Jan. 21, 1947. J. R. HARKNESS ET AL 2,414,692

IGNITION SYSTEM UNIT

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Fig. 1.

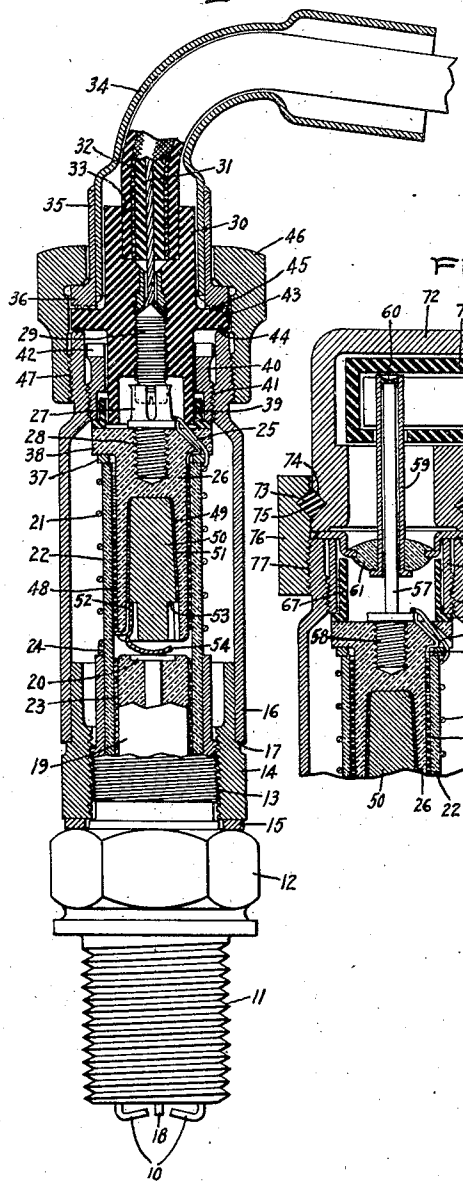


Fig. 2.

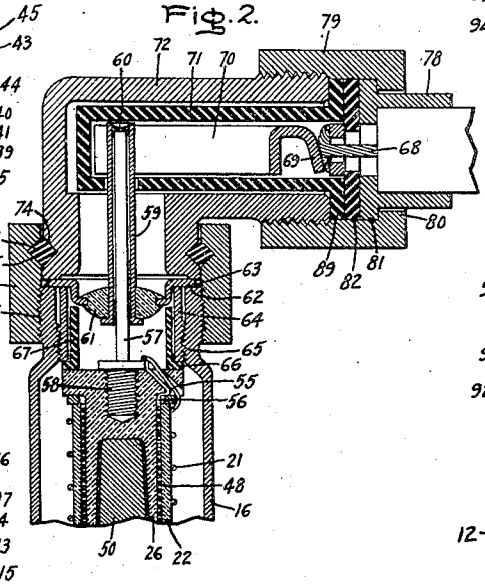
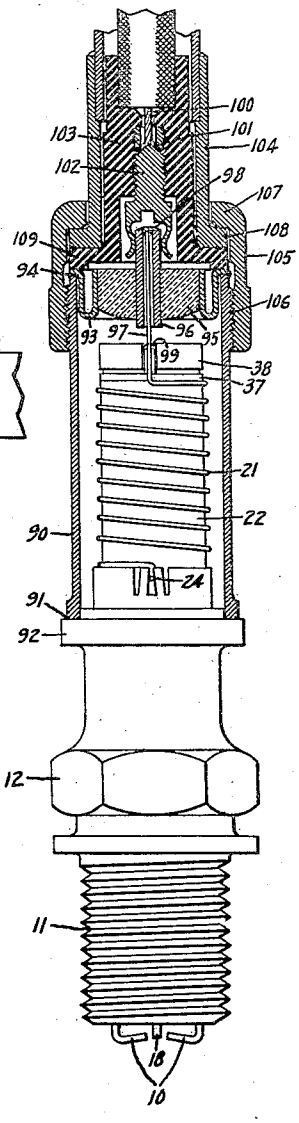


Fig. 3.



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IGNITION SYSTEM UNIT

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7 Claims. (Cl. 315—212)

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Our invention relates to ignition system units and more particularly to combined transformer and spark discharge units.

An object of our invention is to provide an improved ignition unit including a transformer provided with spark discharge electrodes.

Another object of our invention is to provide an improved ignition transformer unit.

Further objects and advantages of our invention will become apparent and our invention will be better understood from the following description referring to the accompanying drawing, and the features of novelty which characterize our 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 side elevational view of an ignition unit, partly broken away, showing an embodiment of our improved transformer spark discharge unit; Fig. 2 is a fragmentary sectional view showing a modification of the construction shown in Fig. 1; and Fig. 3 is a side elevational view, partly broken away, showing another embodiment of our invention.

Referring to the drawing, we have shown an embodiment of our improved ignition unit in which spark discharge electrodes are arranged as in a conventional spark plug and adapted to be energized by an electrical charge supplied to the central electrode by a transformer connected to a suitable source of electrical power supply. The spark discharge electrodes include a plurality of electrodes 10 electrically connected to the lower threaded portion 11 of a conventional spark plug barrel 12. The upper part of the barrel 12 is threaded at 13 and an outer barrel sleeve element 14 threadedly engages the portion 13 and is tightly screwed down against a washer 15 to provide a fluid-tight seal between the barrel sleeve 14 and the barrel portion 12. Another barrel sleeve 16 is tightly fitted over the upper portion of the sleeve 14 and is welded or otherwise secured thereto at the lower edge 17 of the sleeve 16. A second spark electrode 18 of the conventional spark plug type is arranged within the lower barrel portion 12 and is insulated therefrom and supported thereon by a suitable ceramic insulator 19 such as is conventionally used in spark plugs. The upper end of the electrode 18 is turned over to provide a contact terminal head 20. An electrical charge is adapted to be supplied to the spark electrode 18 at a relatively high electrical potential by a transformer unit arranged within the upper portion of the barrel sleeve 16. This transformer includes a relatively low voltage, high current primary winding 21 which is wound about

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a sleeve 22 of any suitable insulating material, such as a ceramic or a heat-hardenable plastic material such as a thermo-setting silicone resin. The insulating sleeve 22 is supported within the upper portion 13 of the barrel portion 12 and arranged between this portion 13 of the barrel and the upper end of the ceramic insulator 19. A suitable sealing cementing material 23 is arranged between the insulating sleeve 22 and the ceramic insulator 19 to secure the sleeve 22 in position and to form a fluid-tight seal with the insulator 19. One end or terminal 24 of the primary winding is electrically connected to the barrel portion 13 and the other end 25 of the primary winding extends through an insulating member 26 and is secured to a terminal 27 having a threaded portion 28 about which the insulating member 26 is molded. The terminal element 27 is formed as a clip and is arranged in engagement with the head of a terminal screw 29 which extends through an insulating member 30 formed of a suitable material, such as a heat-hardenable resin. The end of the screw 29 is arranged in intimate engagement with the end of a distribution lead conductor 31 which extends through a terminal bushing 32 in the insulator 30. This provides a good electrical connection between the end of the distribution lead 31 and the end 25 of the transformer primary winding through the screw terminal 29 and the clip terminal 27. The distribution lead 31 is provided with insulation 32 and extends within a pocket 33 formed in the upper end of the insulating member 30. A metallic elbow 34 is arranged about the end of the distribution lead and is provided with a sealing sleeve 35 formed with a radially outwardly extending flange 36 at the lower end thereof.

It is desirable that the space in the barrel within which the transformer is arranged should be maintained at a predetermined pressure, preferably higher than ten pounds per square inch absolute. It has been found that sea level atmospheric pressure of the air or other fluid about the transformer within the barrel is very satisfactory, and it is desirable, therefore, that the space within the barrel about the transformer should be adequately sealed to insure that the pressure therein will remain at the desired value. This space is sealed at the lower end by the construction of the spark plug portion of the unit and sealed at the upper end thereof by providing a series of sealing bushing elements and threaded connections. A bushing 37 is arranged between the upper end of the insulating sleeve 22 and a flange 38 formed on the upper end of the insu-

lating member 36. Another bushing 39 is arranged between the upper side of the insulator flange 38 and the lower edge of a mounting nut 40 in the form of a threaded sleeve arranged in threaded engagement with the inner threaded upper portion 41 of the barrel sleeve portion 16. The upper end 42 of the nut 40 is castellated so that the nut can be drawn up tightly into engagement with the bushing 39 which holds the insulator 26 and the bushing 37 in position on the upper end of the transformer insulating sleeve 22. A fluid seal is provided at the upper end of the chamber by a flange 43 formed on the insulator 30 arranged in engagement with sharp edges of ribs 44 formed on the upper edge of the barrel 16 and the sharp edges of ribs 45 formed on the lower surface of the flange 36. These sharp edges of the ribs 44 and 45 are drawn into intimate engagement with the insulating member flange 43 by a nut 46 which threadedly engages the outer threads 47 formed adjacent the upper end of the barrel sleeve 16. When the nut 46 is drawn up tightly, it engages the upper surface of the flange 36 and presses the sharp edged rib 45 into the upper surface of the insulating flange 43 and presses the under surface of this flange over the sharp edges of the ribs 44, thereby forming a substantially fluid-tight seal.

In order to provide the desired electrical potential between the spark discharge electrodes 10 and 18, the transformer is provided with a secondary winding 48 wound about the lower portion of the insulator 26 and arranged within the insulating sleeve 22. The insulator 26 is formed with a cavity 49 in its central portion and a core 50 of magnetic material is inserted into the cavity 49 and cemented therein by any suitable cement 51. The core 50 also is retained in position by a spring clip 52 which is arranged within the lower end of the cavity 49 in engagement with a shoulder 53 formed on the core 50 and in engagement with the sides of the cavity 49. This spring clip is formed as a split ring which is compressed in order to make it fit within the cavity 49. The secondary winding 48 of the transformer is electrically connected to the central spark electrode 18 through the spring clip 52 which is electrically connected to the lower end 53 of the transformer secondary winding 48 and forms an electrical connection with the electrode head 20 through a spring finger 54 formed on the lower edge of the spring clip 52. This provides a complete ignition unit which includes transformer primary and secondary windings with a suitable core and ignition spark electrodes properly insulated from each other to provide the desired operation of the unit under varying atmospheric conditions.

In Fig. 2, the ignition unit is provided with a modification of the sealing construction shown in Fig. 1, while the remaining structure may remain essentially the same. In this construction, the transformer is provided with a primary winding 21 and a secondary winding 48 separated from each other by an insulating sleeve 22 arranged about a central insulator 26 within which a core 50 of magnetic material is supported. The upper terminals 55 and 56 of the transformer primary and secondary windings 21 and 48, respectively, are connected together to a terminal rod member 57 secured in the upper end of the insulator 26 by a threaded portion 58, about which the insulator 26 is molded. The upper end of the terminal rod 57 extends through a sleeve 59 of electrically conductive material which is sealed at its upper end by being welded at 60 to the upper end of the terminal rod 57. The space within the barrel about the transformer is effectively sealed by an insulator comprising a glass-to-metal seal formed by a glass element 61 fused to the outer side of the lower end of the sleeve 59 and to a dish-shaped metallic washer 62. The outer edges of the washer 62 are welded at 63 to the upper edge of the barrel sleeve 16 to provide a fluid-tight seal therewith. The transformer assembly is retained in assembled relationship by a nut 64 which threadedly engages threads 65 on the inner surface of the upper end of the barrel sleeve 16 and is drawn up tightly against a flange 66 formed on the lower edge of an insulating sleeve 67 and arranged in engagement with the upper edge of the transformer insulator 26 and the lower edge of the nut 64. This insulating sleeve 67 also insulates the nut 64 from the transformer terminals 55 and 56. The desired electrical charge is supplied to the transformer from a source of electrical power supply, such as a magneto, by a distribution lead 68 which is arranged in engagement with a spring clip finger 69 of a terminal 70 arranged in electrical contact with the transformer terminal sleeve 59 within an insulating member 71. The insulating member 71 is arranged within an elbow 72 secured to the upper end of the barrel sleeve 16 by a gasket 73 arranged in a groove 74 in the elbow 72 and in a groove 75 in a nut 76 which threadedly engages threads 77 on the upper end of the barrel sleeve 16. The other end of the elbow 72 is connected to the shielding armor 78 by a nut 79 having a flange 80 which engages a flange 81 on the armor 78 so as to clamp it into engagement with an insulating washer 82 arranged between the armor flange 81 and a flange 89 on the end of the insulator 71.

In Fig. 3, we have shown another embodiment of our invention wherein the ignition unit is provided with spark discharge electrodes 10 and 18 supported within a barrel portion 12 similar to the construction shown in Fig. 1. In this arrangement, the transformer is sealed in a space in the barrel by having the lower end of the space sealed in a manner similar to that of Fig. 1 and is arranged within a barrel sleeve 90 welded at 91 to a flange 92 formed on the barrel portion 12. The upper end of the space about the transformer is adapted to be sealed by an expansible glass-to-metal seal which includes an expansible metallic U-section washer 93 welded at 94 to the upper end of the barrel sleeve 90 and fused to a glass gasket element 95 which in turn is fused to an electrically conductive tube 96 extending through the central portion thereof. The metallic tube 96 is electrically connected to the transformer primary terminal lead 97 by being welded thereto at 98 at the upper end of the tube which also provides a fluid-tight seal at this end of the tube. The transformer secondary winding also is electrically connected to the tube 96 by being brazed at 99 to the primary terminal lead 97. The transformer construction is essentially the same as that shown in Fig. 1. An electrical charge is supplied to the spark electrodes 10 and 18 through the transformer by connecting the terminal tube 96 to a distribution lead 100 which is electrically connected at 101 to a terminal 102 secured within an insulator 103 in a manner similar to that shown in Fig. 1. The lower end of the terminal 102 is formed with spring fingers 103 which engage the upper end of the terminal tube 96 and provide a good electrical connection therewith. The ignition unit and the

lead armor 104 about the distribution lead 100 are secured together by a nut 105 which threadedly engages threads 106 formed on the outer surface of the upper end of the barrel sleeve 99. By drawing up the nut 105, a flange 107 thereon clamps a flange 108 on the distribution lead armor 104 into tight engagement with a flange 109 formed on the terminal insulator 103 against the upper side of the welded portion of the bushing element 93. This construction is somewhat more simple than that shown in Figs. 1 and 2 and will be found to be preferable where the insulating medium about the transformer may have a larger change in volume due to expansion and contraction thereof at various temperatures of the ignition unit. In each arrangement the space about the transformer may be filled with any desired suitable insulation, such as gases, liquids, or solids.

While we have illustrated and described particular embodiments of our invention, modifications thereof will occur to those skilled in the art. We desire it to be understood, therefore, that our invention is not to be limited to the particular arrangements disclosed, and we intend in the appended claims to cover all modifications which do not depart from the spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An ignition unit including a metallic barrel, a spark electrode connected to said barrel, a second spark electrode insulated from said barrel and providing a spark discharge gap with said first-mentioned electrode, a transformer having a primary winding and a secondary winding mounted in a space in said barrel, means for connecting said secondary winding to said second spark electrode, means including a glass-to-metal seal at one end of said transformer space for sealing the space within said barrel about said transformer for substantially maintaining a pressure therein above ten pounds per square inch absolute, and means for providing an electrical connection between an electrical conductor arranged externally of said glass seal and said transformer primary winding.

2. An ignition unit including a barrel, a spark electrode connected to said barrel, a second spark electrode insulated from said barriel and providing a spark discharge gap with said first-mentioned electrode, a transformer having a primary winding and a secondary winding mounted in said barriel, an insulating element about which said secondary winding is wound, a core of magnetic material within said insulating element, means including a spring clip for retaining said core in position and for connecting said secondary winding to said second spark electrode, expansible means for sealing the space within said barrel about said transformer for substantially maintaining a predetermined pressure therein, and means for providing an electrical connection between an electrical conductor arranged externally of said sealed space and said transformer primary winding.

3. An ignition unit including a barrel, a spark electrode connected to said barrel, a second spark electrode insulated from said barrel and providing a spark discharge gap with said first-mentioned electrode, a transformer having a primary winding and a secondary winding mounted in said barrel, an insulating element about which said secondary winding is wound, a core of magnetic material within said insulating element,

means including a spring clip arranged in engagement with said core and said insulating element for retaining said core in position and having an electrical connection with said secondary winding and said second spark electrode, means for sealing the space within said barrel about said transformer for substantially maintaining a predetermined pressure therein, and means for providing an electrical connection between an electrical conductor arranged externally of said sealed space and said transformer primary winding.

4. An ignition unit including a barrel, a spark electrode electrically connected to said barrel, a second spark electrode insulated from said barrel and providing a spark discharge gap with said first-mentioned electrode, a transformer having a primary winding and a secondary winding mounted in a space in said barrel, an insulating element about which said secondary winding is wound, a core of magnetic material within said insulating element, means including a spring clip arranged in engagement with said core and said insulating element for retaining said core in position and having an electrical connection with said secondary winding and said second spark electrode, means including a glass-to-metal seal at one end of said transformer space for sealing the space within said barrel about said transformer for substantially maintaining a predetermined pressure therein, and means extending through said seal for providing an electrical connection between an electrical conductor arranged externally of said sealed space and said transformer primary winding.

5. An ignition unit including a metallic barrel, a spark electrode connected to said barrel, a second spark electrode insulated from said barrel and providing a spark discharge gap with said first-mentioned electrode, a transformer having a primary winding and a secondary winding mounted in a space in said barrel, means for connecting said secondary winding to said second spark electrode, expansible means including a glass-to-metal seal at one end of said transformer space for sealing the space within said barrel about said transformer for substantially maintaining a pressure therein above ten pounds per square inch absolute, and means for providing an electrical connection between an electrical conductor arranged externally of said glass seal and said transformer primary winding.

6. A transformer having a primary winding and a secondary winding, an insulating spacer element arranged between said windings, a second insulating element about which said secondary winding is wound, a core of magnetic material within said second insulating element, and means including a spring clip arranged in engagement with said core and said second insulating element for retaining said core in position and providing a terminal for said secondary winding.

7. A transformer having a primary winding and a secondary winding, an insulating spacer element arranged between said windings, a second insulating element about which said secondary winding is wound having a central cavity therein, a core of magnetic material within said cavity in said second insulating element, and means including a spring clip arranged in engagement with said core and the sides of said cavity in said second insulating element for retaining said core in position therein.

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