Feb. 15, 1938. C. B. AIKEN ET AL 2,108,635

SHIELD FOR IGNITION PLUGS

Filed May 14, 1929

FIG. 1.

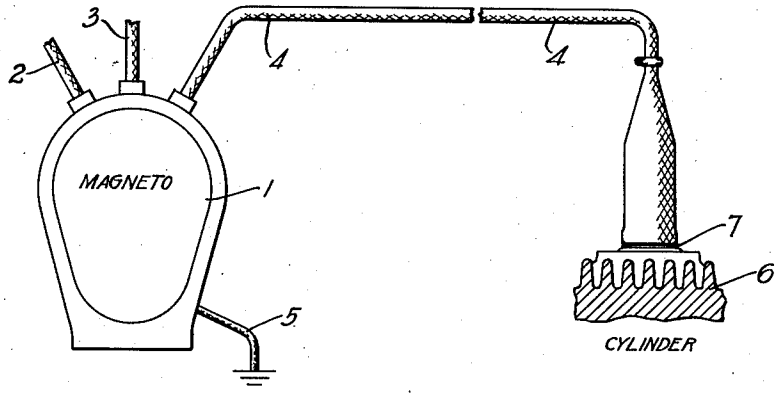



FIG. 2.

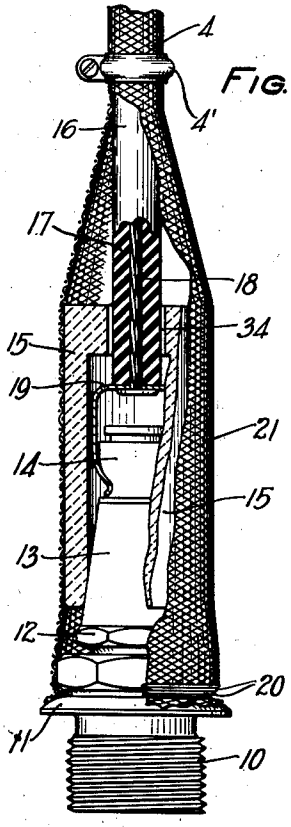



FIG. 4

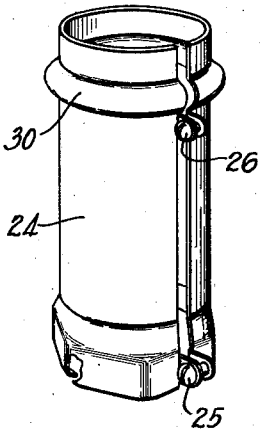
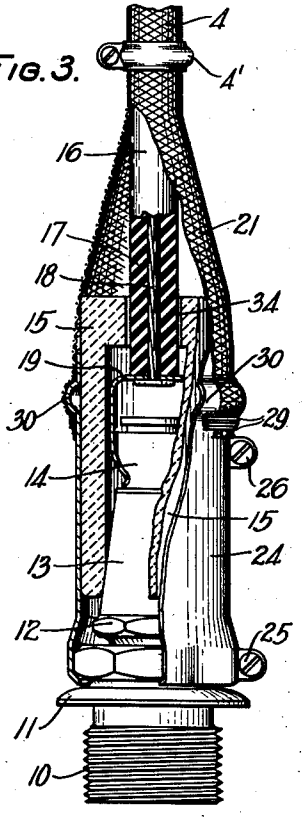



FIG. 3.

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## SHIELD FOR IGNITION PLUGS

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2 Claims. (Cl. 123—169)

The present invention relates to reduction of interference in signaling apparatus arising from the ignition system of a gas engine or similar source. More specifically the invention relates to a means for suitably electrically shielding the ignition system, including the spark plug to reduce disturbances in adjacently located signaling apparatus such as a radio transmitter or receiver.

The invention has particular application to airplane motor ignition systems, but is applicable also to similar uses where practically complete shielding is to be obtained.

An object of the present invention is to provide shielding which is adequate from the standpoint of protecting signaling apparatus from disturbances and which will stand up for indefinitely long periods of time under any and all service conditions.

Shielding which is adequate to suppress disturbances in the radio sets must extend to the entire ignition system including the spark plugs themselves. It is a comparatively simple matter to shield the ignition system from the magneto to the spark plug since this may be done by completely covering the high tension circuit with a grounded metal shield in the form of a metal tube or a screen composed, for example, of braided copper wire.

The problem which has presented great difficulty in the past has been the provision of shielding for the spark plugs which would be adequate for reducing disturbances and at the same time would not in any way impair the operation of the motor even after long periods of use and under adverse weather conditions.

While it has been recognized for years that radio interference on an airplane could be reduced by shielding the ignition system attempts to apply such shielding have resulted in ignition failures in so many instances that apprehensions have been raised in the minds of aviators and manufacturers of engines and airplanes as to the reliability of this method of reducing interference.

Applicants have devised a shielded spark plug construction which has proved successful and dependable in service under extremely adverse weather conditions both in long, continuous flying and what is even more trying, in short flights in wet weather with alternate heating and cooling of the motor.

The construction constituting the present invention will now be described in detail in connection with the attached drawing forming part of this specification.

In the drawing Fig. 1 shows in simple, diagrammatic form the essentials of a typical ignition wiring system, Fig. 2 shows a part sectional view of a shielded cable and spark plug according to this invention, Fig. 3 is a similar view of a modified construction according to the invention, and Fig. 4 is a perspective view showing the construction of the clamping member of Fig. 3.

In Fig. 1 only so much of the ignition system is shown as is necessary to an undertsanding of the shielding requirements. The high-tension magneto 1 supplies the requisite high voltage current to the several ignition leads 2, 3, 4 etc., in succession, of which there may be any number depending on the type of motor. One side of all of the ignition circuits in common is formed by the ground connection 5 which may be the engine frame or chassis. Each lead 2, 3, 4 etc. extends to a motor cylinder, only one of which is indicated, at 6. The spark plug 7 in each cylinder of the motor may be a commercial type of plug of any suitable make or design. The lead 4 is shown as extending to the plug 7 and both the lead and the plug are covered over with a copper braid sheath which is kepth at ground potential by contact with the magneto casing and the cylinder of the motor as well as ground connections at several other points (not shown) along the sheath.

The leads 2, 3, 4 etc. each consists of a rubber-covered cable having a single, usually stranded, copper conductor at the center. Between this conductor and the grounded sheath a high potential exists, which must be carried to and applied across the spark terminals within the motor cylinder. To accomplish this successfully, the insulation resistance between the copper cable and the grounded sheath should be maintained at all times at a high value.

A description of the shielded plug construction of the invention will now be given in connection with Fig. 2. The plug itself is shown as comprising a threaded base 10, an apron 11, hexagonal assembly nut 12, insulator 13, and terminal 14. As stated, the plug itself may be a commercial type of any suitable design.

A hollow insulating cylinder 15, open at the lower end, is placed over the terminal 14 and extends well down over the insulator 13. The lower edge of the cylinder 15 may be beveled, as shown. This cylinder is preferably made of a ceramic product similar to porcelain, known as "isolantite", a commercial insulating product of the Isolantite Company of America, located at Belleville, N. J. This material is preferred because

of its high insulation resistance, mechanical strength and the fact that it can be easily machined before firing. Any other suitable insulation such as porcelain, a phenolic condensation product such as bakelite, or the like may be used, however.

The cylinder 15 has an aperture at the top to admit the rubber-covered cable 16 of the shielded connecting cable 4. The rubber insulation is shown in section at 17 and the copper core at 18. The latter is secured to the spring clip 19 as by passing through an aperture in the clip and being soldered to the metal of the clip. The clip engages the terminal 14 of the plug and makes good electrical contact therewith. The internal diameter of cylinder 15 is such that clip 19 cannot be spread far enough to disengage terminal 14 when the cylinder 15 is once in place.

The copper braid covering 21 over the cable 4 is spread as it approaches the plug and is drawn over the cylinder 15 and brought down into contact with the base of the plug. It is there secured in place in any suitable manner as by passing a few turns of wire 20 around it. A clamp 4' holds the shield 21 securely around the cable 16 at the point where the shield begins to spread.

To assemble the plug and shield, the braided covering 21 is drawn back over the cable 16 which is then cut to the proper length and secured to spring clip 19 after first being passed through the aperture in the insulator 15. The latter is pushed upward on the cable 16 far enough to enable clip 19 to be placed on terminal 14. Then cylinder 15 is dropped over the plug until its lower edge engages the plug. The braided shielding is now brought over the whole and secured in the position shown, by wire 20.

An important effect present in applicants' structure is that the top of the strucure where the high tension lead is brought in remains cool due to the heat radiation from the copper braid. Another important point is that the lead 16 passes through an insulator (15) instead of through a grounded metal shield. A contributing factor also is the good contact between the cable core and the terminal 14, a feature often overlooked in prior art constructions. All of these features cooperate to give reliable operation. Heat soon deteriorates rubber insulation. Where the cable passes through a tight fitting metal which becomes hot applicants have observed complete failure or at least a great reduction in insulation resistance. The presence of a spark causes rapid deterioration of rubber insulation, probably due to the production of ozone which attacks the rubber. This is overcome in applicants' device by the soldered connection and spring clip. The use of the spring clip is facilitated by the cooling, the spring temper being retained indefinitely.

Too great cooling is not advantageous. The sparking terminals and the lower end of the plug generally must be hot in order to prevent accumulation of soot or carbon which would partially shunt the gap. The construction must be such as to keep the sparking end hot and the opposite or top end sufficiently cool for reasons above given. In applicants' structure, the top portion through which the cable passes never becomes too hot to be grasped by the bare hand, even after hours of flying.

The spreading of the shielding braid to pass over cylinder 15 is advantageous in two ways. It promotes cooling, and the greater spacing from the high tension core at this point keeps the insulation resistance high. Also a film of moisture that might form over the surface of the rubber 16 or the outside of insulator 15 is rendered harmless by the spacing between any exposed high tension part (19) and the shield. Protection against conduction along the path 34 may be further guarded against by filling the space between cable 16 and aperture wall in insulator 15 with rubber cement. These facts, particularly the fact that no grounded metal close to the outer surface of the rubber insulation becomes hot, make for long life and reliable service.

Instead of securing the braided shield to the base of the plug by wrapping wire around the shield as shown in Fig. 1 a clamp of any suitable design such as a "hose" clamp may be employed. A special design of combined clamp and shield member is illustrated in Figs. 3 and 4.

The construction shown in Fig. 3 may be identical with that in Fig. 1 so far as concerns the spark plug 10, 11, 12, 13 and 14, the isolantite cylinder 15 and the disposition of the high tension cable 16 and spring clip 19.

After the cable 16, clip 19 and cylinder 15 have been placed in position as shown in Fig. 3, however, the cylinder is engaged and held firmly in place by the split sleeve 24 which is provided with screw clamping means indicated at 25 and 26 for tightening down the sleeve on the cylinder 15 and the hexagonal portion of the spark plug base. In assembling, the split sleeve 24 will have been placed loosely in position before the clip 19 and cylinder 15 are moved into place. After these parts have been positioned, the sleeve is made to grasp firmly the cylinder 15 and the plug base by tightening down on screws 25 and 26. The construction of the split sleeve is shown more fully in Fig. 4.

After these parts have been secured in place the braided sheath 21 is drawn down over the outside of the sleeve 24 and is served with wire 29 to hold the braiding in place. To facilitate this a bulge is made at 30 in the sleeve 24. Instead of using a sheathing of wire 29 for this purpose any suitable clamping means such as a split ring may be used. The sleeve 24 is made approximately hexagonal at the base in order to conform to the plug base and also projects under the edge of the hexagonal base portion. Instead of bringing the braided sheath over the outside of the sleeve 24, it may be placed inside between sleeve 24 and insulator 15 and securely clamped in place by tightening screws 25 and 26.

It will be understood that the construction may be varied widely within the scope of the appended claims without departing from the spirit of the invention, the forms above described being illustrative rather than limiting.

What is claimed is:

1. In a shield construction for a spark plug, a ceramic housing over the plug terminal and surrounding the upper portion of said plug insulator having an aperture in its wall for admitting the high-tension lead wire, means inside the housing for electrically connecting the lead wire to the plug terminal, and a metal shield extending over the outside of the lead wire and the housing and contacting with the base of the plug, said ceramic housing serving to hold the metal shield away from the plug terminal and from the high tension lead wire and its rubber insulation where the latter approaches and enters the said aperture.

2. A shield construction for a spark plug com-

prising a hollow insulator surrounding the upper portion of the plug insulator and enclosing the plug terminal and having an aperture through which the high tension lead extends, and an expansible spring clip carried by the end of said high tension lead adapted to engage said plug terminal, the internal diameter of said hollow insulator being less than the expansion width of said spring clip, and a metallic covering over said insulator, high tension lead, and the exposed insulator portion of the spark plug.

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