J. M. ATWATER.

SPARK PLUG.

APPLICATION FILED APR. 29, 1920.

1,406,810. Patented Feb. 14, 1922.

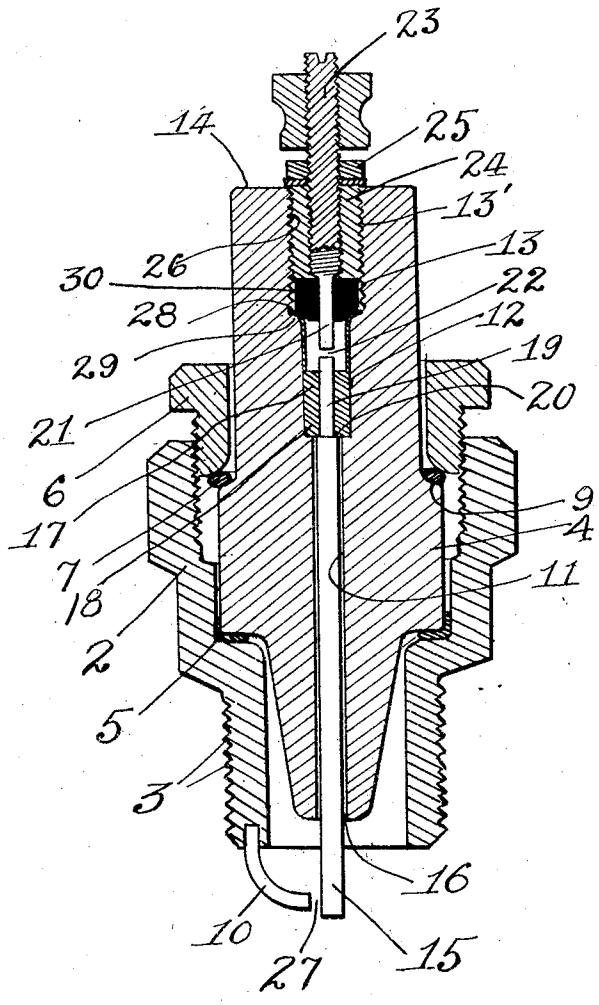


Fig. 1

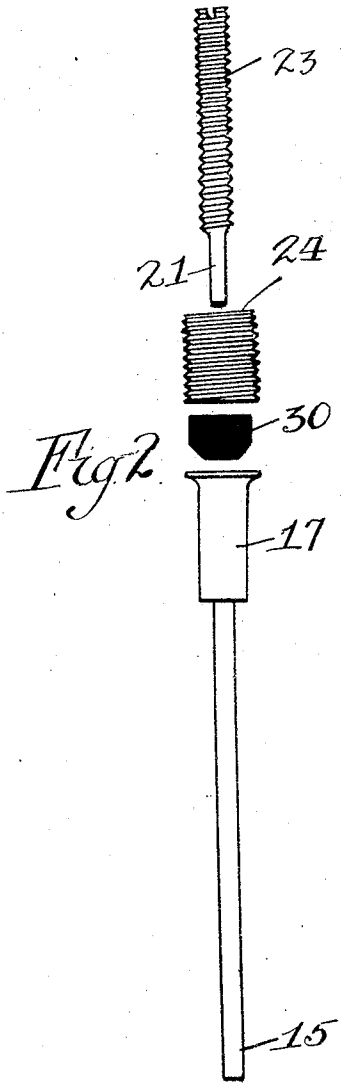


Fig. 2

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UNITED STATES PATENT OFFICE.

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SPARK PLUG.

1,406,810. Specification of Letters Patent. Patented Feb. 14, 1922.

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To all whom it may concern:

Be it known that I, JOHN M. ATWATER, a citizen of the United States, and a resident of Chicago, county of Cook and State of Illinois, have invented certain new and useful Improvements in Spark Plugs, of which the following is a specification.

My invention relates generally to improvements in spark plugs but relates more particularly to spark plugs for use in internal combustion engines.

The spark plug in the modern internal combustion engine because of the fuel conditions, the constantly changing character thereof, its reluctance to vaporizing, and for many other reasons is called upon to perform heroic service in order to function properly, and regularly. It is an acknowledged fact that rarely, if ever, do spark plugs function at their best for any length of time. Even when initially inserted, the average spark plug functions so poorly as to be accountable, in a large measure, for the poor fuel economy and low engine efficiency, so often obtaining.

It is an object of my invention to provide a spark plug construction which, in operation, shall produce a spark better adapted to ignite the fuel in an internal combustion engine, and which shall function regularly and consistently in such manner.

It is also an object of my invention to provide a spark plug construction which, in operation, shall produce a spark of great strength, thus enabling it to function properly under such adverse conditions as are met with in an oil saturated cylinder, in a cylinder provided with fuel that is difficult to ignite, and under numerous other conditions inimical to the proper functioning of a spark plug as heretofore constructed.

Another object of my invention is to provide a spark plug construction which when once conditioned in a predetermined manner adapted to ensure the best results shall maintain this desired status against the innumerable conditions tending to destroy or alter this predetermined and desired status.

Again it is an object of my invention to provide a spark plug construction which can be adjusted as may be necessary to produce a condition adapted to ensure the best functioning with a predetermined engine and its complementary electrical system, or as may be necessary after a long period of use.

Other objects of my invention are to provide a spark plug construction that can be manufactured and assembled quickly, and at low cost, and which shall be of a form conveniently adapted for use in standard internal combustion engines.

My invention consists generally in the form, arrangement, construction and combination of the parts whereby the above named objects, together with others that will appear hereinafter, are attainable; and my invention will be more readily understood by reference to the accompanying drawings which illustrate the preferred embodiment thereof.

In said drawings:

Fig. 1, is a central sectional view of a spark plug construction embodying my invention; and

Fig. 2, is a view of certain of the parts thereof disassembled, but arranged in the order of assembly.

The shape, form, and configuration of the spark plug parts may vary through a wide range and the particular form and arrangement shown in the drawings should, therefore, be considered as by way of illustration and not by way of limitation.

Referring now to Fig. 1, 2 is a metallic shell provided with screw threads 3 so that it may be screwed to the engine cylinder in well-known manner. 4, represents a porcelain insulator which is positioned in the shell 2, in the present instance, being held against a gas-tight packing washer 5, by means of a threaded bushing 6, which operates against a seat washer 7 which, in turn, engages the shoulder 9 of the porcelain insulator. 10, is the side electrode which is permanently affixed to the metallic shell 2. There is no particular novelty in the parts thus far described other than the porcelain part 4, and they have been shown only for the purpose of better illustrating the manner in which the parts constituting the invention function.

The porcelain element 4, as here shown, is provided with a long lower central opening 11, which merges with a larger opening 12, and which, in turn, merges into a still larger opening 13 that extends to the top 14 of the porcelain element. The openings 11 and 12, as here shown, are of smooth cylindrical form whereas the opening 13 is provided with screw threads 13'. 15 represents what I term the lower central electrode and it is preferably cylindrical in form and of a size slightly smaller than the opening 11, thus providing an annular intervening space 16. To the upper end of the lower central electrode 15 I permanently secure a member 17 which member will hereinafter be termed a "shell." The lower central electrode 15 is preferably formed of a hard tough metal such as a nickel manganese alloy whereas I prefer to form the shell of a relatively soft metal such as brass. I have, by experimentation and research, learned that it is essential to the functioning of the device that the union between the shell and the lower central electrode shall be a gas-tight union. It is also essential that the parts shall be accurately aligned in order that the proper positioning of the lower central electrode shall take place and its desired spaced relation to the wall of the porcelain insulator be assured. To these ends, I prefer to reduce the upper end of the electrode 15, as indicated at 19, thus providing a seat 20 against which the element 17 can be forced. The lower part of the shell 17, in turn, is provided with a central opening 18 of considerable length. The relative sizes of the opening 17 and the upper reduced portion 19 of the electrode 15 are such that the shell 17 can be shrunk upon the reduced portion 19, as indicated. Thus a nice alignment of the parts is secured and a gas-tight joint effected. Lest it be thought that expansion of the parts, due to the temperature conditions prevailing in use, would cause this joint to leak, I wish to state that the electrode 15 projecting as it does into the zone of the most intense heat is raised to a considerable higher temperature than that of the shell 17 so that the conditions met with in use not only tend not to destroy the gas-tight joint, but they actually result in the tightening of this joint, due to the greater expansion of the electrode portion 19. The upper portion of the shell 17 is provided with a chamber 20 and into this chamber depends what I term the upper central electrode 21 extending into close proximity to the upper end of the lower electrode 15 thus providing a small gap 22.

Due to different conditions prevailing in different internal combustion engines or in the same internal combustion engine because of the changing character of the electrical ignition system, as well as changing conditions which take place because of ordinary wear and tear, I find it desirable to provide means for adjusting the spaced relation of the upper and lower electrodes, i. e. to provide means for varying the size of the gap, 22. To this end, I thread the upper part of the upper electrode, 21, as indicated at 23, and mount it in the internally threaded bushing 24. Thus by turning the electrode, 21, in one direction the gap can be increased and by turning it in the opposite direction can be decreased.

For the purpose of securely locking the upper electrode in place, I provide a lock nut 25. The bushing 24 is likewise externally threaded as indicated at 26 for coaction with the threads 13' of the porcelain opening 13. By this means the upper electrode assembly, i. e. electrode proper 21, bushing 24 and the parts carried thereby, can be screwed into the porcelain element 4.

It is a purpose of my invention to establish and maintain in the chamber 20 of the shell 17 a predetermined condition or status. It is not necessary to detail the precise character or status to be maintained in the space 20, but suffice it to say that having determined upon the condition which will lend the best results, I desire to maintain that condition or status against alteration or variation. I might state generally that the function of the spaced relation of the upper and lower electrodes forming the gap 22 is to increase the voltage of the spark that will jump the gap 27 formed between the lower ends of the lower central electrode and the side electrode. At the same time, in building up this voltage condition extreme care must be exercised to avoid imposing upon other parts of the electric or ignition of an internal combustion engine of forces that would destroy or injure them. Thus, for example in a modern automobile ignition system care must be taken to avoid "puncturing" the condenser and where a coil is used to avoid injuring the coil.

On the other hand, if the desired results are to be attained the voltage conditions necessary are relatively high. Thus it becomes an important matter, indeed, after having determined that condition which is sufficient on one hand to secure the desired spark at the gap 27 and to avoid injuring other parts of the ignition system to maintain that predetermined desired condition or status. One of the most necessary precautions to this end is that of avoiding the seepage of the dead gas from the engine cylinder up through the spark plug and into the chamber 20. It has been the common practise to secure the central electrode in place by means of cement and while such cement is presumed to be impervious to the passage of gases therethrough, in practise, it is found to be porous to a certain extent, and, in fact, to an extent

such that unless other means be provided would permit seepage of gas into the space surrounding the gap 22 and hence after a time destroy, alter or modify that desired condition initially set up in that space. I prevent the possibility of the occurrence of such a result by the provision of a shell 17 which, as already described, is united to the electrode in such a manner as absolutely to insure a gas-tight joint, under all conditions. The upper end of the shell 17 is open and is provided with an outwardly extending flange portion 28 which rests upon a seat 29 provided in the porcelain insulator. For the purpose of closing the open end of the shell 17, I provide an insulator plug 30. This insulator plug is very tightly pressed against the top of the shell 17 by means of the threaded bushing 26, i. e. as the threaded bushing 26 is screwed into the porcelain insulator it forces the insulator plug 30, very tightly against the shell.

In assembling the device the shell 17 is pressed into the opening 12 provided therefor, and being of soft character forms a fairly tight joint. The gases from the engine cannot possibly find their way into the chamber 20. In the first place, any gases attempting to escape upwardly must pass around innumerable turns or corners which in themselves should baffle the progress of such gases. If it were possible for gases to find their way upwardly to the point above the shell 17, they would be unable to find their way into the chamber 20, for the reason that the insulator plug 30 is very tightly clamped between the bushing 24 and the upper flanged end of the shell 17. The mechanical seal thus provided is admirably adapted to the maintenance of the predetermined condition or status in the chamber 20, and at the same time the arrangement is such that if desired relative adjustment of the upper and lower central electrodes can be very readily and conveniently made.

I claim:—

1. A spark plug construction embodying therein an insulator element, upper and lower electrodes arranged therein and positioned to form a gap therebetween, an impervious metallic shell positioned in said insulator surrounding said gap and forming a chamber adapted to exclude gases inimical to the condition desired in the space surrounding said gap, and means insulating said upper and lower electrodes one from the other.

2. A spark plug construction embodying therein an insulator element, upper and lower electrodes arranged therein and positioned to form a gap therebetween, an impervious shell, formed of metal of softer character than that of the lower electrode, positioned in said insulator, surrounding said gap, and forming a chamber adapted to exclude gases inimical to the condition desired in the space surrounding said gap, and means insulating said upper and lower electrodes one from the other.

3. A spark plug construction embodying therein an insulator element, upper and lower electrodes arranged therein and positioned to form a gap therebetween, a metallic shell initially having openings at both ends, said shell being shrunk upon the lower central electrode thereby closing one opening, and an insulator plug pressed against the other end of said shell and closing the other opening, thereby forming a chamber surrounding said gap, said chamber being impervious to gases inimical to the condition desired in the space surrounding said gap.

4. A spark plug construction embodying therein an insulator element, upper and lower electrodes arranged therein and positioned to form a gap therebetween, a metallic shell initially having openings at both ends, said shell being shrunk upon the lower central electrode thereby closing one opening, and an insulator plug pressed against the other end of said shell and closing the other opening thereby forming a chamber surrounding said gap, said chamber being impervious to gases inimical to the condition desired in the space surrounding said gap, and a screw threaded element for forcing said insulator plug against said shell.

5. A spark plug construction embodying therein an insulator element, upper and lower electrodes arranged therein and positioned to form a gap therebetween, a metallic shell initially having openings at both ends, said shell being shrunk upon the lower central electrode thereby closing one opening, and an insulator plug pressed against the other end of said shell and closing that opening thereby forming a chamber surrounding said gap, said chamber being impervious to gases inimical to the condition desired in the space surrounding said gap, a screw threaded element for forcing said insulator plug against said shell, said screw threaded element being internally threaded and the upper end of said upper central electrode being externally threaded, whereby the position of said upper electrode in said bushing can be adjusted.

6. A spark plug construction embodying therein an insulator element, upper and lower electrodes arranged therein and positioned to form a gap therebetween, a metallic shell initially having openings at both ends, said shell being shrunk upon the lower central electrode thereby closing one opening, and an insulator plug pressed against the other end of said shell and closing the other opening, thereby forming a chamber surrounding said gap, said chamber being impervious to gases inimical to the condi-

tion desired in the space surrounding said gap, a screw threaded element for forcing said insulator plug against said shell, said screw threaded element being internally threaded, and the upper end of said upper central electrode being externally threaded whereby the position of said upper electrode in said bushing can be adjusted, and means for locking said upper central electrode in adjusted position.

In testimony whereof, I have hereunto set my hand, this 22nd day of April, A. D. 1920.

JOHN M. ATWATER.