Oct. 30, 1951

J. J. MASCUCH ET AL

2,573,473

IGNITION CONTROL

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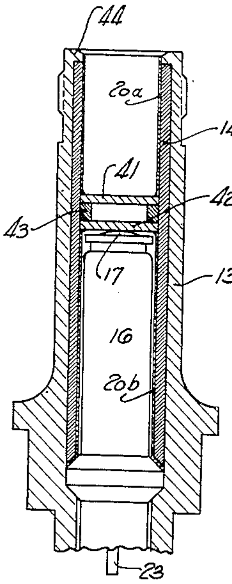


Fig. 3.

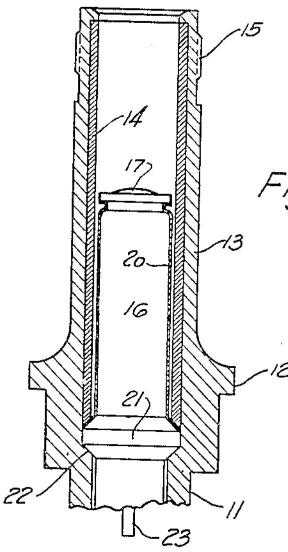


Fig. 1.

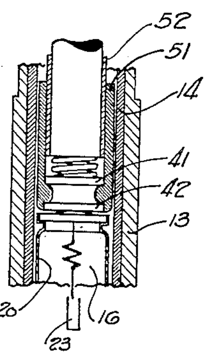


Fig. 5

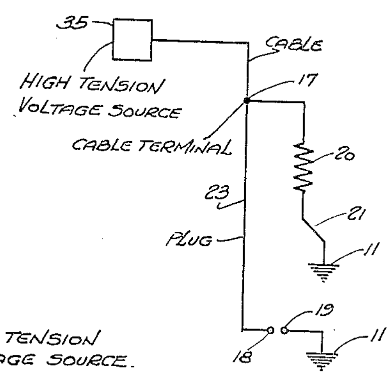
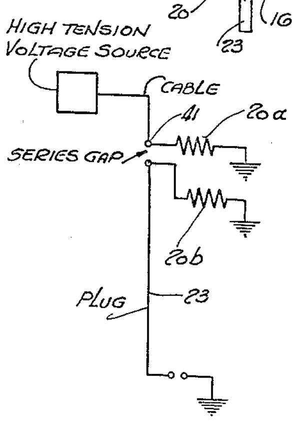


Fig. 2.



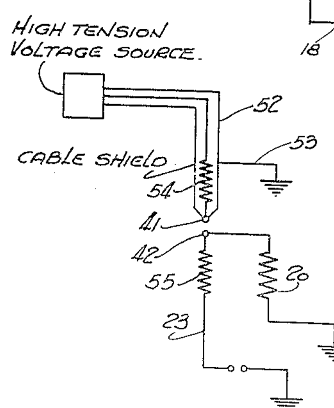


Fig. 6.

Fig. 4.

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IGNITION CONTROL

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3 Claims. (Cl. 315—58)

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This invention relates to internal combustion engines, and particularly to the control of the delivery of fuel igniting sparks across the electrodes of a spark plug constituting a part of the combustion chamber assembly in an internal combustion engine.

In United States patent application Nos. 126,771 and 126,772, filed on November 12, 1949, by Melville F. Peters, one of the joint applicants making this present application, it is explained that in the conventional high-tension cable types of ignition systems for internal combustion engines there is a substantial amount of electrical energy remaining in the ignition cable after the initial spark discharge across the electrodes of the spark plug in which the cable terminates. In said applications it is also explained that this residual energy frequently creates a reverse potential gradient condition that opposes further flow of current to the spark plug in sufficient strength to produce a second spark discharge across the plug electrodes. It is this impediment to "follow-up" flow that frequently interferes with successful "starting" of an internal combustion engine. The patent applications above-identified disclose methods and means for removing from the high-tension cable the objectionable residual energy above described.

The present invention provides novel cable terminal and spark plug constructions adapted to serve automatically to drain off, to ground, the residual energy remaining in the conducting central wire of the ignition cable after each spark charge occurrence, and in such manner as to have no appreciable effect upon the normal function of the cable in delivering energy impulses in spaced sequence to the spark plug electrodes, for spark discharge therebetween. The invention, as illustrated in three embodiments in the annexed drawings, is incorporated in spark plugs and cable terminals of the electrostatically shielded variety, and in certain of its aspects the invention utilizes the shielding elements of the plug and cable to assist in achieving its purposes; however, in other aspects, the invention is capable of embodiment in spark plugs having no radio-shielding applied thereto, all of which will be better understood upon reference to the following description of the three embodiments of the invention as illustrated in the annexed drawings, wherein:

Fig. 1 is a longitudinal sectional view of a portion of a radio-shielded spark plug embodying the invention;

Fig. 2 is a circuit diagram explaining the electrical action, with a plug constructed as illustrated in Fig. 1;

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Fig. 3 is a longitudinal sectional view of a portion of a radio-shielded spark plug constituting a second embodiment of the invention;

Fig. 4 is a circuit diagram explaining the electrical action that occurs with a construction as illustrated in Fig. 3.

Fig. 5 is a longitudinal sectional view of a cable treminal and adjacent portions of a spark plug; and

Fig. 6 shows the electrical circuits involved in the construction of Fig. 5.

Referring first to Figs. 1 and 2, the spark plug of this embodiment has a metallic shell including a base portion 11 for attachment to the wall of the combustion chamber of the engine, as by being threaded thereto; a wrench receiving portion 12 whose outer surface is preferably hexgonal in contour; a thinner tubular extension 13 lined with a sleeve 14 of insulating material; and a fluted collar 15 adapted to receive the terminal fitting (not shown) to which the cable shielding sheath is secured. The plug also has a ceramic body 16 extending from approximately the middle of extension 13 to the lower end of base 11; the body being centrally bored to receive the central electrode spindle 23 connecting the metallic electrode head 17 with the exposed electrode tip (18, Fig. 2) projecting beyond the lower end of ceramic body 16 to cooperate with the negative electrode tip (19, Fig. 2) and provide a spark discharge gap therebetween.

Tip 19 is secured to the grounded shell base 11, and base 11 also serves as a ground for the relatively high resistance coating 20 that surrounds and adheres to the surface of ceramic body 16. This coating 20 is also in contact with electrode head 17, and metallic ferrule 21, the latter surrounding ceramic body 16, and being an integral part thereof, and serving to hold the body 16 within the shell by virtue of its engagement with the beveled internal seat 22 of the shell base 11.

When a cable is inserted into the upper end portion of shell extension 13, and its end terminal brought into contact with electrode head 17, two electrical paths to ground 11 are automatically set up; the first path being by way of the central electrode spindle 23 and spark discharge electrodes 18 and 19; and the second path being by way of resistance coating 20, ferrule 21 and the shell base 11. This second path, which may have a resistance on the order of 10 megohms, becomes effective as a cable draining instrumentality, so that no residual energy remains in the cable conductor, immediately following each "healing" of the spark discharge gap, that is, the cessation of energy flow across the electrode tips 18, 19; but due to its relatively high resistance this cable draining path through coating 20 does not appreciably interfere with the sparking action at gap 18, 19, for it does not divert to itself any substantial part of the peak-voltage energy flowing into the central electrode head 17 at the moment of gap break-down. It is only after the gap has healed (by reason of voltage drop) that said path 17—20—21—11 becomes effective to divert to ground the energy remaining in the cable at the time of such gap healing. By such diversion to ground path 17—20—21—11 serves to condition the cable for effectively transmitting to the plug gap the next succeeding peak-voltage energy impulse generated in the source 35.

The coating 20 may be composed of any material, or compound of materials, having the desired degree of resistance to current flow, yet capable of conducting electric current at a limited rate, proportionate to its resistivity. For such purpose we have found coatings of ordinary enamel (fused glass particles) to be quite suitable, but as there are other equivalent materials that may be substituted we do not limit ourselves thereto.

In the embodiment of Figs. 3 and 4, wherein is shown a cable terminal separated from the spark plug by a spacer consisting of two metallic discs 41, 42 and a collar 43 of insulating material, the resistance material is coated upon the inner cylindrical surface of the sleeve 14, instead of upon the outer cylindrical surface of the dielectric body 16 of the plug, as in Fig. 1; but the coating is interrupted along that portion of the inner surface which is opposite to, and surrounds, the "series gap" found by the spacer 41—43. This interruption of the coating serves to divide the coating into two sections 20*a* and 20*b*, with the upper section 20*a* grounded by way of the inwardly extending upper rim 44 of the shell extension, and the lower section grounded at the junction of ferrule 21 with the shell, as in Fig. 1.

Fig. 4 shows the electrical action diagrammatically.

In the embodiment of Figs. 5 and 6 the plug body 16 is coated with grounded resistance material 20 as in Fig. 1, but a "series gap" combination of discs 41, 42 is employed, as in Fig. 3, except that in place of the short collar 43 of Fig. 3 there is a long sleeve 51 of non-conducting material extending upwardly from the discs 41, 42 and occupying the annular space between the cable shield 52 and the non-conducting sleeve 14 lining the shell extension 13. Thus the sleeve 51 serves to center the cable with its shielding covering 52, while the latter serves as a cable grounding element, as indicated at 53 in Fig. 6, and thus supplements the cable grounding action of plug coating 20.

What we claim is:

1. In an ignition circuit, a spark plug having a central spindle terminating in a spark discharge electrode, a dielectric body surrounding said spindle, a metallic shell receiving said dielectric body and serving as a mounting base therefor, and a coating of resistance material on said dielectric body, said coating forming a current path of limited conductivity for draining off to ground, by way of said metallic shell, any residual energy remaining in said ignition circuit at the conclusion of a spark discharge at said electrode.

2. In an ignition circuit, a spark plug having a central spindle terminating in a spark discharge electrode, a dielectric body surrounding said spindle, a metallic shell having an internally formed shelf, a metallic ferrule attached to said dielectric body and adapted to rest upon said shelf, and means constituting a current path of limited conductivity for draining off to ground, by way of said metallic ferrule and said shell, any residual energy remaining in said ignition circuit at the conclusion of a spark discharge at said electrode.

3. In an ignition circuit, a spark plug having a central spindle terminating in a spark discharge electrode, a dielectric body surrounding said spindle, a metallic shell supporting said dielectric body, and means constituting a current path of limted conductivity for draining off to ground, by way of said metallic shell, any residual energy remaining in said ignition circuit at the conclusion of a spark discharge at said electrode.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,626,693	Rentschler	May 3, 1927
1,897,587	Pirani	Feb. 14, 1933
2,064,369	Biggs	Dec. 15, 1936
2,118,795	Littleton	May 24, 1938
2,323,931	Peters	July 13, 1943
2,441,047	Wall	May 4, 1948