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METHOD OF MAKING SPARK PLUGS

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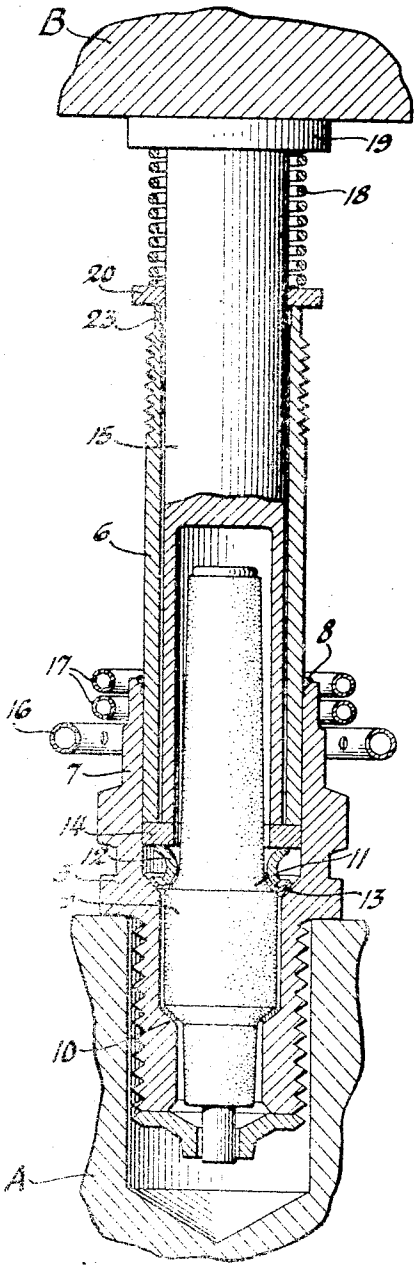

Fig. 1

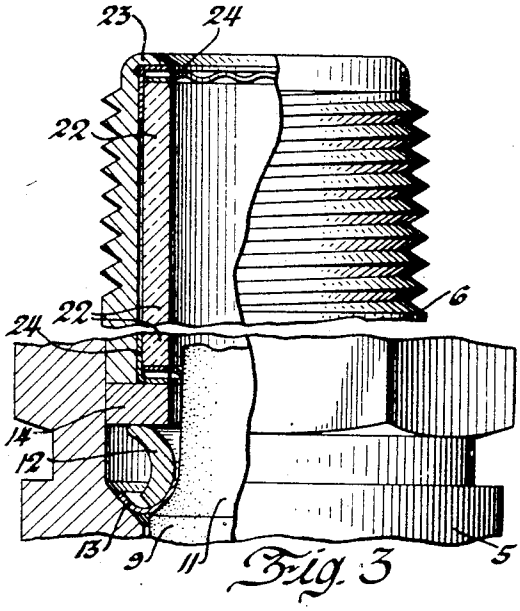

Fig. 3

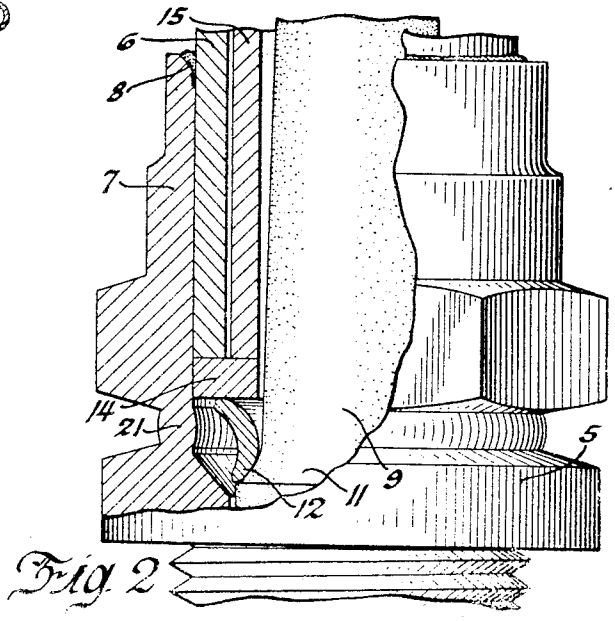

Fig. 2

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METHOD OF MAKING SPARK PLUGS

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My invention relates to spark plugs comprising a hollow tubular shell portion externally threaded at its lower end within which the usual insulating member of the plug is housed, and a tubular metallic shield the lower end of which fits closely within the upper end of said hollow shell and is welded in place therein; there being an annular holding member surrounding the upper end of the insulating member and which holding member is compressed to secure gas-tightness of the plug, and is held in a compressed condition while the shield and shell are being welded together to thereby provide a unitary plug structure. My invention relates particularly to the welding of the tubular shield in place within the upper end of the shell of the plug so as to make of the two a single unitary part, and consists in particular features of plug structure contributing to that end; in means cooperating with said plug features for subjecting said resilient holding member to compression; and in means for holding said holding member in a compressed condition while the welding is being accomplished, all as will hereinafter appear.

The drawing submitted herewith illustrates a spark plug made in accordance with my invention, and therein:

Figure 1 is a view showing a section taken upon a central longitudinal plane of a nearly, but not entirely completed plug, the plug being shown about twice its normal size.

Figure 2 is a fragmentary view showing alternative forms of various features of my invention and illustrating a different procedure in welding the shell and shield together.

Figure 3 is a fragmentary view showing a feature of a completed plug not shown in Figure 1.

Referring now to the drawing accompanying and forming a part of this specification, the reference numeral 5 designates the hollow tubular metallic shell portion of a spark plug the lower end of which is threaded to screw into an internally threaded opening in the head of an internal combustion engine cylinder; and 6 designates a tubular metallic shield portion of the plug, the lower end of which fits closely within a tubular upper portion 7 of the shell. In the finished plug the lower end of the shield is held in place within the portion 7 by welding, as indicated by the numeral 8 and as will hereinafter appear.

The usual insulating member of the plug is indicated by the numeral 9, the same being supported by a lower annular ledge 10, and having an inclined upper shoulder 11; and above this shoulder and surrounding the upper end of the

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insulator member is an annular holding member preferably C-shaped in cross-section as shown; and which in the finished plug acts as a stiff spring to force the insulating member against a gasket supported by the ledge 10 to thereby secure gas-tightness in the finished plug. A metallic gasket 13 of copper, nickel or equivalent material is shown as interposed between the lower end of the holding member 12 and the shoulder 11.

Fitting within but not joined to the inner wall of the tubular upper portion 7 of the shell (as it moves downward therein when the holdnig member 12 is compressed as will hereinafter appear) is an annular washer 14 against which the lower end of the metallic shield 6 abuts, and which washer acts to compress the holding member 12 and force the insulating member 9 downward when said washer is forced downward as a step preceding the welding of the lower end of the shield 6 in place within the tubular upper part 7 of the shell 5; this yielding to a superior force as will next appear being due to the form and resilience of the member 12 as will be understood.

The washer 14 extends inward beyond the inner edge of the lower end of the shield, as shown, and provides a member or feature independent of and separate from the shield 6 whereby the holding member 12 may be forced downward independently of the shield, thereby avoiding the necessity of transmitting excessive compressive force through the shield and permitting the shield wall to be designed without regard to the transmission of excessive compressive force along it, during the assembling of the parts of the plug. In fact this shield may be rolled or drawn from thin sheet metal stock, instead of being produced from a solid bar by an automatic turret lathe or like machine, as has heretofore commonly been done; as the lower end thereof does not have to be thick enough to permit a thread to be formed therein, as it necessary when the lower end of an equivalent shield is screwed into the upper end of a tubular extension the equivalent to the part 7 herein. It will be appreciated that the parts thus far referred to form parts of the completed plug, which is of the unitary or single piece type.

The numeral 15 designates a compressor member adapted to enter the shield 6 and abut against the washer 14 whereupon and when pressure is applied thereto, as by the press elements indicated conventionally by the characters A—B, said member forces the insulating member 9 into gas tight engagement with a gasket supported upon the

ledge 10; this being accompanied by downward movement of the washer 14 and by distortion of the resilient holding member 12 as the pressure applied between the press elements is ordinarily around 3000 pounds. The downward movement of the washer, however, and despite the great pressure commonly employed, is slight; because the C-shaped holding member 12 is extremely stiff and is but little distorted notwithstanding the great pressure to which it is subjected. The compressor member 15 is commonly tubular in form for at least part of its length to accommodate the upper end of the insulating member, and while it is functionally longer than the shield 6 it is not necessarily an integral device as shown.

While the parts are held under compression between the press elements A—B the lower end of the shield 6 is welded or brazed in place within the tubular extension 7 of the shell as by a brazing material 8 melted in situ, and the joint between the parts is commonly cooled rapidly by jets projected from an annular air or water supply conduit 16. Heating of the upper end of shell to accomplish the welding of the parts together may be accomplished by a coil 17 through which an alternating current flows as in the usual method of induction heating. A spring 18 acting between a fixed abutment 19 and a washer 20 loose upon the compressor member 15, and which abuts against the upper end of the shield 6, is ordinarily provided to press the lower end of the shield into contact with the washer 14 during the welding step; but this is a weak spring exerting, usually, a pressure of around twenty pounds, and is used merely to keep the parts in contact with one another during the welding operation.

Figure 2 contemplates a slightly different procedure in assembling the shell and the metallic shield wherein the holding member 12 is not subjected, initially, to the high pressure hereinbefore contemplated; the spring 18, however, being commonly retained to press the lower end of the shield 6 into firm contact with the washer 14, the shell and shield are, however, welded together the same as in Figure 1.

In proceeding as contemplated in Figure 2 the press elements A—B if used, and the compressor member 15, do not, initially, subject the holding member 12 to substantial pressure (except as they act through the spring 18 to press the shield 6 against the washer 14), and the joint between the insulator 9 and the lower annular ledge which supports it may not be sufficiently gas tight; and to correct this objection and secure gas-tightness in the finished plug a groove is provided in the shell 5, whereby the wall thereof at 21 is reduced in area to such a degree that it may be heated to plasticity by a current of electricity, obviously of large volume, caused to flow through it.

Then and after the shell and shield have been welded together in accordance with the disclosure relating to Figure 1 the wall 21 is heated to plasticity by a current of electricity made to flow through it and pressure (usually around 3000 pounds as in Figure 1, as that pressure has been found to be about the pressure necessary to secure gas-tightness), is applied to the holding member 12 through the compressor member 15 and washer 14, as in Figure 1. This higher pressure may be applied by the same press elements A—B, or by equivalent elements of another and similar machine or device, the heating being continued to maintain the wall section plastic; and after the wall section has been sufficiently collapsed by pressure thus applied to secure gas-tightness, the current is disconnected and the highly heated wall section is permitted to cool, with consequent contraction. During this collapsing of the wall section 21 the compressor member 15 acts directly upon the washer 14 and through it upon the holding member 12; but there is no independent downward movement of the washer within the tubular part 7 of the shell 5, because the part 7 and the shield 6 are welded together before the wall section is collapsed.

The spark plug thus produced is ordinarily provided with a tubular lining 22 of ceramic material the lower end of which is supported by the inwardly extending portion of the washer 14, and which is held in place within the metallic sheld 6 by an inturned flange 23 at the upper end thereof; suitable resilient gaskets 24 being provided for cushioning the ends of lining 22 and preventing it from being broken when being installed and afterward when the plug is in use.

Having thus described and explained my invention I claim and desire to secure by Letters Patent:

1. In the manufacture of a spark plug which includes a shell, an insulator within the shell, and a shield which extends into the shell and holds the insulator with respect to the shell so that gas cannot pass between it and the shell: the operations of disposing between the shield and the insulator a member which is separate from the shield and the insulator, applying to the member sufficient pressure to hold the insulator with respect to the shell so that gas cannot pass between it and the shell without applying such pressure to the shield, applying sufficient pressure to the shield to hold it firmly against the member, and, while the pressures are thus applied, metallically bonding the shield to the shell.

2. In the manufacture of a spark plug which includes a shell, an insulator within the shell, an annular spring within the shell, and a shield which extends into the shell and loads the annular spring and thus holds the insulator with respect to the shell so that gas cannot pass between it and the shell: the operations of disposing between the shield and the annular spring an annular member which is separate from the shield and the annular spring, applying to the annular member sufficient pressure to hold the insulator with respect to the shell so that gas cannot pass between it and the shell without applying such pressure to the shield, applying sufficient pressure to the shield through a yielding member to hold it firmly against the annular member, and, while the pressures are thus applied, metallically bonding the shield to the shell.

3. In the manufacture of a spark plug which includes a shell with a seat for an insulator, an insulator disposed within the shell with a portion in contact with the seat, and a shield which extends into the shell and holds the insulator in contact with the seat so that gas cannot pass between it and the shell; the operations of disposing between the shield and the insulator a member which is separate from the shield and the insulator, applying axially of the spark plug sufficient pressure to the member, without applying such pressure to the shield, to move the member axially of the spark plug with respect to the shell as a whole and to hold the insulator in contact with the seat so that gas cannot pass between it and the shell, and, while the pressure is thus applied, metallically bonding the shield to the

shell in a position to hold the insulator in contact with the seat so that gas cannot pass between it and the shell.

4. In the manufacture of a spark plug which includes a shell with a seat for an insulator, an insulator disposed within the shell with a portion in contact with the seat, and a shield which extends into the shell and holds the insulator in contact with the seat so that gas cannot pass between it and the shell: the operations of inserting the shield into the shell, applying axially of the spark plug sufficient pressure to the upper surface of an element at the inner end of the shield through a member other than the shield, without applying such pressure to the portion of the shield outwardly of the element, to move the element axially of the spark plug with respect to the shell as a whole and to hold the insulator in

contact with the seat so that gas cannot pass between it and the shell, and, while the pressure is thus applied, metallically bonding the shield to the shell in a position to hold the insulator in contact with the seat so that gas cannot pass between it and the shell.

HECTOR RABEZZANA.

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