H. M. CROWTHER

SPARK PLUG.

APPLICATION FILED OCT. 16, 1919.

1,363,842. Patented Dec. 28, 1920.

FIG. 1.

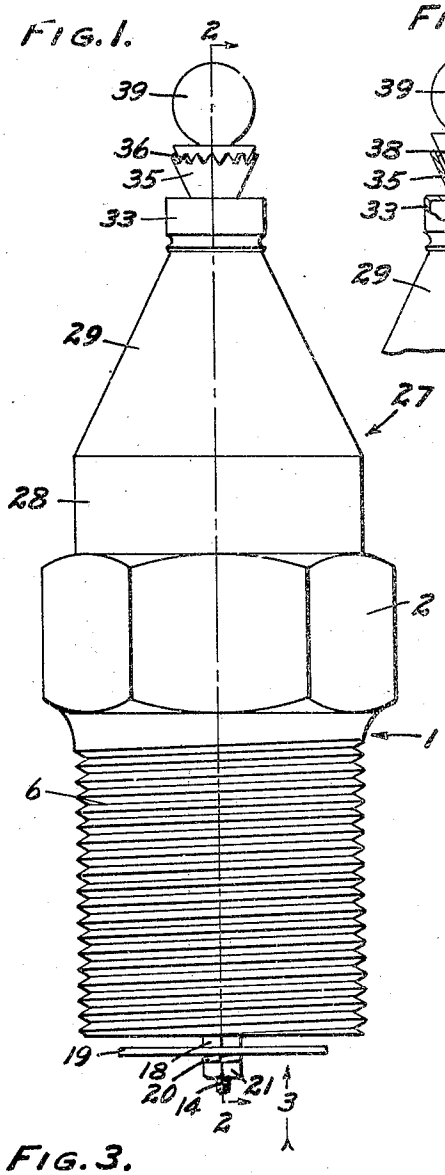


FIG. 4.

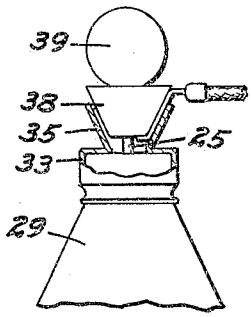


FIG. 2.

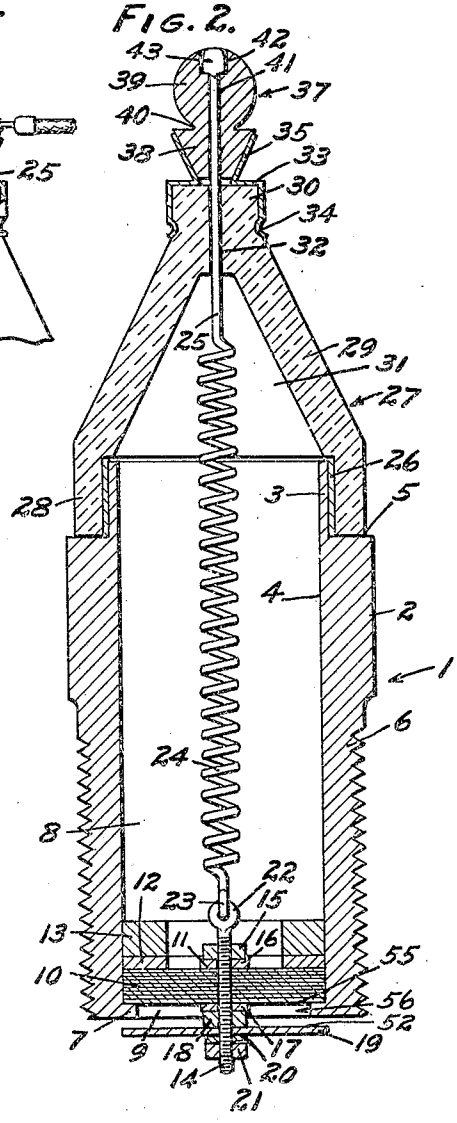
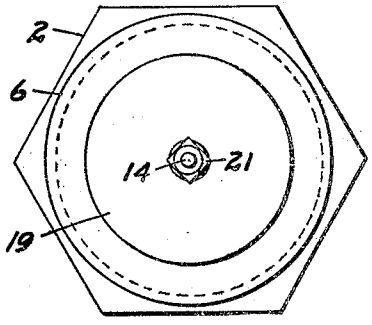


FIG. 3.



INVENTOR.

HENRY M. CROWTHER

BY Hazard & Miller

ATTORNEYS.

UNITED STATES PATENT OFFICE.

HENRY M. CROWTHER, OF KINGMAN, ARIZONA.

SPARK-PLUG.

1,363,842. Specification of Letters Patent. Patented Dec. 28, 1920.

Application filed October 16, 1919. Serial No. 331,164.

To all whom it may concern:

Be it known that I, HENRY M. CROWTHER, a citizen of the United States, residing at Kingman, in the county of Mohave and State of Arizona, have invented new and useful Improvements in Spark-Plugs, of which the following is a specification.

My invention relates to spark plugs and consists of the novel features herein shown, described and claimed.

Figure 1 is a view in elevation of a spark plug embodying the principles of my invention.

Fig. 2 is a diametrical longitudinal sectional detail as on the line 2—2 of Fig. 1.

Fig. 3 is a bottom plan view as indicated by the arrow 3 in Fig. 1.

Fig. 4 is a fragmentary sectional detail of the outer end of a plug showing partly in section the fastener with one form of conductor terminal attached thereto.

The metal case 1 has a hexagonal upper end 2 forming a wrench seat, a straight annular flange 3 extending upwardly from the wrench seat 2, the flange 3 being in line with the inner face 4 of the casing and there being a flat shoulder 5 at the upper end of the wrench seat outside of the flange 3, an externally screw-threaded nipple 6 extending downwardly from the wrench seat 2, and an annular flange 7 extending inwardly from the lower end of the nipple 6 thus forming a straight chamber 8 surrounded by the face 4 and an opening 9 through the flange 7.

The main insulator 10 is formed of a multiplicity of circular mica disks and the disks are cut to fit very tight in the chamber 8 upon the flange 7, and the insulator 10 has a circular central opening 11.

An asbestos gasket or cushion ring 12 fits tightly within the chamber 8 against the insulator 10. The heavy metal retaining ring 13 is pressed tightly into the chamber 8 against the gasket 12 so as to hold the insulator 10 gas tight and so as to withstand the pressure of the explosion.

The threaded wire 14 is inserted through a binding nut 15, then through an asbestos washer 16, then through the opening 11 in the insulator 10, then through an asbestos washer 17, through a binding nut 18, through the terminal 19, through a spring washer 20 and through a binding nut 21. The upper end of the wire 14 is flattened and perforated to form an eye 22. A hook 23 is formed upon the lower end of the retractile coil spring 24, and the stem 25 extends from the upper end of the spring 24.

A cushion ring 26 is made of asbestos paper saturated with shellac and fits tightly upon the flange 3. The auxiliary insulator 27 has a straight portion 28 fitting the cushion 26 and fitting the shoulder 5, a conical portion 29 extending upwardly from the straight portion 28, and the head 30 at the upper end of the conical portion 29. The insulator 27 forms a conical chamber 31 extending upwardly from the chamber 8 there being a central opening 32 extending upwardly from the chamber 31 through the head 30. The stem 25 fits slidingly in the opening 32. The auxiliary insulator 27 simply serves as a cover for the case 1 and a mounting for the feed wire binding post.

A metal cap 33 fits upon the head 30 and the edge 34 of the cap is spun into a groove around the head. A funnel-shaped socket 35 extends upwardly from the center of the cap 33 and has saw teeth 36 in its upper edge. The terminal or binding post 37 consists of a conical plug 38 fitting in the socket 35 and a spherical head 39 extending upwardly from the plug, there being a neck 40 between the head and the plug and there being a central bore 41 to receive the stem 25 and a socket 42 at the upper end of the bore 41. The stem 25 extends through the bore 41 and in making the spark plug the stem 25 is made over length and the stem 25 is pulled upwardly to give the spring 24 the desired tension, and then a spot is flattened in the stem 25 to form the head 43 and the wire is cut away above the head 43 and the head 43 released to settle into the socket 42. The socket 35 and the terminal 37 form a universal connector that will take a great variety of wire fasteners and hold the fasteners securely without the use of any nuts.

The coil spring 24 is of a comparatively light tension and the function of the coil spring is to assist in retaining the auxiliary insulator 27 in place and to allow for excessive expansion and contraction under heat and operation and to provide a spring terminal connection for the feed wire without the use of nuts. The wire 14, the head 22, the hook 23, the coil 24 and the stem 25 form the feed wire conductor to the spark gap terminal 19 and the case 1 forms the return conductor in the usual way.

The spark gap terminal 19 is circular in plan and is made of thin metal preferably

copper-nickel or copper-tungsten alloy so that it will be refractory to heat and expose a metal (copper) that has the property of not readily accumulating soot and that will readily heat and cool under the action of the engine.

The spark for ignition within the cylinder establishes itself between the disk terminal 19 and the end of casing 2. A spark may establish itself at any point around the edge of the disk and when that point is worn back by the action of the spark another point on the edge of the disk becomes the point most acceptable for the spark, being then the point of least resistance, and in this manner the disk may continue being operative as a conductor for the jump spark for a long time or until it is worn back too far from the end of the casing, at which time a new disk can be positioned in place of the old one and properly set relative to its distance from the end of the casing.

The trouble with the best spark plugs heretofore made has been that the insulating cores will become coated with smoke, lamp black, or carbon from poor combustion of the explosive mixture, and this coating forms more or less of an electric conductor to carry the electricity from the central feed rod along the surface of the insulating core to the casing. In this type of spark plugs the casing forms the return side of the spark gap. In order that a spark plug shall work satisfactorily it is necessary that the entire force of the electric current pass through the spark gap and any leakage of the current due to the smoke deposit upon the insulating core will reduce the power and certainty of the spark. It is not necessary that a full short circuit be established between the feed rod and the casing to ruin the efficiency of the spark plug. Any continuous layer of soot or smoke or carbon, all of which may be called lamp black, extending from the feed rod along the exposed face of the insulating core to the casing reduces the efficiency of the spark to the extent of the current which will leak through this layer of lamp black, and any effective gap or break in this layer of lamp black will stop the leak, although the other parts may be loaded with lamp black.

The lower face 55 of the main insulator 10 within the area of the opening 9 is exposed to the lamp black deposit and the object of the particular construction of the spark gap terminal 19 is to bring the portion 52 close enough to this exposed face 55 to burn the lamp black from the insulator and break the circuit of electricity through the lamp black from the nut 18 or the terminal 19 to the case 1.

The chamber 56 between the insulator 10 and the terminal 19 is substantially of even thickness. The material of the terminal 19 is exposed to the flash of the exploding fuel mixture on both sides and all around, and the material of this terminal 19 is of a high degree of fusibility so that it will stand the temperature rising to the verge of red-hotness or incandescence for an indefinite time, and the material is of high conductivity, absorption and radiation so that it will readily become heated to the desired extent and readily give off the heat to lower the temperature so that at the time of the explosive flash the terminal will be almost or quite red-hot and will retain this temperature for an instant and then cool sufficiently so that it will not prematurely ignite the next charge.

The explosive mixture will enter and fill the chamber 56, and at the time of the explosion there will be a flash inside of the terminal 19 as well as outside, and the heat will circulate freely all around the terminal and at the time of the explosion and immediately following the explosion the terminal 19 will be hot enough to burn the lamp black from the surface 55 of the insulator 10 thereby breaking the continuity of the lamp black between the terminal 19 and the case 1. At this time the lamp black is backed by the refractory non-heat-conducting non-heat-absorbing insulator 10 and faced by an element of high conductivity, high absorption, and rapid radiation, and the heat of this element, that is the terminal 19, in close proximity to the lamp black, the lamp black being a perfect absorber of heat will instantly ignite and burn the lamp black.

The lamp black deposit upon the inner and outer surfaces of the terminal 19 during the period of poor combustion will ignite and burn when the combustion improves and the burning of this lamp black will assist in heating the terminal 19 and assist in burning the lamp black from the insulation face 55. The layer of lamp black as deposited is porous and more or less saturated with oxygen, and while it will not ignite and burn from the flash of the explosion it will readily burn in the presence of a hot element where the heat continues for a short time after the flash has gone.

In the construction of the plug the metallic ring is made oversize and is forced into place in the bottom of the casing against the mica disk which operation might swell the casing slightly, therefore the thread is then formed on the casing after the ring is in place.

While the mica insulator is the preferred form for my plug it is readily understood that a disk of other suitable material such as porcelain might be used.

It is obvious that various changes might

be made in the invention as herein set forth in its preferred form without departing from the spirit thereof as claimed.

I claim:

1. A spark plug comprising a casing having an inner screw threaded end carrying an inwardly extending flange, an outer insulator mounted upon the outer end of the casing, an inner insulator fixed within the inner end of the casing against the flange, a spark disk positioned upon the inner insulator and properly spaced therefrom and spaced to form a proper spark gap between it and the inner end of the casing, and a conductor rod comprising a means for connecting with the spark disk and passing through the inner insulator, a retractile spring within the casing and spaced from its inner wall and an outer extension passing through the outer insulator adapted to draw inwardly on the outer insulator.

2. A spark plug comprising a casing having an inner screw threaded end carrying an inwardly extending flange, an outer insulator mounted upon the outer end of the casing, an inner insulator fixed within the inner end of casing against the flange, means mounted on the inner insulator for forming a spark gap with the inner end of the casing and a conductor rod comprising a means for connecting with the spark disk and passing through the inner insulator, a retractile spring within the casing and spaced from its inner wall and an outer extension passing through the outer insulator adapted to draw inwardly on the outer insulator.

3. A spark plug comprising a casing having an inner screw threaded end carrying an inwardly extending flange and an outer face and an extending annular member, an outer cone shaped insulator adapted to fit over the annular member and seat upon the outer face, a metallic cap having a funnel shaped outwardly extending portion fixed to the outer end of the insulator, an insulator comprising plurality of mica disks fitting closely the bore of the casing against the inwardly extending flange, a non-conducting gasket laid against the mica insulator, a metallic retaining ring pressed against the gasket whereby the insulator is retained in its position against the internal pressure developed in an engine cylinder, a threaded rod passing through a central bore in the mica insulator having set nuts on either side thereof, a spark disk mounted on the inwardly extending end of the rod and properly spaced from and parallel with the face of the mica insulator and spaced from the inner end of the casing to form a proper spark gap, a retractile spring connecting with the end of the rod within the casing and extending outwardly through the end of the cone shaped insulator and terminating in a metallic fitting adapted to the funnel shaped cap and loosely connected therewith whereby a conductor connecting with the fitting may set up a circuit through the spring, through the spark disk across the gap returning through the casing.

4. A spark plug including a casing having an inner screw threaded end, an outer insulator mounted upon the outer end of said casing, an inner insulator fixed in the inner end of the casing, a spark disk mounted upon the inner insulator and properly spaced therefrom and from the inner end of the casing, a terminal on the outer end of said outer insulator, a conductor extending through said inner insulator and connected to said spark disk, a spring connected at one end to the inner end of said conductor and extending through said casing and said outer insulator and connected to said terminal and holding said disk, outer insulator and terminal in position.

5. A spark plug including a casing having an inner screw threaded end, an outer insulator mounted upon the outer end of said casing, an inner insulator fixed in the inner end of the casing, a spark disk spaced from said inner insulator and from the inner end of said casing and forming a spark gap between it and the casing, a screw extending through said inner insulator and through said disk, a nut screwing on the outer end of said screw outside of said disk, a terminal on the outer end of said outer insulator, and a spring connected at one end to the inner end of said screw and extending through said casing, said outer insulator and connected at its other end to said terminal and holding said disk, said outer insulator and said terminal in position.

In testimony whereof I have signed my name to this specification.

HENRY M. CROWTHER.