Feb. 18, 1936. R. REICHMANN 2,030,937

INCANDESCENT IGNITER

Filed Aug. 4, 1933 2 Sheets-Sheet 1

Fig.1

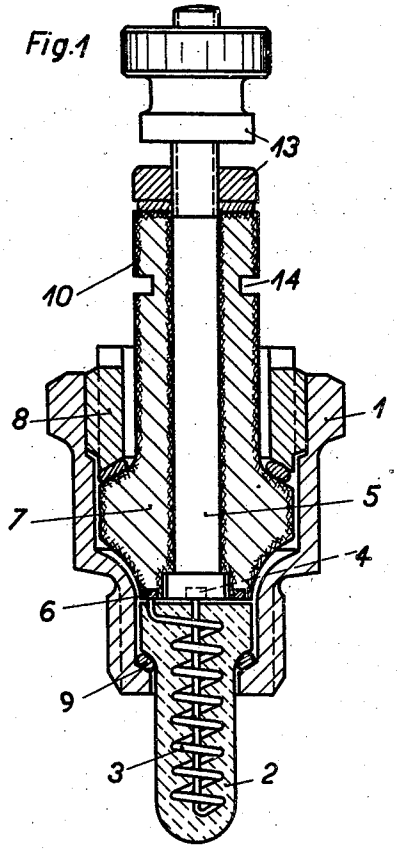


Fig.3

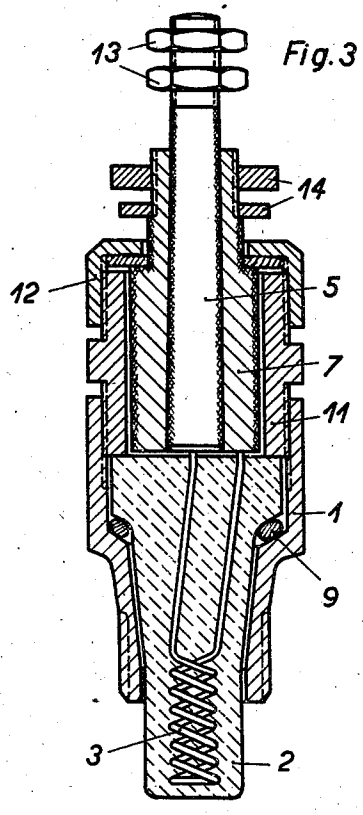
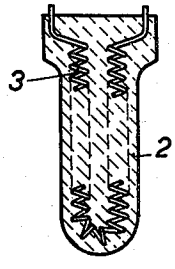


Fig.2



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Feb. 18, 1936. R. REICHMANN 2,030,937

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Filed Aug. 4, 1933 2 Sheets-Sheet 2

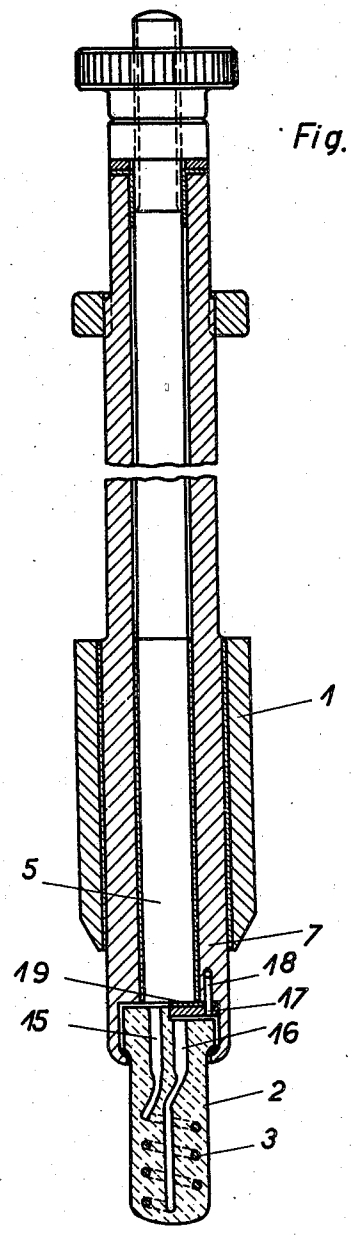


Fig. 4

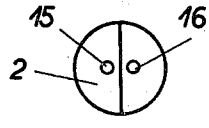


Fig. 5

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INCANDESCENT IGNITER

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19 Claims. (Cl. 123—145)

My invention relates to incandescent igniters, for example, glow plugs such as are used for starting up and operating heavy oil engines and the like. Incandescent igniters of this kind are often provided with a filament of considerable thickness, which is arranged, for example, freely suspended in helical turns at the bottom end of the igniter. A chrome nickel alloy has proved to be the best material for the filament as it is capable of withstanding comparatively high temperatures without any special protection. The disadvantage of chrome nickel and like filaments, however, resides in their tendency to absorb carbon from the fuel or the lubricating oil, tending to make the filament material brittle. Due to the percussions of the engine the filament is caused to vibrate and, having become brittle, tends to break. Moreover, the filament is subjected, in rapid alternations, to the influence of the atomized cool fuel and the hot combustion gases; it is unable to withstand the resulting extreme changes in temperature for any long period of time.

It has already been proposed to support the filament by disposing it on an insulator. Experience has shown, however, that the usual types of insulator bodies are unable to withstand the great strain resulting, particularly, from the abrupt and extreme changes in temperature which occur during the operation of the engine. In addition, the chrome nickel wire or like material reacts under high temperatures toward the silicated material of the carrier and is destroyed.

The present invention proposes an incandescent igniter wherein the filament is fired into a ceramic body consisting of highly sintered metallic oxide or a mixture of several metal oxides.

In the accompanying drawings, Fig. 1 shows a longitudinal section through an incandescent igniter; Fig. 2 illustrates a modified form of the incandescent body; Fig. 3 represents a longitudinal section of another form; Fig. 4 a longitudinal section of another embodiment of an incandescent igniter; and Fig. 5 illustrates a top view of the corresponding incandescent body.

In Fig. 1, numeral 1 denotes the casing of the igniter. The incandescent body 2, which may be made of highly sintered alumina, together with filament 3, is arranged at the bottom end of the igniter and protrudes into the cylinder of the engine. The ends or terminals of the filament project slightly from the top of the ceramic body. One end is pressed against contact piece 4 on a center metal pin 5, and the other end is brought to bear on a contact ring 6 provided on a metal body 7. The contact pieces 4 and 6 are preferably used in an embodiment wherein parts 5 and 7 consist of a comparatively hard material, in which case the contact pieces are made of relatively soft material, e. g., of copper or aluminum. Member 7 is pushed into the casing through a screw joint and presses both the incandescent body 2 against packing 9, and the contact pieces 4 and 6 against the ends of the filament. The metal member 7 is provided on its surface with an integral insulating layer 10, which serves the purpose of insulating the metal body from the centre pin and from the igniter casing. In the case of aluminum this can be an oxidized layer produced according to one of the well-known processes. The insulating materials generally used, such as mica, for example, which are subject to changes under the influence of heat, introduce difficulties in tightening the assembly and also increase its cost, can thus be dispensed with. The centre pin 5 is connected to the current supply at 13 and the metal body 7 at 14.

In Fig. 3 the incandescent body 2 is separately pressed against the packing 9 by means of a member 11; the current carrying parts 5 and 7 are likewise separately pressed against the ends of the filament 3 by means of a cap nut 12. The current conducting parts 5 and 7 are pressed into each other conically and are likewise provided with insulating surface layers formed homogeneously by the metal of which they are made. In the present case, both centre pin 5 and body 7 have this insulating layer on the outer surface. The centre pin is driven into the outer body 7 and fits into the body 7 tight and in insulated relation thereto.

It is desirable to develop the heat as far as possible at the free end of the ceramic body and to maintain the other portion cooler, i. e., that portion disposed in the interior of the igniter so as to ensure a rapid heating of the incandescent igniter and to avoid an oxidation at the ends of the filament projecting from the ceramic body as well as to attain a reliable contact at the ends of the filament.

To this end, the filament is so designed that the enlarged ends thereof taper to the operative heating cross-section, as is disclosed in Fig. 4.

The igniter shown in Fig. 4 comprises an outer casing 1, and the incandescent body 2 with the filament 3. The ends 15 and 16 of the filament are enlarged and taper to the operative heating cross-section 3. This form of filament may be obtained by rolling or hammering the filament body which may be originally of a uniformly large cross-section. The enlarged ends 15 and 16

are also embedded in the incandescent body with the exception of the end portions of the filament which project from said body. The end 15 is in engagement with the central electrode 5. Since the ends 15 and 16 are spaced apart a distance less than the diameter of the central electrode 5, the engagement of the enlarged end 16 with the outer supply member 7 is effected by securing a metallic plate 17 to the member 7 by means of a pin 18, and by causing the end 16 of the filament to press against this metallic plate 17. The pin 18 is insulated from the central electrode 5 by an intermediate layer 19. The incandescent body 2 is held in position by flanging inwardly the sleeve-like end of member 7.

In this embodiment the heat is substantially developed only in the thin cross-section of the filament and transferred along the shortest possible path to the incandescent body 2, whereas the enlarged ends 15 and 16 remain cooler, and the portions of the ceramic body surrounding the ends become less heated.

The heating resistor with its enlarged ends consists of one piece; breakdowns are therefore avoided which may be caused in the case of enlarged extensions, since such enlarged separately secured extensions due to the manner of attaching such to the filament by relatively unreliable methods, e. g. by welding, soldering, clamping or the like. Contact resistance results also which may be considerable particularly upon applying small operating voltages.

Tungsten or molybdenum or alloys of these metals have been found to be suitable materials for the filament. Alumina, beryllia, magnesia and similar oxides or mixtures of several of these oxides may be used for the ceramic body. In manufacturing the incandescent igniter, the filament may be wound in continuous turns of comparatively small diameter, as shown in Fig. 2, or in turns of a slightly larger diameter, with the other end passed back through the middle of the turns (Fig. 1). A bifilar winding, as shown in Fig. 3, may also be used. The advantage of the latter is that the winding acts somewhat like a spring as soon as the ceramic body shrinks, the result being that a straining of the filament is avoided. The filament body might, for instance, be disposed in the ceramic body by freely suspending it in a plaster mold and filling the mold with a slip of the ceramic material, for instance, alumina. The ceramic body on being dried and sufficiently solidified, can be taken out of the mold together with the embedded heating resistance. The body may then be sintered at a temperature exceeding 1600 degrees centigrade, e. g. at about 1750°. Sintering is preferably effected in a protective atmosphere in order to prevent the short ends of the heating resistance projecting from the ceramic body from being attacked. When ready, the body is inserted in the igniter casing, as shown in the drawings. The assembly is easily effected.

Upon connecting the igniter to one of the ordinary low tension current sources, the filament is heated; the heat thus created is rapidly transferred to the ceramic body surrounding the filament, and the ceramic body begins to glow after a short time. Due to the good thermal conductivity of the highly sintered ceramic body it is only necessary to subject the filament to a small excess temperature; the heating takes only a comparatively short time. With the engine in operation it is not the filament which acts directly as incandescent body, as in the case of former incandescent igniters, but the highly sintered ceramic body. The ceramic body can also be glazed. The incandescent body has a large and uniformly glowing surface. The body is neither affected by the high temperature prevailing within the engine, nor by the fuel or oil employed, nor by the combustion gases. Due to its high resistance against temperature changes it is insensitive to large temperature differences between the hot combustion gases and the atomized cool fuel. Since the highly sintered oxides, e. g. alumina, have a coefficient of expansion corresponding substantially to that of tungsten or molybdenum or alloys of these substances, there is no danger of the ceramic body breaking in consequence of different expansion of the filament. Owing to the fact that the filament is tightly embedded in the ceramic body, it is unaffected by the operating conditions occurring within the engine cylinders. In other words, the filament is embedded gas tight within the ceramic body and insulated thereby, and this condition will be true regardless of operating temperatures within the cylinder of an engine due to the aforementioned considerations. Breakage will therefore be prevented and continual performance mechanically and electrically will be maintained.

With incandescent igniters hitherto in use the glow temperature of the filament is relatively close to its melting point. In the incandescent igniter according to the present invention, the glow temperature is nowhere near the melting point of the filament or the sintering temperature of the ceramic body. An occasional higher load on the filament will, therefore, be of no detriment. With the incandescent igniters formerly in use an overload frequently resulted in the destruction of the igniter device.

The new incandescent igniter improves the sensitive part and performance of heavy oil engines, and increases the reliability of service.

I claim as my invention:

1. An igniter of the class described comprising, a self-supporting ceramic body forming an incandescent member for direct operation within the cylinder of an internal combustion engine, and a filament disposed gas-tight within said body for incandescing said body.

2. An igniter of the class described comprising, a self-supporting ceramic body consisting of highly sintered metallic oxide and forming a unitary incandescent member, and a filament consisting of a metal of the tungsten group disposed gas-tight within said body for incandescing said body.

3. An igniter of the class described comprising, a self-supporting insulating member consisting of highly sintered beryllium oxide and forming a unitary incandenscent body, and a filament consisting of a metal of the tungsten group disposed gas-tight within said body for incandescing said body.

4. An igniter of the class described comprising, a self-supporting insulating member forming an incandescent body for direct operation within the cylinder of an internal combustion engine, filament means disposed gas-tight within said body for incandescing said body, the ends of said filament means projecting from said body and forming terminals thereon, and current carrying means cooperating with said terminals.

5. An igniter of the class described comprising, a self-supporting insulating member forming an incandescent body for direct operation within the cylinder of an internal combustion en-

gine, filament means disposed gas-tight within said body for incandescing said body, the ends of said filament means projecting from said body and forming terminals thereon, telescoping current carrying means for supplying current to said terminals, and means for effecting the engagement of said current carrying means with said terminals.

6. An igniter of the class described comprising, a self-supporting insulating member forming an incandescent body for direct operation within the cylinder of an internal combustion engine, filament means disposed gas-tight within said body for incandescing said body, the ends of said filament means projecting from said body and forming terminals thereon, telescoping conductor means for supplying current to said terminals, a casing for holding said incandescent body and said conductor means, and means for effecting the engagement of said conductor means with the terminals of said incandescent body.

7. In an igniting device of the class described, an incandescent body, conductors for supplying current to said body, and insulating means between said conductors consisting of insulating layers formed homogeneously by the metal of said conductors.

8. In a glow plug of the class described, an incandescent body containing a filament and contacts therefor, members for supplying current to said contacts and said filament, said members being insulated from each other by means of an insulating layer on the surface of at least one of said members and integral therewith.

9. In an igniter of the class described, a self-supporting insulating member forming an incandescent body for direct operation within the cylinder of an internal combustion engine, filament means disposed gas-tight within said body for incandescing said body, the ends of said filament means projecting from said body and forming terminals thereon, telescoping conductor means for supplying current to said terminals, means for insulating said conductors consisting of insulating layers formed homogeneously by the metal of said conductors, a casing for holding said incandescent body and said conductor means, and means for effecting the engagement of said conductor means with the terminals of said incandescent body.

10. An incandescent igniter comprising, an insulating member carrying a filament gas-tight embedded therein and forming an incandescent body therewith, terminals on said body associated with said filament, current conducting means for supplying current to said terminals, a casing for receiving said body and said current conducting means, means for securing said body relative to said casing, and separate means for effecting the engagement of said current conducting means with said terminals.

11. An igniter comprising, an insulating member containing a filament embedded therein gas-tight and forming therewith an incandescent body arranged for direct operation within the cylinder of an internal combustion engine, said filament consisting of conductor means of predetermined cross section and having enlarged ends forming contacts on said body.

12. In an igniter device of the class described, a unitary member forming an incandescent body for direct operation within the cylinder of an internal combustion engine and consisting of a filament and an insulating body of metallic oxide arranged to envelope the same gas-tight regardless of operating temperatures within said engine, said filament being fixed within said body by sintering the same at a temperature above 1600° C.

13. In a glow plug of the class described, a refractory incandescent body arranged to be disposed for operation directly within the cylinder of an internal combustion engine, said body consisting of highly sintered metallic oxide and a filament disposed within said body for incandescing said body to perform said operation within said cylinder, said body enveloping said filament gas-tight regardless of operating temperatures of said body within said engine.

14. The process of making incandescent bodies of the class described, which consist in forming a resistor element, disposing said element freely within a mold, filling said mold with a plastic mixture consisting substantially of metallic oxide and embedding said element therein, drying the resulting body, and then sintering said body at a temperature above 1600° C.

15. A glow plug for internal combustion engines comprising, a filament, a carrier therefor, and a metallic housing for holding said carrier, wherein said filament is gas tight encased in and protected by said carrier and electrically insulated from said housing regardless of operating temperatures within said engine to which said carrier is subjected.

16. The structure defined in claim 15, wherein said carrier consists of highly sintered metallic oxide and forms a unitary body with the filament encased thereby.

17. A device as defined in claim 15, wherein said filament is coiled within said carrier.

18. A device as defined in claim 15, wherein said filament extends at one end of said carrier to the outside thereof and forms terminals thereon.

19. A device as defined in claim 15 wherein said filament extends at one end of said carrier to the outside thereof and forms terminals thereon, and electrode means for engaging said terminals.

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