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ALTITUDE COMPENSATING IGNITION DEVICE

William C. Parrish, Park Ridge, Ill., assignor to
Stewart-Warner Corporation, Chicago, Ill., a
Corporation of Virginia

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4 Claims. (Cl. 175—115)

My invention relates to altitude compensating ignition devices more particularly adapted for, but not limited to, use in connection with the internal combustion heaters of aircraft.

It is now common practice to provide aircraft with internal combustion heaters to provide heated ventilating air for cabins and other enclosed spaces. In most types of internal combustion heaters used for this purpose, the combustion chamber of the heater is maintained at a pressure differing only slightly from atmospheric pressure. Where a spark plug is used to ignite the combustible mixture delivered to the combustion chamber, it has been found that when the aircraft reaches an altitude above 20,000 or 25,000 feet, the spark plug produces a corona effect but does not provide a spark capable of igniting the combustible mixture.

An object of my invention is to provide a spark plug or similar ignition device which is automatically compensated for variations in atmospheric pressure and which is effective to produce, at all altitudes, a spark capable of igniting a combustible mixture.

Another object of my invention is to provide an altitude compensating ignition device wherein the spark producing electrodes are protected against the increased burning effect resulting from lowered gap resistance due to increased altitudes.

Another object of my invention is to provide an altitude compensated ignition device which may be easily disassembled for purposes of inspection and repair.

Other objects of my invention will become apparent as the description proceeds.

In the drawings:

Fig. 1 is a sectional view showing a unitary spark plug embodying my invention. This plug is shown attached to the wall of a combustion chamber;

Fig. 2 is a sectional view showing a modified form of my invention applied to a combustion chamber;

Figs. 3 and 4 are transverse sections taken on the lines 3—3 and 4—4, respectively, of Fig. 2;

Fig. 5 is a sectional view showing a third form of my invention applied to a combustion chamber; and

Fig. 6 is a top plan view of the form of my invention shown in Fig. 5.

In Fig. 1, I have shown, at approximately twice normal size, an embodiment of my invention which assumes the form of an ordinary spark plug and may be used in lieu thereof. In this figure I have illustrated a combustion chamber 10 of an internal combustion heater of the kind commonly used in aircraft. This heater may be like that shown in my co-pending application, Serial No. 494,155, filed July 10, 1943, or of any other suitable type. The wall of the combustion chamber is threaded, as indicated at 12, to receive a spark plug of conventional form or of the particular type disclosed and claimed in this application.

My altitude compensating ignition device in this instance takes the form of a spark plug having a sleeve 14 threaded at the lefthand end to cooperate with the conventional threads 12 of the spark plug receiving opening of the combustion chamber 10. A conventional gasket 16 is provided in accordance with usual practice to seal the joint between the spark plug and the wall of the combustion chamber.

The sleeve 14 is provided with a fixed electrode 18 which is grounded through the sleeve wall and of the combustion chamber. A second or movable electrode 20 is formed by the bent over end of a wire 22 mounted over end of a wire 22 mounted in a porcelain sleeve 24 and secured in proper position therein by lock nuts 26 engaging threads provided on the righthand end of the wire 22. This wire may be of uniform composition throughout, or the bent over end 20 may be coated or of different material from the rest of the wire to provide an efficient electrode while at the same time the righthand end of the wire is of sufficient strength to carry out the functions hereinafter described.

A tubular guide 28, having in-turned ends 30 and 32, is pressed fitted or otherwise secured in the metal sleeve 14 in the position shown in Fig. 1. The wire 22 and porcelain sleeve 24 are slidably mounted in this guide and the porcelain sleeve 24 is preferably covered with a metal skirt 34 which moves with the porcelain sleeve and has direct sliding contact with the in-turned end of the guide 28. The skirt 34 and porcelain sleeve 24 have engaging shoulders 36 and 38, respectively, and leftward movement of the electrode 20 is limited by engagement of the shoulder 38 with the end 32 of the guide 28.

A sheet metal shell 40 is welded or soldered to an annular base 42 screwed to the righthand end of the metal sleeve 14. An evacuated metal
A metal sleeve 114 carrying the porcelain sleeve 108 and electrode 104 is positioned in the ring 112 and secured therein by a tubular nut 116. A conventional gasket 115 may be confined between an internal shoulder 120 provided by the ring 112 and an external flange 122 provided by the sleeve 114 to prevent leakage between the ring 12 and this sleeve.

A sheet metal housing, indicated generally by reference numeral 124, is welded or otherwise attached to a second wall of the pocket 102. This housing comprises a base 125 having a tubular extension 126 projecting into the pocket 102 and forming a guide for a movable electrode 106. The housing 124 also includes a cylindrical central portion 130 attached to the base 125 by screws 132 and a cap 134 secured to the other end of the central portion 130. The housing 124 provides an enclosure for an evacuated, spring loaded, expandable bellows 136. A pin 138 extends diametrically through the cylindrical housing 124 and through a bracket 140 attached to the lower end of the bellows 136 so that the pin 138 constitutes a support for this bellows.

The upper end of the bellows abuts a plate 142 attached by bolts 144 to the upper end of an elongated cup 146. The movable electrode 106 has a reduced, threaded end 148 passing through an opening in the base 150 of the cup 146 and secured to this base by nuts 152. Pin 138 passes through slots 154 in the cup 146 whereby this cup is permitted to move with expansion and contraction of the bellows 136. Plate 142 is of smaller diameter than the cylindrical section 130 of the housing 124 and is slidably guided in this housing by inwardly projecting ribs 156. The interior of the housing 124, therefore, forms a single chamber 158 surrounding the bellows 136 and freely communicating with atmosphere by way of openings 160 in cap 134.

In this form of my invention the operation of the bellows is reversed in the sense that expansion of this bellows causes movement of the movable electrode toward the fixed end of the bellows and contraction of the bellows causes movement of this electrode away from the fixed end of the bellows. However, expansion with decreases in atmospheric pressure to increase the gap between electrodes 104 and 108 and contracts with increases in atmospheric pressure to decrease this gap, so that the operation of this embodiment of my invention is generally the same as the operation of the embodiment shown in Fig. 1.

In the embodiment of Figs. 5 and 6, the combustion chamber 200 has a pocket 202 in open communication therewith. A fixed electrode 204 is carried in a porcelain sleeve 208 and metal sleeve 206, which are mounted in a wall of the pocket 202 in the same manner in which the corresponding parts of Fig. 2 are mounted in a wall of the pocket 102. An electrical conductor 210 connects the fixed electrode 204 with any suitable source of current.

A sheet metal base 212 is welded or otherwise secured to a second wall of the pocket 202. The walls to which the base 212 and fixed electrode 204 are attached are preferably at right angles to each other. The base 212 supports a sleeve 214 having a tubular part extending downward into the pocket 202. The sleeve 214 is clamped against the base 212 by clamps 216 and 218 which are screwed or otherwise secured to the base 212.
A tubular cap 220 is threadedly attached to the upper end of the sleeve 214. The movable electrode 222 is rotatably mounted in the sleeve 214 and has a bent over lower end 224 adjacent the inner end of fixed electrode 204 to provide an adjustable spark gap. The upper end of the electrode 222 is of reduced diameter and threaded as indicated at 226 to receive nut 228 which secures a gear 230 to the upper end of this electrode in non-rotative relation thereto. A flange 232 is integral with a sleeve 234 confined between the gear 230 and an opposed shoulder provided by the electrode 222. This flange is located between sleeve 214 and cap 220 and limits longitudinal movement of the electrode 222 relative to sleeve 214.

Gear 230 is driven by a segment gear 235 mounted on a pin 236 carried by a bracket 238 integral with the clamp 216. Arm 240 has one end rigidly attached to the sector gear 235 and a second end pivotally connected to a link 242 having its other end pivotally attached to the free end of a Bourdon tube 244. The fixed end of the Bourdon tube is soldered or otherwise secured to the bracket 238.

The Bourdon tube 244 will expand and increase its diameter with decreases in atmospheric pressure. This will produce a clockwise movement of sector gear 235 and a counterclockwise movement of gear 230 and electrode 222. Such movement of the electrode will swing the lower end 224 away from alignment with fixed electrode 204, as indicated in Fig. 6 to thereby increase the gap between the electrodes. A subsequent increase in atmospheric pressure will partially or completely return the movable electrode to its original position, depending upon the extent of this increase.

From the foregoing description taken in connection with the accompanying drawings, it will be apparent that my invention may assume numerous forms and may be incorporated in either a single, unitary structure or form part of a larger assembly. Numerous other changes and variations may be made without departing from the scope of the invention and the particular embodiments shown are to be considered as illustrative only, as my invention includes all modifications, variations and equivalents coming within the scope of the appended claims. While I have described my invention as being particularly adapted for application to the combustion chamber of aircraft heaters, my invention is not limited to such use but may be utilized wherever varying pressure conditions make its use desirable or advantageous either to insure a hot and effective spark or to prevent undue burning of the electrodes.

I claim:

1. A spark plug of the class described, comprising a sleeve adapted to be secured to a wall of a combustion chamber, a fixed electrode carried by said sleeve, a guide located in said sleeve, a rotatably mounted in said guide, a metal shell attached to the other end of said sleeve, said shell providing a chamber therein, an expansible bellows located in said chamber and adjustably connected to said movable electrode for shifting the same, an electrical terminal connected to one end of said bellows, said bellows serving as a conductor for connecting said terminal with said movable electrode, and means connecting said chamber with atmosphere whereby the position of said movable terminal is varied with variations in atmospheric pressure.

2. A spark plug of the class described, comprising a sleeve adapted to be secured to a wall of a combustion chamber, a fixed electrode carried by said sleeve, a guide located in said sleeve, a movable electrode slidably mounted in said guide, a shell attached to the other end of said sleeve, said shell providing a chamber therein, an expansible bellows located in said chamber and adjustably connected to said movable electrode for shifting the same, an electrical terminal connected to one end of said bellows, said bellows serving as a conductor for connecting said terminal with said movable electrode, and means connecting said chamber with atmosphere whereby the position of said movable terminal is varied with variations in atmospheric pressure.

3. A spark plug of the class described, comprising a sleeve adapted to be secured to a wall of a combustion chamber, a fixed electrode carried by said sleeve, a guide located in said sleeve, a movable electrode slidably mounted in said guide, a metal shell attached to the other end of said sleeve, said shell providing a chamber therein, pressure responsive means located in said chamber and connected to said movable electrode for shifting the same, an electrical terminal connected to one end of said bellows, said bellows serving as a conductor for connecting said terminal with said movable electrode, an insulating cup located in said shell, additional means for insulating said shell from said terminal, and means connecting said chamber with atmosphere whereby the position of said movable terminal is varied with variations in atmospheric pressure.

4. Ignition apparatus of the class described, for igniting a combustible mixture in a chamber subject to variations in atmospheric pressure, said apparatus comprising a fixed electrode, a movable electrode shiftable lengthwise to vary the gap between said fixed and movable electrodes, a housing providing a second chamber, a pressure responsive bellows located in said second chamber and connected to said movable electrode, a guide in which said movable electrode is slidably mounted, said guide and electrode substantially cutting off communication between said two chambers, and means providing a free communication between said second chamber and atmosphere.

WILLIAM C. PARRISH.

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