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IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES

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Fig. 1

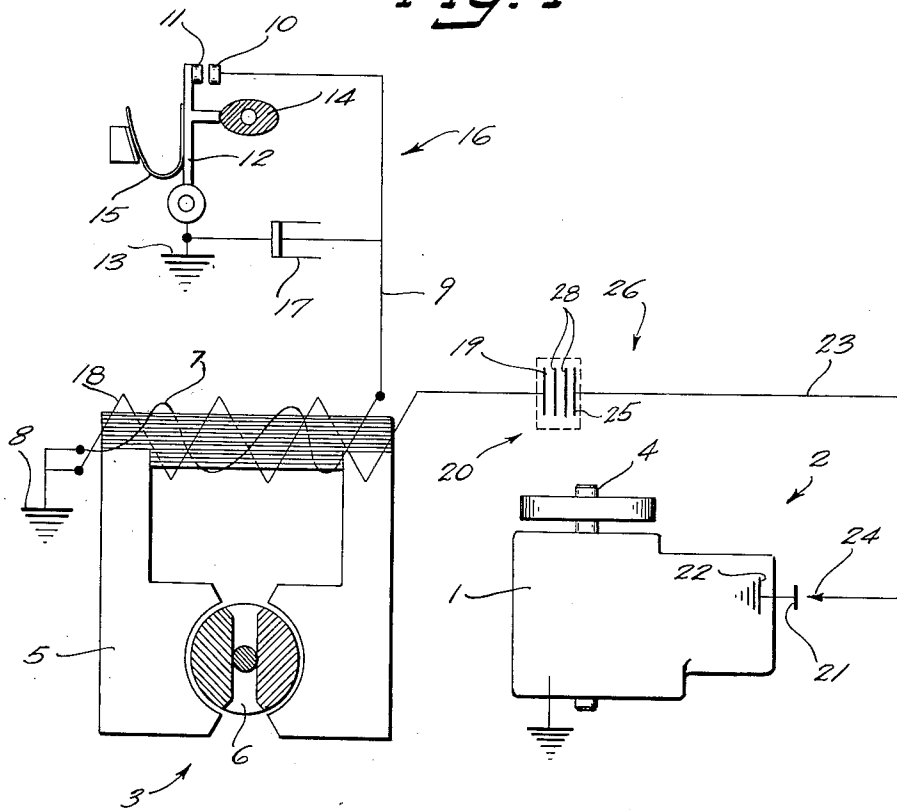
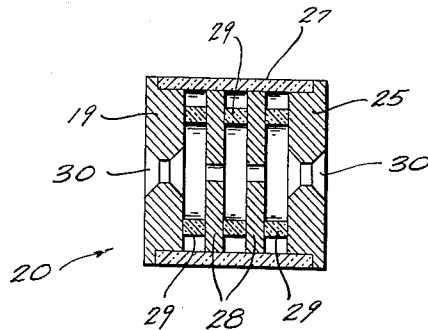


Fig. 2



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IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES

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1 Claim. (Cl. 315—224)

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This invention relates to ignition systems for internal combustion engines and is a continuation in part of the joint application of Noble P. Sherwood and Gloris R. Hofmann, the present inventor, filed November 22, 1944, Serial No. 564,602, now abandoned.

The invention provides a small capacitor in certain types of secondary circuits and in series with the spark plug of the engine.

In practice it is well known that higher frequency electrical discharges across the electrodes of the spark plug will provide a larger and heavier spark. Furthermore, high frequency electrical charges will overcome carbon deposits on the electrodes of the spark plug which would ordinarily foul the spark plug and interfere with the operation of the engine.

An object of the invention is to utilize the capacitance of small capacity, high frequency condensers so as to materially improve the spark.

A further object is to eliminate the need of or avoid as unnecessary the use of large capacity condensers either in series or in parallel with the spark plug.

A further object is to utilize where possible capacitors of less size and cost.

These and other objects will be more fully set forth in the following description of a preferred embodiment of the invention as illustrated in the accompanying drawing.

In the drawing:

Figure 1 is a diagrammatic illustration of an electrical generator and ignition system for one cylinder and spark plug of an engine; and

Fig. 2 is an enlarged view in longitudinal, central, vertical cross-section of a condenser unit adapted to be incorporated in the secondary circuit of the electrical generator and ignition system illustrated in Fig. 1.

The internal combustion engine 1, shown diagrammatically in Fig. 1, includes the spark plug 2 for cylinder firing and the magneto 3, shown diagrammatically, which is driven by the shaft 4 of engine 1 for supplying a current to the spark plug.

Magneto 3 comprises the stationary winding core 5 and the permanent magnet or armature 6 mounted on shaft 4 adjacent the ends of core 5. The low potential primary winding 7 on core 5 is grounded at one end as at 8 to engine 1 and the other end of winding 7 is connected by the wire 9 to the insulated stationary electrical contact member 10. The complementary contact member 11 is carried by the pivotally mounted arm 12 and through arm 12 is grounded as at

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13. The cam 14 operating in synchronism with engine 1 is disposed to engage arm 12 to separate contacts 10 and 11 and operates in opposition to the spring 15 which normally closes the contacts to complete the primary circuit 16 including winding 7. A condenser 17 is connected in parallel with contact members 10 and 11 to prevent corrosion of the contacts due to high temperature sparking.

The high potential secondary winding 18 on core 5 is grounded at one end as at 8 and is connected at the opposite end to the plate 19 of condenser unit 20.

The electrode 21 of spark plug 2 is grounded as at 22 and the lead wire 23 passing alongside engine 1 connects the other electrode 24 of spark plug 2 and the discharge plate 25 of condenser 20 to complete the secondary circuit 26.

The condenser unit 20 as shown in Fig. 2 comprises the cylindrical outer casing 27 which carries plates 19 and 25 at opposite ends and the intermediate plates 28 which are maintained within casing 27 between plates 19 and 25 in spaced relation by the non-conductors 29. In condenser 20 as shown, air which is allowed to circulate through the openings 30 in plates 19, 25 and 28 comprises the dielectric of the condenser.

The size of the condenser may vary according to the number of plates which need not exceed one-half inch in diameter in the engine application as will be described.

In the operation of engine 1 and the rotation of the magnetic field of magnet 6, a current is intermittently generated in the primary circuit 16 which continues each time until the opening of contacts 10 and 11 at the precise moment for cylinder firing.

Upon the opening of contacts 10 and 11 the sudden current drop in the primary circuit induces a current on the secondary winding 18. By providing the necessary number of turns of winding 18, a high potential is impressed on winding 18 which is able to spark across the gap between the electrodes of spark plug 2, and also across the gaps between the plates of condenser 20, and provide the necessary ignition.

The use of a capacitor in series with the spark plug has heretofore generally served merely to provide a series of sparks of uniform intensity. Such condensers were normally of large capacity.

Attempts to provide an improved series of sparks by using small capacity condensers have been relatively unsuccessful because the capacity of the system was not sufficiently large, so that

generally only a series of weak sparks was obtained. Attempts to overcome this defect have included the use of a capacitance across the spark plug electrodes intended to accumulate a series of capacity discharges of supposedly higher intensity and by making the spark gap narrower.

According to the invention, in small engines particularly, which do not involve the use of excessively long lead wires, a small capacity condenser of not over about 5-micro-microfarads, which imposes high frequency oscillations on the spark potential, will provide the necessary full spark notwithstanding the low capacitance of the system.

In electrical circuits the usual transmission losses due to various factors such as the resistance of the circuit will increase disproportionately as the ultra-high frequencies are approached. For this reason the use of a small capacity condenser in circuits of considerable length, while increasing the frequency somewhat, will accomplish no improvement in the spark because of the current losses due to the high frequency which reduce the intensity of the spark.

It has been found, however, that where a condenser of not exceeding about 5 micro-microfarads is employed that the frequency of the secondary circuit may be increased to over 300 and up to 1,000 megacycles. This is provided that the lead wire, by which is meant the entire secondary circuit except the condenser 20, coil 18, spark plug 2, and the motor 1 which serves as a ground, does not exceed about 18 inches in length.

The described high frequency results from the fact that the particular values recited form a resonant circuit which amplifies one of the ultra-high frequencies present both in the spark plug discharge and in the spark discharge in the condenser 20. In operation, as soon as the spark discharges occur in the spark plug and in the condenser the frequency amplified by the

resonant circuit is superimposed on the spark plug spark. Where the gap in the spark plug has been bridged by carbon deposits or the like, the high frequency resonant voltage generated by the arc or discharge in the condenser 20 effects a spark discharge in the spark plug over the carbon deposits instead of a mere flow of current through the particles of carbon.

Under the invention, the spark gap may be anywhere from .012 to .040 inch with good results.

The size of the condenser may, in fact, be considerably less than 5 mmf. particularly where the lead wire is about or slightly longer than 18 inches.

The condenser employed may be of various types employing a non-conductor other than air for the dielectric as described.

Various embodiments of the invention may be employed within the scope of the accompanying claim.

I claim:

In an ignition system for engines, a source of high potential current, a spark plug for said engine, a condenser of a capacity not exceeding 5 micro-microfarads and a circuit connecting said source of current, spark plug and condenser in series, said circuit including lead wire not exceeding 18 inches in length.

GLORIS R. HOFMANN.

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