Oct. 24, 1944. W. I. LINLOR 2,361,218

SPARK DISCHARGE DEVICE

Filed Feb. 8, 1943

Fig. 1.

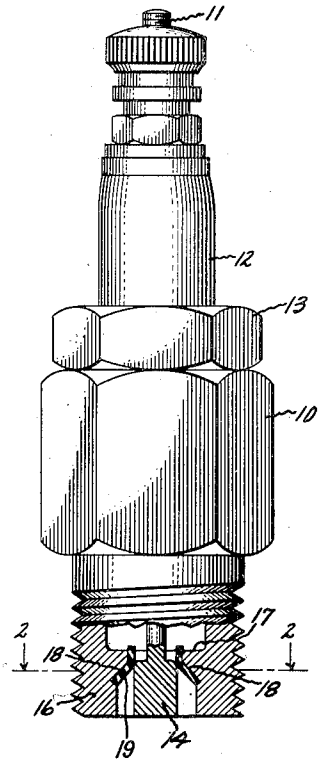



Fig. 2.

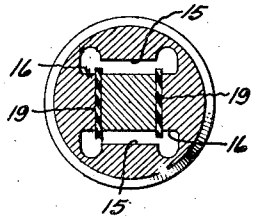
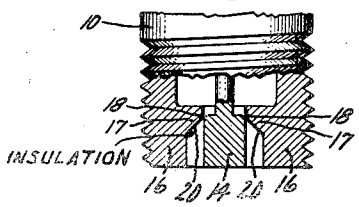



Fig. 3.




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William I. Linlor,
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His Attorney.

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2,361,218

# UNITED STATES PATENT OFFICE

2,361,218

## SPARK DISCHARGE DEVICE

William I. Linlor, Scotia, N. Y., assignor to General Electric Company, a corporation of New York

Application February 8, 1943, Serial No. 475,089

12 Claims. (Cl. 123—169)

My invention relates to spark discharge devices such as spark plugs used in the ignition systems for internal combustion engines.

An object of my invention is to provide an improved spark discharge device.

Another object of my invention is to provide a spark plug wherein an auxiliary element is arranged to provide for the breakdown of the spark gap between the spark plug electrodes at a voltage substantially lower than that normally required to break down a spark gap of the given spacing.

Further objects and advantages of my invention will become apparent and my invention will be better understood from the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In the drawing, Fig. 1 is a side elevational view, partly broken away, of a spark plug provided with an embodiment of my invention; Fig. 2 is a sectional view taken along line 2—2 of Fig. 1; and Fig. 3 is a partial sectional view of the lower end of a spark plug provided with another embodiment of my invention.

Referring to the drawing, I have shown my invention applied to a spark discharge device in the form of a spark plug provided with a conventional spark plug barrel 10 in which a central electrode 11 is supported by a ceramic insulator 12 held in position by a nut 13 of the conventional type. The lower or spark discharge end 14 of the central electrode 11 is formed as an enlarged section and is spaced a desired distance from two sets of discharge electrodes 15 and 16 to provide a predetermined breakdown gap spacing therebetween for breakdown at a suitable voltage. These electrodes are constructed and arranged to provide an effective tapered spacing between the central discharge electrode 14 and the outer electrodes 16 by providing auxiliary elements 17 electrically connected by being integrally formed with the inner portions of the electrodes 16 so as to extend to closely adjacent the central electrode discharge end portion 14. This provides a tapered gap spacing between the electrode 14 and the tapered portion 18 of the elements 17, and an insulating element formed as a sheet insert 19 of insulating material, as shown in Figs. 1 and 2, or as a solidified coating 20 of high dielectric strength, as shown in Fig. 3, which is arranged over the tapered surface 18 of the elements 17 to prevent breakdown of the gap between the electrodes, except through that part of the gap between the electrodes, except through that part of the gap having the desired breakdown spacing. The coating 20 may be applied in any suitable manner, as by spraying, painting, dipping, or other suitable method of applying a thin coating. Such an arrangement provides for electrically stressing the gas between the electrode 14 and the auxiliary insulating element 19, providing progressive ionization of the gas therebetween, ranging from the effective smaller spark gap spacing at the narrowest part of the tapered portion of the gap to the breakdown spaced gap portion between the electrode 14 and the electrode 16. The operation of this auxiliary element is in effect to provide for the initial ionization of the gas near the apex of the tapered gap portion, which ionization progressively moves the effective surface of the electrode 14 from the metal portion thereof outwardly towards the adjacent surface of the electrode 16 to the end of the insulating element 19 under which condition the gap breaks down and an electrical discharge takes place between the electrodes 14 and 16 at a voltage which is substantially less than that which would be required for the breakdown of the gap if no auxiliary elements were present. With this arrangement, discharge of the spark plug is greatly facilitated under adverse firing conditions, as when the engine and fuel may be very cold or when the voltage supplied to the plug may be lower than is normally available.

While I have illustrated and described a particular embodiment of my invention applied to a spark plug, modifications thereof and other applications will occur to those skilled in the art. I desire it to be understood, therefore, that my invention is not to be limited to the particular arrangement disclosed, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A spark discharge device having spaced apart electrodes providing a spark discharge gap therebetween, means for providing an effective spacing between said electrodes which varies from a relatively small spacing to that of a predetermined breakdown spark gap spacing, and means for preventing breakdown of said gap between said electrodes except through that part of the gap having the desired breakdown spacing.

2. A spark discharge device having spaced apart electrodes providing a spark discharge gap therebetween, means for providing an effective tapered spacing between said electrodes which tapers from a relatively small effective spacing to that of a predetermined breakdown spark gap spacing, and means for preventing breakdown of said gap between said electrodes except through that part of the gap having the desired breakdown spacing.

3. A spark discharge device having spaced

apart electrodes providing a spark discharge gap therebetween spaced for an effective suitable breakdown voltage, means providing for electrically stressing the gas between said electrodes producing progressive ionization of the gas therebetween for electrical discharge therebetween at a voltage substantially less than said suitable breakdown voltage, and means for preventing breakdown of said gap between said electrodes except through that part of the gap having the desired effective breakdown spacing.

4. A spark discharge device having spaced apart electrodes providing a spark discharge gap therebetween spaced for a suitable breakdown voltage, means providing for electrically stressing the gas between said electrodes producing progressive ionization of the gas therebetween for electrical discharge therebetween at a voltage substantially less than said suitable breakdown voltage, and means including an insulating element in said gap between said electrodes, said insulating element preventing breakdown of said gap between said electrodes except through that part of the gap having the desired breakdown spacing.

5. A spark discharge device having spaced apart electrodes providing a spark discharge gap therebetween, means electrically connected to one of said electrodes for providing an effective tapered spacing between said electrodes which tapers from a relatively small effective spacing to that of a predetermined breakdown spark gap spacing, and means for preventing breakdown of said gap between said electrodes except through that part of the gap having the desired breakdown spacing.

6. A spark discharge device having spaced apart electrodes providing a spark discharge gap therebetween, means for providing an effective tapered spacing between said electrodes which tapers from a relatively small effective spacing to that of a predetermined breakdown spark gap spacing, and means including an insulating element between said electrodes in said effective smaller than breakdown gap spacing for preventing breakdown of said gap between said electrodes except through that part of the gap having the desired breakdown spacing.

7. A spark discharge device having spaced apart electrodes providing a spark discharge gap therebetween, means electrically connected to one of said electrodes providing an effective tapered spacing between said electrodes which tapers from a relatively small effective spacing to that of a predetermined breakdown spark gap spacing, and means including an insulating element between said electrodes in said effective smaller than breakdown gap spacing for preventing breakdown of said gap between said electrodes except through that part of the gap having the desired breakdown spacing.

8. A spark discharge device having spaced apart electrodes providing a spark discharge gap therebetween, means for providing an effective spacing between said electrodes which varies from a relatively small spacing to that of a predetermined breakdown spark gap spacing producing progressive electrical stress of the gas between said electrodes and progressive ionization of the gas therebetween from said smaller spark gap spacing to said breakdown spaced gap portion, and means including an insulating element between said electrodes in said effective smaller than breakdown gap spacing for preventing breakdown of said gap between said electrodes except through that part of the gap having the desired breakdown spacing.

9. A spark discharge device having spaced apart electrodes providing a spark discharge gap therebetween, means including the construction and arrangement of said electrodes providing a spacing between said electrodes which varies from a relatively small spacing to that of a predetermined breakdown spark gap spacing for electrically stressing the gas between said electrodes producing progressive ionization of the gas therebetween from said smaller spark gap spacing to said breakdown spaced gap portion, and means between said electrodes in said effective smaller than breakdown gap spacing for preventing breakdown of said gap between said electrodes except through that part of the gap having the desired breakdown spacing.

10. A spark discharge device having spaced apart electrodes providing a spark discharge gap therebetween, means including an auxiliary element electrically connected to one of said electrodes providing an effective spacing between said electrodes which varies from a relatively small effective spacing to that of a predetermined breakdown spark gap spacing for electrically stressing the gas between said electrodes producing progressive ionization of the gas therebetween from said effective smaller spark gap spacing to said breakdown spaced gap portion, and means including an insulating element between said electrodes in said smaller than breakdown gap spacing for preventing breakdown of said gap between said electrodes except through that part of the gap having the desired breakdown spacing.

11. A spark discharge device having spaced apart electrodes providing a spark discharge gap therebetween, means including an auxiliary element electrically connected to one of said electrodes providing an effective tapered spacing between said electrodes which tapers from a relatively small effective spacing to that of a predetermined breakdown spark gap spacing for electrically stressing the gas between said electrodes producing progressive ionization of the gas therebetween in said tapered gap from said effective smaller spark gap spacing to said breakdown spaced gap portion, and means including an insulating element between said electrodes in said effective smaller than breakdown gap spacing for preventing breakdown of said gap between said electrodes except through that part of the gap having the desired breakdown spacing.

12. A spark discharge device having spaced apart electrodes providing a spark discharge gap therebetween, means including an auxiliary element forming a tapered end portion on one of said electrodes providing an effective tapered spacing between said electrodes which tapers from a relatively small effective spacing to that of a predetermined breakdown spark gap spacing for progressively electrically stressing the gas between said electrodes producing progressive ionization of the gas therebetween in said tapered gap from said effective smaller spark gap spacing to said breakdown spaced gap portion, and means including an insulating element between said electrodes in said effective smaller than breakdown gap spacing for preventing breakdown of said gap between said electrodes except through that part of the gap having the desired breakdown spacing.

WILLIAM I. LINLOR.