

[54] **HIGH FREQUENCY SHIELD FOR SPARK PLUG BOOT HAVING SUPPRESSION COIL THEREIN**

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[56] **References Cited**

UNITED STATES PATENTS

3,212,044	10/1965	Cloud, Jr.	338/66
2,173,766	9/1939	Ramsay	123/148 P X
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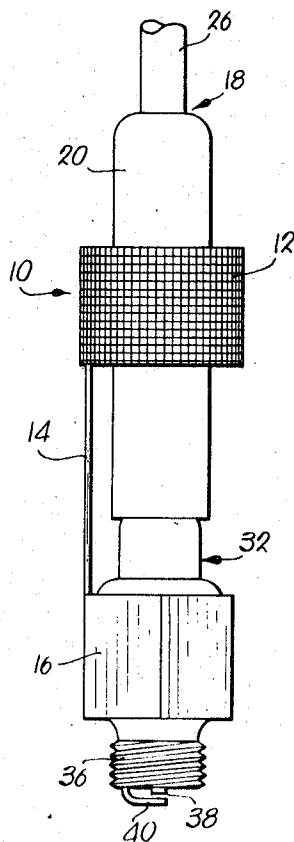
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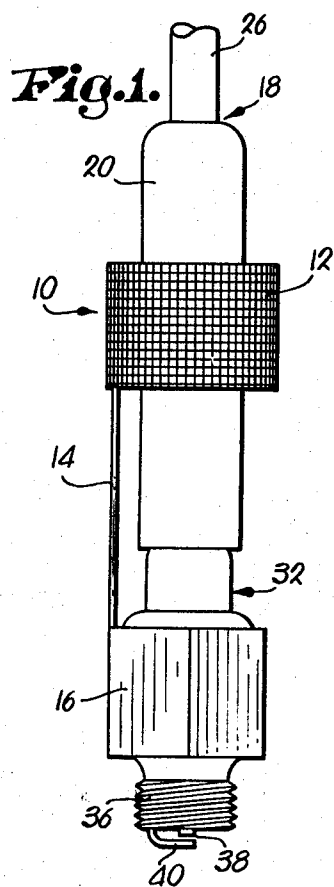
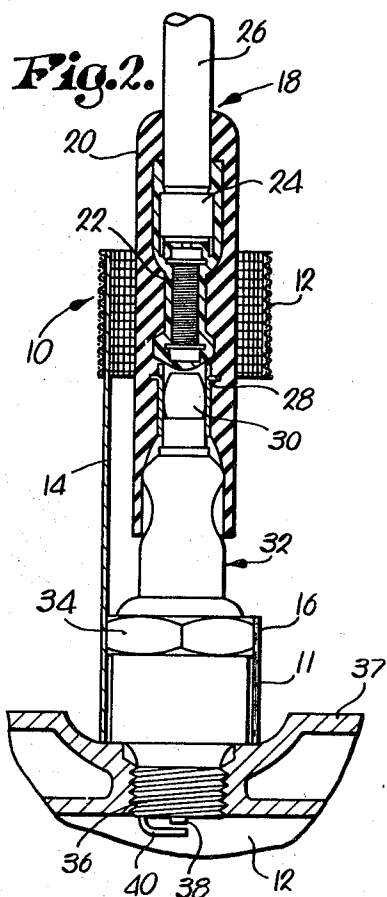
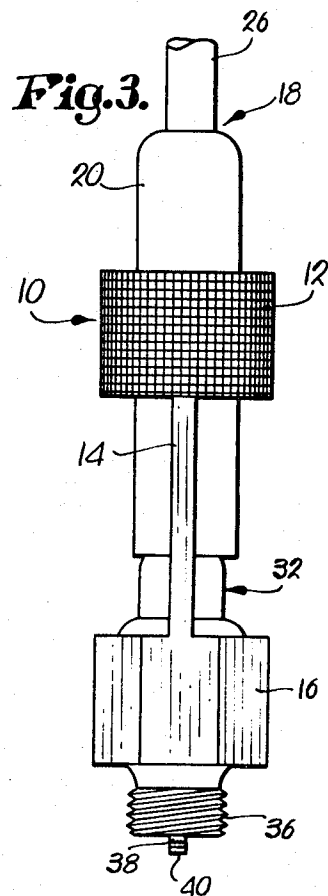
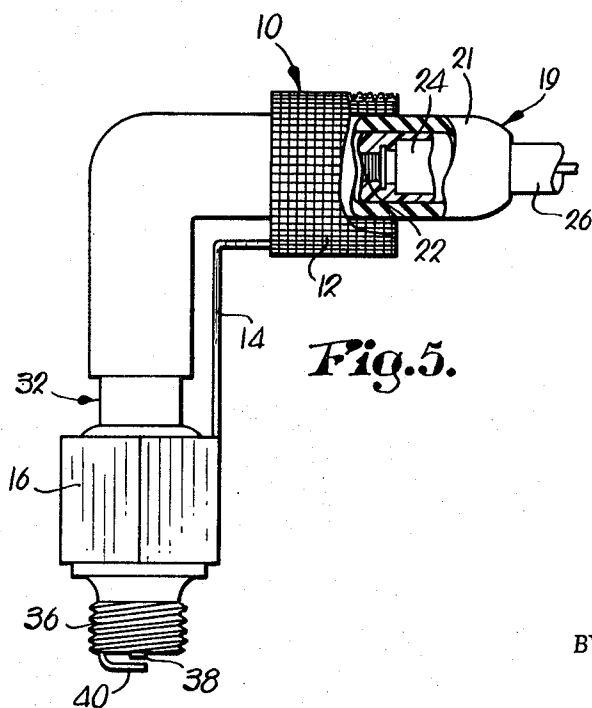
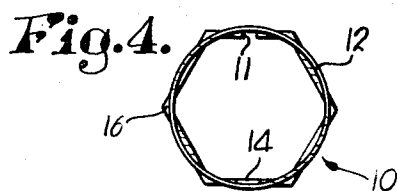
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ABSTRACT

A high frequency shield for use with a spark plug lead having an electrical discharge suppression coil interposed between the plug and the end of the lead and contained within a portion of the spark plug boot for confining electrical emissions emanating from the suppression coil to an area within the limits of the shield. The shield employs a support member adapted to be positioned over the grounded metallic body portion of the plug while a metallic electrical emission controlling screen is held in surrounding relationship to the segment of the boot containing the suppression coil therein by an elongated, rigid, combination support strip and grounding element extending between the shielding screen and the base member. The support strip is adapted to be bent from its normal straight-line configuration to a right-angle configuration to enable the shield to be used on conjunction with either the conventional, straight type spark plug boot or the right-angle type boot.

8 Claims, 5 Drawing Figures





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HIGH FREQUENCY SHIELD FOR SPARK PLUG BOOT HAVING SUPPRESSION COIL THEREIN

This invention relates to the field of shielding apparatus for electrical devices of the type which create high frequency emissions and, more particularly, to shielding apparatus for use with the spark plug leads of an automotive ignition system which are provided with boot assemblies having electrical discharge suppression coils therein.

It has long been a serious problem in the automotive and replacement parts industries to provide spark plug leads of the type which do not emit emissions which produce radio interference or otherwise interfere with communications equipment, which provide maximum ignition efficiency and service life, and which may easily and economically be fabricated by effective production methods. Numerous devices have been proposed in the past to meet this problem. These devices have taken many different forms and have had varying degrees of success, but generally speaking, all have failed in one respect or another to provide a spark plug lead having the above-mentioned characteristics. Carbon filament wires for example, are widely used but have a relatively short service life because of their relatively fragile nature.

One device however, which is more successful than others in meeting all of the above requirements is shown and described in U.S. Pat. No. 3,212,044, issued Oct. 12, 1965, and entitled "Spark Plug Boot Having High Frequency Electrical Discharge Suppression Means Therein." This device employs a high frequency suppression coil mounted within the plug boot in series with a solid metal core spark plug lead. The coil acts as a resistance to prevent the oscillation of electrical impulses through the plug lead and spark plug, resulting from the capacitor-like characteristics of the spark plug and the ionized state of the air or gas along the path that has just been traversed by a main or direct current arc. The overall result of preventing the oscillation of electrical impulses within the lead wire is the elimination of secondary arcing across the terminals of the plug. This secondary arcing, which may occur as many as 50 times after each main or firing arc, has been found to be one of the principal sources of radio and communications interference.

Even though provision of a spark plug lead with a suppression coil therein eliminates interference resulting from secondary arcing or discharge across the spark plug electrode, it does not completely eliminate radio interference emissions altogether. The suppression coil itself becomes a source of interference and high frequency emissions.

It has now been discovered that by effectively shielding the suppression coil against discharge of high frequency emissions therefrom, a lead having all of the above-mentioned requirements and characteristics is feasible. However, the structure used to eliminate or shield the coil against high frequency emissions must be capable of being economically and easily produced for use with the various types of plug boots including both the straight-line and right-angle variations, and must be able to function effectively while subjected to the extreme heat and vibration present under the hood of an automotive vehicle.

Accordingly, it is the primary object of this invention to provide a high frequency shield for use with spark

plug leads equipped with electrical discharge suppression coils which will restrict the high frequency emissions emanating from the suppression coil within the region defined by the shield.

It is another important object of this invention to provide such an extremely simple and dependable shield which will eliminate radio and communications interference resulting from the high frequency emissions from the suppression coil under all normal conditions of heat and vibration associated with operation of a conventional internal combustion engine.

It is still another important object of this invention to provide such a shield which is supported on and grounded by the metallic base portion of the spark plug in such a manner as to negate any adverse affects from engine or road vibrations.

It is yet another important object of this invention to provide such a shield which will assure adequate ventilation for both the shielded spark plug lead and the shield as well.

It is a further important object of this invention to provide such a shield which may be used in a single embodiment either with a straight-line plug boot or with a right-angle type boot. In the drawing:

FIG. 1 is a side elevational view of a shield embodying the principles of my invention mounted on a spark plug and in surrounding relationship to a conventional straight type plug boot having a suppression coil therein;

FIG. 2 is a fragmentary, cross-sectional view of the shield, plug boot, and suppression coil of FIG. 1, mounted on the cylinder head of an internal combustion engine;

FIG. 3 is similar to that of FIG. 1 with the shield, plug, and boot rotated 90° to more clearly show details of construction;

FIG. 4 is a top plan view of the shield of FIG. 1 with the plug and boot removed; and

FIG. 5 is a side elevational view of the shield of FIG. 1 shown in its bent configuration and mounted on a right-angle type plug boot having a suppression coil therein.

A high frequency shield embodying the principles of the present invention is generally designed by the numeral 10 in the drawing. The primary components of shield 10 comprise a shielding element 12, an intermediate connecting strip 14, and a grounding and support clip 16.

The shield 10 is especially adapted to be used in conjunction with either a spark plug lead assembly 18 having a straight type boot 20 or a spark plug lead assembly 19 having a right-angle boot 21. The boots 20 and 21 each contain a suppression coil 22, a connecting clip 24 attaching the spark plug lead 26 to the suppression coil 22, and a sleeve 28 attached to the opposite end of suppression coil 22 which is adapted to be mounted over the terminal end 30 of a spark plug 32 for providing a direct electrical contact between the electrical source (not shown) and the plug 32.

The plug 32 is conventionally provided with a polygonal metallic base portion 34 (usually transversely hexagonal) adjacent an externally threaded end portion 36, the latter adapted to be mounted on the cylinder head 37 of an internal combustion engine (not shown) by screwing the same into place within the

cylinder head, thereby exposing electrodes 38 and 40 to the combustion chamber 42 within the cylinder head 37 as illustrated in FIG. 2.

The shield element 12 is constructed from thin screen-like, metallic material and is cylindrical in form in order to be positioned around the spark plug boot 20 in partial confining relationship thereto when shield 10 is in place on the plug 32. The intermediate connecting strip 14 is constructed of a lightweight, thin, metallic material and is of narrow, elongated straight-line configuration securely attached at one end thereof to the shield element 12 (as illustrated in FIG. 3). It should be noted, however, that while strip 14 is constructed in straight-line configuration it is adapted to be bent into the L-shaped configuration as shown in FIG. 5 when it is desired to use shield 10 with a right-angle plug boot. The opposite end of the strip 14 is securely affixed to an end margin of the transversely hexagonal, tubular grounding clip 16. The grounding clip 16 is also constructed of a lightweight, thin metallic material and is adapted to be mounted on the hexagonally shaped portion 34 of the spark plug 32 in tight frictional engagement therewith.

The grounding clip 16 is provided with a break 11 as indicated in FIG. 4, extending the length of one side thereof. The break 11 is provided in order to permit expansion of grounding clip 16 during installation thereof on the spark plug 32 so that the clip 16 is securely attached to the plug 32 once it has been positioned on the latter. It should be understood that when the clip 16 is removed from the plug 32, the cross-sectional area enclosed by the sides of the clip 16 is smaller than the cross-sectional area of the hexagonally-shaped portion 34 of the spark plug 32. This difference in size, coupled with the break 11 and the resiliency of clip 16, provides the necessary clamping action in order to securely attach clip 16 to the spark plug 32. Although break 11 in the preferred construction illustrated in the drawing extends the full length of the sidewalls of the clip, a discontinuous break or one that does not extend the full length of the clip will still function in essentially the same manner as the construction shown in the drawing and specifically described above. As may be appreciated, the mounting of the shield assembly 10 by virtue of the hexagonally shaped grounding clip 16, the break 11, and the hexagonally shaped portion 34 of the plug 32, provides a firm support for the shield assembly 10 as well as providing an excellent electrical ground for the latter.

In use, with lead assembly 18, the shield assembly 10 is first mounted over the spark plug 32 by spreading the grounding clip 16 apart at the break 11 and slipping the grounding clip 16 over the terminal end 30 of the spark plug 32 and downwardly into the hexagonally shaped portion 34. With the shield 10 in place on the spark plug 32, the boot assembly 20 having the suppression coil 22 therewithin is then inserted through the space within the cylindrical shield element 12 and is slipped over the terminal end 30 of the spark plug 32 with the terminal end 30 being received within the sleeve 28. The cylindrical shield element 12 is then in surrounding relationship to the suppression coil 22 located within the boot 20.

Shield 10 is used with lead assembly 19 in a manner similar to that just described, however prior to the in-

stallation of shield 10 and boot 21 on plug 32, strip 14 is first bent at right angles, with shield element 12 and clip 16 being disposed on opposite sides of strip 14, as illustrated in FIG. 5. The end of lead 26 remote from boot 21 is then inserted through the space within shield element 12 and the open end of boot 21 is positioned in general alignment with clip 16. With strip 14 bent in the proper manner and lead 26 inserted through screen element 12, clip 16 and boot 21 may then be installed on plug 21 in the manner previously described.

During operation of the engine, a number of timed, main, firing electrical impulses are directed through the spark plug lead 26 from the electrical source (not shown) to the boot assembly 20 and the coil 22 therewithin. These main firing impulses are of sufficient voltage to pass through the coil 22 and the plug 32 in order to reach the electrode 38 and arc across to electrode 40, thereby providing the necessary spark for the combustion chamber 42. A number of secondary electrical impulses are generated by the capacitor-like characteristics of the spark plug electrodes 38 and 40 and oscillate back and forth through the spark plug lead 26 and the plug 32 if a suppression coil 28 is not incorporated into the spark plug lead 26, thus causing a number of secondary arcs across the electrodes 38 and 40 and resultant radio and communications interference.

The inclusion of the suppression coil 28 within the spark plug lead 26 serves to dampen or absorb these secondary electrical impulses and thus eliminate the secondary arcing across the electrodes 38 and 40 resulting from the secondary electrical impulses. The presence of the secondary impulses within the coil, however, creates a secondary source of high frequency emissions emanating from the coil 28 within the boot assembly 20. The shield element 12, which is in surrounding relationship to the coil 28, serves to retain these secondary emissions within the zone defined by the shield element 12, thereby preventing the unrestricted emanation of the high frequency emissions from the coil 22. The emissions are intercepted by the shield element 12 and are conducted through the intermediate connecting strip 14 and through the grounding clip 16 to the electrical ground in the cylinder head 37.

It is readily apparent that by construction of the shield element 12 in the form of a screen, and utilizing a narrow intermediate connecting strip 14, sufficient ventilation of the spark plug boot 20 and spark plug 32 is permitted to prevent excessive heat buildup within the shield assembly 10. This construction also permits a single embodiment of shield 10 to be used equally well with both types of plug boots commonly used in automotive applications. It is equally apparent that the construction of the grounding clip 16 in hexagonal form to mate with the hexagonally shaped portion 34 of the spark plug 32 provides a supporting and grounding system which is virtually free from any adverse effects attributable to engine vibrations.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. For use with electrical ignition apparatus having a spark plug provided with a transversely polygonal, grounded body portion, a boot assembly normally coupled to said plug, and an electrical discharge suppression coil mounted within a segment of the boot, a unit

for suppressing high frequency emissions from the coil comprising:

grounding means adapted to be mounted on said body portion of the plug in electrical contact therewith;

high frequency shielding means configured to be disposed in confining relationship to said segment of the boot and said coil without enclosing the remainder of the boot; and

connecting means supporting the shielding means on said grounding means and maintaining the latter in said emission confining relationship to the coil for suppressing discharge of said high frequency emissions therefrom during firing of the plug.

2. The invention of claim 1, wherein said shielding means comprises a tubular shield element.

3. The invention of claim 2, wherein said shield element is constructed of screen material.

4. For use with electrical ignition apparatus having a spark plug provided with a transversely polygonal, grounded body portion, and a boot assembly normally coupled to said plug and provided with an electrical discharge suppression coil therein, a unit for suppressing high frequency emissions from the coil comprising:

grounding means adapted to be mounted on said body portion of the plug in electrical contact therewith, said grounding means comprising a tubular, metallic member having sidewalls which define a polygonal passage therethrough adapted to complementally engage the body portion of said plug, said member being adapted to be mounted on said plug by sliding said member over said body portion of said plug with the polygonal portion of

the latter at least partially received within said passage;

high frequency shielding means configured to be disposed in confining relationship to said coil; and

connecting means supporting the shielding means on said grounding means and maintaining the latter in said emission confining relationship to the coil for suppressing discharge of said high frequency emissions therefrom during firing of the plug.

5. The invention of claim 4, wherein said connecting means comprises a metallic strip interconnecting said tubular member and said shielding means, said strip being in at least partial circumscribing relationship to said spark plug boot assembly when said tubular member is mounted on said plug.

6. The invention of claim 4, said sidewalls being configured to define a polygonal passage therethrough of slightly less overall size than the cross-sectional shape of the body portion of the plug and said sidewall having a break therein whereby the member may be positioned over said body portion of the plug in tight frictional engagement therewith as the edges of the sidewalls defining said break spread apart relatively.

7. The invention of claim 6, said shielding means comprising a tubular, metallic, screen element, and said connecting means comprising an elongated, metallic strip interconnecting a portion of one side of said member with said element.

8. The invention of claim 7, wherein said strip is adapted to be bent into a selected configuration in order to dispose said screen element in the proper position for use with plug boots of other than straight-line configuration.

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