

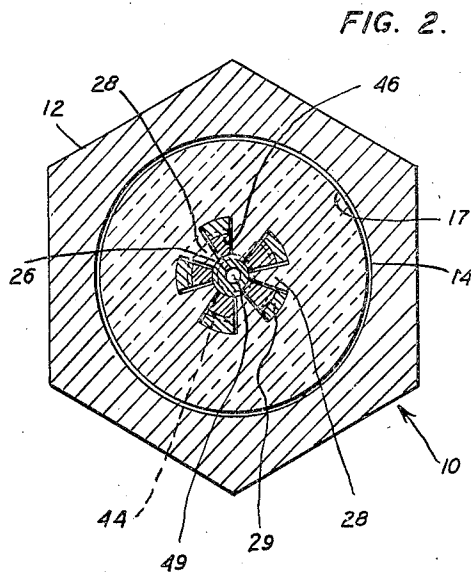
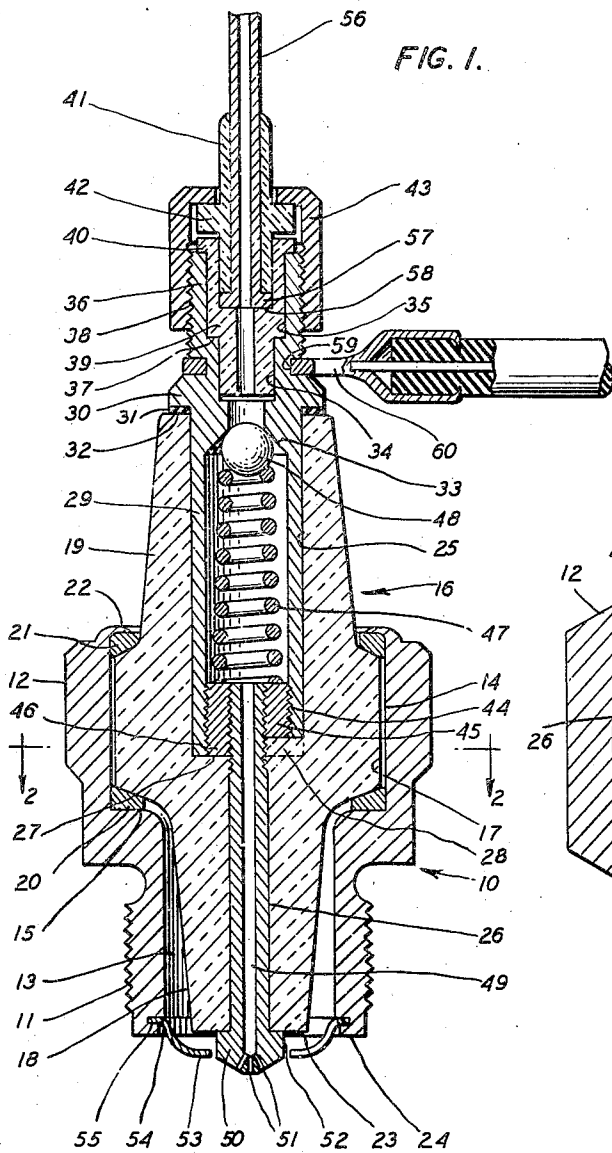
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INJECTION VALVE SPARK PLUG

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INJECTION VALVE SPARK PLUG

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4 Claims. (Cl. 123-169)

The invention relates to a combined injection valve and spark plug for use in internal combustion engines. It contemplates the provision of a device of the mentioned kind which is simple and inexpensive, and which may be so dimensioned that it fits the standard threadings for conventional spark plugs. Another object of the invention is the provision of a combined injection valve and spark plug wherein the spark gap may be readily readjusted when the electrodes are worn, and wherein the movable parts, in particular the valve, are remote from the combustion chamber of an engine cylinder into which the plug may be screwed.

According to the invention, a tubular element surrounded by an intermediate insulating shell and an outer metal shell is shaped as an injection nozzle on its one end, a spring-biased valve being movable in the interior of that element so as to cooperate with the seat. The spark gap is formed between the nozzle end of the tubular element and an electrode attached to the outer shell, the other end of the tubular element being provided with means whereby it may be insulatedly connected with a fuel line, and with other conductive means for the attachment of an ignition cable.

Further objects and details of the invention will be apparent from the description given hereinafter and the accompanying drawing illustrating an embodiment thereof by way of example.

In the drawing,

Fig. 1 is a longitudinal cross-section of the embodiment; and

Fig. 2 is a cross-section along line 2-2 of Fig. 1.

Referring now to the drawing, an outer shell 10 of conductive material is provided with an exterior threading 11 to fit into the tapped hole of a combustion chamber of an internal combustion engine (not shown). The upper portion has faces 12 to which a wrench for inserting the plug may be applied. The shell is interiorly stepped with an inner cylindrical wall 13 of a diameter smaller than the diameter of the upper cylindrical wall 14, and with a shoulder 15 between the portions 13 and 14. An intermediate shell 16 of insulating material is exteriorly formed as a double cone with a cylindrical portion 17 between the lower cone 18 and the upper cone 19. The cylindrical portion 17 fits into the cylinder 14. A gasket 20 is interpositioned between the shoulder 15 and the shell 16 and another gasket 21 is placed between the shell 16 and the top rim 22 of the outer shell 10 which is turned inwardly down upon the gasket 21 after the

insertion of shell 16 into shell 10. In this manner, the one is safely and tightly secured in the other. In this position, the bottom face 23 of shell 16 may be approximately flush with or slightly projected from the bottom face 24 of shell 10. The shell 16 is provided with an axial bore which is wider in its upper part 25 than in its lower part 26 and has a shoulder 27 between these parts. The top face of shoulder 27 is provided with serrations or projections 28 for a purpose to be explained hereinafter. In the illustrated embodiment, the aforementioned tubular element located interiorly of the insulating shell is composed of two main parts, one of which includes the valve chamber, whereas the other one includes a spray nozzle head also serving as one of the spark plug electrodes. Both these parts are connected by a third part as will be described hereinafter. The first part is a tubular member 29 of conductive material fittingly inserted into the hollow 25 of shell 16 and preferably bonded thereto by some suitable material of cementing properties. An outer flange 30 may be provided on the member 29 so that a gasket 31 between the flange and the top face 32 of shell 16 may further insure tightness of the two parts. A valve seat 33 is provided interiorly and near the upper end of the tubular member 29 and preferably integral therewith. Above the seat the bore of member 29 is first restricted at 34 and, then, wider again at 35 in the ultimate end portion 36 so as to form a shoulder 37, and the end 36 is provided with an outer threading 38. Furthermore, a peripheral groove 39 is provided between the end 36 and flange 30. Into the end portion 36, a bushing 39 of insulating material is inserted, bearing with an outer shoulder on the aforementioned shoulder 37 and covering with an end flange 40 the top face of the end 36 of the tubular member 29. A short tubular piece 41 fits into the bushing 39. It is provided with a flange 42 intermediate its ends, and a cap nut 43 is so arranged as to engage flange 42 when screwed on the threading 38.

The lower end of the tubular member 29 is interiorly threaded at 44 and an externally and internally threaded nut 45 is screwed into the threading 44. The nut is serrated on its lower face 46 so as to engage the aforementioned serrations 28 of shoulder 27. Similarly, the lower end face of the tube 29 may be serrated for the same purpose. Interiorly of member 29 a compression spring 47 bears on the top face of nut 45 and acts against a valve 48 of suitable form, i. e. in the present case of ball-shape, tending to press the valve on the seat 33. The second

part of the tubular element is a narrow tube 49 inserted in the bore 26 of shell 16 and screwed into the nut 45 so that its lower head 50 bears against the lower face 23 of the shell 16. The head is provided with a plurality of spray nozzle bores 51 communicating with the interior of the tube 49. The side face 52 of the head 50 constitutes one of the spark plug electrodes. The other one is formed by one or several radial projections 53 of a ring 54 on the outer shell 10, where it may be inserted into an inner circumferential groove or recess 55. The projections 53 are slightly spaced from the head 50 according to the desired spark gap and are curved so that they may be bent to increase or decrease their distance from the head 50, that means, the length of the gap.

In order to assemble the parts, first the shell 16 may be inserted into the shell 10, and secured and tightened by the gaskets 20 and 21 and the rim 22 turned down on the latter. Valve 48 and spring 47 will be placed into the tube 29 and nut 45 will be screwed into the tube which, then, may be inserted into the shell 16 so that the serrations 28 and 46 in engagement with each other prevent the parts from turning. Thereupon, tube 49 will be inserted into the bore 26 and screwed with its threaded end into the nut 45 until head 50 comes to bear tightly on face 23. Any additional bonding or tightening material may be applied between contacting surfaces wherever it is deemed necessary. The electrode ring 54 may be secured to the shell 10 either from the start or after the insertion of tube 49. In order to connect the plug to a fuel pipe 55, bushing 39 will be inserted in the bore 35 and the tubular piece 41 with nut 43 will be shifted on a pipe 56 which is part of the fuel system of an engine. The end of pipe 56 may then be turned outward to form a flange 57 which bears on the inner shoulder 58 of the bushing 39 when the nut 43 is screwed on the threading 38. Finally, an ignition cable connector 60 may be secured to the tubular member 29 in groove 59.

Now it will be clear that flow of injection fluid can take place from pipe 56 through bushing 39 to separate the valve 48 from its seat against the restraint of the spring 47 owing to an injection pressure prevailing in the pipe 56. The fuel will then pass through the tubes 29 and 49 to be ejected through the spray openings 51. On the other hand, ignition current can flow from the connector 60 along tubes 29 and 49 to the head 50 of the latter, and from there, jumping the gap to the electrodes 53 on to the outer shell 10 and the ground constituted by the engine cylinder into which the plug is screwed.

It will be noticed that the combined injection valve and spark plug according to my invention is very simple in structure and lends particularly well to mass production. It is greatly reliable in view of the fact that the location of the valve is remote from the end exposed to the effect of combustion gases, and it is readily adjustable as a spark plug when the length of the spark gap is to be changed.

It will be apparent to those skilled in the art that many alterations and modifications of the device described and illustrated by way of example are possible within the spirit and essence of the invention which shall be limited therefore only by the scope of the appended claims.

I claim:

1. A combined injection valve and spark plug comprising in coaxial arrangement a conductive outer shell, an insulating intermediate shell, a conductive inner tubing including one end shaped as a spray nozzle and an interior valve seat near its other end, a valve interiorly of said tubing for cooperation with said seat, and an electrode attached to said outer shell opposite said one end of said tubing, the other end of said tubing embodying first means for conductive connection with a cable and second means for insulated connection to a fuel-conducting pipe.

2. A combined injection valve and spark plug comprising in coaxial arrangement a conductive outer shell, an insulating intermediate shell, a conductive inner tubing including a narrow portion with a spray head projecting from said intermediate shell and a wider portion connected with its one end to said narrow portion so as to form a shoulder and embodying, near its other end, an interior valve seat, a valve member interiorly of said wider portion for cooperation with said seat, a compression spring between said valve member and said shoulder, an electrode attached to said outer shell opposite said spray head, said other end of said wider portion embodying first means for conductive connection with a cable and second means for insulated connection to a fuel-conducting pipe.

3. A combined injection valve and spark plug comprising in coaxial arrangement a conductive outer shell, an insulating intermediate shell embodying an interior shoulder with serrated surface, a conductive inner tubing comprising a wider part and a narrower part, said wider part embodying an inner valve seat near its one end and being interiorly screw-threaded at its other end, an exteriorly and interiorly threaded nut with a serrated face, said nut being screwed into said threading of the wider tubing part and engaging said serrated shoulder with its serrated face, said narrower tubing being screwed into said nut with its one end and embodying, at its other end, a spray head projecting from said intermediate shell, a valve interiorly of said wider part for cooperation with said seat, and an electrode attached to said outer shell opposite said spray head, said one end of said wider part embodying first means for conductive connection with a cable and second means for insulated connection to a fuel-conducting pipe.

4. A combined injection valve and spark plug comprising in coaxial arrangement a conductive outer shell, an insulating intermediate shell, a conductive inner tubing including one end shaped as a head projecting from said intermediate shell and provided with a plurality of spray nozzle bores communicating with the interior of said tubing, said tubing embodying an interior valve seat near its other end, a valve interiorly of said tubing for cooperation with said seat, and a ring-shaped electrode attached to said outer shell and including at least one projection opposite to and spaced from said spray head to form a spark gap, the other end of said tubing embodying first means for conductive connection with a cable and second means for insulated connection to a fuel-conducting pipe.

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