April 27, 1954 J. J. MASCUCH 2,677,009

SHIELDED SPARK PLUG LEAD ASSEMBLY

Filed Feb. 5, 1952

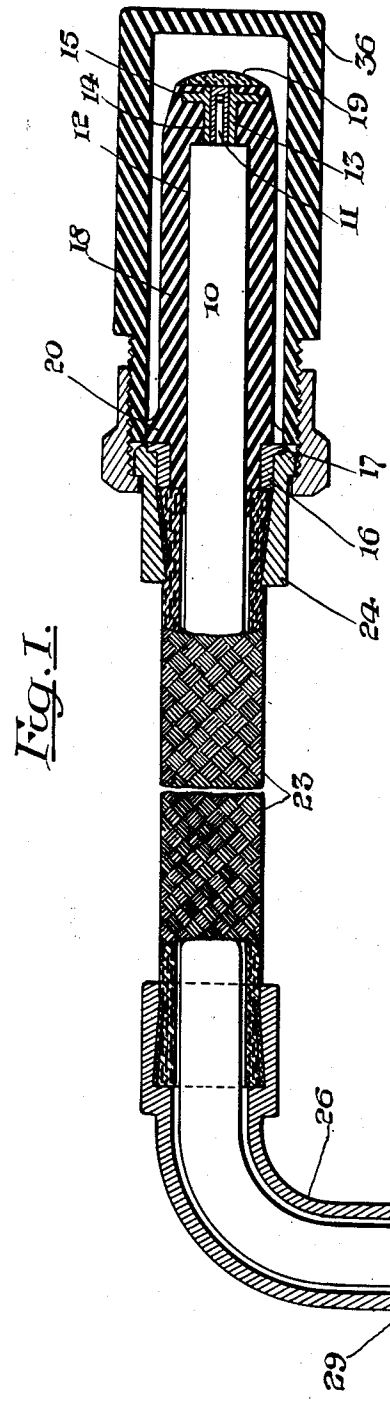

Fig. 1.

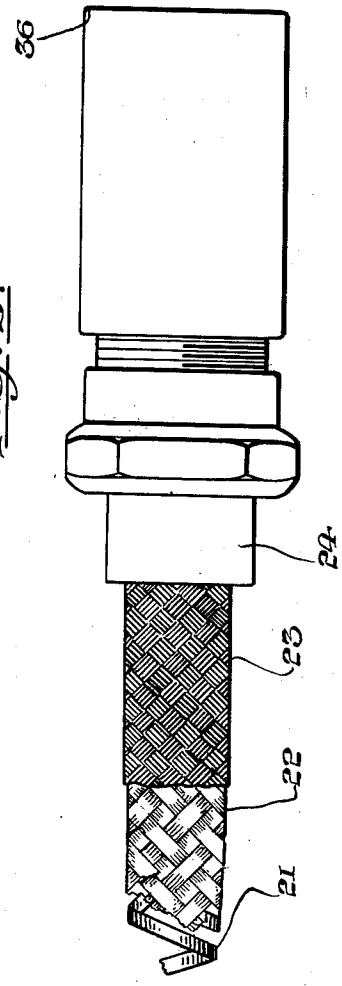

Fig. 2.

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Patented Apr. 27, 1954

2,677,009

UNITED STATES PATENT OFFICE

2,677,009

SHIELDED SPARK PLUG LEAD ASSEMBLY

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Application February 5, 1952, Serial No. 270,087

7 Claims. (Cl. 174—35)

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This invention relates to a spark plug lead assembly such as may be used to cover parts of a circuit, and specifically for connecting ignition wires contained in a manifold with spark plugs.

Where spark plug lead assemblies are presently used in connection with the aviation industry, they frequently become defective through the breakdown of the insulation contained therein. The faults in the insulation result from the wide variation of temperatures, to which such leads may be suddenly exposed in the course of airplane operations. Sharp changes from excessive heat to excessive cold cause the dielectric material within the assembly to crack and leak. Moisture thereupon finds its way into the shield, resulting in electrical discharge and a certain amount of electrical potential finds its way through the shield, causing radio interference. As a result, the operational life of presently known radio shielded conduits is rather limited.

One of the presently known materials which would be suitable for withstanding the wide and sudden variations in temperature, and also provide the dielectric properties needed for insulating ignition leads, is silicone rubber. However, due to the adhesive non-sticking qualities of this material, it has heretofore been impossible to use it in such structures.

Accordingly, it is an object of the present invention to provide a shielded spark plug lead assembly which will withstand excessive changes in temperature, without rapid deterioration or breakdown in shielding efficiency.

Another feature of the present invention is the provision of a spark plug lead assembly, which will incorporate the heat conductive advantages, while at the same time, retaining the electrical shielding properties of a satisfactory article.

Another object of the present invention is to provide a shielded spark plug lead assembly which will have a maximum amount of flexibility while maintaining its shielding properties.

A feature of the present invention is its use of silicone as the dielectric material for covering the ignition lead wires.

Another feature of the present invention is the use of a brass elbow in conjunction with silicone.

A further feature of the present invention is the use of steel inserts intermediate the silicone and brass to provide a maximum bond therebetween.

Another feature of the present invention is the use of a spiral of metal in the nature of a ribbon wound upon the dielectric covered ignition lead for the purpose of adding strength and flexibility to the assembly.

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The invention consists of the construction, combination and arrangement of parts, as herein illustrated, described and claimed.

In the accompanying drawings, forming a part hereof, are illustrated one form of embodiment of the invention, in which drawings similar reference characters designate corresponding parts, and in which:

Figure 1 is a side elevation of a complete embodiment of the present invention, with certain portions cut away to show the structure thereof.

Figure 2 is a fragmentary view in side elevation of the shielded lead shown in Fig. 1, with successive layers thereof cut back to show the construction of said lead.

Referring to the drawings, 10 indicates a length of ignition cable comprising a wire 11 which is centrally disposed within a dielectric covering 12 of silicone rubber such as "Dow-Corning Silastic." One end of the ignition lead is bared so that the wire 11 extends beyond the covering 12 and is provided with a steel sleeve 13 which is secured to the wire 11 as by solder 14. The sleeve 13 is provided with an outwardly disposed flange 15, for a hereinafter described purpose.

The outer surface of the sleeve 13 is roughened as by sand blasting, knurling, or the like. A steel insert 16 is slipped over the end of the lead 10, and its silicone covering 12, and disposed a suitable distance from said end. The steel insert 16, which is in the nature of a ring, having an outwardly disposed flange 17 on end thereof, is also provided with a roughened inner surface, as previously described in connection with the sleeve 13. The end of the lead, together with the sleeve 13 and the insert 16, is then placed in a mold in which there is formed a terminal extension of silicone rubber 18 about the sleeve 13, the ignition lead 10 and beneath the steel insert 16, as shown in Figure 1. The end of the solder 14, which has been formed into a contact button 19, extends beyond the terminal extension 18.

A portion of the silicone rubber terminal extension 18 is molded between the flange 15 and the contact button 19, so as to grasp the steel sleeve 13. In addition, the roughened surface of the sleeve 13 forms a bond with the silicone rubber because it overcomes the difficulty of causing silicone rubber to adhere to a surface. A collar 20 is molded on the inner end of the silicone rubber terminal extension 18, which collar 20 butts up against the flange 17 on the insert 16. The silicone rubber terminal extension 18 which is molded beneath the steel insert

16, also adheres to the inner surface of the steel insert 16, by reason of the roughened nature of said inner surface.

The remainder of the ignition lead 10 is covered with a single strand ribbon of metal 21, best shown in Fig. 2, which strand is spirally wound upon the outside surface of said lead. Successive layers of metallic braid are applied upon the metal spiral 21, as for example, the tinned Phosphor bronze braid 22 and the iron or monel braid 23, shown in Figure 2. A brass ferrule 24 is then silver-soldered to the outside of the braid adjacent the sleeve 17, in such manner that it overlies both the braid and the sleeve 17. In this manner the electrical conductivity and heat dissipating properties of brass are incorporated into the structure, despite the fact that brass and silicone rubber will fail to adhere.

The opposite end of the ignition lead 10 shown in Figure 1 is adapted to be applied to the spark plug shield (not shown) of an internal combustion engine. Accordingly, the ignition lead 10 is stripped of its coverings of spirally wound metal 21 and braid 22—23, for a suitable distance, and a steel terminal 25 is secured to the bared end of the wire 11. The terminal 25 is provided with a thread at the spark plug end thereof, and an external surface roughened in the manner previously described in connection with the steel sleeve 13, and insert 16.

A brass elbow 26 is slipped upon the silicone rubber covering of the lead 10, and secured to the outside of the steel braid 23, as by swaging and silver soldering it thereto. The elbow 26 is provided with an outwardly disposed flange 27 for the purpose of limiting the travel of the nut 28, which is carried upon the outside of the elbow 26.

A second steel insert 29, having a somewhat funnel-shape, is slipped over the silicone rubber covering 12 of the lead 10, and silver-soldered to the inside of the outwardly flared portion of the elbow 26, so that the outwardly disposed portion 27 on the insert 29 extends in the direction of the spark plug. The steel insert 29 is provided with a roughened inside surface to facilitate adherence to silicone rubber.

The assembly extending from the elbow 26 is placed within a suitable mold whereby a second silicone rubber terminal extension 30, (such as "Silastic Number 250") may be disposed about the end of the lead 10, the threaded terminal 25 and between the lead 10 and the steel insert 29. The roughened inner surface of the insert 29 provides a bond between the two materials, and the roughened outer surface of the terminal 25 operates in a similar manner.

A cavity 31 is molded into the end of the molded silicone rubber terminal extension 30, as shown in Figure 1. The end of the terminal 25 extends into the cavity 31 a short distance, and a nut 32 is threadedly engaged thereon. The nut 32 is provided with a groove 33 for the purpose of receiving therein a spark plug contacting spring 34. The walls of the cavity 31 serve to support and guide the spring 34.

The nut 28 is internally threaded so as to be engageable with a shield of a spark plug (not shown).

It will be apparent that on the spark plug side of the lead assembly described above, the advantages of the electrical conductivity and heat dissipating properties of the brass elbow have been obtained, while at the same time using silicone rubber and deriving the benefits of that substance's ability to withstand sudden and extreme variations in temperature. In addition, the single strand, spirally wound metal covering 21, provides extreme flexibility to the assembly, so that it may be applied with a minimum amount of difficulty, and used where space is at a premium.

In the illustration of the lead depicted in Figure 1, there are shown shipping caps 35, 36 which consist of plastic cup-shaped members having a thread at one end, and being closed at the other end, for the purpose of protecting the contact assemblies. It is understood that these shipping caps form no part of the present invention, but illustrate the customary manner in which this lead assembly is supplied.

Having thus fully described the invention, what is claimed as new and desired to be secured by Letters Patent of the United States, is:

1. A spark plug lead assembly comprising an ignition wire, a silicone rubber dielectric covering around said wire, a steel sleeve having a roughened outer surface secured to one end of the wire, a steel terminal secured to the opposite end of the wire, said terminal having a roughened outer surface, a first terminal extension silicone rubber moulded around one end of the silicone rubber covered ignition wire and the sleeve, a second terminal extension of silicone rubber moulded around the other end of the silicone rubber covered wire and the terminal, a spirally wound metal strip overlying the covered ignition wire between the two terminal extensions, a layer of braided wire upon the outside of the metal strip covering, and coupling means in electrical contact with the wire braid adapted to incorporate the lead assembly into a radio shielded ignition system.

2. A spark plug lead assembly comprising an ignition wire, a silicone rubber dielectric covering around said wire, a steel sleeve, a flange on the sleeve, said sleeve and flange having a roughened outer surface and being secured to one end of the wire, a steel terminal secured to the opposite end of the wire, said terminal having a roughened outer surface, a first terminal extension of silicone rubber moulded around one end of the silicone rubber covered ignition wire and the sleeve, a second terminal extension of silicone rubber moulded around the other end of the silicone rubber covered wire and the terminal, a spirally wound metal strip overlying the covered ignition wire between the two terminal extensions, a layer of braided wire upon the outside of the metal strip covering, and coupling means in electrical contact with the wire braid adapted to incorporate the lead assembly into a radio shielded ignition system.

3. A spark plug lead assembly comprising an ignition wire, a silicone rubber dielectric covering around said wire, a steel sleeve, a flange on the sleeve, said sleeve and flange having a roughened outer surface and being secured to one end of the wire, a steel terminal secured to the opposite end of the wire, said terminal having a roughened outer surface and a threaded end portion thereon, a terminal extension plug of silicone rubber moulded around one end of the silicone rubber covered ignition wire, the flange and the sleeve, a second terminal extension of silicone rubber moulded around the other end of the silicone rubber covered wire and the unthreaded portion of the terminal, a cavity provided in the end of the second plug to receive therein the threaded portion of the terminal, a

spirally wound metal strip overlying the covered ignition wire between the two terminal extensions, a layer of braided wire upon the outside of the metal strip covering, and coupling means in electrical contact with the wire braid adapted to incorporate the lead assembly into a radio shielded ignition system.

4. A spark plug lead assembly comprising an ignition wire, a silicone rubber dielectric covering around said wire, a steel sleeve having a roughened outer surface secured to one end of the wire, a steel terminal secured to the opposite end of the wire, said terminal having a roughened outer surface, a first terminal extension of silicone rubber moulded around one end of the silicone rubber covered ignition wire and the sleeve, a second terminal extension of silicone rubber moulded around the other end of the silicone rubber covered wire and the terminal, a single strand, spirally wound, metal strip overlying the covered ignition wire between the two terminal extensions, a layer of braided wire upon the outside of the metal strip covering, and coupling means in electrical contact with the wire braid, adapted to incorporate the lead assembly into a radio shielded ignition system.

5. A spark plug lead assembly comprising an ignition wire, a silicone rubber dielectric covering around said wire, a steel sleeve having a roughened outer surface secured to one end of the wire, a steel terminal secured to the opposite end of the wire, said terminal having a roughened outer surface, a ring shaped first steel insert having a roughened surface slipped upon the sleeve end of the covered ignition wire, a first terminal extension of silicone rubber moulded around one end of the silicone rubber covered ignition wire so as to adhere to and underlie the first insert and cover the sleeve, a second terminal extension of silicone rubber moulded around the other end of the silicone rubber covered wire and the terminal, a spirally wound metal strip overlying the covered ignition wire between the two terminal extensions, a layer of braided wire upon the outside of the metal strip covering, and coupling means in electrical contact with the wire braid adapted to incorporate the lead assembly into a radio shielded ignition system.

6. A spark plug lead assembly comprising an ignition wire, a silicone rubber dielectric covering around said wire, a steel sleeve having a roughened outer surface secured to one end of the wire, a steel terminal secured to the opposite end of the wire, said terminal having a roughened outer surface, a ring shaped first steel insert having a roughened surface slipped upon the sleeve end of the covered ignition wire, an outwardly flared ring shaped second steel insert having a roughened surface slipped upon the

terminal end of the covered ignition wire, a first terminal extension of silicone rubber moulded around one end of the silicone rubber covered ignition wire so as to adhere to and underlie the first insert and cover the sleeve, a second terminal extension formed of silicone rubber moulded around the other end of the silicone rubber covered wire and the terminal and to also adhere to and bear against the second insert, a spirally wound metal strip overlying the covered ignition wire between the two terminal extensions, a layer of braided wire upon the outside of the metal strip covering, and coupling means in electrical contact with the wire braid adapted to incorporate the lead assembly into a radio shielded ignition system.

7. A spark plug lead assembly comprising an ignition wire, a silicone rubber dielectric covering around said wire, a steel sleeve having a roughened outer surface secured to one end of the wire, a steel terminal secured to the opposite end of the wire, said terminal having a roughened outer surface, a ring shaped first steel insert having a roughened surface slipped upon the sleeve end of the covered ignition wire, an outwardly flared ring shaped second steel insert having a roughened surface slipped upon the terminal end of the covered ignition wire, a first terminal extension of silicone rubber moulded around one end of the silicone rubber covered ignition wire so as to adhere to and underlie the first insert and cover the sleeve, a second terminal extension formed of silicone rubber moulded around the other end of the silicone rubber covered wire and the terminal and to also adhere to and bear against the second insert, an elbow member disposed around the ignition wire dielectric immediately behind the second insert and secured to said insert, a spirally wound metal strip overlying the covered ignition wire between the elbow and the first terminal extension, a layer of braided wire upon the outside of the metal strip covering, and coupling means in electrical contact with the wire braid adapted to incorporate the lead assembly into a radio shielded ignition system.

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