United States Patent

Berry

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[54] IGNITION CIRCUIT RADIATION SUPPRESSION RESISTOR

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[52] **U.S. Cl.** .....**338/334,** 123/148 A, 174/35.5 M, 252/513, 338/66, 338/270

[51] **Int. Cl.** **H01c 1/06**

[58] **Field of Search** .....338/66, 267–270, 338/264, 301, 302, 334; 174/35.5 M, 36; 123/148 A, 148 P; 252/513; 330/177

[56] **References Cited**

UNITED STATES PATENTS

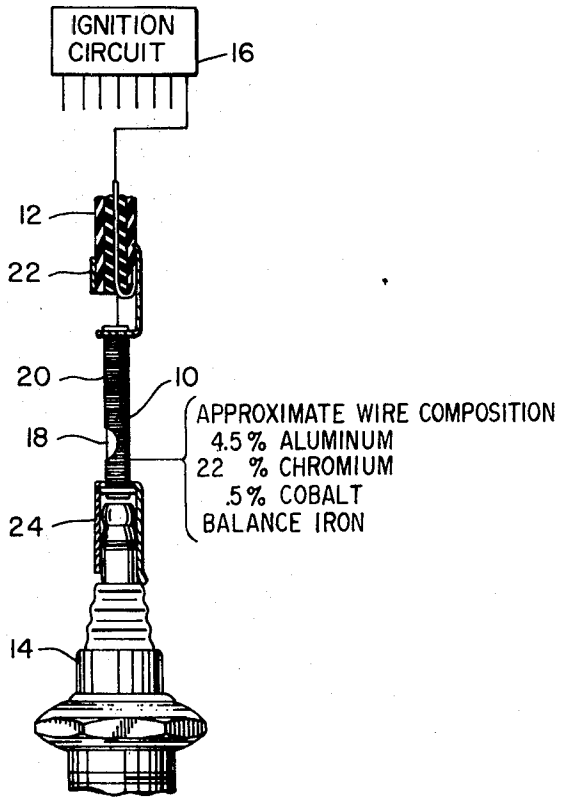
58,439	10/1866	Lyon	336/177
1,306,815	6/1919	Houchin	136/177
3,191,132	6/1965	Mayer	174/36
3,212,044	10/1965	Cloud	338/66
3,529,273	9/1970	Morris	338/66

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[57] **ABSTRACT**

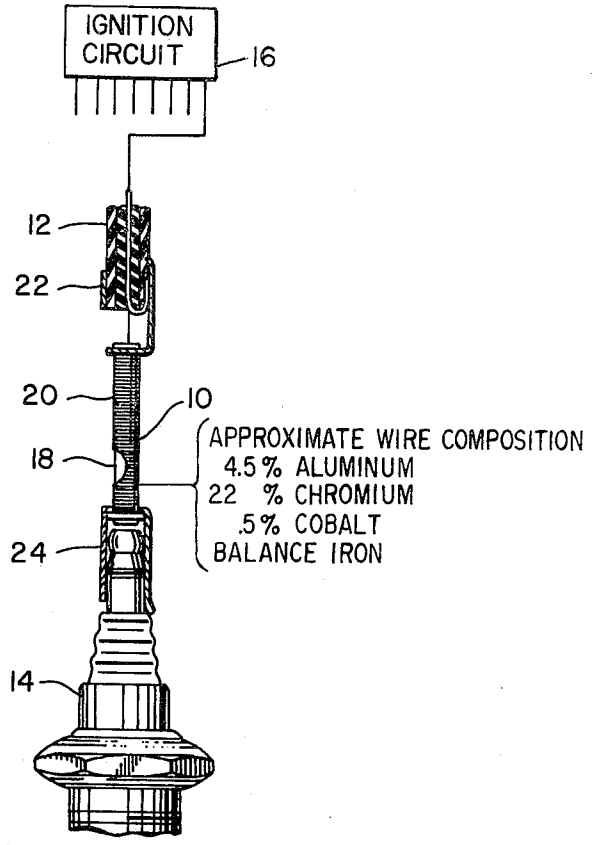
A wire resistor including a ceramic core and a resistor wire wrapped on the core constructed of approximately 4.5 percent aluminum, 22 percent chromium, 0.5 percent cobalt and the balance iron, which is coated with an insulating material, is positioned between an internal combustion engine ignition circuit spark plug lead and the associated spark plug for suppressing electromagnetic radiation on firing of the spark plug in the frequency range of 20–1,000 megahertz to prevent pollution of the air by extraneous radiation.

9 Claims, 1 Drawing Figure



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IGNITION CIRCUIT RADIATION SUPPRESSION RESISTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to ignition circuits of the type used on automobiles and refers more specifically to a wire wound resistor including a substantial amount of iron in the resistor wire for suppressing extraneous electromagnetic radiation produced on firing of the spark plugs, which suppression is enhanced due to the hysteresis effect of the iron in the resistor wire.

2. Description of the Prior Art

Relatively recently, ecologists have discovered pollution of the airwaves in certain areas by electromagnetic waves which are not dissipated or confined in the area of use thereof. Thus, for example, garage doors may open and close for no apparent reason in areas where a large number of automobiles are operated, communication may be interrupted with satellites and navigational gear may mysteriously indicate incorrect directions. Such malfunctioning due to electromagnetic interference of our airwaves may be particularly expensive and sometimes dangerous.

Thus, for example, in a newly built Internal Revenue Service complex in Louisiana, part of the computer's memory suddenly went blank, and it was subsequently discovered that signals from the New Orleans airport erased the tax records that had been freshly stored on the computer's electronic tape. Also, certain pacemakers for the heart designed to steady the beat of a faltering heart can be knocked temporarily out of rhythm if they happen to come close to microwave ovens.

The Federal Communications Commission has therefore attempted to regulate the use of the airwaves and has provided standards for electronic radiation control. The Society of Automotive Engineers (S.A.E.) have recommended one such regulation in S.A.E. Standard J551a, stating maximum permissible radiation from automobile ignition circuits on firing of the spark plugs therein.

Standard original equipment automobile ignition circuits maintain their emission below the maximum recommended by the S.A.E. at the testing required by the S.A.E. Standard J551*a*. Such original equipment generally includes a non-metallic carbon impregnated nylon core spark plug lead. Replacement spark plug leads, however, have generally been of the insulated wire type. For example, copper wire has been used. The solid wire spark plug leads radiate substantial energy on firing of the spark plugs if the energy is not suppressed.

In the past resistors have been placed between the spark plugs and spark plug leads to suppress passage of energy from the spark plugs to the leads on firing of the spark plugs. Also, the spark plug leads have sometimes in the past been wrapped with monel coils to suppress the radiation from the spark plug leads on firing of the spark plugs. Such radiation suppression means have been effective in after-market spark plug leads to reduce radiation from the spark plug leads to within the prescribed S.A.E. limits at lower frequencies. However, at higher frequency in the band indicated above the radiation permitted by these devices has in the past been at or slightly over the maximum recommended by S.A.E. Standard J551*a*. It is desirable to reduce the radiation from the after-market spark plug leads to a radiation no greater than that provided by the original equipment manufacturers in the frequency range from 20MH$_z$ to 1,000MH$_z$.

SUMMARY OF THE INVENTION

To further reduce the emission from solid wire spark plug leads, there is therefore provided in accordance with the invention a resistor between the spark plug and spark plug lead which is a wire wound resistor on an insulating core. The wire wound resistor has a substantial iron content so that the electromagnetic energy produced on firing of the park plugs will be dissipated in the resistor partly due to the hysteresis effect of the iron in the resistor along with the usual attenuation of the radiation due to the alternating and direct current resistance provided by the resistor.

BRIEF DESCRIPTION OF THE DRAWINGS

The FIG. is a partial section view of a resistor constructed in accordance with the invention positioned between a solid wire spark plug lead and a spark plug in an automobile ignition circuit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the FIGURE, a wire wound resistor **10** is connected between a spark plug lead **12** and a spark plug **14** in a usual internal combustion engine ignition circuit **16**.

In accordance with the usual operation of the ignition circuit **16**, the spark plug **14** is periodically caused to discharge, whereby alternating signals over the entire frequency range of, for example, from 20–1,000MH$_z$ may be created which if passed back to the spark plug lead wire **12** will be radiated a substantial distance from the ignition circuit to cause radiation pollution of the airwaves.

The wire wound resistor **10** includes a core **18** of high temperature resistant material such as a ceramic and a resistor wire coil **20** wound on the core **18**. Metal connectors **22** and **24** are provided, as shown, to connect the wire of the wire wound resistor **10** to the spark plug lead **12** at one end and to the spark plug **14** at the other end.

The electrical energy created on firing of the spark plug **14** is dissipated in the resistor **10** due to the impedance of the wire **20** to the frequency of the signals produced on firing of the spark plug **14** and the direct current resistance of the material of which the wire **20** is constructed.

In addition and in accordance with the invention, the alternating energy produced on firing of the spark plug **14** is further attenuated before arriving at the spark plug lead **12** by the hysteresis effect of the particular resistor wire **20**. Resistor wire **20** contains a substantial amount of iron to provide the hysteresis effect which further attenuates the alternating energy created by the spark plug **14**.

The wire **20** is relatively thin and may be between 0.001 and 0.0015 inches in diameter and approximately **18** feet long and include amounts of chromium, aluminum and cobalt to provide required direct current resistance which a pure iron wire would provide very little of.

In one example, the wire **20** wound on a ceramic core one eighth inch in diameter and three fourth inch inch long was 0.0015 inches in diameter and had a composition of approximately 4.5 percent aluminum, 22 percent chromium, 0.5 percent cobalt and the balance was iron by weight.

The energy absorption due to the hysteresis of the iron in the coil, which hysteresis is defined as the magnetization of a sample of iron due to a magnetic field which is made to vary through a cycle of values and lags behind the magnetic field. Standard textbooks provide an equation developed by Steinmetz for hysteresis and give the law of energy in ergs per cycle per centimeter cubed which may be dissipated by the hysteresis effect as:

$$i\,W = nB^{1.6}$$

where B is the maximum induction in maxwells per cm^2 and n is the coefficient of hysteresis.

While as noted above a pure iron resistor wire will provide a minimum of direct current resistance of approximately 300Ω in comparison to approximately 5,000Ω for the wire composition indicated above and is not therefore as effective a suppressor of the undesired radiated energy on firing of spark plugs in the usual automotive ignition circuit as a resistor wire having a composition with more direct current resistance as well as an iron content, the pure iron wire is effective to lower radiation in ignition circuits wherein ignition is marginal such as in some lawn mower ignition circuits below that permitted by resistor wire having no iron content with little or no adverse effect on ignition.

While one embodiment of the invention has been considered in detail, it will be understood that other modifications and embodiments are contemplated by the inventor. It is intended to include all modifications and embodiments as are defined by the appended claims within the scope of the invention.

What I Claim as my invention is:

1. A resistor for use in automobile ignition spark plug circuits or the like comprising a ceramic insulating core, a wire coil wound on the insulating core having a substantial iron content whereby energy is dissipated in the resistor due to the hysteresis effect of the iron content thereof and insulating material applied to the wire coil and ceramic core.

2. Structure as set forth in claim 1 wherein the wire is approximately 4.5 percent aluminum, 22 percent chromium, 0.5 percent cobalt and the balance iron.

3. Structure as set forth in claim 1 wherein the resistor wire is approximately 70 percent iron.

4. Structure as set forth in claim 1 wherein the wire is approximately 0.0015 inches in diameter.

5. Structure as set forth in claim 1 wherein the resistor wire is approximately 18 feet long.

6. A resistor for use in automobile ignition spark plug circuits or the like comprising an insulating core and a wire coil wound on the insulating core, the wire of which is approximately 4.5 percent aluminum, 22 percent chromium, 0.5 percent cobalt and the balance iron, whereby energy is dissipated in the resistor due to the hysteresis effect of the iron content thereof.

7. Structure as set forth in claim 6 wherein the resistor wire is approximately 0.0015 inches in diameter.

8. Structure as set forth in claim 6 wherein the resistor wire is approximately 18 feet long.

9. In combination in an ignition system, a spark plug lead, a spark plug and a wire wound resistor in series between the spark plug and the spark plug lead immediately adjacent the spark plug for suppressing radiation on firing of the spark plug which resistor includes a ceramic core and a wire coil wound on the ceramic core including a substantial amount of iron whereby alternating energy created by the spark plugs in the range of 20—1,000 megahertz, in addition to that dissipated due to the resistance value of the resistor, is dissipated due to the hysteresis effect of the iron in the resistor coil.

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