United States Patent

[11] **3,599,030**

[72] Inventor **Daniel A. Armstrong**
Oakfield, Wis.

[21] Appl. No. **841,901**
[22] Filed **July 15, 1969**
[45] Patented **Aug. 10, 1971**
[73] Assignee **Brunswick Corporation**
Chicago, Ill.

[54] **ANNULAR SURFACE GAP SPARK PLUG**
1 Claim, 2 Drawing Figs.

[52] **U.S. Cl.** ..... **313/131 R,** 313/141
[51] **Int. Cl.** **H01t 13/02**
[50] **Field of Search** ..... 313/130, 131, 141, 141 I

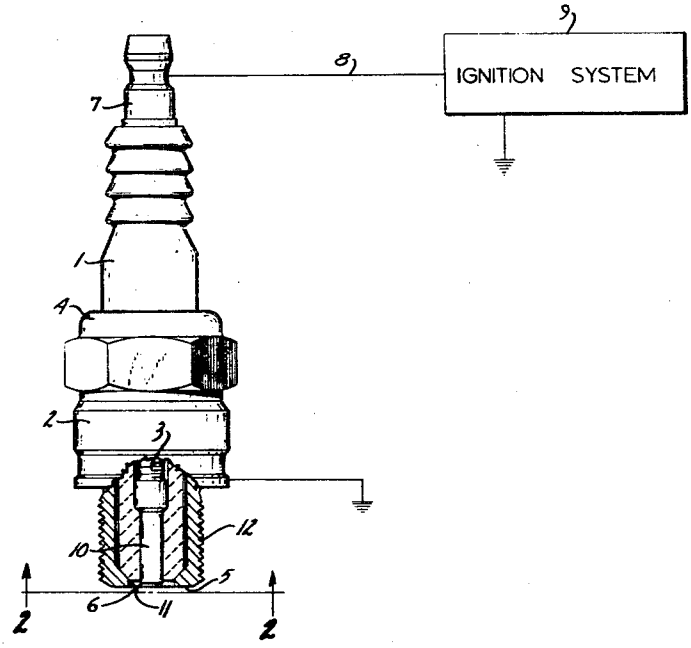
[56] **References Cited**

UNITED STATES PATENTS

2,860,272	11/1958	Segall	313/130
2,908,569	10/1959	Peras	313/131 X
3,395,686	8/1968	Minks	123/148

Primary Examiner—Raymond F. Hossfeld
Attorney—Roy T. Montgomery

ABSTRACT: A tungsten alloy center electrode is employed in a spark plug of the annular surface gap-type for use with a high tension ignition system.



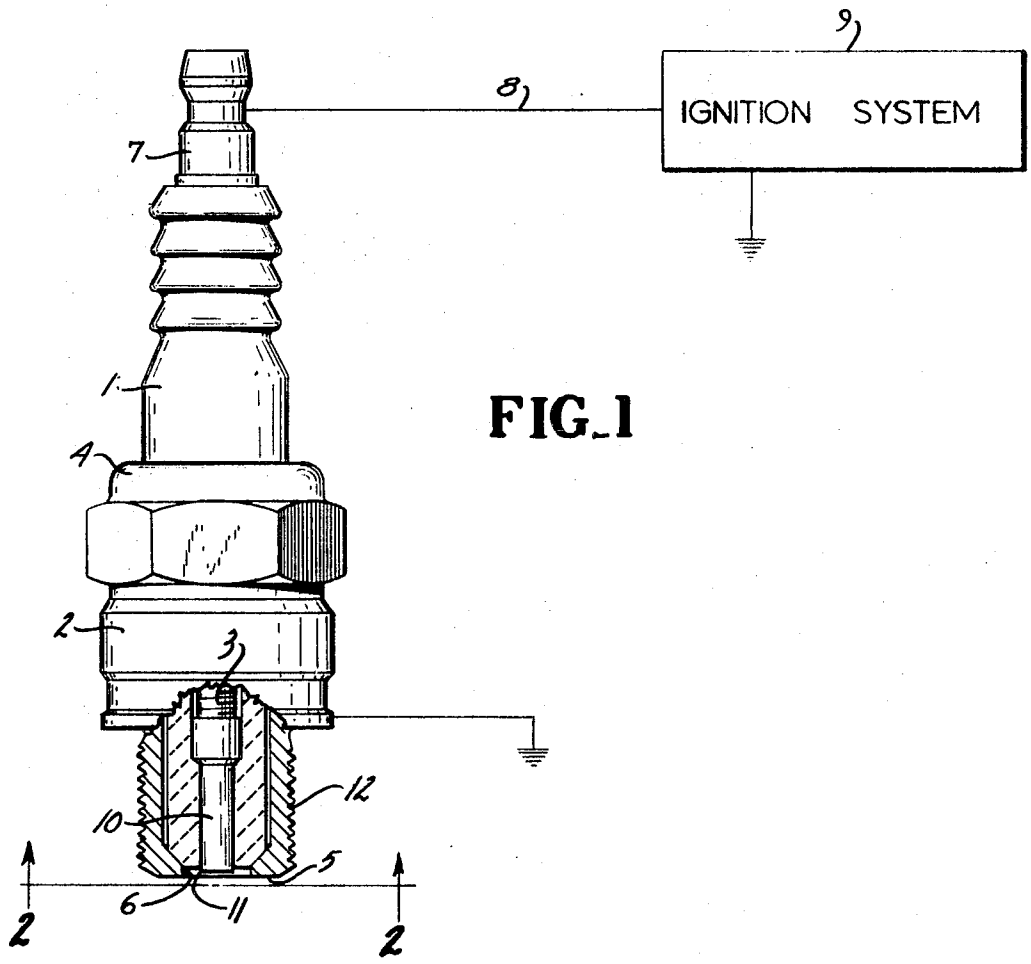


FIG_1

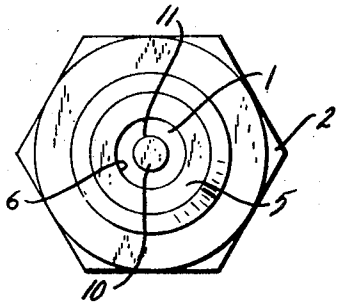


FIG_2

INVENTOR.
DANIEL A. ARMSTRONG
BY
Ambrus, Scealey, Starke, & Sewall
Attorneys

ANNULAR SURFACE GAP SPARK PLUG

BACKGROUND

This invention relates to an annular surface gap spark plug for high tension ignition systems such as a capacitor discharge system.

This spark plug is particularly adapted for use in two stroke cycle type internal combustion engines employing leaded fuel oil mixtures which require a high energy, fast rise-time spark discharge for igniting the same reliably. However, the spark plug may also be used for any ignition purpose, and will greatly reduce or eliminate spark plug replacement costs.

Heretofore, highly sophisticated constructions have been provided in the spark plug art. In most instances the basic plugs have been designed to meet a reasonable service in the high production automobile industry wherein the sale of replacement plugs is often more profitable than original equipment sales, thus discouraging the development of a spark plug that will last for an extended period of time.

It has been customary to employ plugs having the ground electrodes constructed of wire or thin rod. Such plugs are satisfactorily fired with conventional ignition systems and the problems of maintenance generally revolve around carbon build up, fouling, ground electrode burning, oxidizing or eroding.

Spark plugs for two cycle engines firs twice as often per cycle as spark plugs utilized conventionally in four cycle automotive engines. Also, two cycle engines often run at higher engine speeds than do most four cycle engines. To eliminate electrode burning or oxidation, two cycle engines utilize what are known as "cold" plugs.

If the electrodes of a conventional plug become too hot they will glow, causing preignition which may lead to eventual destruction of the engine. If the plug is not kept hot enough, it will be susceptible to fouling or deposit build up which may render the plug inoperable.

Annular surface gap spark plugs have been known for some time as a type providing a gap that is, in effect, multidirectional since the gap between central electrode and the outer ground electrode is concentric. Such electrodes have been generally used with high tension capacitor discharge-type ignition systems capable of firing the wider fixed gap. Where the gap is of the order of 0.05 inch, a very effective spark is obtained by a high tension system that is very efficient in starting and running engines utilizing a leaded, fuel oil mixture. Such plugs and ignition systems generally eliminate the aforementioned disadvantages of conventional type plugs except that the center electrode has a tendency to erode because of the high peak currents involved.

In the spark plug art, various alloy tips have been proposed for the electrodes in an attempt to obtain either better performance or longer life, particularly with the standard automotive-type plugs. Tungsten and its alloys were generally unsuitable for such spark plugs because of a susceptibility to fast deterioration under the temperatures normally involved. For instance, tungsten will oxidize rapidly at temperatures of above approximately 1000° F. and even the "cold" conventional plugs exceed 1000° F. in normal operation. Consequently, tungsten has not been generally considered of advantage in commercial spark plugs, although various proposals for its use appear in the patent art and literature.

SUMMARY OF THE INVENTION

The objective of the present invention is to provide a trouble-free and practically maintenance-free annular surface gap spark plug for high tension ignition systems.

The present invention is based upon the finding that the central electrodes in annular surface gap spark plugs generally run much cooler than the conventional type spark plugs.

Reasoning from this, that it might be possible to utilize tungsten for the central electrode of a high tension annular surface gap spark plug which operates at below approximately 1000° F., the present invention arose with astonishing results. Tests showed that tungsten tipped central electrodes of the annular surface gap plugs did not deteriorate in service at anywhere near the rate of deterioration of electrodes of other materials.

Given the generally self-cleaning effect of a high tension ignition with a circular spark gap, it was found that annular surface gap spark plugs with a central electrode of tungsten alloy gave a substantially maintenance-free service.

THE DRAWING

The invention is illustrated in the accompanying drawing in which:

FIG. 1 is a side elevation of an annular surface gap spark plug with a portion broken away and sectioned; and

FIG. 2 is an end elevation taken on line 2–2 of FIG. 1.

THE PREFERRED EMBODIMENT

The spark plug generally comprises a tubular refractory body 1 having an outer steel casing 2 at the larger end thereof and a central electrode 3 extending axially therethrough.

The central portion of the refractory body 1 is generally larger than its ends and the casing 2 is secured thereto by a flange 4 formed on the casing and abutting a shoulder on body 1.

The casing 2 constitutes the outer circular ground electrode and has an inner flange 5 bearing against the end of body 1 and provides the electrode terminal face 6 for the spark gap across the end of the body 1. The lower end of casing 2 has threads 12 for assembly into an engine, not shown.

The central electrode 3 has an outer terminal 7 for connection with a higher tension lead wire 8 of a high tension ignition system 9 such as is described in U.S. Pat. No. 3,395,686.

The inner end of electrode 3 has a tungsten alloy tip 10 which extends through a portion of refractory body 1 and is exposed to provide the electrode face 11 opposed to face 6 and concentric therewith.

In operation, the ignition spark occurs repeatedly in various radial directions over the inner end surface of the refractory body and between the concentric electrode faces 6 and 11.

The tip 10 is primarily of tungsten and may have an alloy constituency approximately of the following analysis:

87 percent tungsten
10 percent nickel
2 percent iron
1 percent silicon

In construction, the tip 10 is confined in the refractory body 1 except for the exposed end portion of the tip constituting the electrode face 11.

The gap between faces 6 and 11 is fixed by the dimensional manufacturing design of the parts and is generally more than 0.03 inch and preferably of the order of 0.05 inch. This gap may be varied, depending upon usage.

The high tension ignition system 9 is preferably of a capacitor discharge type having a very rapid rise time to maximum voltage. When such a system is used with the annular surface gap spark plug herein described, it is possible to avoid substantially all maintenance and, in average two cycle engine use, to use a signal set of spark plugs for the life of the engine.

I claim:

1. An annular gap spark plug for a two-cycle engine having capacitor discharge fast-rise time ignition system with a sufficiently high voltage capacity to fire across a gap exceeding 0.03 inch, said spark plug being constructed to operate at temperatures below 1000° F. and having a refractory body with a central electrode of tungsten alloy confined therein and a circular casing constituting an electrode substantially concentric with the central electrode and providing a circular gap between said electrodes of substantially uniform dimension exceeding 0.03 inch, said central electrode being substantially free of deterioration at temperatures below approximately 1000° F.