W. H. McNUTT.

SPARK PLUG.

APPLICATION FILED AUG. 4, 1910.

975,056. Patented Nov. 8, 1910.

Fig. 1.

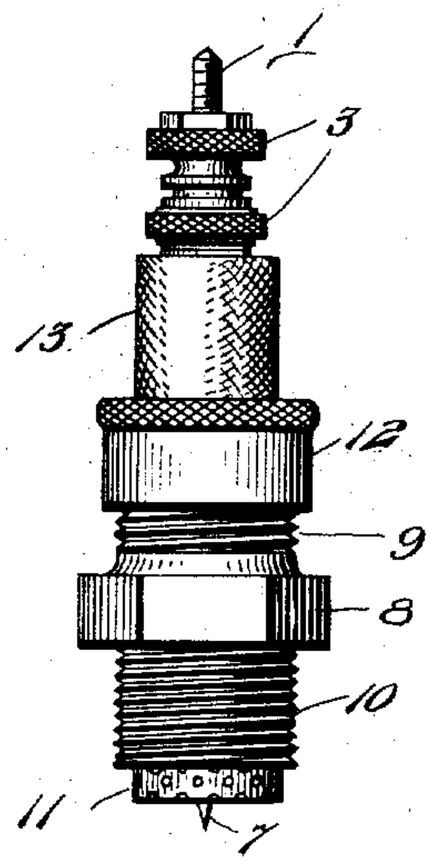


Fig. 2.

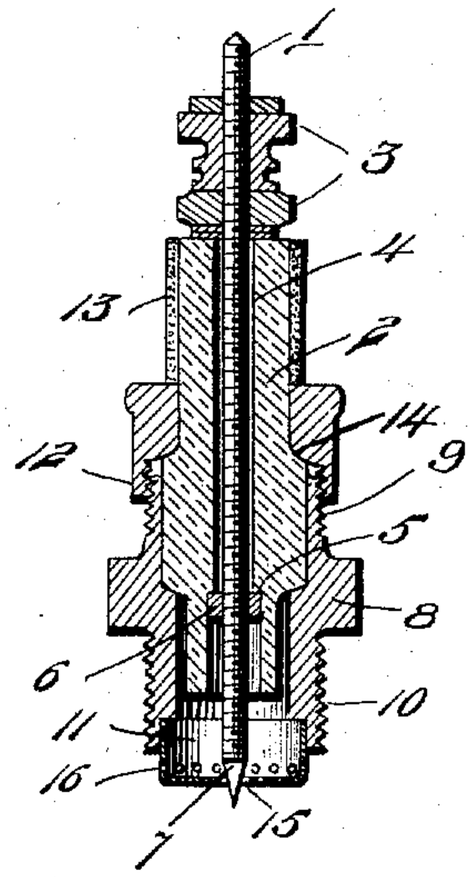
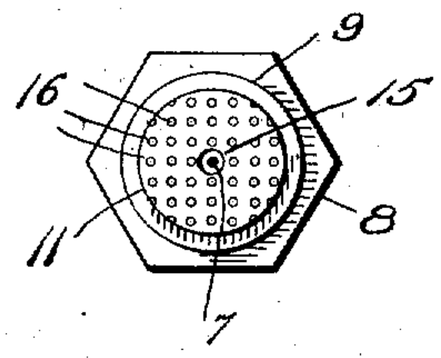


Fig. 3.



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SPARK-PLUG.

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To all whom it may concern:

Be it known that I, WILLIAM H. McNUTT, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Spark-Plugs, of which the following is a specification.

This invention relates to spark plugs; and it comprises a spark plug for an explosion motor provided with an electrode or pole piece in coöperative relationship to an inclosing foraminous member, said foraminous member constituting a second pole piece and having a sparking orifice in coöperative relationship to the first pole piece, and having a plurality of smaller distributed flame-extinguishing orifices; all as more fully hereinafter set forth and as claimed.

In the operation of internal combustion motors, considerable difficulty is always experienced with the spark forming devices employed for igniting the explosive mixture in the engine cylinder, for the reason that the insulating surfaces between the pole pieces tend to become covered with an adherent coating of carbon or soot which, in time, short circuits the current around the pole gap. In a spark plug, there must of necessity be a layer of insulation, which is generally of porcelain, between the pole pieces and there is much difficulty in keeping the surface of this insulating layer free from soot. One of the chief causes of this deposition of soot is the sudden chilling of the hot explosion flame carrying incandescent carbon particles as it impinges on the relatively cool metal around the plug, the explosion cylinder being usually water-jacketed. In the case of mixtures rich in hydrocarbons, as for example the gasolene-air mixture commonly employed in automobiles, this effect is especially pronounced. The soot produced in the cylinder is oily in its nature and tends to cling strongly to porcelain. Another important cause of a carbon-film formation is the cracking and carbonization of the heavier oil injected into the cylinder for purposes of lubrication. This oil is distributed by the repeated compressions and explosions to every part of the cylinder chamber as a clinging film or layer, and by exposure to the direct explosion flame it becomes cracked, baked and carbonized into a tenacious film. The result of these combined causes is therefore that every surface within the cylinder in direct contact with the explosion flame tends to become coated with soot. And with the usual structures in spark plugs, the insulation is exposed more or less directly to the flame. Sometimes the insulation is placed at the base of a restricted chamber communicating with the flame chamber proper through a more or less circuitous passage but this merely delays the sooting. Such a chamber is, relatively speaking, a "dead end" for gases and tends in time to fill up with soot, this tendency being the greater the more circuitous the communication. And in the alternate compression and expansion of the gases in the cylinder more or less of the sooty gases tend to enter the small chamber and leave their soot behind. Occasionally the insulation is covered with a metal cap having a perforation registering with the end of the spark point, the spark being produced between the point and the walls of the perforation; but such a cap, for similar reasons, has been found to form an excellent soot-accumulating chamber. Except where the soot coating occurs on the insulation between the electrodes and on the sparking terminals it does no great harm. Where formed on the insulation, the short circuit resulting in time prevents further use of an engine until the spark plug has been taken out and the insulating surfaces freed from adhering soot. The soot deposited on sparking points causes the points to pit and wear away rapidly, thus requiring constant adjustment and frequent replacement of the electrode terminals.

In the present invention I use a metal cap but in lieu of leaving it imperforate and thereby forming a dead gas chamber around the insulation, I provide it with a plurality of substantially uniformly distributed small orifices, each too small to permit the passage of flame therethrough. This prevents the cap chamber forming a dead end since the small perforations operate to equalize pressures within and without the chamber and at each change in pressure the gases stream into and out of the chamber in all directions. The perforations in the metal being relatively small however, the cap acts like a Davy lamp in that the flame in the explosion chamber cannot pass inward to deposit soot within the cap chamber during the expansion incident to explosion. Soot cannot permanently clog these orifices since

the rush of gases therethrough is relatively violent.

In a particularly advantageous form of plug embodying my invention the end of the plug to be inserted into the body of the cylinder is provided with a foraminous metal thimble or cap, forming one pole piece and inclosing another and rodlike pole piece which at its base is passed through the usual insulating layer. Approximately in the center of the cap face is a relatively large orifice registering with the end of the pole piece, and distributed over the remaining surface of the cap are a number of considerably smaller distributed orifices of such diameter that they will not permit the passage of flame. The thicker the metal of the cap the larger, within bounds, may be these perforations. The cap may be chrome steel. The other coöperating pole piece is best mounted substantially in the axis of the plug and is insulated from its walls in the usual way as by a porcelain sleeve. Its sparking terminal is best peaked or cone-shaped being of a shape and size adapting it to fit tightly in the large orifice and is so positioned in use with respect to this large central orifice of the cap that the distance between the edges of the orifice and the adjacent conical pole point is substantially uniform at all points and the width of the annular clearance is approximately equal to the diameter of the smaller orifices in the face of the thimble, thereby preventing the passage of flame in either direction. By screw-threading this pole piece it may be made adjustable in this respect. By this arrangement the igniting spark is produced at the surface of the protecting cap between the edges of the orifice and the point of the electrode and in contact with the explosive mixture in the cylinder. In mounting the plug in position, the adjustable threaded cone-pointed pole piece is screwed into position until it engages with the orifice and is then given a backward turn until the desired narrow annular clearance is produced between the orifice edges and the cone point. With this narrow clearance, a hot, blue, highly efficient spark is produced. This ignites the main body of mixture in the cylinder but the flame thereof cannot pass backward into the cap chamber. With the described type of foraminous cap, the cap chamber will also contain explosive mixture and this small sub-body of mixture is also and simultaneously ignited. This by its equilibrating pressure tends further to prevent entrance of the main flame into the cap chamber and on the release of pressure the gases in the cap chamber positively sweep out the chamber and clear the flame extinguishing orifices of any accumulated soot. The orifices being evenly distributed, this sweeping action clears the whole cap chamber, leaving no corners or pockets for accumulation of soot. The explosion flame in the engine cylinder cannot strike back into the electrode or cap chamber since with this arrangement all the orifices in the thimble are too small for the passage of flame. The foraminous protective cap also operates to keep the surface of the insulation relatively cool since it prevents the main flame coming into direct contact therewith and gases such as may pass inward through the orifices are cooled somewhat by the metal, so that oil coming into contact with the insulation does not crack or char readily. The usual insulation in spark plugs is porcelain and hot porcelain surfaces have a catalytic action on hot oil favoring the deposition of carbon.

In the accompanying illustration I have shown, somewhat diagrammatically, an embodiment of the described invention.

In this showing, Figure 1 is an elevation of the spark plug as a whole; Fig. 2 is a vertical section of the same; and Fig. 3 is a plan view of the perforated protective cap.

In this showing, the threaded pole 1 carries the lock nuts 3—3 and passes through the opening 4 which extends through the insulating sleeve 2 of procelain or other like material. The opening 4 is somewhat enlarged beyond the shoulder 5 as shown. The collar 6 is threaded to engage the pole 1, and with the lock nuts 3—3 serves to adjust the position of the pole terminal which has a cone-shaped point 7. The pole piece may be of any desired diameter provided the coned end be reduced sufficiently to permit engagement with the orifice. The nipple 8 is provided with threads 9 and 10 and carries inset at its lower end the foraminous cap 11 of relatively heavy metal in good thermal contact therewith. A threaded coupling 12 engages thread 9 of the nipple 8 and also abuts against the shoulder 14 of the porcelain sleeve 2, thus serving to hold the parts 2 and 8 firmly together. The porcelain sleeve is preferably provided at its upper portion with a protecting sleeve 13 of asbestos fabric or other suitable material which prevents cracking of the hot porcelain by contact with cold water or oil splashed upon it. Cap 11 is provided with a relatively large orifice 15 located in the center of the cap face and adapted to register with terminal 7, and is also furnished with a plurality of other smaller orifices 16 distributed over its entire surface. These smaller orifices as before noted are of such diameter that a flame cannot pass through them. Terminal 7 may or may not project somewhat beyond the cap.

The operation of this structure is obvious from the foregoing. In use, the pointed end of the inner electrode may be adjusted in the manner stated to and from the orifice in the foraminous cap, with which it regis-

until the desired amount of clearance is obtained. On sparking the explosive mixture in the engine cylinder and inflaming it, there is no possibility of the main flame of mixture being propagated backward through the relatively small holes of the cap with attendant deposition of soot within the cap while with proper adjustment of the point, the flame cannot pass backward through the large orifice. And with the alternating pressure and release of pressure in the cylinder, the cap chamber is swept and kept clean by inwardly and outwardly rushing gas currents in the manner stated and cannot become a dead end. The heat of the flame is also kept away, in large measure, from the porcelain insulation since the cap is of relatively heavy metal and in thermal contact with the metal of the engine cylinder.

A plurality of pole pieces and corresponding registering orifices in the foraminous cap may of course be employed though for the sake of simplicity I have shown but a single axial pole piece.

The foraminous protective cap may be employed with any of the ordinary types of spark plug.

What I claim is:—

1. A spark plug provided with a protruding electrode or pole piece, a foraminous metal cap inclosing said pole piece and having one orifice registering with the end thereof and forming the opposing electrode, the size of said pole piece being so proportioned to that of said orifice, that when the electrodes are operatively positioned the passage therebetween is of less than flame-passing magnitude, and all the other orifices of said foraminous cap being also of less than flame-passing magnitude.

2. A spark plug provided at one end with a foraminous cap or thimble, all but one of the orifices in said foraminous cap or thimble being too small to permit flame passage while one of said orifices is of larger size, a rod-like electrode supported substantially in the axis of said cap and insulated therefrom, and having one end positioned in spark-forming relationship to the relatively large orifice and adapted to form a spark gap therewith of less than flame-passing magnitude.

3. A spark plug comprising a multiperforated metal cap or thimble forming a sparking terminal, and a second electrode inclosed by and insulated from said terminal and having one end in spark-forming relationship to the edges of a relatively large orifice in said foraminous thimble, the gap therebetween being of less than flame-passing width, and the other orifices in said thimble also being so small as to prevent the passage of flame therethrough.

4. In a sparking plug, an electrode chamber comprising a foraminous metal cap or thimble and constituting one electrode, the majority of the orifices in the cap being so small as to prevent passage of flame therethrough, and a second adjustable electrode adapted to close the remainder of the orifices to an extent sufficient to prevent flame passage therethrough.

5. A spark plug provided at one end with a foraminous cap or thimble all but one of the orifices in said foraminous cap or thimble being too small to permit flame passage and the remaining orifice being relatively large and an insulated rod-like electrode supported in the axis of the plug with one end positioned in spark-forming relation to said foraminous thimble, and closing said relatively large orifice to an extent sufficient to prevent flame passage therethrough.

6. A spark plug comprising an electrode surrounded by a projecting sleeve of insulating material, a fibrous sleeve covering a part of said insulated electrode, a metallic sleeve inclosing the remainder of said insulated electrode and forming a second electrode, and a foraminous cap carried by said second electrode having a relatively large central orifice registering with the terminal of the first electrode and forming therewith a spark gap too small to permit flame passage, and also having a plurality of other orifices too small to permit flame passage therethrough.

7. In a sparking device having a metal body and provided with electrodes spaced by porcelain insulation, a foraminous cap of relatively heavy metal forming one electrode terminal and inclosing said porcelain and in heat-conducting relationship to the metal body of said sparking device, all but one of the orifices in said cap being relatively minute and adapted to extinguish flame passing therethrough and the remaining orifice being of greater magnitude, and an adjustable electrode within said cap and having an end adapted to register with the larger orifice and form an annular spark gap therewith of less than flame-transmitting magnitude.

8. A sparking device comprising an electrode provided with a foraminous metal cap or thimble forming an electrode chamber and a vertically-adjustable electrode insulated from and supported within said electrode chamber, said electrode chamber being provided with a relatively large orifice in register with the end of said adjustable electrode and of size and form adapting it to form with said end an annular spark gap of less than flame-transmitting magnitude and said chamber being also provided with a plurality of other orifices, all of which are of less than flame-transmitting magnitude.

9. A sparking device comprising an electrode provided with a foraminous metal cap or thimble forming an electrode chamber

and a vertically adjustable electrode having a coned end and insulated from and supported within said electrode chamber, said electrode chamber being provided with an orifice registering with the coned end of said adjustable electrode and of somewhat smaller diameter than the body of said adjustable electrode, said orifice being adapted to form with said coned end an annular spark gap of less than flame-passing magnitude, and said chamber being also provided with a plurality of other orifices, all of which are of less than flame-transmitting magnitude.

In testimony whereof, I affix my signature in the presence of witnesses.

WILLIAM H. McNUTT.

Witnesses:

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JNO. MORGAN.