

Aug. 29, 1950

L. M. WITTLINGER
SHIELDED IGNITION CABLE

2,520,705

Filed March 21, 1945

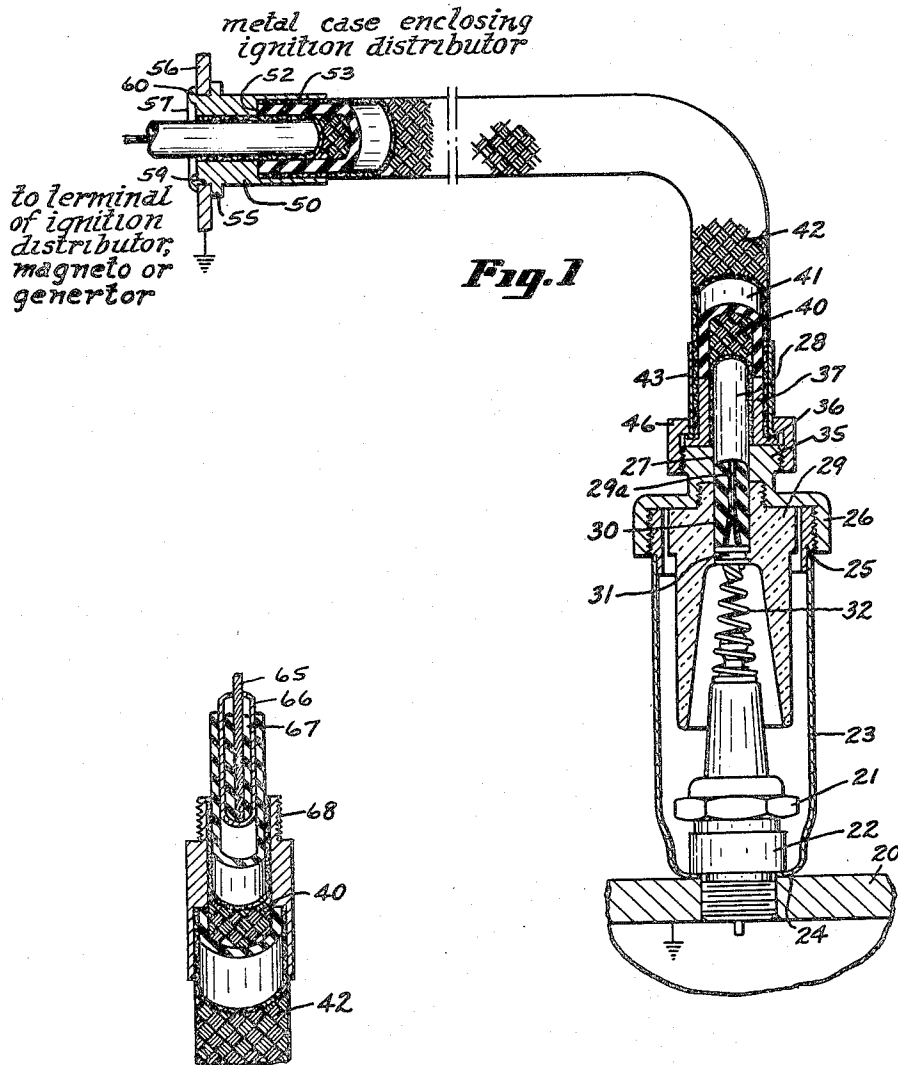


Fig. 2

INVENTOR
Leonard M. Wittlinger
BY
Spencer, Hardman & Fisher
H28 ATTORNEYS

UNITED STATES PATENT OFFICE

2,520,705

SHIELDED IGNITION CABLE

Leonard M. Wittlinger, Flint, Mich., assignor to
General Motors Corporation, Detroit, Mich., a
corporation of Delaware

Application March 21, 1945, Serial No. 583,967

5 Claims. (Cl. 174-36)

1

This invention relates to the shielding of ignition cables for the ignition system of internal combustion engines so that their effect upon radio apparatus in proximity to the ignition system is reduced or entirely eliminated.

It is well known that in the ignition system for an internal combustion engine, due to the periodic breaking and making of the ignition circuit, the high tension circuit and the spark plug discharge sets up a field and electromagnetic waves are produced in the atmosphere surrounding the system to such an extent as to create considerable interference with the proper reception in radio communication in apparatus that is in the vicinity of the ignition system. The high tension ignition system for internal combustion engines produces disturbances that are so violent that good radio reception is practically impossible. This is especially true in aircraft engines. Therefore, because of these interferences it is imperative that the ignition cables be properly shielded and grounded for the successful operation of the radio equipment.

Heretofore it has been the practice in conventional ignition systems, particularly aircraft ignition systems, to enclose the ignition cables in a rigid or combination of rigid and air tight flexible tubing in order to eliminate ignition interference upon the radio receiving apparatus. In the flexible portion of shielding system it was the practice to use a soldered spiral bellows or a continuous convolution type bellows in order to have an air tight system. Therefore it is one of the objects of the present invention to provide a flexible cable that is structurally stronger than the bellows type and one that need not be air tight.

In order to shield effectively extraneous apparatus, namely, radio apparatus, against violent electrical disturbances caused by ignition system of an internal combustion engine, it is essential that conductors of the ignition system be completely enclosed by a plurality of metallic surfaces; and that enclosing metallic surfaces be electrically connected together at the ends and grounded. Therefore, it is another object of the present invention to provide an efficient radio shield for enclosing the ignition conductor which shield shall comprise an inner shield of low resistance and an outer shield of high resistance and connecting the shields together and to ground. By this arrangement the lower frequency currents divide in proportion to the resistance of the low resistance inner shield and the higher resistance outer shield. In the case of the ultra high frequencies they tend to travel

2

on the surface of a conductor and therefore would be on the inner surface of the low resistance inner shield and be out of phase with its corresponding current in the main conductor and cancel the fields. Any stray field would then be absorbed by the higher resistance steel outer shield.

Further objects and advantages of the present invention will be apparent from the following description reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a side elevation, partly broken away and partly in section of an ignition conductor embodying the present invention.

Fig. 2 is a fragmentary view showing a modified form of the present invention shown in Fig. 1, but showing concentric conductors.

Referring to Fig. 1, 20 designates a fragment of a cylinder head supporting a spark plug 21 having a base 22. Disposed around the base of the plug is a metal tubular member 23 having at its bottom an internal flange 24 adapted to seat on the cylinder head 20. The member 23 is rigidly secured to the cylinder head by the base 22 of the plug when the plug is affixed to the cylinder head. The top of the tubular member 23 terminates in a screw fitting or nipple 25 for the attachment of a coupling member 26 having a bore 27 for receiving a cable 28. Screwed in the coupling 26 is a tubular member 29 of insulation having a bore 30 in alignment with the bore 27. The bores 27, 29 receive one end of the cable 28 having a conductor 29a which may be a plurality of copper strands. The lower end of the bore 30 is closed by a contact member 31 having a pointed portion which is forced between the flexible strands 29a. The lower side of the contact member 31 has affixed thereto in any suitable manner a spring 32 for making contact engagement with the central electrode 33 of the spark plug 21.

The upper end of the coupling member 26 in this instance is provided with a threaded portion 35 the end of which has a surface against which one end of a flanged coupling member 36 rests. The coupling member 36 is provided with a skirt 37 to which is attached one end of the shielded cable comprising one form of the present invention, as shown in Fig. 1. The shielded cable includes the conductor 29a covered with suitable insulating material. It is desirable that the core have a minimum amount of inductance. About the insulation of the cable 28 a flexible metallic shield 40, preferably of braided copper wire, is

wound. It is pointed out that the braided metallic shield 40 may be made of any suitable metal, for instance aluminum or other metal having a resistance equal to or appreciably lower than the copper conductor strands forming the core 29a. This shield of low resistance will be referred to hereinafter as the "inner shield." About the inner shield a sheath of insulation 41 is provided, this sheath isn't necessary from the radio standpoint. The purpose of the insulation between the two shields, as shown, is purely a matter of preventing abrasion between the two shields or to exclude any moisture or electrolytic action between the dissimilar metals. On the outside of the insulated sheath 41 a flexible metallic shield 42 of the stranded wire is provided and said shield has an iron or steel base. This latter shield 42 has a higher resistance than the "inner shield" 40 and will be known hereinafter as the "outer shield." It is pointed out that the arrangement of low resistance shield 40 and the higher resistance shield 42 may be reversed if desired.

One end of the flexible shielded cable 28 is attached to the coupling member 36. The flexible shields 40 and 41 terminate short of the ends of the cable 28 to allow the cable to extend through the bore 27 of the member 35 and into the bore 30 of the member 29. The inner shield 40 contacts the inner surface of the skirt 37 while the outer shield 42 contacts the outer surface of the skirt 37, by soldering or other suitable means, and thereby electrically connecting the shields 40 and 42 together. The insulation 41 terminates short of the ends of the shields 40 and 42 and abuts the upper end of the skirt 37 as shown in Fig. 1. A sleeve or ferrule 43 of metal is attached to the "outer shield" 42 by swaging or soldering. The upper end of the coupling member 26 is provided with a plane surface against which the flange portion of the coupling member 36 rests. A nut 46 is adapted to engage a flange provided by the ferrule 43 and press the flange against the flange of the coupling member 36 which in turn is pressed against the plane surface of the threaded portion 35, and thereby form a tight joint and ground connection. If desired, in order to get a high pressure unit pressure metal to metal contact the flange of the coupling member 36 could be formed with a V-shaped projection or other suitable sharp cornered means which will press against the plane surface of the part 35.

The other ends of the shields 40 and 42 are connected together by a ferrule 50 having a bore of step formation to provide an internal shoulder 52. The ends of the shields 40 and 42 terminate short of the end of the cable 28 in a manner that the outer shield 42 and the insulation 41 abut the shoulder 52 while the outer shield 42 contacts the interior of the ferrule as at 53. The inner shield 40 extends into and contacts the ferrule within the reduced portion of the bore. Thus, the inner and outer shields 40, 42 are electrically connected together by swaging, soldering or other suitable means. The ferrule is provided with an external flange 55 which abuts a metal case 56 when the end 57 of the ferrule 50 extends through an aperture 59 provided by the case 56. The end 57 is shown as suitably recessed and riveted over as at 60 to hold securely the ferrule to the case 56 to provide a ground connection. It is to be understood that other suitable means could be used to attach the ferrule 50 to the metal case 56 to provide the ground connection. For example, the end 57 could be provided with threads and screwed into an appropriate aperture

in the case 56. The ferrule 50 could be affixed to the case 56 by soldering or spot welding.

In Fig. 2 the modified form of the invention two concentric conductors 65 and 66 are used, the conductor 65 being substantially straight while the conductor 66 may be a woven or spiral form. It is to be understood that more than two conductors may be used so long as the conductors are insulated from each other and from ground. It is to be understood that the ends of the conductor 66 will be straightened out so that same can be easily attached to suitable terminals, not shown. A sheath 67 of insulation separates the conductors. Both conductors 65, 66 extend beyond the ends of two metallic shields 40, 42. Since these shields 40, 42 correspond to the inner and outer shields described in Fig. 1 they are given the same reference character and therefore need not be described in detail. The two shields 40 and 42 are connected electrically in the manner as described from the construction shown in Fig. 1. The ferrule construction shown in Fig. 2 is substantially the same as ferrule 50 with the exception of the end which is attached to the metal case is provided with threads 68.

It is pointed out here that the metals specified for the inner and outer shields 40, 42 are preferred, but it is to be understood that other metals could be utilized producing equivalent results. If desired, the arrangement of the shields of low and of higher resistance may be reversed.

As set forth heretofore the inner and outer shields 40, 42 terminate short of the cable 28. By this arrangement the cable extended ends can be easily attached to terminals one end to a terminal of a distributor (not shown) enclosed within the casing 56 while the other end is forced over the pointed projection of the contact 31 shown in Fig. 1.

It will be observed that in the foregoing described structure that both ends of the inner and outer shields 40, 42 are electrically connected together and grounded. This arrangement is of great value in eliminating ignition interference upon the radio receiving system. It has been found that by grounding the shields at both ends a much more effective shield is provided and that the need for shielding the conductor for the radio equipment is unnecessary so far as ignition radiation is concerned.

It will also be observed that the inner and outer metallic shields 40, 42 are spaced from each other by the sheath 41 of insulating material. It is pointed out here that this sheath is not necessary from the standpoint of suppressing radio interference. It has been found that when the outer shield 42 of steel braided wire was directly in contact with the inner shield of copper the radio system is quiet. As set forth heretofore, the purpose of the sheath of insulating material for spacing the inner and outer shield would be to prevent abrasion between the two shields, to exclude moisture and prevent electrolytic action between the different metals.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An ignition cable assembly including a central metallic conductor surrounded by a covering of yieldable insulating material; an inner flexible metallic shield surrounding and fitting against the insulating material; an outer flexible shield

5

surrounding the inner shield, both of the shields terminating short of the opposite ends of the cable, one of said shields having a higher resistance than the other; a tubular metallic member supported on each end of the cable and fitting over the inner shield and engaging the outer shield to connect electrically both shields together, said tubular member engaging the shields with sufficient force to anchor the inner shield to the insulating material and also to prevent longitudinal movement of the metallic members and the shields relative to the insulating material, said members operable to ground the shields when assembled in one ignition circuit.

2. An ignition cable assembly including a central metallic conductor surrounded by a covering of yieldable insulating material; an inner flexible metallic shield surrounding and fitting against the insulating material; an outer flexible shield surrounding the inner shield, insulating means disposed between the shields to prevent abrasion between the shield; a tubular metallic member supported on each end of the cable and fitting over the inner shield and engaging the outer shield to connect electrically both shields together, said tubular member engaging the shields with sufficient force to anchor the inner shield to the insulating material and also to prevent longitudinal movement of the metallic members and the shields relative to the insulating material, said members operable to ground the shields when assembled in one ignition circuit.

3. An ignition cable assembly including a central metallic conductor surrounded by a covering of yieldable insulating material; an inner flexible metallic shield surrounding and fitting against the insulating material; an outer flexible shield surrounding the inner shield, said shields being of less length than the cable; a pair of bendable sleeves slidably mounted on the cable, said sleeve having a portion fitting against the inner shield and another portion engaging the outer shield to connect electrically the shields together said sleeves adapted to be swaged to anchor the inner shield to the cable to retain the sleeves and the shields in immovable relation to the cable.

4. A means for shielding a flexible cable, said means comprising a pair of bendable metal

6

sleeves slidably mounted on the cable, each of said sleeves having an internal diameter larger than the cross dimension of the cable; a pair of concentric flexible shields disposed on said cable, said shields being of less length than the flexible cable with one of said shields having a higher resistance than the other, the sleeves and shields being adjustable along the cable the ends of the shields engaging different portions of sleeve, said sleeves being adapted to be swaged against the shields and causing the inner shield to be impressed into the cable to retain the sleeves and the shields in fixed relation on the cable.

5. An ignition cable assembly comprising, a plurality of concentric conductors insulated from each other within a flexible body of yieldable insulating material; an inner flexible metallic shield about the body; an outer flexible metallic shield about the inner shield, both of the shields being of less length than the flexible body; one of said shields having a high resistance while the other shield has a lower resistance, insulating means disposed between the shields to prevent abrasion between the shields a metallic sleeve slidable on the body at each end of the shields and being adapted to engage both shields to connect electrically both shields together, said sleeve being adapted to be deformed against the shields and causing the inner shield to be embedded in the body to retain the sleeves and the shield in immovable relation to the body whereby said sleeves are capable of grounding the shields when assembled in an ignition circuit.

LEONARD M. WITTLINGER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
809,313	Lougee	Jan. 9, 1906
2,047,152	Mitchell	July 7, 1936
2,082,800	Holliday	June 8, 1937
2,105,791	Mascuch	Jan. 18, 1938
2,226,479	Pupp	Dec. 24, 1940
2,234,579	Robertson	Mar. 11, 1941
2,362,034	Stahl	Nov. 7, 1944