of said barrel and the shell, reduces the number of machining operations and the number of the spark plug parts to a minimum resulting in a decrease in the cost of manufacture and in the price of the spark plug, and in an increase in production. The necessity of using heat to satisfactorily join the shell and barrel is also eliminated.

Although only a single embodiment of the invention has been illustrated in the accompanying drawings and described in the foregoing specification, it is to be expressly understood that the invention is not limited to said embodiment. Various changes, particularly in the design of the parts illustrated and in the method of fabricating the one-piece shell and shielding barrel, may be made 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. In a spark plug, a tubular shell, a ground electrode on said shell, a center electrode assembly in said shell comprising a center electrode having spark gap relation with said ground electrode and a rigid insulator surrounding a portion of said center electrode, means for securing said center electrode assembly in said shell, a rigid pre-formed insulating tube surrounding a portion of said center electrode assembly and extending upwardly from said assembly and shell, said tube having an externally reduced portion at the upper end thereof, and a tubular shielding barrel molecularly integral with and extending upwardly from said shell, said barrel surrounding said tube and having a reduced upper end conforming to the reduced upper end portion of said

tube, and being slightly separated therefrom by an air space.

2. In a spark plug, a tubular one-piece metallic member comprising a shell and a shielding barrel, said shell being molecularly integral with said barrel, a center electrode assembly supported in said shell and extending into said barrel, the inner enlarged portion of the bore of said barrel into which said assembly extends being cylindrical and the outer portion of said bore being of smaller diameter than said enlarged portion and joined thereto by an intermediate tapering portion, an internal shoulder being formed at the inner end of said barrel around said assembly and a portion of the outer end of said barrel being turned inwardly to form an internal flange, and a pre-formed rigid tube of insulating material interposed between said flange and said shoulder around the end portion of said assembly and having an external contour conforming approximately to the size and shape of the bore of said barrel.

3. A spark plug as defined in claim 2 comprising a cushion of yieldable insulating material, such as asbestos, interposed between said insulating tube and said shoulder.

4. A spark plug as defined in claim 2 comprising a cushion of yieldable insulating material, such as rubber, interposed between said insulating tube and said flange.

5. A spark plug as defined in claim 2 wherein there is a slight clearance between the external surface of said insulating tube and the internal surface of said barrel.

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