

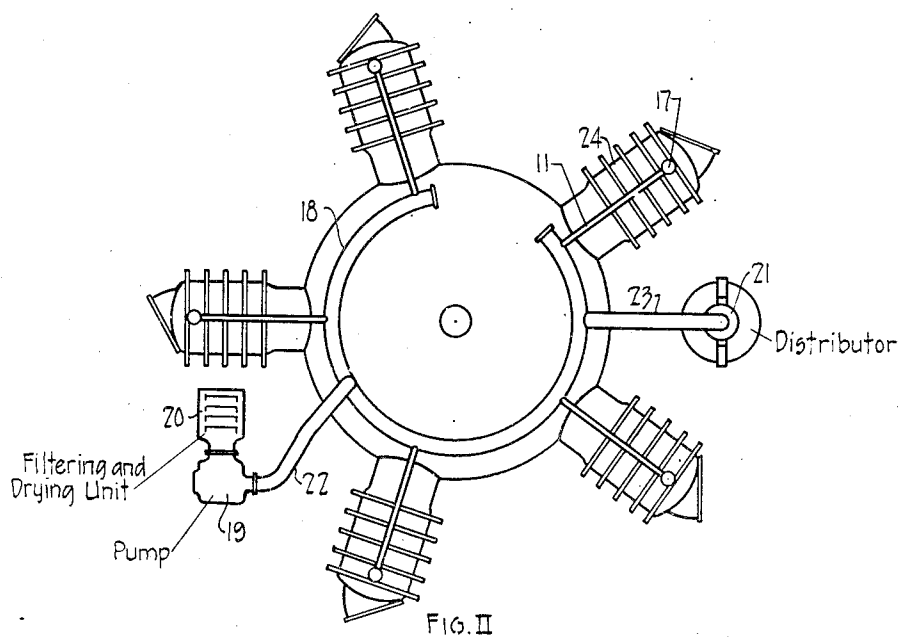
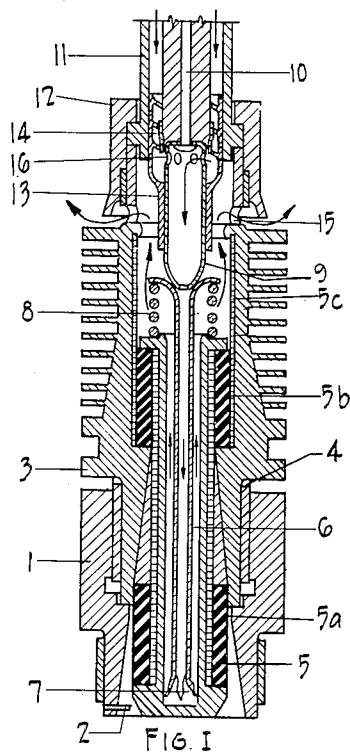
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IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES

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IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES

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The present invention relates to an improvement in ignition systems for internal combustion engines and particularly to a method and apparatus for cooling the central electrode of spark plugs of internal combustion engines utilizing spark ignition.

It is known that when spark ignition engines are heavily loaded in operation, the electrodes of the spark plugs may become sufficiently overheated to cause pre-ignition, detonation and similar forms of uncontrolled combustion. This trouble is encountered especially with gasoline engines, particularly owing to the central electrode, for this electrode must be electrically insulated from the body of the spark plug by means of materials which in most instances are also heat insulators. Whereas the body of the spark plug can be cooled by metal fins which are exposed to the air, this is not the case with the central electrode, since the latter is not only largely enclosed in the body of the spark plug, but the projecting part is frequently surrounded by a radio screening device as well.

It is also known that a large part of the ignition troubles encountered in aircraft engines and formerly attributed to faulty spark plug operation has in reality been caused by the high tension cables leading from the current source to the spark plugs due to the presence of moisture in the cable harness, the tendency to high tension cable breakdown at high altitudes, and other factors which tend to permit at least a temporary short circuit between the grounded metal harness and the cables themselves.

It is an object of the present invention to provide a system and apparatus whereby both of these common difficulties are overcome in a related manner. Further, it is an object of the instant invention to provide a spark plug of improved design, particularly suitable for use according to the system to be described. Still further, it is an object to provide means whereby these difficulties are overcome with but slight modification of equipment already normally existent in aircraft engines.

It has already been proposed to cool spark plug electrodes in internal combustion engines by making the electrodes hollow and drawing air from outside into the cylinders through the electrodes during the suction stroke of the piston. In this case the conduits leading from the atmosphere to the cylinder space through the electrodes must be provided with non-return valves of one sort or another to prevent air or combustion gases from being driven out during the

compression and working strokes of the pistons. These valves constitute a weak point from an operating standpoint, since their failure to operate will have serious consequences.

In the method according to the present invention a coolant, preferably air or other suitable gaseous materials such as carbon dioxide or exhaust gases, is passed through a hollow central spark plug electrode which is closed towards the cylinder space. The internal hollow electrode is, therefore, not in communication with the cylinder space, so that there can be no escape of hot combustion gases through the electrode. As a coolant, dry air is quite suitable; it is a satisfactory electric insulator and further, in the present case will be supplied to the hollow electrode under pressure, the electrode being thus easily kept within the desired operating temperature range of 500° to 800° C.

It has also now been found that by pressurizing the so-called "harness," which consists of metallic tubing suitably formed and which serves to protect the spark plug cables, most of the heretofore encountered trouble with short circuiting between the harness and the cables may be eliminated. In the present invention air under pressure from a pressurized harness is utilized as a coolant for the central electrode of the spark plugs, as will be more clearly understood from the following description of the appended drawing.

Figure I is a sectional elevation of a spark plug especially adapted for use according to the invention.

Figure II is a diagrammatic drawing of a pressurized harness as utilized according to the invention.

Referring particularly to Figure I, the spark plug comprises a bushing-shaped part 1 including an earthed electrode 2, a central body 3 with the central electrode 4, which is insulated by insulating material 5, 5a, 5b, 5c from the body 3 of the spark plug. The part of the central body projecting from the cylinder is provided with cooling fins.

Electrode 4 is provided with a cavity extending to the bottom end thereof and a tube 6 is fitted within this cavity projecting to the bottom of the same, where it is split and equipped with tongues bent outwards to center it as at 7. The top of the tube 6 is widened and is subjected to the action of the spring 8 which tends to urge the tube upwards. As a result the tube 6 is pressed against the hollow contact piece 9, which both established electric contact between

the central electrode 4 and the spark plug cable 10 and conveys cooling air to tube 6 from the space between cable 10 and the harness tube 11. Harness tube 11 is fastened to the electrode body 3 by means of a cap nut 12. Care must of course be taken that contact piece 9 is insulated with respect to the grounded portion of the spark plug. To this end the intermediate piece 13, provided with air ducts 14, should be made on non-conductive material. Near its top, the central body 3 is provided with openings 15, through which the air which has passed through tube 6 of the central electrode and then through the annular space around this tube can escape to the atmosphere. The hollow contact piece 9 is also provided with openings as at 16 to permit ingress of air to tube 6.

In Figure II, each cylinder as at 24 of a radial aircraft engine is supplied with a spark plug 17 constructed as shown in Figure I. A harness lead as at 11 extends from each spark plug to the harness manifold 18. High tension cables lead from a distributor 21 through a sealed conduit 23 to the harness manifold 18 and thence to each spark plug through harness leads as at 11. An air pump 19 including a unit 20 for drying and cleaning purposes supplies compressed air through a sealed conduit 22 to the harness manifold 18. If the engine or auxiliary equipment already includes a source of compressed air, as for example in airplanes utilizing pressurized cabins or those wherein fuel injection for the engines is used, the supercharger in such cases compressing only air, the air pump 19 shown is not necessary.

In operation, sufficient air is supplied to the manifold harness 18 and harness leads (as at 11) to maintain a positive pressure upon the high tension cables to the spark plugs of approximately 5 lbs. per square inch, this pressure having been found satisfactory for most operating conditions to inhibit short circuiting. The air pressure within the harness will of course depend upon the volume and pressure of air supplied to the harness as well as the resistance to air flow through the spark plugs. Therefore, in operating a given engine according to the invention the flow resistance through the spark plugs should be modified (for example by varying the size of the orifices at 14, 15 or 16) so that a sufficient amount of air is passed through the spark plugs for cooling purposes and at the same time enough resistance to air flow is provided to maintain the desired pressure in the harness around the high tension cables.

The conditions mentioned previously herein, i. e., sufficient air to control the spark plug temperature between 500° and 800° C. and at the same time maintain an approximate 5 lbs. per square inch pressure in the harness will be found satisfactory in most instances.

I claim as my invention:

1. Ignition means for internal combustion engines comprising in combination a spark plug including a hollow central electrode closed toward the firing end, a cable leading from a source of high tension current to said spark plug, a harness enclosing said cable and means adapted to continuously pass a gaseous coolant under pressure into said harness and through said hollow central electrode of said spark plug.

2. Ignition means for internal combustion engines comprising in combination a spark plug including a hollow central electrode closed toward the firing end, a tube in said hollow electrode of substantially lesser diameter than the inside diameter of said hollow electrode, communication means between the interior of said tube and the space between said tube and the inner wall of said hollow electrode near the firing end of said hollow electrode, communication means between said space and the atmosphere, a cable leading from a source of high tension current to said spark plug, conductive means forming a contact between said cable and said hollow central electrode, a harness enclosing said cable, means for continuously supplying gaseous coolant under pressure to said harness and means connecting said harness and said tube adapted to permit passage of gaseous coolant from said harness to said tube.

3. Ignition means for internal combustion engines comprising in combination a spark plug, a hollow central electrode in said spark plug closed toward the firing end, a cable leading from a source of high tension current to said spark plug, a harness enclosing said cable, means adapted to continuously pass a gaseous coolant under pressure into said harness, a connecting passageway between said harness and the firing end of said hollow central electrode, an independent connecting passageway between the firing end of said hollow electrode and the atmosphere, said passageways being arranged and adapted to provide sufficient resistance to gas flow to maintain a pressure in said harness.

4. The method of operating the ignition means of a spark-fired internal combustion engine utilizing a spark plug adapted to permit passage of a gaseous coolant therethrough and a harness enclosed high tension cable leading to said spark plug comprising continuously supplying a gaseous coolant under pressure to said harness and from said harness to said spark plug, a sufficient gaseous pressure being maintained in said harness to inhibit the tendency to high tension cable breakdown.

5. The method according to claim 4 wherein the gaseous pressure is maintained in the cable harness at approximately five pounds per square inch.

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