

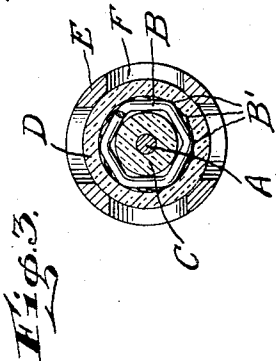
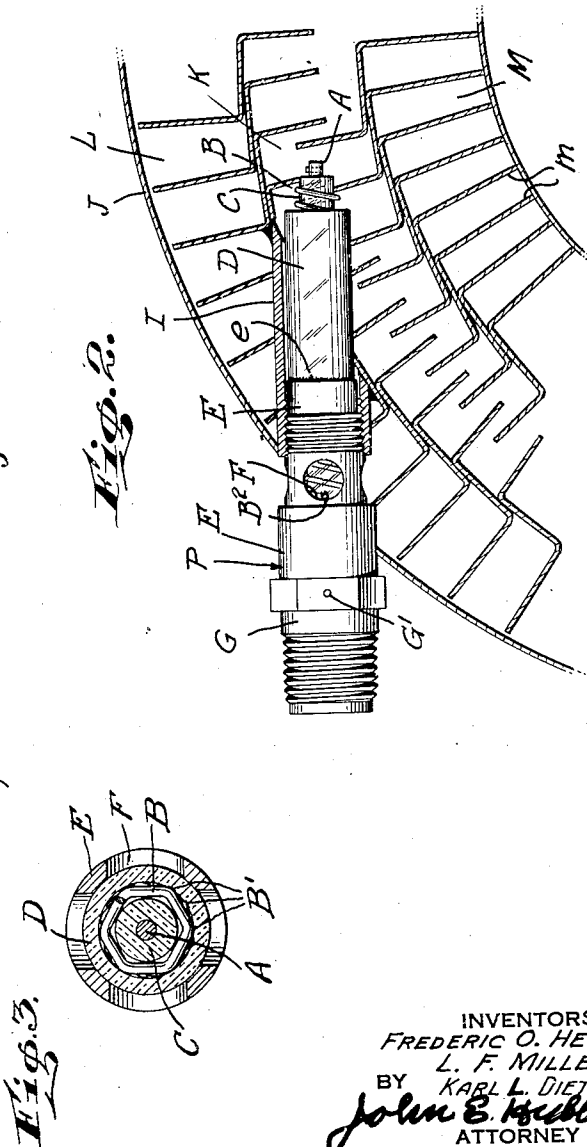
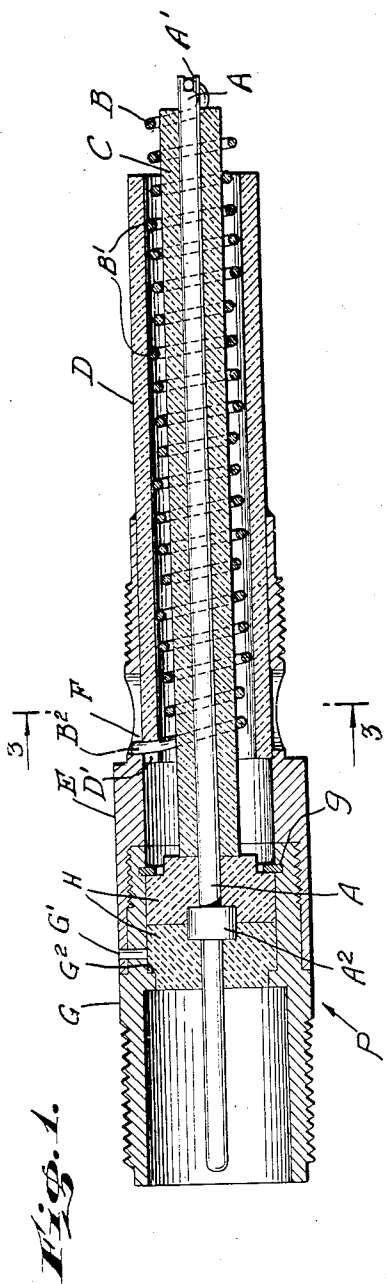
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F. O. HESS ET AL

2,404,841

IGNITION DEVICE

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2,404,841

IGNITION DEVICE

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6 Claims. (Cl. 219—32)

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The general object of the present invention is to provide improved electric ignition means of the hot wire type. More specifically stated, the general object of the invention is to provide a hot wire ignition device suitable for use in and as part of an airplane heater to ignite a combustible mixture of air and atomized gasoline which at times may be at a temperature as low as 40° or 50° F. below zero or even lower.

Our improved ignition device is characterized in particular by its simple and effective provisions for minimizing the loss of heat from the electric conductor forming its "hot wire," in operation with the ignition device exposed to sub-zero temperatures. Our improved ignition device is further characterized by its simple and desirable structural features and by its provisions for visually determining whether the hot wire element is being heated by current flow through it.

The various features of novelty which characterize our invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects attained with its use, reference should be had to the accompanying drawing and descriptive matter in which we have illustrated and described a preferred embodiment of the invention.

Of the drawing:

Fig. 1 is a longitudinal section through an ignition device;

Fig. 2 is a plan section through a portion of a heater in which the ignition device is mounted; and

Fig. 3 is a section on the line 3—3 of Fig. 2.

In the preferred construction shown, the ignition device comprises a metallic conductor rod A and a heating or "hot wire" element B having one end brazed in a slot A' formed in the inner end of the rod A. The latter extends axially through a tube C of refractory insulating material which advantageously is quartz. Advantageously, the wire B is made of nichrome alloy and its body portion is in the form of a helix with spaced apart convolutions which surround the tube C, and are surrounded by a tube D of refractory insulating material, such as quartz, which is transparent enough to permit an observer looking through it to see whether the wire B is heated.

The helical body portion of the wire B may advantageously be formed by wrapping a straight wire snugly about a bar hexagonal in cross sec-

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tion so that when the bar is removed from the helix thus formed and the winding tension is released, the helix will unwind slightly, with the result that corresponding corner portions or bends B¹ of hexagonal convolutions are angularly displaced slightly from one another as shown in Fig. 3. Advantageously, the parts are so proportioned that in the assembled ignition device, the corner portions B¹ snugly engage the inner wall of the tube D, and each straight wire portion between each two adjacent corners or bends B', has its center in snug engagement with the outer surface of the tube C. The extent of contact surface between the wire B and the tubes C and D is thus relatively small as is desirable to minimize the heat loss from the wire to the tubes. The outer end B² of the wire B extends radially outward through a notch D' in the adjacent end of the tube D, and into one of the window openings F in a tubular metallic member E, and the portion of the wire end B² within said window opening is brazed to the adjacent portion of the member E.

The member E surrounds the outer end portion of the tube D and forms the inner portion of the casing or shell of the ignition device. The outer portion of said shell is formed by the tubular member G coaxial with the member E. As shown, the externally threaded inner end of the member G is screwed into an internally threaded outer end portion of the member E. In the assembled device the telescoping portions of the members E and G are locked together by a radial locking pin G'.

The shell member G is formed with an internal rabbeted seat G² for a ceramic plug or bushing H. The latter comprises two end to end cylindrical parts, each of which is formed with an axial passage transversed by a corresponding portion of the rod A, and each of the adjacent ends of the two bushing parts is recessed to receive the corresponding end of an enlargement or collar portion A² of the rod A. The latter is thus anchored in the bushing H when the two parts of the latter are secured in place in the seat G² by a snap ring g or other suitable locking means.

Preferably, and as shown, the tube D fits snugly in the member E and the outer end of the tube C abuts against the inner end of the bushing H. Refractory cement may be employed if necessary to anchor the tube D in place in the member E, and to prevent gas leakage through the joint between those parts.

As shown in Fig. 2 the ignition device extends into an airplane heater J and an externally

threaded portion of the shell member E is screwed into an internally threaded tubular member I forming a part of the heater structure and the parts are so formed that a short inner end portion of the helical body of the wire B is then located in the annular combustion chamber K of the heater. The heater shown, comprises annular air heating spaces L and M at the inner and outer sides of the combustion space K, and separated therefrom by walls formed by bent sheet metal parts comprising overlapping intermediate wall forming sections, and inner and outer edge portions *m*. The edge portions *m* of each sheet metal part extends radially from the combustion wall into the combustion chamber and air heating spaces separated by said wall, so that one edge portion *m* of each part serves as a heat absorbing fin, while the other edge portion of the same part serves as a heat dissipating fin.

The particular heater structure shown, is of a type and form disclosed in an application for patent, Serial No. 409,440 which Frederic O. Hess, one of the applicants herein, filed September 4, 1941, now Patent No. 2,386,462, granted October 9, 1945. Said structure forms no part of the present invention, but is one example of apparatus in which our improved ignition device may be used with advantage.

As shown in Fig. 2, the tubular part I is brazed to the outer wall of the combustion chamber of the heater, which provides a ground connection for the end B' of the wire B. The other end of the wire B may be connected to a source of energizing current through the conductor A and connections (not shown) to the outer end of the latter. As shown, the shell member G is externally threaded at its outer end for connection to a connector or terminal box and associated switch mechanism through which the conductor A and inner end of the wire are connected to a suitable current supply means, none of which is illustrated herein, as they form no part of the present invention. Ordinarily, energizing current is passed through the wire B only while the heater is being started into operation, since after the heater has been heated up, ignition is normally maintained so long as the normal supply of combustible mixture to the combustion chamber is maintained.

Advantageously, the parts shown in Fig. 2 are so proportioned that a few outer convolutions of the helical body portion of the wire B may be visually inspected from outside of the heater J through one or more of the windows F and the tube D, to determine whether or not the wire B is heated as it is when the proper current flow through the wire is maintained. As shown, the member E is formed with four windows having their centers uniformly spaced in a circle extending about the axis of the ignition device. With this window arrangement visual inspection of the wire B through one or more of the windows is possible no matter what the relative angular portions of the members I and E may be. The ability to visually determine whether the wire B is heated is especially important when the heater is being started into operation under adverse conditions making it difficult to determine whether failure of the fuel mixture to ignite is due to a failure of the ignition energizing circuit or to some other cause.

With the tubes C and D formed of material of the character specified and with the different portions of the igniter relatively formed and

arranged generally as illustrated, the rate of heat loss from the wire B will not be great enough to prevent the wire from quickly heating up to the glowing temperature required for the ignition of the combustible mixture entering the combustion chamber K, when the temperature of the mixture and of the heater and its enveloping atmosphere is 50° F. or so below zero, as it may be while the heater is being started into operation in Polar regions or at high altitudes.

While in starting the heater into operation under such adverse conditions the portion of the wire B extending into the combustion chamber from the inner end of the tube D is subjected to a considerable cooling effect by the combustible mixture initially moving in an unignited condition through the combustion chamber K, the mixture has little cooling effect upon the wire B for the major portion of its length, and the exposed inner end portion of the wire quickly attains the temperature needed to ignite the combustible mixture. As is plainly apparent, the igniter shown and described, is mechanically and operatively simple, and is reliable in operation. Furthermore, the igniter shown may be readily disassembled and reassembled for inspection or repairs.

The dimensions of the wire B and the material out of which it is made may vary with conditions. By way of example and illustration and not by way of limitation, in a form of the invention now being used in airplane heaters, the wire B is made of nichrome alloy, is .032 inch in diameter, is 30 inches long and has a resistance of 1.63 ohms, and is connected directly into the main airplane current supply circuit.

The voltage in that circuit varies from 24 to 28 volts, and the fact that the wire B is adapted to be energized by said voltage without the use of an auxiliary resistance in series with the wire, is of substantial practical importance.

While in accordance with the provisions of the statutes, we have illustrated and described the best form of embodiment of our invention now known to us, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of our invention as set forth in the appended claims, and that in some cases certain features of our invention may be used to advantage without a corresponding use of other features.

Having now described our invention, what we claim as new and desire to secure by Letters Patent is:

1. An ignitor of the hot wire type adapted to extend into a combustion space of apparatus, such ignitor comprising a body portion for mounting the ignitor in position on the apparatus, the body portion having a window opening therein external to the apparatus when the ignitor is mounted thereon, a tube of high temperature ceramic refractory material mounted in the body portion, the part of the body portion having the window opening overlying a region of the tube which is light transmitting, the light transmitting region being integral with the tube, and a resistance wire within the tube having one part exposed at the end of the tube adapted to extend into the combustion space and another part adjacent the window opening which, when the ignitor is connected to a source of electrical energy, will indicate energization of the resistance wire when the window opening is viewed.

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2. An ignitor of the hot wire type adapted to extend into a combustion space of apparatus, such ignitor comprising a body portion for mounting the ignitor in position on the apparatus, the body portion having a window opening therein external to the apparatus when the ignitor is mounted thereon, an outer tube of high temperature ceramic refractory material mounted at its inner end in the body portion, the part of the body portion having the window opening overlying a region of the outer tube which is light transmitting, the light transmitting region being integral with the outer tube, a second tube of high temperature ceramic refractory material mounted at its inner end in the body portion and extending lengthwise within the outer tube and having a gap therebetween which is open at the outer ends of the tubes, and a resistance wire having one part exposed at the outer ends of the tubes adapted to extend into the combustion space and another part in the gap adjacent the window opening which, when the ignitor is connected to a source of electrical energy, will indicate energization of the resistance wire when the window opening is viewed.

3. An ignitor of the hot wire type adapted to extend into a combustion space of apparatus, such ignitor comprising a metallic body portion for mounting the ignitor in position on the apparatus, a plurality of tubes of high temperature ceramic refractory material one within the other and having a gap therebetween which is open at the outer ends of the tubes, means for mounting the tubes at the inner ends in the body portion, a conductor passing through the inner tube having one end adapted to be connected to a source of electrical energy and the opposite end extending from the outer end of the inner tube, a resistance wire having one end fixed to the body portion and the other end joined to the conductor extending from the outer end of the inner tube, the wire having one portion disposed in the gap between the tubes and another portion

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exposed about the outer end of the inner tube adapted to project into the combustion chamber.

4. An ignitor of the hot wire type adapted to extend into a combustion space of apparatus, such ignitor comprising a body portion for mounting the ignitor in position on the apparatus, a plurality of tubes of high temperature ceramic refractory material one within the other and having a gap therebetween which is open at the outer ends of the tubes, means for mounting the tubes at the inner ends in the body portion, a conductor extending through the inner tube having one end adapted to be connected to a source of electrical supply and the opposite end extending from the outer end of the inner tube, a resistance wire having one end fixed to the body portion and the other end joined to the end of the conductor extending from the outer end of the inner tube, the wire having one portion helically disposed about the inner tube in the gap between the tubes and another portion exposed about the outer end of the inner tube adapted to project into the combustion chamber.

5. An ignition device of the hot wire type adapted to extend into a combustion space, comprising a casing, inner and outer tubes of refractory insulating material mounted in said casing, and a resistance wire having a helical portion between said tubes comprising a series of straight sections engaging the outer surface of the inner tube between their ends and bends therebetween engaging the inner surface of the outer tube.

6. An ignition device as specified in claim 5, in which the straight sections and bends of the wire are so proportioned that, when in place between said inner and outer tubes, the turns of the helical portion will be approximately polygonal in form and the bends of adjacent turns will be slightly displaced from one another angularly about the axis of the helical portion.

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