

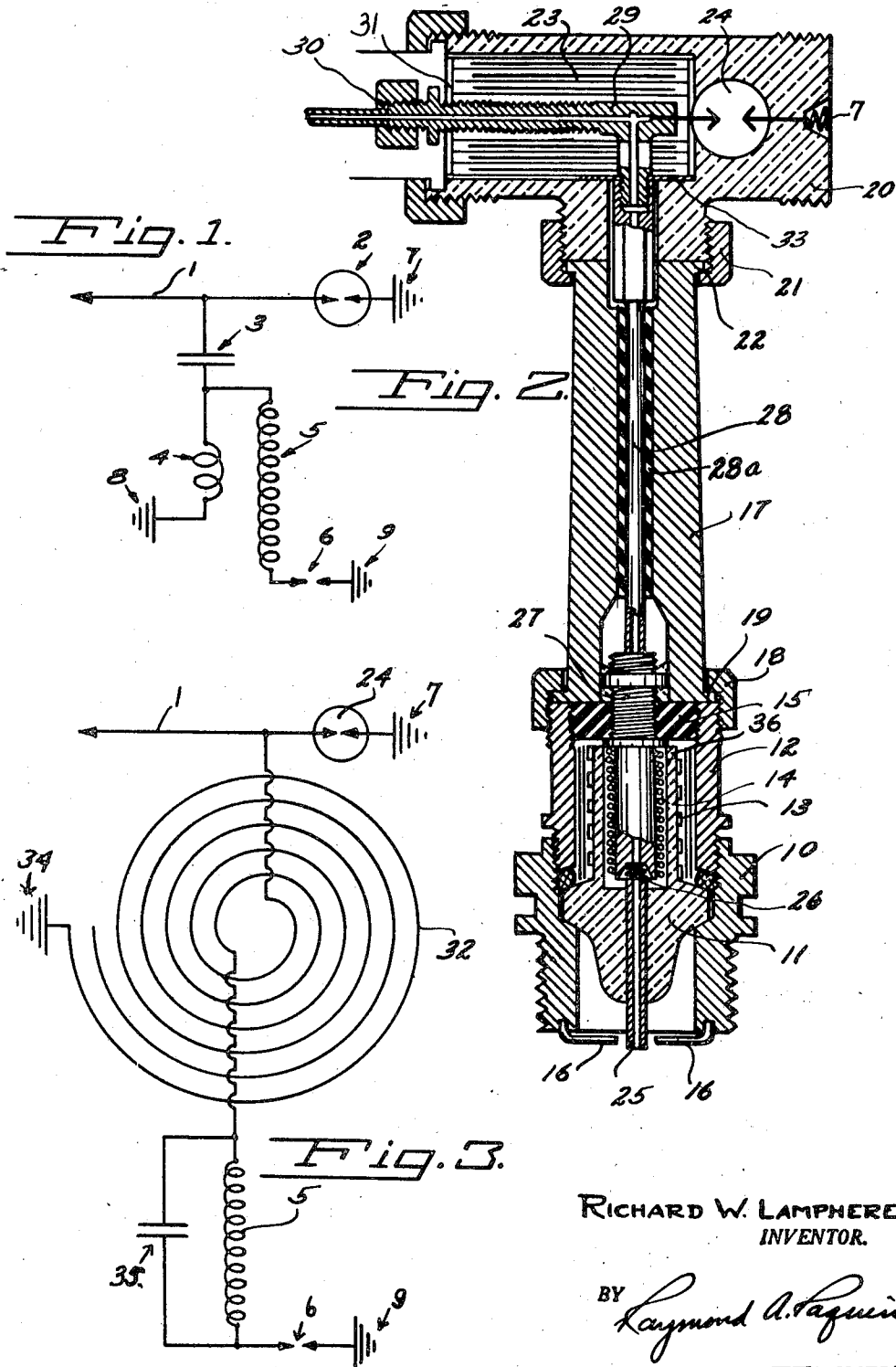
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R. W. LAMPHERE

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COMBINED INJECTOR NOZZLE AND SPARK PLUG

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RICHARD W. LAMPHERE
INVENTOR.

BY *Raymond A. Laguerre*
ATTORNEY

UNITED STATES PATENT OFFICE

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COMBINED INJECTOR NOZZLE AND
SPARK PLUG

Richard W. Lamphere, Wilbraham, Mass., assign-
or to American Bosch Corporation, Springfield,
Mass., a corporation of New York

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This invention relates to a combined spark plug and injector nozzle.

In the construction of internal combustion engines and particularly engines of the brake mean effective pressure commonly called "high output" type particularly employed in aircraft, it is very desirable to keep to a minimum the number of holes in the cylinder heads.

The high frequency ignition systems of the type incorporating the transformer within the spark plug recently employed make it necessary to provide an additional hole or opening through the cylinder head for the injector nozzle when fuel is supplied by injection.

It is the object of this invention to provide a new and improved combined high frequency spark plug and injector nozzle whereby the extra hole for the usual injector nozzle may be eliminated while at the same time retaining all of the advantages of both fuel injection and high frequency ignition.

Referring to the drawings:

Fig. 1 is a schematic diagram of the electrical circuit employed with an injector type, high frequency plug;

Fig. 2 is a sectional view of a combined high frequency spark plug and injector nozzle constructed according to the invention; and

Fig. 3 is a schematic diagram of a circuit which may be used with condenser winding, injector nozzle and high frequency spark plug.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout the several views, in the circuit shown in Fig. 1, 1 is a lead from the distributor and magneto of the engine and 2 is the oscillator gap; 3 is a condenser; 4 is the primary winding; 5 is the secondary winding and 6 is the combustion gap. 7, 8 and 9 are grounds.

In this construction the transformer is incorporated within the spark plug which should be of the radio shielded type and the operation of this ignition system is similar to that described in my application, Serial No. 575,418, filed January 31, 1945.

In such ignition systems a magneto or battery energized induction coil discharges rapidly recurring timed oscillations to the spark gap, and through the primary winding of the transformer when each breakdown voltage of the gap occurs. A surge of current is thereby produced in the primary winding, causing a rapid change in the magnetic flux linking the secondary winding of the transformer and producing a sufficiently high voltage from that secondary winding to result in

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a spark between the electrodes of a spark plug arranged in an engine cylinder in circuit with that winding. Such ignition systems are being used for aircraft engines in place of prior magneto and battery systems, because they have been found to be inherently better for firing fouled spark plugs on account of the greatly increased time rate of voltage rise across the electrodes thereof, and also because of less erosion of the spark plug electrodes on account of the reduced energy in the sparks occurring there.

In Fig. 2 there is shown the general arrangement of the various components in the spark plug comprising the base 10 and ceramic portion 11 which members are held in operative position by the tubular member 12 containing the primary 13 and secondary 14 which may be formed in the manner described in the application of Joseph T. Osterman, Serial No. 603,170, filed July 4, 1945 and which are retained in position by the insulating block 15.

The base 10 is provided with the electrodes 16.

The plug also includes the shielded extension member 17 held in operative position on the tubular member 12 by the threaded ring 18 which has a flange which engages the flange 19 adjacent the end of member 17.

Secured to the upper end of the member 17 is the housing member 20 which is retained thereon by the threaded ring 21 which has a flange which engages the flange 22 adjacent the upper end of the member 17.

Within the housing member 20 is the wound condenser 23 and the oscillator gap 24. The oscillator gap 24, which may be of the type disclosed in my application, Serial No. 575,418, referred to above, is grounded at 7 and is connected to the elbow 29.

The condenser 23 is of the type formed by winding alternate layers of a metallic foil and an insulating material.

The combined center electrode and nozzle 25 provides a means for injecting gasoline or other fuel into the combustion chamber and may be formed in a manner similar to fuel injection nozzles and in addition acts as the electrode for the high tension spark plug. The center insulator 11 is preferably made of a good grade of ceramic and of such shape that it also provides insulation between the primary 13 and secondary 14 and at the same time is a carrier for the primary winding 13 which is plated on the outer surface of the insulator in the form of a helix and the secondary consists of a relatively large number of turns of fine wire wound on an insulat-

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ing rod which may be hollow. The lower end of the secondary makes contact with the combined nozzle electrode member 25 by means of the coil spring 26 while the upper end joins with the upper end of the primary to a metal pipe fitting 27 which screws into the insulated plug 15. The fuel pipe 28 then runs through a hollow bore in member 17, and is insulated therefrom by insulating means 28a to the elbow 29 which makes connection with the oscillator gap 24 as previously described. The condenser 23 has the terminals 31 and 33 with the terminal 31 adapted to make contact with the fuel supply line 30 and the terminal 33 adapted to make contact with the upper end of the fuel line 28.

The combined electrode and nozzle member 25 has been shown by way of illustration only and it is pointed out that this nozzle can be of any desired type which nozzle may be adapted for functioning also as an electrode for embodiment in the type of spark plug shown and described.

It will be noted that the fuel lines also carry the electrical energy and, therefore, must be shielded and insulated electrically from the grounded shield and also that the gasoline or other fuel is used to insulate the plug transformer, thereby acting as an impregnant therefor. Gasoline and other fuels such as Diesel fuels have been found to be good insulators and being a liquid under pressure and flowing acts not only as a perfect impregnant at all altitudes but also protects the electrical parts from injury caused by extreme heat, and, therefore, excellent insulation is provided thereby for the primary and secondary windings. In such case holes or openings 36 may be provided through the portions of the center insulator 11 on which the primary 13 is formed.

If desired, the condenser 23 and the primary transformer winding 13 can be combined with certain material advantages. In such a construction the general embodiment would be similar to that shown in Fig. 2 except that the condenser 23 would be combined with the primary 13 thereby simplifying the fuel line by the elimination of a connection and by reducing the size of the housing as the condenser would be eliminated from outside of the plug body leaving only the oscillator gap 24 remaining outside of the plug body and the oscillator gap 24 may be connected as shown in Fig. 2 and the condenser winding wrapped about the plug insulator and, if desired, may be connected as shown in Fig. 3 to simplify the construction.

Fuel for injection into the combustion chamber is received through the fuel line 30 from which it passes through the elbow 29 and fuel line 28 and through the hollow body of the spark plug to the combined electrode and nozzle member 25.

The electrical diagram shown in Fig. 3 is similar to that previously described with the member 32 illustrating the condenser winding combined with the primary transformer winding 13, which is further described in another application executed and filed by me concurrently herewith, and the only change from Fig. 2 is the point of connection of the secondary winding 5. The member 32 is grounded at 34.

It is pointed out that the member 35 shown in Fig. 3 is merely shown by way of illustration to illustrate the effective distributive capacity of the secondary winding turn to turn and between the secondary winding and ground and that this element is not embodied in the device as constructed.

From the foregoing, it will be seen that I have provided simple, efficient and economical means

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for obtaining all of the advantages and objects of the invention.

Having described my invention, I claim:

1. A combined spark plug and injector nozzle for high frequency ignition systems of internal combustion engines comprising an oscillator gap, means for connecting said gap to a source of energy, means for supplying liquid fuel, primary and secondary windings, a nozzle, means connecting said nozzle with said fuel line and means for electrically connecting said oscillator gap to said spark plug.

2. A combined spark plug and fuel injection member for high frequency ignition systems comprising a fuel line, a condenser and an oscillator gap, means for connecting said oscillator gap to a source of energy, a transformer, a nozzle, and said transformer having means whereby fuel may pass therethrough to said nozzle from said fuel line.

3. A combined spark plug and fuel injection member for high frequency ignition systems comprising a fuel line, a condenser and an oscillator gap, means for connecting said oscillator gap to a source of energy, a transformer, a nozzle, and said transformer having means whereby fuel may pass therethrough to said nozzle from said fuel line, said nozzle being adapted to function both as nozzle for the fuel and electrode for the spark plug.

4. A combined spark plug and fuel injector nozzle for high frequency ignition systems comprising a spark plug member containing a condenser and oscillator gap, a hollow conduit adapted to serve both as fuel line and electrical connector, a transformer and a nozzle, and means whereby fuel may pass through said transformer to said nozzle.

5. A combined spark plug and fuel injector nozzle for high frequency ignition systems comprising a spark plug member containing a condenser and oscillator gap, a hollow conduit adapted to serve both as fuel line and electrical connector, a transformer and a nozzle, and means whereby fuel may pass through said transformer to said nozzle, and said nozzle being adapted to function both as nozzle for said fuel and electrode for said spark plug.

6. A combined spark plug and injector nozzle arrangement for high frequency ignition systems comprising a housing member, a condenser, an oscillator gap and a transformer in said housing, a nozzle, and a hollow conduit member adapted to supply fuel to said nozzle and electrical energy for said spark plug.

7. A combined fuel injector and spark plug for an internal combustion engine comprising a housing member, an oscillator gap, a condenser and a transformer in electrical connection in said housing member, means whereby a fuel line may be connected to said housing member, means whereby fuel may pass through said condenser and through said transformer, a nozzle and means for connecting said fuel line to said nozzle.

8. A combined fuel injector and spark plug for an internal combustion engine comprising a housing member, an oscillator gap, a condenser and a transformer in electrical connection in said housing member, means whereby a fuel line may be connected to said housing member, means whereby fuel may pass through said condenser and through said transformer, a nozzle and means for connecting said fuel line to said nozzle, said means also electrically connecting said condenser with said transformer.

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9. A combined fuel injector and spark plug for an internal combustion engine comprising a housing member, an oscillator gap, a condenser and a transformer in electrical connection in said housing member, means whereby a fuel line may be connected to said housing member, means whereby fuel may pass through said condenser and through said transformer, a nozzle and means for connecting said fuel line to said nozzle, said means also electrically connecting said condenser with said transformer, said nozzle also being adapted to act as electrode for said spark plug.

10. A combined spark plug and injector nozzle comprising a spark plug, an extension member on said spark plug, said extension member containing a condenser and a spark gap, means for connecting said extension member to a source of energy and to a fuel line, a transformer and a nozzle in said spark plug and means for connecting said fuel line and condenser to said spark plug.

11. A combined spark plug and injector nozzle comprising a spark plug, an extension member on said spark plug, said extension member containing a condenser and a spark gap, means for connecting said extension member to a source of energy and to a fuel line, a transformer and a nozzle in said spark plug and means for connecting said fuel line and condenser to said spark plug, said nozzle also acting as electrode for said spark plug.

12. A combined spark plug and injector nozzle comprising a spark plug portion, said spark plug having an insulated extension member, an oscillator gap and a condenser in said extension member, a transformer, a nozzle, means for connecting said transformer and said condenser and means for supplying fuel to said nozzle.

13. A combined spark plug and injector nozzle

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comprising a spark plug portion, said spark plug having an insulated extension member, an oscillator gap and a condenser in said extension member, a transformer, a nozzle, means for connecting said transformer and said condenser and means for supplying fuel to said nozzle, said nozzle being adapted to function both as a fuel injection nozzle and an electrode of said spark plug.

14. A combined spark plug and fuel injector member for high frequency, internal combustion engines comprising a spark plug portion, a transformer in said spark plug, an insulated T-shaped extension member on said spark plug, a condenser and an oscillator gap adjacent the upper end of said extension member, a nozzle, and a conduit for supplying fuel to said nozzle.

15. A combined spark plug and fuel injector member for high frequency, internal combustion engines comprising a spark plug portion, a transformer in said spark plug, an insulated T-shaped extension member on said spark plug, a condenser and an oscillator gap adjacent the upper end of said extension member, a nozzle, and a conduit for supplying fuel to said nozzle, said conduit extending through said transformer.

16. A combined spark plug and fuel injector member for high frequency, internal combustion engines comprising a spark plug portion, a transformer in said spark plug, an insulated T-shaped extension member on said spark plug, a condenser and an oscillator gap adjacent the upper end of said extension member, a nozzle, and a conduit for supplying fuel to said nozzle, said conduit extending through said transformer, and said nozzle acting both as fuel injection nozzle and spark plug electrode.

RICHARD W. LAMPHERE.