Jan. 9, 1962 B. C. FISHER 3,016,411

IGNITION DEVICE

Filed Sept. 8, 1959

Fig. 1.

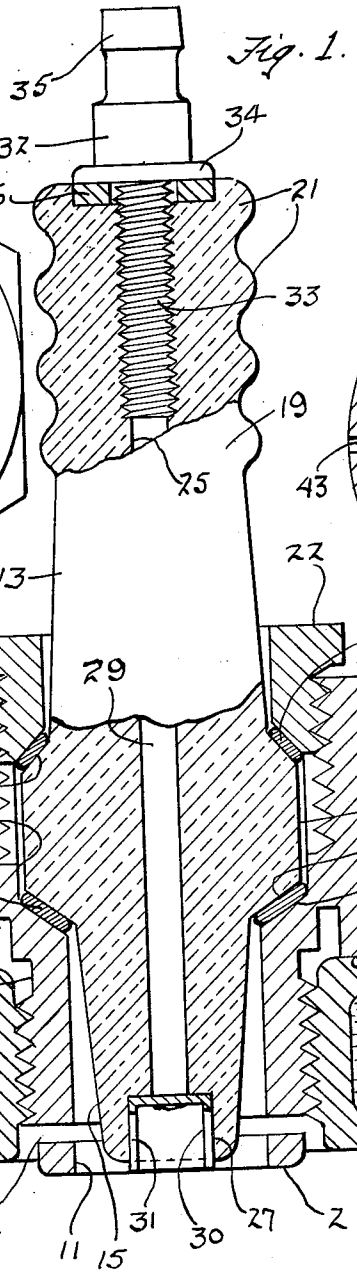


Fig. 2.

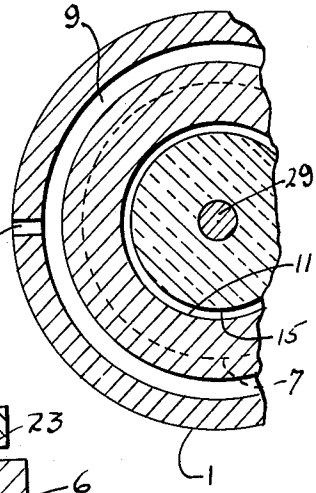


Fig. 3.

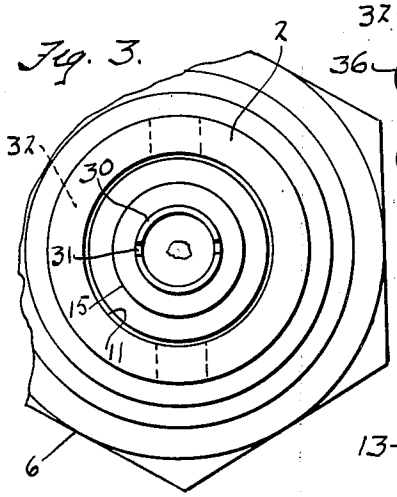
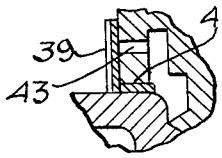


Fig. 4.



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IGNITION DEVICE

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5 Claims. (Cl. 123—169)

This invention relates to ignition devices used especially with internal combustion engines.

One of the causes of detonation in internal combustion engines is the overheating of parts of the spark plugs, causing them to become incandescent and to take over the firing of the explosive mixture, thus causing firing at the wrong time and consequent detonation and loss of power.

One of the objects of this invention is to provide an ignition device which will operate in such a manner that none of the parts will become incandescent in operation or hot enough to ignite the mixture.

In my United States Patent No. 2,646,782 I have disclosed an ignition device having a cavity or auxiliary firing space therein in which the compressed fuel mixture is stratified according to its air content when compressed and provides a control of the timing of the spark for varying conditions of speed and load, so as to give the maximum firing efficiency.

It is therefore also one of the objects of the invention to provide an ignition device which combines the control of the firing time by means of the cavity with a greatly increased heat conduction path away from the sparking electrodes for extremely rapid cooling of the electrodes and adjacent parts.

Another object of the invention is to provide an ignition device which requires no gasket when applied to an internal combustion engine, part of the device itself acting in this capacity.

Still another object of the invention is to provide an ignition device for an internal combustion engine in which a relatively long duct of small cross section is provided leading from the atmosphere to a point near the sparking electrodes which admits air to the combustion chamber during the intake stroke and plays an important part in the cooling of the device.

Another object of the invention is to provide an ignition device which will act to scavenge and blow exhaust gases and residues out of the combustion area of the engine.

Other objects and advantages will appear as the description proceeds.

The invention is illustrated in the accompanying drawings, in which:

FIGURE 1 is a sectional elevational view of an ignition device embodying the invention;

FIGURE 2 is a sectional plan view of the device taken on the line 2—2 of FIGURE 1;

FIGURE 3 is a bottom view of the device; and

FIGURE 4 is a fragmentary sectional view of a modified portion of the device.

Referring now to the drawings, the ignition device, which I prefer to call a "fuse," comprises a body member 1 which is tubular in form and is preferably made of cold rolled steel. One end 2 is threaded so as to be screwed into a tapped hole in the engine block 3 of an internal combustion engine provided with a cooling chamber 4 filled with a coolant 5. The other end 6 of the body member is enlarged and has a hexagonal end surface configuration so that a wrench may be applied thereto in order to screw the fuse into the engine block. A straight cylindrical portion 7 is provided between the threaded end 2 and the enlarged end 6, slightly smaller in diameter than the threaded end and forming a shoulder

8 between it and the enlarged portion. An annular groove 9 is cut into the shoulder 8 and provides a cavity for a purpose to be described later. The surface of the shoulder 8 between the groove 9 and the portion 2 is cut back so that when the fuse is inserted in an engine the outer rim of the shoulder 8 will engage the engine block.

The body member is provided with two interconnecting bores 10 and 11 having two different diameters. The bore 10 is in the enlarged portion 6 of the body member and has the large diameter, while the bore 11 is in the end 2 and has a smaller diameter. The two bores are joined by a tapered surface 12.

An insulator 13 is fitted within the body member 1. It has an enlarged portion 14 of sufficient diameter to fit easily into the bore 10 of the body member and a tapered portion 15 which is small enough in diameter so that its walls are spaced from the walls of the bore 11 into which the portion 15 extends. The end of the insulator is slightly rounded and lies just short of a plane through the end of the body member from which it is spaced. The two portions of the insulator are joined by a tapered surface 17 having the same taper as the surface 12 in the body member close to which it rests, a sealing gasket 16 being provided between the two surfaces.

A third portion 19 of the insulator extends in the other direction from the enlarged portion 14 a distance which may be greater than the length of the body member. This portion is of smaller diameter than the portion 14 and is tapered slightly from the enlarged portion to which it is joined by a tapered surface 20. The outer end of the portion 19 may be provided with circular corrugations 21 for a short distance from the end to increase the possible electrical path over the outside of the insulator and to provide a greater surface for the radiation of heat.

It is important to make the insulator of some ceramic material having a high heat conductivity, and I have found that brown alumina having a coefficient of thermal conductivity of 0.0180 is satisfactory.

The insulator is held in the body member 1 by means of a collar nut 22 which engages internal threads provided in the bore 10, a gasket 23, similar to the gasket 18, being provided to make a substantially gas-tight joint. In addition, a ceramic cement may be used between the insulator portion 14 and the body member to increase the sealing effect.

The insulator has a bore 25 extending coaxially therethrough from the end of the portion 19 to a point near the end of the portion 15. This bore is arranged to receive a central conductor 29 which extends through the insulator. The bore 25 terminates a short distance from the end of the portion where it emerges into a second bore 27 somewhat larger in diameter. The conductor 29 terminates at the shoulder formed between the bores 25 and 27.

The outer end of the conductor 29 is formed into a terminal stud 32 which has a threaded portion 33 adapted to be screwed into a tapped portion of the outer end of the bore 25 of the insulator, an enlarged flange 34 adapted to fit over the end of the insulator, and a terminal end 35 adapted for making the electrical connection to the device. A gasket 36 of silicone or other suitable material is provided under the flange 34, the end of the insulator being recessed to receive it.

A cup-shaped member 30 is inserted into the bore 27 of the insulator and forms a lining for the bore, the open end of the member extending slightly beyond the end of the insulator. The base of the member is spot welded to the end of the conductor. The outer edge of the member forms the central sparking electrode for the device. In order to prevent expansion of the member 30 from cracking the end of the insulator, the member is preferably slotted on diametrically opposite sides, as at 31, which

compensates for unequal expansion under temperature changes. The metal of the member **30** is preferably an alloy of 95% nickel and 5% manganese, although cold rolled steel has given good results.

The spark jumps between the edge of the member **30** and the rim of the shell portion **2** in any radial direction.

The groove **9** forms part of a passageway between the atmosphere and the combustion space of the engine. To this end I provide a duct **43** through the wall of the body member into the groove **9**. Between the groove **9** and the combustion space of the engine the passageway comprises the spiral leakage path along the threads of the threaded end **2** of the body member **1**.

When the member **1** is screwed into the engine block using a standard uniform thread, one surface of one thread is in contact with one surface of the thread on the other part and there is a slight clearance between the other surfaces of the threads and between the tips of one thread and the valleys of the other. This clearance provides just the right cross section for my purpose. Of course the length of the passageway, thus formed, is an important factor in the amount of gases which will pass through. I have found that good results are obtained in an ordinary automobile engine if the threaded portion of the end **2** is ⅜ inch long and threaded with standard 14 millimeter thread with a so-called No. 2 fit having a tolerance of plus or minus 0.002 inch. Different thread dimensions will of course be necessary for different size devices to be used in different size engines.

With the shell described above, no gasket is necessary in screwing the fuse into the engine block, the rim of the shoulder **8** being forced against the surface of the block. Since air is admitted to the groove **9** through the duct **43**, a slight leakage at the juncture of the shoulder and the engine block is not objectionable. Under certain conditions, however, I may use a closely fitting sleeve **39** of aluminum or other soft metal which surrounds the shell for a sufficient distance to cover the duct **43**. The sleeve may be provided with a flange **40** which extends between the shoulder **8** and the surface of the engine block and which acts as a gasket, although its principal effect is to secure the sleeve in position. The walls of the sleeve may be corrugated so as not to interfere with air passing into the duct **43**. The sleeve is used principally with engines in which oil is mixed with the gasoline and prevents any spattering of oil from the duct **43**.

The end of the portion **2** of the body member is reduced in diameter for a short distance beyond the threads, and I provide this reduced portion with two diametrically opposite slots **32** extending towards the center and cutting completely through the wall of the portion **2**.

The ignition device, when constructed as described above, performs with astonishing efficiency in an internal combustion engine. In the first place, the interior of the cup-shaped **30** and the space between the end of the insulator and the body portion combine to form the cavity referred to in my above-mentioned United States Patent No. 2,646,782, which has the effect of causing stratification of the air and gas mixture during the compression stroke, producing the "blow torch" effect when the spark occurs and controlling the timing of this effect with variations of speed and load.

In the second place, there is a heat conducting path from the member **30** and rod **29** which is far more effective than that of any spark plug heretofor used. The insulator draws the heat rapidly from the member **30** and rod into its much larger mass from which the heat passes to the air and through the portion **14** to the body member **1**. In the third place, the air drawn into the groove **9** at high velocity during the intake stroke and through the helical path along the threads from the groove **9** into the combustion chamber has a very great cooling effect on the parts of the device adjacent the sparking electrodes. This air is trapped under pressure during the compression stroke and during the explosion stroke and passes through

the helical path around the threads with great velocity during the exhaust stroke and swirls through the slots **32** and around the space adjacent the sparking electrodes, sweeping all burned gases before it and thoroughly cleaning the sparking electrodes and the end of the insulator and producing a cooling effect on these parts. The slots **32** tend to increase the turbulence of air and gases adjacent the electrodes and increase the cooling surface of the end **2** of the body member. Passage of exploding gases through the duct **43** is negligible.

As a result of these effects, the fuse operates relatively cool and neither the end of the insulator nor the sparking electrodes can ever become incandescent and the firing is always under control of the spark regardless of speed or load conditions.

In the embodiment of the invention shown, the following measurements of the important elements have been found to give good results:

Inside diameter of end **2** of body member	inch	0.415
Length of end **2** of body member to gasket	do	0.687
Diameter of end **2** of body member between threads and shoulder **8**	do	0.558
Overall length of insulator **13**	do	2.34
Diameter of rod **29**	do	0.093
Diameter of insulator bore **27**	do	0.180
Outer taper of insulator portion **15**		6°
Outer diameter of insulator portion **15** adjacent enlarged portion **14**	inch	0.370
Depth of groove **9**	do	0.125
Width of groove **9**	do	0.010
Diameter of duct **43**	do	0.040

Modifications may be made in the parts of the device as shown and described, and I do not wish to limit the invention except as limited by the appended claims.

What I desire to claim and secure by Letters Patent is:

1. An ignition device comprising a tubular metallic body member having screw threads at one end for attaching said device to an internal combustion engine and having an enlarged other end, an insulator having one end within said body member and the other protruding out of the other end of said body member, said insulator being tapered at said one end, there being a space between the tapered end of said insulator and the interior walls of said body member, a conductor extending through said insulator and having sparking electrode means adjacent the tapered end of said insulator and a connecting terminal extending beyond the other end of said insulator, all but the extreme end of said electrode means being covered by said insulator, said body member having a cavity in the enlarged portion thereof, a duct leading from said cavity to the atmosphere, and means providing a tortuous path of small cross section from said cavity to a point adjacent said electrode means, the length of said path being greater than three times the circumference of said one end of said body member, said one end of said body member being provided with at least one cut-away portion through the wall thereof near said end, whereby gases can flow through said cut-away portion adjacent said electrode means.

2. An ignition device, as defined in claim 1, in which the cut-away portion through the wall of the end of the body member comprises a pair of diametrically opposite slots transverse to the axis of said body member.

3. An ignition device, as defined in claim 2, in which the tortuous path between the cavity and the point adjacent the electrode means comprises the clearance between the threads of the threaded end of the body member and the engine block.

4. An ignition device, as defined in claim 3, in which the insulator is provided with a recess in the tapered end and the electrode means comprises a cup-shaped

member in said recess with the open end thereof protruding from the end of said insulator, said cup-shaped member being in electrical contact with the end of the conductor.

5. An ignition device, as defined in claim 1, in which the insulator is provided with a recess in the tapered end and the electrode means comprises a cup-shaped member in said recess with the open end thereof protruding from the end of said insulator, said cup-shaped member being in electrical contact with the end of the conductor.

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