March 14, 1950 T. R. ARDEN 2,500,395

IGNITION PLUG

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Fig. 1.

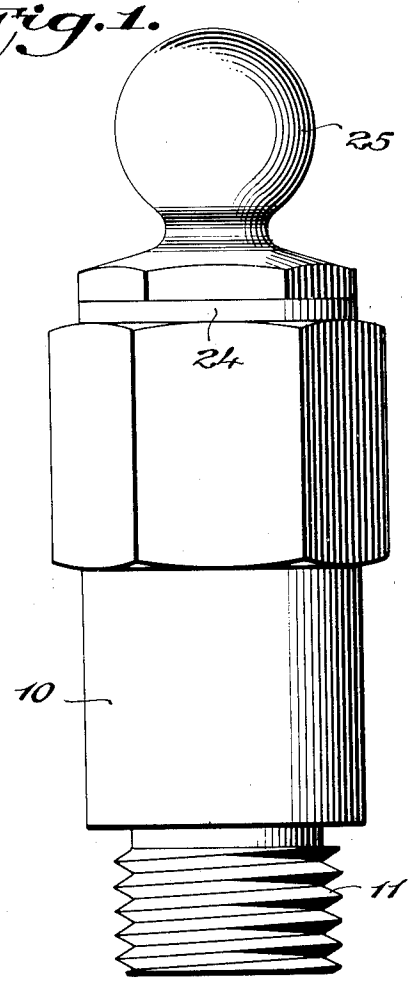


Fig. 2.

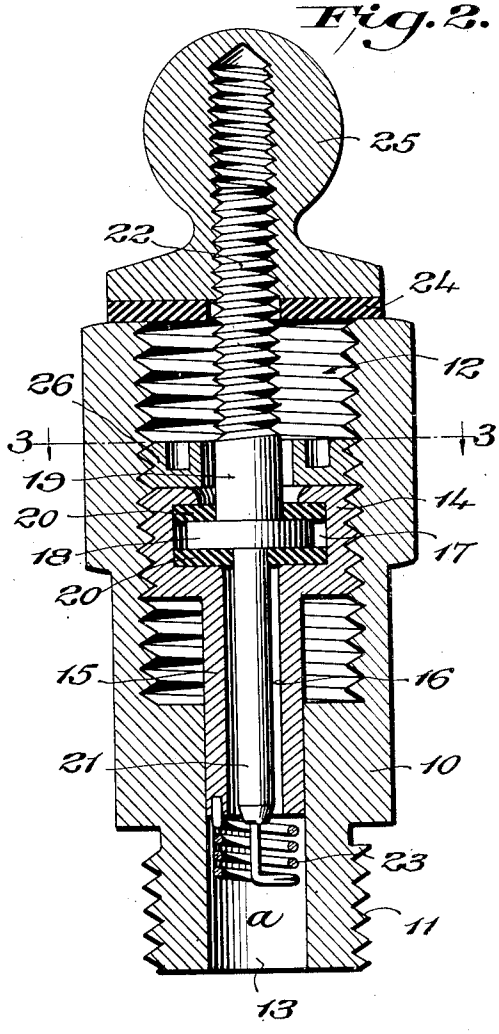
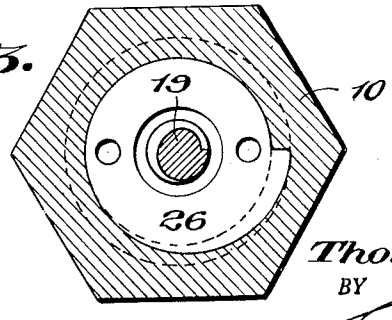


Fig. 3.



INVENTOR.
Thomas R. Arden
BY
Samuel L. Hoff
ATTORNEY

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IGNITION PLUG

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Fig. 4.

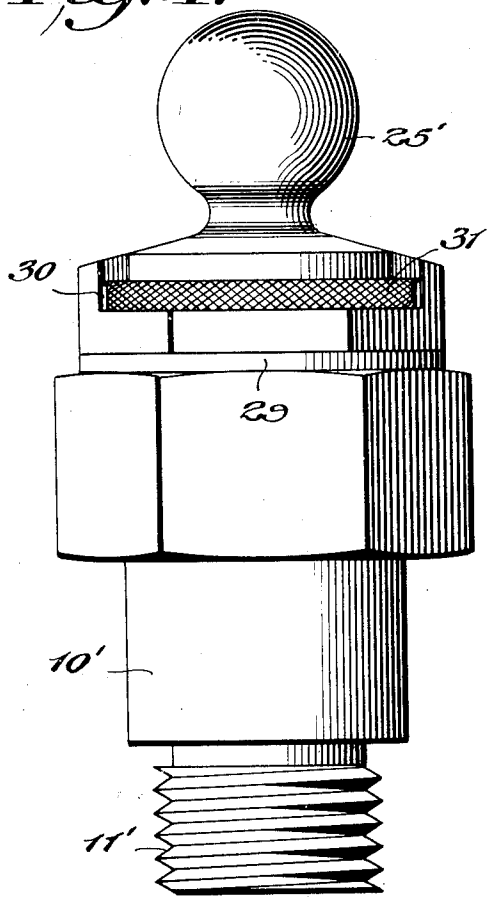


Fig. 5.

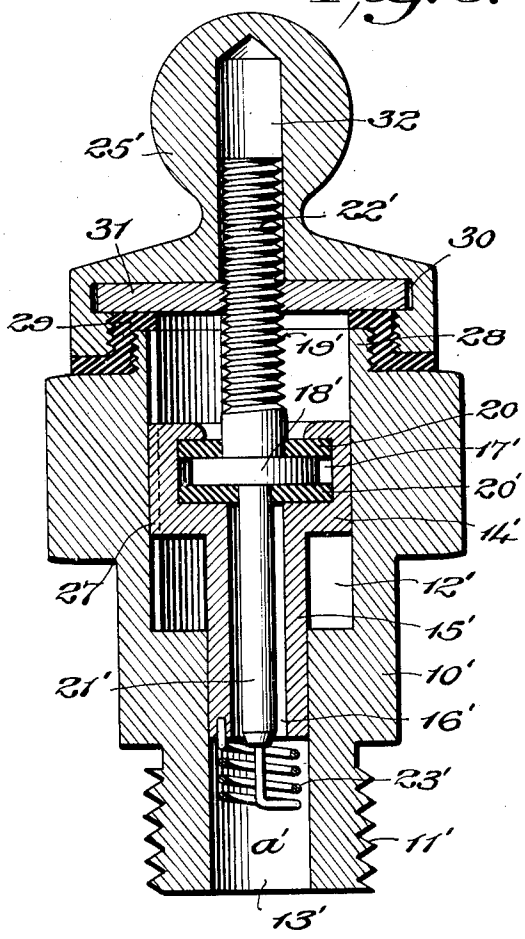


Fig. 6.

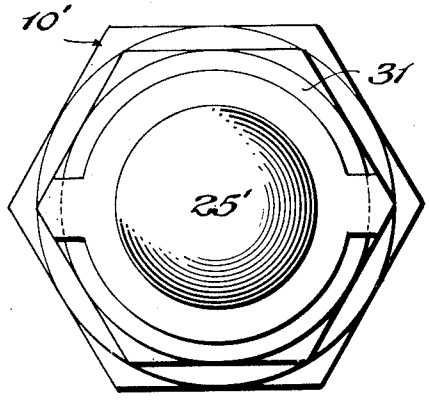
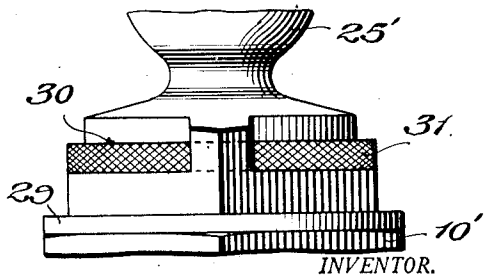


Fig. 7.



INVENTOR.

Thomas R. Arden,

BY

Emory P. Hoff Atty

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UNITED STATES PATENT OFFICE

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IGNITION PLUG

Thomas R. Arden, Danbury, Conn., assignor to Bard-Parker Company, Inc., Danbury, Conn., a corporation of New York

Application March 2, 1948, Serial No. 12,630

5 Claims. (Cl. 123—145)

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This invention relates to ignition plugs for internal combustion engines, and has particular reference to improvements in ignition plugs of the so-called "glow" type which are heated by the fuel charges which they ignite, as distinguished from ignition plugs of the well known so-called "spark" type.

One object of the invention is to provide an ignition plug of the glow type which embodies a simple, practical construction such that its heating or glow element may readily be heated electrically for engine starting purposes.

According to the invention, the plug body has therein a chamber which opens through the inner end of the plug body and in which the heating or glow element is disposed, whereby it is protected against flow over the same, and chilling by, the fuel charges to be ignited. In this connection, highest efficiency and most satisfactory operation of an engine is attained for any given fuel used for its operation if the engine has a compression space of definite size, best suiting it for operation by that particular fuel. It is very desirable, therefore, to provide means whereby the size of the compression space of an engine may be varied to adapt it for most highly efficient and satisfactory operation by any of a number of different fuels which may be employed for its operation. The glow element-containing chamber of the present ignition plug constitutes, of course, part of the compression space of an engine with which the plug is used. Accordingly, a special and important object of the present invention is to provide an ignition plug embodying a simple, practical construction such that the size of its glow element-containing chamber may readily be varied to vary the size of the compression space of the engine and thus adapt the engine for most highly efficient and satisfactory operation by any given fuel which may be employed for its operation.

In the foregoing connection another special and important object of the present invention is to provide for increasing the size of the compression space of an engine by increasing the length of the plug chamber and simultaneously moving the glow element outwardly in said chamber and, conversely, for decreasing the compression space of the engine by reducing the length of the plug chamber and simultaneously moving the glow element inwardly in said chamber. When a fuel charge is fired, some of the burnt gases remain in said plug chamber and act to retard entrance into the same of fresh gases so that, depending upon the length of said chamber and therefore upon the amount of burnt gases that remain therein, the time of firing of the engine is varied. This, in turn, enables fuels having different characteristics, such

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as ignition temperature and speed of combustion, to be used and, for any given fuel used, enables firing at a time to secure maximum power.

Another special and important object of the invention is to provide an ignition plug embodying a simple, practical construction such that the size of its glow element-containing chamber may be varied while the plug is applied to an engine and while the engine is operating, thereby to facilitate obtaining a proper adjustment of the size of said chamber and, hence, of the compression space of the engine.

With the foregoing and other objects in view, which will become more fully apparent as the nature of the invention is better understood, the same consists in an ignition plug embodying the novel features of construction, combination and arrangement of parts as are illustrated by way of example in the accompanying drawings and as will be hereinafter more fully described and claimed.

In the accompanying drawings, wherein like characters of reference denote corresponding parts in related views:

Figure 1 is a side elevation of an ignition plug constructed in accordance with one practical embodiment of the invention;

Figure 2 is a central, longitudinal section through the plug shown in Figure 1;

Figure 3 is a cross section on the line 3—3 of Figure 2;

Figures 4 and 5 are views similar to Figures 1 and 2, respectively, of an ignition plug constructed in accordance with an alternative embodiment of the invention;

Figure 6 is an end view of the plug shown in Figures 4 and 5; and

Figure 7 is a fragmentary elevation at right angles to Figure 4 of the outer end portion of the plug shown in Figures 4 and 5.

Referring to the drawings in detail, first with particular reference to the embodiment of the invention illustrated in Figures 1 to 3, 10 designates the plug body which is exteriorly threaded at its inner end as indicated at 11, to adapt it to be threaded into a plug-accommodating opening in an engine and which, in accordance with the invention, is provided with outer and inner axial bores 12 and 13, respectively, which open at their outer ends through the outer and the inner ends, respectively, of said plug body and are in communication with each other at their inner ends. The inner bore 13 is smooth-walled and of smaller diameter than the outer bore 12. On the other hand, the outer bore 12 is threaded and has threaded therein the enlarged outer end portion or head 14 of a stem 15 which extends into and neatly, slidably fits the bore 13.

The stem 15 is provided with an axial bore

16 and the head 14 of said stem is provided with a chamber 17 wherein an annular flange 18 on a rod 19 is clamped between a pair of electrical insulating washers 20, 20.

The rod 19 includes an inner end portion 21 which is disposed in the bore 16 and extends from the flange 18 substantially to the inner end of the stem 15, and an outer end portion 22 which is threaded and extends beyond the outer end of the plug body 10.

The washers 20, 20 are confined in the head 14 of the stem 15, closely embrace the rod 19, and clamp the flange 18 of said rod between them. Thus, said rod is secured rigidly to said stem for movements with the latter. Moreover, said washers serve to hold both the rod 19 and its flange 18 coaxially disposed with respect to said stem and spaced therefrom so that said rod is electrically insulated from said stem.

The heating or glow element 23 of the present plug is disposed beyond, but adjacent to, the inner end of the stem 15 and may be of any suitable form. Preferably, however, it comprises a length of suitable electrical resistance wire wound into helical form as shown, and having one end thereof welded or otherwise suitably connected to the inner end of said stem 15 and its other end welded or otherwise suitably connected to the inner end of the portion 21 of the rod 19.

Disposed against the outer end of the plug body 10 is a washer 24 of electrical insulating material, while threaded on the outer end portion 22 of the rod 19 against said washer 24 is a suitable electrical terminal element 25.

When the plug is applied to an engine, the portion of the bore 13 between the inner end of the plug body 10 and the inner end of the stem 15, together with the space between said stem and the inner end portion 21 of the rod 19, constitute a chamber a which is in communication with the compression space of the engine and, therefore, constitutes a part of the engine compression space. It follows, therefore, that by adjusting the stem 15 toward or from the inner end of the plug body, the size of the chamber a may be increased or reduced and that thereby the size of the engine compression space may be varied to adapt the engine for most highly efficient and satisfactory operation by any given fuel.

Since the head 14 of the stem 15 is threaded in the bore 12, said stem is, of course, by rotation thereof, adjustable into and from the bore 13 to vary the size of the chamber a. In this connection, to adjust said stem, the terminal element 25 may simply be removed from the portion 22 of the rod 19 and said portion of said rod may be engaged and rotated in any suitable manner to rotate the stem 15. Or, the washer 24 also may be removed and a suitable implement may be engaged in any suitable manner directly with the head 14 to rotate said stem. If desired, a nut 26 may be screwed into the bore 12 against the head 14 to lock the stem 15 in any desired adjusted position thereof.

The bore 13 is of sufficient length to accommodate the glow element 23 as well as a considerable portion of the stem 15 so as to permit all necessary variation in the size of the chamber a and, hence, in the size of the compression space of an engine with which the plug is used, while maintaining the glow element 23 protectively confined in the chamber a. In this connection it is apparent that since the glow element 23 is carried by the stem 15 and the rod 19, it is movable outwardly and inwardly in the chamber a with said stem and said rod as the latter are adjusted to increase and to decrease the length of said chamber. This is an important feature of the present plug for the reason that when a fuel charge is fired, some of the burnt gases remain in the chamber a and act to retard entrance into the same of fresh gases so that, depending upon the length of said chamber and the consequent amount of burnt gases that remain therein, the time required for fresh gases to reach the glow element 23 and to be ignited is varied with consequent varying of the time of firing of the engine. In other words, the time of firing of the engine is varied not only by varying the size of the compression space of the engine as a result of varying the length of the chamber a, but by varying the position of the glow element 23 in said chamber. This, obviously, enables fuels having different characteristics, such as different ignition temperatures and speeds of combustion, to be used and, for any given fuel used, enables firing to be effected at the proper time to secure maximum power therefrom.

The plug body 10 is electrically grounded through an engine upon which the plug is used. Accordingly, if one side of a source of current is grounded to the engine and the other side thereof is connected to the terminal element 25, a circuit will be established through the glow element 23 and the latter will be electrically heated for engine starting purposes. After the engine has started, the heat of combustion in its compression space will, of course, maintain the glow element 23 heated so that electrical heating of said element may be discontinued.

Obviously, by removing the terminal element 25 and the washer 24, the electric circuit may be established through the rod 19 and adjustment of the stem 15 may advantageously be effected while the engine is running. After the proper adjustment of the stem 15 has been effected, the washer 24 and the terminal element 25 may be applied and said terminal element may, if desired, be relied upon in lieu of the lock nut 26 to maintain the adjustment.

Referring now particularly to the plug of alternative form shown in Figures 4 to 7 of the drawings, 10' designates the plug body which is exteriorly threaded at its inner end, as indicated at 11', to adapt it to be threaded into a plug-accommodating opening in an engine, and which, in accordance with the invention, is provided with outer and inner axial bores 12' and 13', respectively, which open at their outer ends through the outer and the inner ends, respectively, of the plug body and are in communication with each other at their inner ends. The bore 13' is of smaller diameter than the bore 12' and both bores are smooth-walled. In the bore 12' is disposed an enlarged outer end portion or head 14' of a stem 15' which extends into and neatly, slidably fits the bore 13'. The head 14' slidably fits the bore 12' and is suitably splined or keyed to the plug body 10', as indicated at 27, so that it and the stem 15' are held against rotation relative to said plug body.

The stem 15' is provided with an axial bore 16' and the head 14' of said stem is provided with a chamber 17' wherein an annular flange 18' on a rod 19' is clamped between a pair of electrical insulating washers 20', 20'.

The rod 19' includes an inner end portion 21' which is disposed in the bore 16' and extends substantially to the inner end of the stem 15', and an outer end portion 22' which is threaded and

extends beyond the outer end of the plug body 10'.

The washers 20', 20' are confined in the head 14', embrace the rod 19' and clamp the flange 18' of said rod between them. Thus, said rod and said stem are secured rigidly together so that longitudinal adjustments of said rod effect longitudinal adjustments of said stem. Moreover, said washers serve to hold both the rod 19' and its flange 18' coaxially disposed with respect to said stem and spaced therefrom so that said rod is electrically insulated from said stem.

The heating or glow element 23' may be of the same form as the heating or glow element 23 of the Figures 1 to 3 form of the invention, and may be mounted with reference to the stem 15' and the inner end portion 21' of the rod 19' in the same manner as the heating or glow element 23 is mounted with reference to the stem 15 and the inner end portion 21 of the rod 19.

At the outer end of the plug body 10', in axial alinement with the bores 12' and 13', is an annular flange 28 which is exteriorly threaded and has threaded thereon a collar 29 of electrical insulating material. This collar also is exteriorly threaded and has threaded thereon a terminal element 25' which may be of any suitable form, but which is transversely slotted, as indicated at 30, to accommodate a nut 31.

The nut 31 is threaded on the outer end portion 22' of the rod 19' and the terminal element 25' is suitably cut away to expose the knurled edge of said nut for finger engagement to effect its rotation.

Because the nut 31 is disposed in the slot 30, it is held against longitudinal movement relative to the terminal element 25' or, in other words, is swiveled with respect to said terminal element. The stem 15' and the rod 19' are, as aforesaid, held against rotation due to the splined connection 27, between the head 14' of said stem and the plug body 10'. Consequently, simply by rotating the nut 31, the rod 19' and the stem 15' may be longitudinally adjusted to vary the size of the chamber a', corresponding to the chamber a of the Figures 1 to 3 form of the invention, for, of course, the same purpose as the size of the chamber a is varied.

The terminal element 25' is provided with an axial bore 32 to accommodate the outer end of the portion 22' of the rod 19', but is electrically connected to said rod through the nut 31. On the other hand, the collar 29 serves to electrically insulate the terminal element 25' and the nut 31 from the plug body 10'. Accordingly, if one side of a source of current is connected to the plug body 10' and the other side thereof is connected to the terminal element 25', a circuit will be completed through the heating or glow element 23' and the same will become electrically heated for engine starting purposes. After the engine has started, the heat of fuel charges ignited by the glow element will maintain the latter hot and electrical heating of said element may be discontinued.

A particular advantage of the Figures 4 to 7 form of the invention is that there is no need of disturbing the plug assembly in any way in order to adjust the size of the chamber a', since the nut 31 always is exposed for ready manipulation to accomplish that purpose.

From the foregoing description considered in connection with the accompanying drawings, it is believed that the construction and operation of the present ignition plug will be clearly understood and its advantages appreciated. It is desired to point out, however, that while only certain specific structural embodiments of said plug have been illustrated and described, the same is readily capable of specifically different structural embodiments within the spirit and scope of the invention, as defined in the appended claims.

I claim:

1. An ignition plug comprising a plug body having a bore opening through its inner end, a stem extending into said bore from its outer end, means holding said stem against rotation relative to said plug body, a rod extending through said stem and electrically insulated therefrom and fixed with respect thereto, a terminal element mounted on the outer end portion of said plug body and electrically insulated therefrom, a nut swiveled in said terminal element and threaded on said rod whereby it is effective by rotation to adjust said rod and stem longitudinally to vary the size of the compression space of an engine with which the plug is used, said nut serving to connect said rod electrically with said terminal element, and a glow element of electrical resistance material disposed adjacent to the inner end of said stem and connected at spaced points to said stem and said rod.

2. An ignition plug comprising a plug body having inner and outer axially alined bores opening through its inner and its outer ends, respectively, said outer bore being of great diameter than said inner bore and being in communication with the latter, a stem extending into said inner bore from the outer end thereof and having a head disposed in said outer end thereof and having a head disposed in said outer bore, said stem having an axial bore and said head having a chamber, an electrical conductor including a portion disposed in said stem and a flange disposed in said chamber, washers of electrical insulating material disposed in said chamber and cooperating with said head and said flange to electrically insulate said conductor from and to rigidly fasten the same to said stem, means for adjusting said stem and its head longitudinally relative to said plug body to vary the distance between the inner end of said stem and the inner end of said plug body, thus to vary the size of the compression space of an engine with which the plug is used, and a glow element of electrical resistance material disposed in the inner end portion of said inner bore and connected at spaced points to said conductor and said stem.

3. An ignition plug comprising a plug body having inner and outer axially alined communicating bores opening through its inner and its outer ends, respectively, a stem extending into said inner bore from the outer end thereof and having a head threaded in said outer bore whereby rotation of said head and stem is effective to adjust said head and stem longitudinally relative to said plug body to vary the distance between the inner ends of said stem and said plug body thus to vary the size of the compression space of an engine with which the plug is used, an electrical conductor extending through and insulated from and fixed rigidly to said stem and head, and a glow element of electrical insulating material disposed in the inner end portion of said inner bore and connected at spaced points to said conductor and said stem.

4. An ignition plug as set forth in claim 3 in which the conductor includes a threaded portion extending through the outer bore beyond the outer end of the plug body, and in which an elec-

trical terminal element is threaded on said stem in closing relationship to the outer end of the outer bore.

5. An ignition plug comprising a plug body having inner and outer axially alined communicating bores opening through its inner and its outer ends, respectively, a stem extending into said inner bore from the outer end thereof, an electrical conductor extending through and fixed to and insulated from said stem, said conductor including a threaded outer end portion, a nut swiveled with respect to said plug body and having threaded engagement with the outer end portion of said conductor for adjusting the latter and said stem longitudinally relative to said plug body to vary the distance between the inner ends of said stem and said plug body thus to vary the size of the compression space of an engine with which the plug is used, and a glow element of

electrical insulating material disposed in the inner end portion of said inner bore and connected at spaced points to said conductor and said stem.

THOMAS R. ARDEN.

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