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A. M. HUBBARD

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INTERNAL COMBUSTION ENGINE SPARK PLUG

Filed Feb. 11, 1924

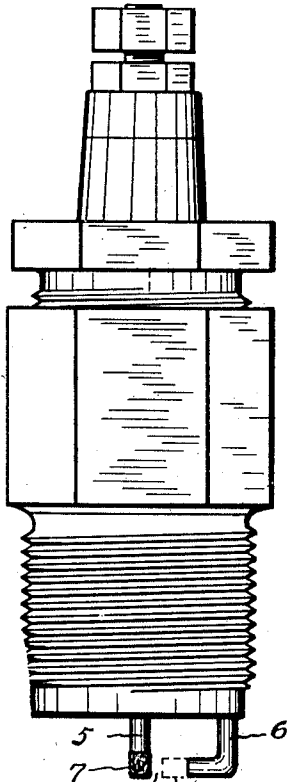


Fig. 1

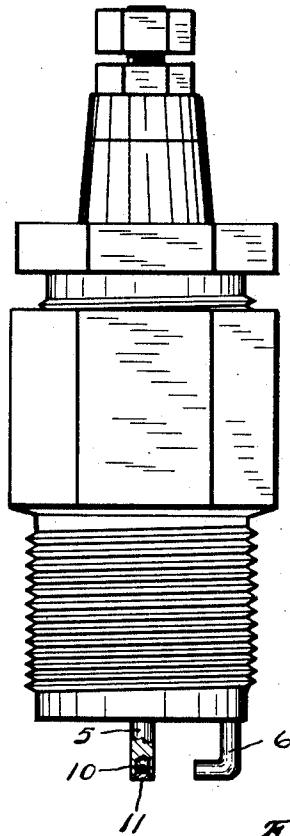


Fig. 2

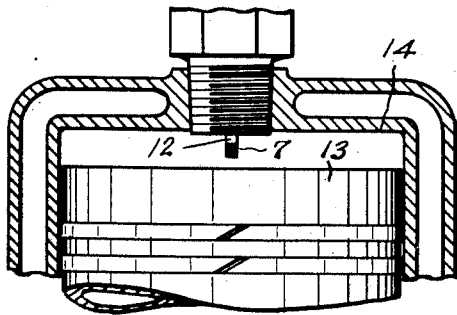
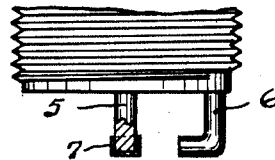


Fig. 4

Fig. 3



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INTERNAL-COMBUSTION ENGINE SPARK PLUG.

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My invention relates to the art of spark plugs. More particularly, my invention relates to a spark plug the terminals of which, that are disposed within the cylinder of an internal combustion engine, are provided with radium for ionizing the space between said terminals.

While I will describe my invention as applied to spark plugs for use in internal combustion engines, nevertheless, it is to be expressly understood that my invention is not to be construed as limited to such specific application, but is applicable to all uses where like conditions and like problems obtain.

Spark plugs, as heretofore designed for use in automobiles, are provided with a gap between the terminals of approximately one-thirty-second of an inch ($\frac{1}{32}$ "'). The aim of automobile engineers is to provide as great a gap as possible, in order to provide as prolonged an exposure of the fuel to the ignition spark as possible. However, the length of this exposure to the ignition means is definitely limited by the factors obtaining in the timing mechanism. If too large an amperage is employed, the breaker points in the timing mechanism are burned off. Therefore, it has been found that a compromise in the time during which the fuel may be exposed to the ignition spark and the ability of said breaker points to support the current is necessary, and, as a result, the gap between the terminals of the ordinary spark plug, as used in automobile engines, has been established as about one-thirty-second of an inch ($\frac{1}{32}$ "'). A primary object of my invention is to extend the period of exposure of the fuel to the ignition spark, and at the same time take into due consideration the weakness or limitations imposed by the breaker points of the timing mechanism.

A further difficulty that obtains in the ignition of fuel in internal combustion engines, by means of spark plugs of present practice design, resides in the fact that while under compression the spaced relation is limited to about one-thirty-second of an inch ($\frac{1}{32}$ "'), the same spark would jump a gap of some ten times the said space when exposed to pressures no greater than atmospheric pressure. In other words, it seems that subjecting the fuel gases to compression, as obtains in the ordinary internal combustion engine as used in automobiles, greatly reduces the space that

may be provided between the terminals. That is, in the ordinary internal combustion engine, the necessity of compressing the fuel gases militates against providing the best condition for providing the ignition spark with spark plugs of ordinary practice design; that is, the said compression militates against providing a spark which will ignite any other than the more volatile parts of the fuel. A primary object of my invention is to provide a spark plug which overcomes this objection.

A further primary object of my invention is to provide a spark-plug which will reduce the period of combustion of the fuel charge of the internal combustion engine, by providing an ignition means of a higher degree of heat.

The above mentioned general objects of my invention, together with others inherent in the same, are attained by the device illustrated in the following drawings, the same being merely preferred exemplary forms of embodiment of my invention, throughout which drawings like reference numerals indicate like parts:

Figure 1 is a preferred form, in side elevation, of a spark plug embodying my invention, having its terminals provided with radioactive matters;

Fig. 2 is a view of such a spark plug, having the radioactive matter disposed in a pocket within the end portion of the terminals;

Fig. 3 is a fragmentary view of such a spark plug having the radioactive matter applied to the end portions of the terminals; and

Fig. 4 is a view of still another modified form embodying my invention, where the spark plug has but one terminal and the engine piston constitutes the other terminal for the ignition means.

In constructing a spark plug embodying my invention, preferably one or both of the terminals 5 and 6 are provided with radioactive matter 7 such as, for example, radium zinc sulphite. Preferably, one terminal 5, which is the positive terminal, is provided with said radioactive matter. These terminals, it will be noted, are in spaced relation,—the space 8 is provided between the same. The dotted line 9 indicates the relative position of the terminal of present practice design of spark plug for use in automobile internal combustion engines. The radioactive

matter is disposed throughout the material constituting the terminal in the preferred form shown in Fig. 1.

The providing of such a terminal may be accomplished by heating the material constituting the said terminal to a very high degree of temperature in an electric furnace, and then when the molecules of said terminal material are in expanded form, the same may be dipped in radioactive matter, thereby impregnating the terminal substance with the radioactive matter.

In Fig. 2, the terminal may be provided with pocket 10, and this pocket supplied with radioactive matter. Then the said pocket may be closed by suitable plugging material 11.

In the modified form shown in Fig. 3, the radioactive matter is applied to the end portions of the terminal by coating the same with material containing radioactive matter 7.

In the modified form shown in Fig. 4, a spark plug having but one terminal 12, which is the positive terminal, may be provided with radioactive matter, and the piston 13 itself in cylinder 14 may be employed to constitute the negative terminal. The use of the piston for such a purpose is rendered possible owing to the fact that the space between the terminals may be greatly increased as compared to the present practice design of spark plug, so that the spark may be caused to pass from the terminal 12 to the piston 13, when the said piston is at its topmost position, or as it approaches its topmost position.

The mode of operation of a spark plug embodying my invention is as follows. The radioactive matter provided on one or both of the terminals of the spark plug facilitates the current passing between said terminals by ionizing the space therebetween. Hence, instead of the short interval of one-thirty-second of an inch ($\frac{1}{32}$ "), which normally obtains between the terminals of spark plugs used in automobile internal combustion engines, I provide a much greater space. Said space may be one-fourth inch ($\frac{1}{4}$ ") or more. My experiments and use of the spark plug so constructed have proven that the spark thus provided is of much greater degree of brightness, and is characterized by a much greater degree of heat. Thus, I provide for a much longer exposure of the fuel to the ignition spark, so that parts of said fuel, which are of less volatility than others, may be ignited by the spark, owing to its high degree of heat, as well as the heat developed by the burning of the more volatile parts of the fuel charge. This results in

providing for a more complete combustion of the fuel in a much briefer period of time than has heretofore been possible, and also the more nearly complete elimination of all the unburnt fuel left in the cylinder.

By providing for the more complete combustion, I also provide for the reduction of carbon, which results from imperfect combustion, and which is very objectionable in that it dilutes the lubricating qualities of the oil in the crank casing.

Furthermore, a distinct advantage is noted in that a leaner fuel mixture may be employed to secure the same amount of power due to the more complete combustion provided by my invention. In other words, an advantage results by reason of my invention. In other words, an advantage results by reason of my invention in the economizing of fuel. My experiments have shown that an engine, which may be very slow to start with spark plugs as heretofore designed, operates forthwith when provided with spark plugs embodying my invention, i. e., it is not necessary to "heat up" before the engine is able to move the car.

The same principles hereinabove set forth, as respects the spark plug embodying my invention, applies to the other modified forms illustrated.

The modified form shown in Fig. 4 manifestly overcomes any difficulty of the carbon collecting between the terminals, not only by the elimination of one of the terminals in the form of a small terminal wire, but the completeness of the combustion reduces the amount of carbon which is developed. The necessity of providing a carefully adjusted space interval is not requisite when the said interval is ionized, and, therefore, the care and attention now required to maintain said space is eliminated.

Obviously, changes may be made in the forms, dimensions and arrangement of the parts of my invention, without departing from the principle thereof, the above setting forth only preferred forms of embodiment.

I claim:—

1. An internal combustion engine spark plug embodying terminals, having radioactive matter impregnated therein.
2. The process of manufacturing spark plugs having a terminal provided with radioactive matter consisting of heating the matter constituting said terminal, and then dipping said matter in radioactive matter while so heated.

In witness whereof, I hereunto subscribe my name this sixth day of February, 1924.
ALFRED M. HUBBARD.