April 16, 1946. J. R. HARKNESS 2,398,635

IGNITION SYSTEM

Filed Jan. 2, 1943

Fig. 1.

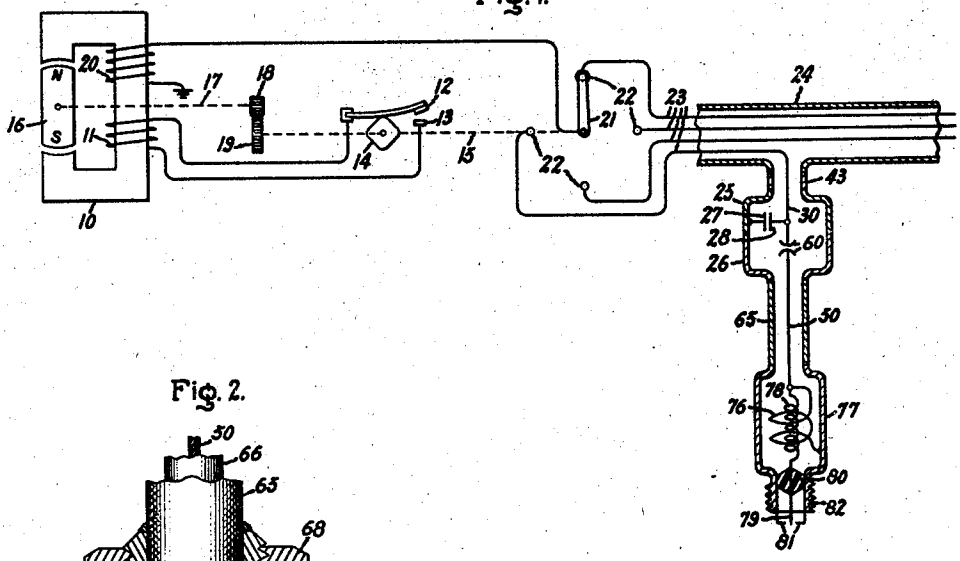


Fig. 2.

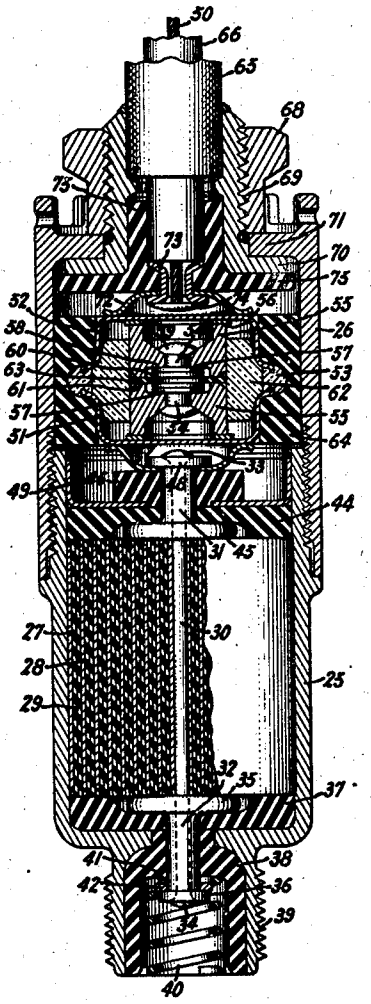
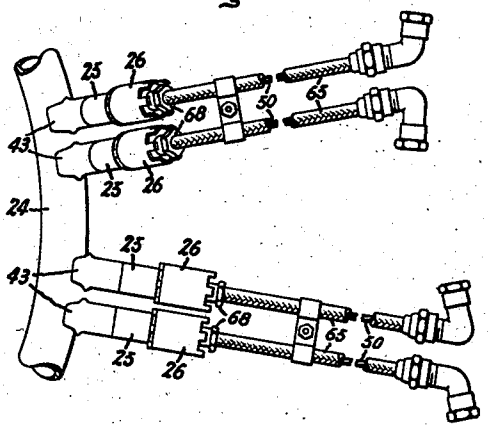


Fig. 3.



Inventor:
Joseph R. Harkness,
by Harry E. Dunham
His Attorney.

Patented Apr. 16, 1946 2,398,635

UNITED STATES PATENT OFFICE

2,398,635

IGNITION SYSTEM

Joseph R. Harkness, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application January 2, 1943, Serial No. 471,181

9 Claims. (Cl. 315—85)

My invention relates to ignition systems and particularly to such systems utilizing high frequency for the spark plug discharge portion of the circuit.

An object of my invention is to provide an improved ignition system.

Another object of my invention is to provide an improved high frequency ignition circuit having a capacitor and quenched spark gap unit thermally isolated from the spark plug.

A further object of my invention is to provide an improved unit comprising a capacitor and quenched spark gap within a shield, which unit shield is adapted to be grounded on the shield of the remainder of the ignition circuit.

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 schematic diagram of an ignition system provided with an embodiment of my invention; Fig. 2 is a partial sectional view through a unit embodying my invention adapted for use in my improved ignition system; and Fig. 3 is a perspective view of a part of an ignition harness and spark plug leads provided with units of the type shown in Fig. 2.

Referring to the drawing, I have shown an ignition system including a magneto provided with a core 10 of magnetic material about which a primary winding 11 is arranged which is electrically connected to breaker contacts 12 and 13 adapted to be operated by a breaker cam 14 mounted on an operating shaft 15. The magneto is provided with an exciting magnet 16 mounted on a shaft 17 which is mechanically driven by any suitable source of mechanical power at a predetermined speed relative to the speed of the engine to which the ignition is supplied. The magneto shaft 17 is mechanically connected through gears 18 and 19 to the shaft 15 so as to drive the shaft 15 at a predetermined speed relative to the speed of the magnet 16 and the speed of the engine. The magneto is provided with a secondary coil 20 which is electrically connected to a distributor arm 21 mounted on the shaft 15 and adapted to be driven thereby. The distributor is provided with a plurality of terminals 22 to which the distributor arm 21 is adapted to supply energizing voltages from the magneto secondary coil 20. These distributor terminals 22 are connected to distribution lead conductors 23 arranged within a harness provided with a shield 24 of electrically conductive material to minimize inductive interference of the ignition currents with other electrical apparatus. The distributor leads 23 are connected to a high frequency portion of the ignition circuit which includes a unit having an outer shield formed of a pair of substantially cylindrical elements 25 and 26 mounted on the harness shield 24 and electrically connected thereto to provide a good grounding connection therewith. Each of these units is provided with a capacitor forming a part of a tuned high frequency circuit and arranged within the shield element 25 and formed of electrically conductive plates or sheets 27 and 28 electrically insulated from each other by a suitable insulating material 29, such as paper or Pyranol. The plates 27 and 28 of the capacitor are wound spirally about each other and about a central conductor 30 which forms a part of the distribution lead conductor, and the inner capacitor plate 28 is electrically connected to the distribution lead conductor 30, while the outer capacitor plate 27 is electrically connected to the grounded shield element 25. The ends of the distribution lead conductor 30 extend through electrically conductive bushings 31 and 32 and are electrically connected thereto in any suitable manner, as by soldering at 33 and 34. The bushing 32 is formed as a spool with an inner shoulder 35 and an outer shoulder 36 formed in any suitable manner, as by spinning over. The bushing 32 is insulated from the shield 25 by an insulating washer 37 having a central opening therethrough which extends about the bushing 32 and by a cup-shaped insulating member 38 also arranged about the central portion of the bushing 32 and extending between this bushing and the shield 25 and within a smaller diameter threaded end portion 39 of the shield 25. A resilient terminal is electrically connected to the distribution conductor 30 and to the bushing 32 and includes a coil spring 40 arranged within the cup-shaped insulator 38 having an end 41 secured between the insulator 38 and a washer 42 of electrically conductive material retained in position on the bushing 32 by the bushing flange 36. The threaded portion 39 of the shield 25 is adapted to engage threadedly a complementary threaded portion in an outlet element 43 on the harness shield 24 to provide for securing the unit to the harness, and the terminal spring 40 is adapted to provide an electrical connection between the distribution conductor 30 and a distribution lead con-

ductor 23 in the harness 24 to form a connector between the harness distribution leads 23 and spark plug leads 50. In this manner, the capacitor is electrically connected between the grounded shield of the ignition system and the distribution conductor 30. The electrically conductive bushing 31 is mounted on the end of the distribution lead 30 away from the resilient terminal spring 40 and is insulated from the shield 25 by an insulator 44 arranged adjacent a shoulder 45 on the bushing 31 and held in position by a second insulator 46 arranged over the central portion of the bushing 31 between the insulator 44 and a flexible contact terminal element 47 arranged in electrical contact with a shoulder 48 formed on the end of the bushing 31 away from the shoulder 45. A cup-shaped element 49 is secured between the insulators 44 and 46 and extends into engagement with the sides of the shield 25 to provide a closure for this end of the condenser. The flexible terminal element 47 is arranged to provide an electrical contact with a terminal of a spark gap member arranged within the shield element 26 adapted to be connected in circuit between the distribution conductor 30 and a spark plug lead conductor 50. This spark gap member is formed as a quenched spark gap and includes a pair of similar cup-shaped terminal elements 51 and 52 of electrically conductive material which are held together by a ring 53 of insulating material, such as glass, which is hermetically sealed to the edges of the two members 51 and 52 to provide a hermetically sealed spark gap member. The quenched spark gap is adapted to be formed between a pair of similar electrodes, each of which includes a rivet element 54 of electrically conductive material extending through a central opening formed in a mounting element 55, also of electrically conductive material electrically connected and mechanically secured to one of the terminal elements 51 or 52 through a contact plate or ring 56 arranged between the terminal element and the supporting member 55 and secured to these two members in any suitable manner, as by welding or brazing. The ring 56 might be replaced by a plurality of spaced apart supporting blocks or the supporting member 55 might be welded or otherwise secured directly to the terminal element. The rivet 54 is formed with a head 57 which extends outwardly and provides a retaining flange at one end of the rivet arranged in engagement with a face 58 formed on the outer side of the supporting member 55 and is provided with a rivet head 59 at the other end thereof for securing the rivet in the central opening of the supporting element 55. The rivet head 57 is provided with an electrode discharge face 60 formed of an electrically conductive material, such as tungsten, which will resist pitting which might result from arcing between the electrode faces. Pitting of these faces is further minimized by the fact that the discharge between these electrode faces 60 is more in the nature of a high frequency spark than an arc discharge. The distance between these faces is very accurately predetermined by assembling the rivet electrode 54, the supporting element 55, and the supporting plate 56 and grinding or otherwise suitably finishing the discharge surface of the electrode face 60 and the outer edge 61 of the supporting element 55 to make these surfaces lie in a single plane. The two discharge electrodes and the terminal elements are then assembled with the supporting members 55 arranged within an insulating bushing 62 with a suitable insulating spacer 63 arranged between the adjacent edges 61 of the supporting members 55. The spacer element 63 is made of a suitable insulating material, such as mica, and is finished to a very accurate thickness with its two outer surfaces lying in parallel planes to assure an even spacing at all points between the adjacent surfaces 61 of the supporting members 55 and, therefore, assure an even and parallel spacing between all parts of the discharge electrode faces 60 of the spark gap member. The terminal elements 51 and 52 then are hermetically sealed together by the insulating ring 53, and this provides a sealed-in spark gap between the discharge faces 60, such that when an electrical discharge occurs between these faces, the tendency of the gas to expand between the discharge faces quenches or extinguishes the spark discharge at a predetermined voltage, thereby minimizing arcing between these faces. The quenched spark gap member is resiliently supported within the shield element 26 by an insulating bushing 64 of any suitable material, such as rubber, which is arranged about the terminal elements 51 and 52 and the sealing ring 53 and slightly compressed by a tight sliding fit within the shield 26 to secure the quenched spark gap member within the shield and to minimize the transmission of vibrations thereto.

The unit comprising the condenser and quenched spark gap member is adapted to be secured and electrically connected to a shield 65 of electrically conductive material arranged about the spark plug conductor lead 50 and insulated therefrom by suitable insulation 66 arranged between the conductor 50 and the shield 65. This connection is formed by a nut 68 which threadedly engages a threaded portion 69 of a connector flange 70 secured to the end of the spark plug lead conductor shield 65 and is adapted to secure an inwardly extending flange 71 of the shield 26 between the edge of the nut 68 and the outwardly extending connector flange 70 to assure good electrical contact between these elements. The spark plug lead conductor 50 is provided with a flexible terminal element 72 electrically connected to the end of the conductor 50 through a bushing 73 arranged about the end of the conductor 50 and suitably connected thereto, as by soldering at 74. An insulating bushing 75 is arranged about the end of the conductor 50 and the bushing 73 to provide a suitable insulation between these elements and the shielding members formed by the shield 26, the connector flange 70, and the nut 68. The spark plug lead conductor 50 is adapted to be connected to a transformer having a primary winding 76 connected between the conductor 50 and a spark plug barrel 77 and provided with a secondary winding 78 connected between the lead conductor 50 and a spark plug central discharge electrode 79. The discharge electrode 79 is suitably insulated by a bushing 80 of insulating material and arranged within the spark plug barrel 77 in spaced apart relationship relative to discharge electrodes 81 electrically connected to the spark plug barrel 77 and adapted to be grounded by threaded engagement of the lower end 82 of the spark plug barrel 77 with an engine cylinder. In this manner, I have provided an ignition system including a high frequency circuit provided with a shielded unit in which a condenser and a quenched spark gap mem-

ber are arranged which are suitably removed from the relatively high temperature spark plug to prevent injurious heating of the elements of this unit and also have provided a suitable mounting for the unit to assure suitable grounding of the shield about the unit with an adequate resilient support of the spark gap member to minimize the transmission of destructive vibrations to this member.

While I have illustrated and described a particular embodiment of my invention, modifications thereof 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. An ignition system including a harness with distribution lead conductors and a grounded shield thereabout, and a shielded unit including a capacitor and spark gap member with an outer shield mounted on and electrically connected to said harness shield, said capacitor being connected between one of said distribution lead conductors and said grounded shield of said unit. means for supporting said spark gap member insulated from said unit shield, said spark gap member having discharge electrodes electrically connected between said one of said harness distribution lead conductors and a terminal of a spark plug lead conductor said shielded unit being removed from direct contact with relatively high temperature spark plugs.

2. An ignition system including a harness with distribution lead conductors and a grounded shield thereabout, a high frequency circuit connected to said harness distribution lead conductors, spark plug lead conductors each having a shield thereabout, and a shielded unit including a capacitor and quenched spark gap member with an outer shield mounted on and electrically connected to said harness shield and removed from the relatively high temperature spark plugs and connected to one of said spark plug conductor lead shields, said capacitor being connected between one of said distribution lead conductors and said grounded shield of said unit, said quenched spark gap member having discharge electrodes electrically connected between said one of said harness distribution lead conductors and one of said spark plug lead conductors, and means for resiliently supporting said spark gap member in said unit shield.

3. An ignition system including a harness with distribution lead conductors and a grounded shield thereabout, and a shielded unit including a capacitor and quenched spark gap member with an outer shield mounted on and electrically connected to said harness shield and removed from the relatively high temperature spark plugs, said quenched spark gap member having discharge electrodes electrically connected between one of said harness distribution lead conductors and a terminal of a spark plug lead conductor, said capacitor being connected between said one of said distribution lead conductors and said grounded shield of said unit and including a resilient terminal member for connection to said distribution lead conductor and a second resilient terminal member for connection to one of said spark gap electrodes adjacent said harness, and means for resiliently supporting said spark gap member in said shield of said unit.

4. An ignition system including a harness with distribution lead conductors and a grounded shield thereabout, a high frequency circuit connected to said harness distribution lead conductors including a spark plug having a transformer connected thereto, spark plug lead conductors each having a shield thereabout electrically connected to said spark plug, a shielded connector unit including a capacitor and quenched spark gap member with an outer shield mounted on and electrically connected to said harness shield and removed from the relatively high temperature spark plugs and connected to one of said spark plug conductor lead shields, said capacitor being connected between one of said distribution lead conductors and said grounded shield of said unit, said quenched spark gap member having discharge electrodes electrically connected between said one of said harness distribution lead conductors and one of said spark plug lead conductors, and means including a resilient insulating element about said quenched spark gap member for resiliently supporting said quenched spark gap member in said unit shield.

5. An ignition system including a harness with distribution lead conductors and a grounded shield thereabout, a high freuency circuit connected to said harness distribution lead conductors including a spark plug having a transformer connected thereto, spark plug lead conductors each having a shield thereabout electrically connected to said spark plug, and a shielded connector unit including a capacitor and quenched spark gap member with an outer shield mounted on and electrically connected to said harness shield and removed from the relatively high temperature spark plugs and connected to one of said spark plug conductor lead shields, said capacitor being connected between one of said distribution lead conductors and said grounded shield of said unit, said quenched spark gap member having discharge electrodes electrically connected between said one of said harness distribution lead conductors and said spark plug lead conductors, and means for supporting said spark gap member insulated from said shield of said connector unit.

6. An ignition system including a harness with distribution lead conductors and a grounded shield thereabout, a high frequency circuit connected to said harness distribution lead conductors including a spark plug having a transformer connected thereto, spark plug lead conductors each having a shield thereabout electrically connected to said spark plug, a shielded connector unit including a capacitor and quenched spark gap member with an outer shield mounted on and electrically connected to said harness shield and removed from the relatively high temperature spark plugs and connected to one of said spark plug conductor lead shields, said capacitor being connected between one of said distribution lead conductors and said grounded shield of said unit, said quenched spark gap member having discharge electrodes electrically connected between said one of said harness distribution lead conductors and one of said spark plug lead conductors, and means including a resilient insulating element about said quenched spark gap member for resiliently supporting said quenched spark gap member in said unit shield.

7. A shielded ignition circuit harness connector unit including a capacitor and spark gap mem-

ber with an outer shield, a distribution lead conductor in said capacitor, said capacitor being connected between said outer shield of said unit and said distribution lead conductor, said spark gap member having discharge electrodes, means for electrically connecting one of said discharge electrodes to said distribution lead conductor, and means including a resilient insulating element about said spark gap member for resiliently supporting said spark gap member in said unit shield.

8. A shielded ignition circuit harness connector unit including a capacitor and quenched spark gap member with an outer shield having mounting means for securing said unit on a harness and for electrically connecting said unit to a harness shield, a shielded distribution lead conductor, said capacitor being connected between said shield of said unit and said distribution lead conductor, said quenched spark gap member having discharge electrodes, one of said discharge electrodes being electrically connected to said distribution lead conductor and the other of said discharge electrodes being adapted to be connected to a spark plug lead conductor, and means for supporting said spark gap member insulated from said shield of said unit.

9. An ignition circuit shielded unit including a capacitor and quenched spark gap member with an outer shield adapted to be mounted on and electrically connected to a harness shield, a distribution lead conductor, said capacitor being connected between said shield of said unit and said distribution lead conductor, said quenched spark gap member having discharge electrodes being electrically connected to said distribution lead conductor and the other of said discharge electrodes being adapted to be connected to a spark plug lead conductor, and means including a resilient insulating element about said quenched spark gap member for resiliently supporting said quenched spark gap member in said unit shield.

JOSEPH R. HARKNESS.