Oct. 4, 1949. M. F. PETERS 2,483,428

IGNITION SYSTEM

Original Filed Oct. 17, 1944

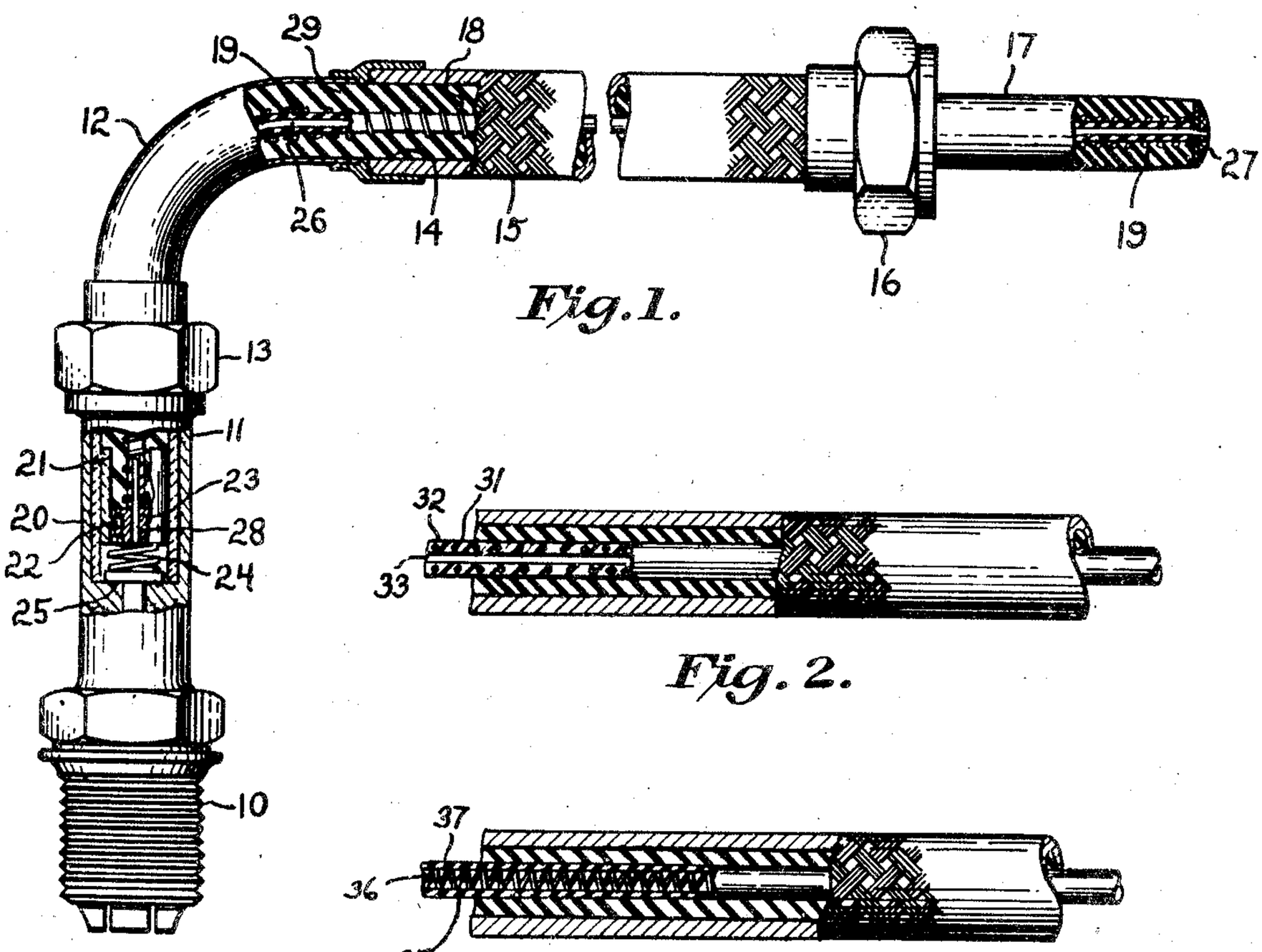

Fig. 1.

Fig. 2.

Fig. 3.

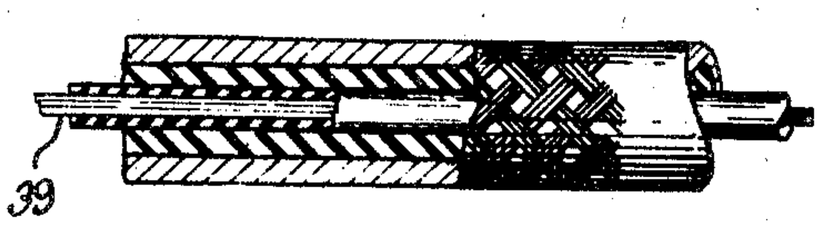

Fig. 4.

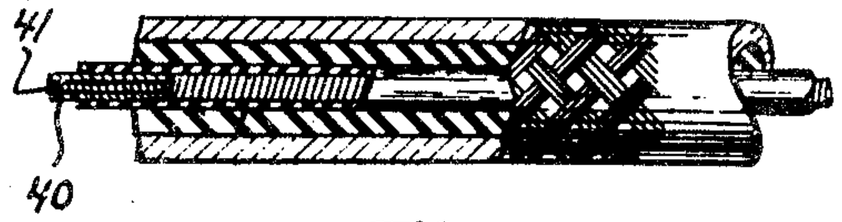

Fig. 5.

Fig. 6.

Melville F. Peters
INVENTOR
by William Jones

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UNITED STATES PATENT OFFICE

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IGNITION SYSTEM

Melville F. Peters, East Orange, N. J.

Continuation of application Serial No. 559,107, October 17, 1944. This application June 21, 1948, Serial No. 34,230

6 Claims. (Cl. 123—148)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to improvements in electrical ignition systems for internal combustion engines. It provides an improved apparatus for pressurizing the ignition harness and spark plugs thereof in the case of aviation engines, and has utility in the case of such engines which are subjected only to normal atmospheric conditions.

The increasingly high altitudes to which aircraft are being flown has caused short circuiting between the ends of the ignition cables and the spark generator, and between the said ends and the radio shielding manifold or housing or other grounded parts of the harness such as that part of the shielded portion of the spark plug where the ignition wire contacts the central electrode of the spark plug. As is well known, it has become common practice to pressurize the radio shielding so that the ignition wires and insulation therein as well as the spark plugs and magneto are maintained at a pressure above the ambient pressure, thereby eliminating the aforementioned failure at high altitudes. However, a leak or break in the airtight radio shielding, such as caused by vibration or gun fire, even though it may not rupture the ignition cable, will cause ignition failure at high altitudes due to the loss of pressure.

In many present installations such as in ordinary motor vehicles which may at times be required to operate in deep fords or the like whereby the engine or parts thereof may be partially under water, the ignition systems including the cables leading to the spark plugs have been totally enclosed and sealed in a watertight manner. Due to the fact that spark plugs will frequently leak gases from the combustion chamber past the central electrode, they build up a pressure where the ignition cables are attached, and the ignition cables will frequently be damaged or destroyed.

This invention provides an apparatus whereby the ignition cables in the case of airplane engines are pressurized in such a manner that the radio shielding, if used, need not be made airtight, and whereby the spark plug itself is pressurized where the ignition cable contacts the central electrode thereof, and whereby short circuiting between the cable shield of the plug and the ignition cable and electrode therein is prevented.

The apparatus in either case involves the use of an ignition cable having a continuous longitudinal passageway therein within the central insulation. In the case of aircraft engine systems, particularly, the conductor may advantageously lie within this passageway, and the passageway provides a chamber which is pressurized so that the conductor itself may be maintained at the

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required atmospheric pressure, irrespective of the altitude at which the engine might be used. The cable is sealed to the spark plug in such a manner that air pressure within the passageway of the ignition cable is applied to the interior portion of the spark plug within the tubular radio shield. Thus the ignition cable conductor and the interior of the spark plug as well as the magneto are maintained at the required pressure. Where the engine on which the cable is used has the ignition system sealed to prevent the entrance of moisture therein, as when operating under water, the central passageway in the ignition cable insulation provides an exit for gases which leak past the central electrode from the combustion chamber and which would otherwise blow open the means by which the ignition cable is sealed to the spark plug.

This application is a continuation of Application Serial No. 559,107, filed October 17, 1944, for Ignition systems, now abandoned.

It is therefore a primary object of this invention to provide an improved apparatus for pressurizing the ignition system of an internal combustion engine to prevent failure due to short circuiting at low atmospheric pressures.

Another object of this invention is the provision of an improved apparatus for pressurizing radio shielded spark plugs so as to prevent short circuiting between their central electrode or the ignition wire therein and the grounded tubular portion of the spark plug at low atmospheric pressures.

Another important object of my invention is the provision of an apparatus whereby the leakage combustion gases which would otherwise increase the pressure to such an extent as to damage the seal of waterproofed ignition systems may be vented off.

Another object of my invention is the provision of a novel hollow insulated ignition cable particularly adaptable for use in pressurized aviation ignition systems and in waterproofed installations.

Other objects will become apparent as the description proceeds in connection with the drawings wherein:

Fig. 1 is a side elevation, partly in section, of a detachable radio shielding ignition cable lead particularly adapted for aviation use, together with a spark plug to which it is attached, illustrating one species of hollow insulated and shielded ignition cable embodying my invention.

Figs. 2 to 6 are partial sectional views of other

species of the ignition cable embodying my invention.

As shown in Fig. 1 a spark plug 10 has a tubular radio shield 11 to which is attached an elbow 12. A nut 13 secures the elbow to the top of the radio shield in the conventional manner. At the end of the elbow is a flexible metallic radio shielding element comprising a corrugated metallic tube 14 surrounded by a metallic braid 15. The other end of the metallic tube has a flange, not shown, against which the nut 16 bears to secure that end of the flexible lead to the manifold of the metallic radio shield which carries the other ignition cables.

A flexible element 17 of rubber or the like protrudes from the manifold end of the lead and connects to an ignition cable within the aforesaid manifold. The flexible tube, braid, element 17, and nut 16 are conventional and well known. In the embodiment illustrated in Fig. 1, the conductor of the ignition cable comprises a conducting a wire 18 helically wound around a flexible tubular body 19. The tubular body 19 is advantageously of electrically conducting rubber or the like, whereby the electrical stress in the surrounding insulation is reduced, as disclosed in my U. S. Patent No. 2,322,773, issued June 29, 1943, and the conducting wire 18 may have the characteristics disclosed in said patent. The tubular body and wire are centrally disposed within the flexible element 17, the flexible tube 14, the elbow 12, and the radio shield 11. The space between the wire 18 and body 19 is sealed with a suitable high tension insulation material 29 which is plastic or flexible so that it will not break with flexure. Within the shield 11 of the spark plug is located an insulating cigarette 20. An insulating bushing 21 lies within the cigarette and has an interior flange 22. The tubular body 19 terminates adjacent the flange 22, and the spirally wound wire 18 is electrically bonded to a metallic contact 23 which is held by the flange 22. A spring 24 contacts both the contact 23 and the top of the central electrode 25. The plastic or flexible insulation material 29 which centralizes the wire 18 continues down to the top of the contact 23 as shown in Fig. 1. Within the hollow body 19 the passageway 26 provides a means for applying pressure to the portion of the spark plug within the radio shield 11. It should be noted that the passageway 26 extends all the way to the end of the flexible element 17 and through the conventional metal contact 27 at its end. Said passageway communicates with the interior of the shield 11 through a central passageway 28 in the contact 23. At its other end, the passageway communicates with a similar passageway in the cable leading to the magneto which is also pressurized. Thus the system from the magneto to the spark plug is pressurized. Since there is no potential gradient within the helical conductor the pressurized air within the passageway will not become ionized.

In the embodiment of Fig. 2 the helical wire 31 is moulded within the hollow body 32 which may be of conducting rubber or the like having a central passageway 33. In all other respects this embodiment is the same as that shown in Fig. 1.

In Fig. 3 the helical wire 35 lies within the central passageway 36 of the hollow body 37 which may also be of conducting rubber or the like. The embodiment of Fig. 4 is similar to that of Fig. 3 except that the conductor 39 is straight instead of helical as is the wire 35 of Fig. 3. In

the embodiment of Fig. 5 the conductor 40 is similar to the helical wire 35 of Fig. 3 except that its coils are closely wound without any spacing therebetween, thus forming a single passageway 41 within the coil of wire.

In Fig. 6 the conductor comprises a braid of metallic strands and nonconducting strands. The braid may be impregnated with conducting rubber or the like. As clearly shown in Fig. 6 the braided metallic conductor 44 has a central longitudinal passageway 45 for the passage of fluid or the application of internal pressure which feature is common to all the embodiments for the purpose of pressurizing the spark plug or ignition conductor, or for venting gases from the spark plug.

The system thus provides an improved apparatus for applying pressure to the spark plug, or for relieving pressure therefrom, according to the end which is desired. The pressurization of the magneto and ignition harness is well known, and the details of how the magneto is enclosed and pressurized do not form any part of my invention. However, the apparatus by which the pressure is transmitted from the magneto through the harness and to the spark plug eliminates many difficulties encountered when the pressure is transmitted through airtight radio shielding; in fact such shielding is not necessary to the use of my method. Since the passageway through the ignition cable may be quite small and still transmit the required pressure, a complete break through one of the cables or leads as a result of gun fire or the like, will not affect the pressurization of the other cables or leads because of the small rate at which the air can discharge through the break in the cable.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. In an ignition system for internal combustion engines having a source of high voltage and a spark plug including an ungrounded electrode, an ignition cable comprising a conductor surrounded by insulation and connected between said electrode and said source, there being a passageway extending longitudinally through said cable and communicating with said electrode and said source whereby gaseous pressure may be applied to or vented from said electrode.

2. A cable according to claim 1 wherein said conductor is a composite member of resistance wire and conducting rubber.

3. A cable according to claim 1 wherein said conductor comprises a composite hollow tube of conducting rubber having embedded in the wall thereof a continuous helical conductor.

4. A cable according to claim 1 wherein said conductor comprises a composite hollow conductor of conducting braid impregnated with conducting rubber.

5. An ignition system for internal combustion engines, said system comprising: a spark plug having an ungrounded electrode; a source of high voltage; and an ignition cable connected between said source and said electrode, said cable comprising a composite hollow member of resistance wire and conducting rubber whereby fluid pressure may be transmitted through the hollow passageway in said member.

6. An ignition system for use in internal combustion engines for damping out electrical oscillations having ultra-short wavelength, said system comprising: a source of high voltage; a spark plug having an ungrounded electrode; and an ignition cable connecting said electrode to said source, said cable comprising a composite hollow conductor of conducting metal and conducting rubber, the hollow in said conductor communicating between said electrode and said source for transmission of fluid pressure.

MELVILLE F. PETERS.

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