Oct. 3, 1933. L. F. HAHN 1,929,202

SHIELDED SPARK PLUG

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Fig. 1.

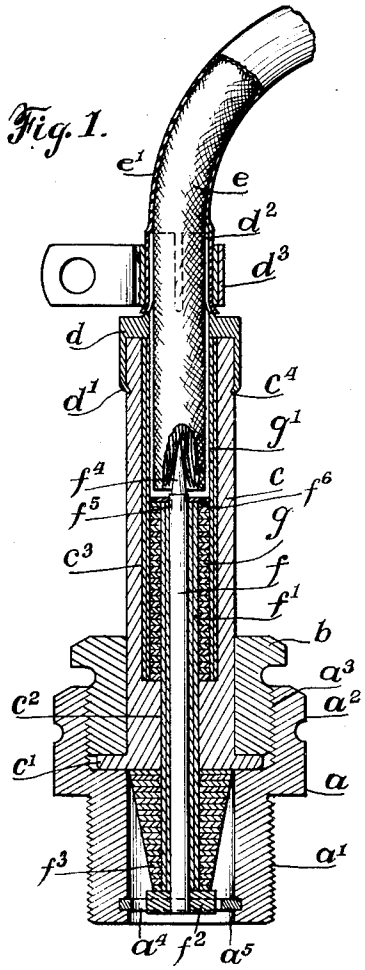
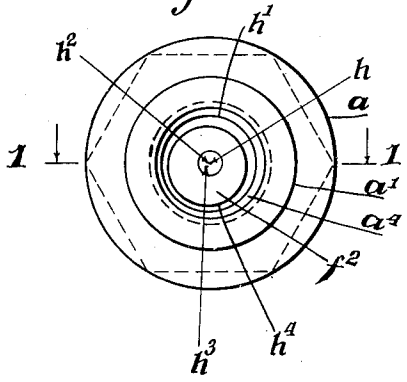


Fig. 2.



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SHIELDED SPARK PLUG

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11 Claims. (Cl. 123—169)

The present invention relates to spark plugs and embodies, more specifically, an improved spark plug constructed in such manner that it is shielded to prevent electrical disturbances set up by the ignition system from affecting radio communication adjacent the engine. There has arisen a very considerable demand for spark plugs which are shielded in this manner and a great amount of experimentation has been done with the result of the designing of various forms of spark plugs having the above object in view.

Such spark plugs have been found to be objectionable by reason of the fact that, in addition to not being moisture proof, the plugs have become so greatly over heated as to cause pre-ignition in the engine cylinders. This difficulty, which is to be found in shielded spark plugs developed prior to the present invention, may be attributed in general to the failure to provide a short enough and good enough heat conducting path from the interior of the engine cylinder to the exterior atmosphere.

An object of the invention, accordingly, is to provide a spark plug which is effectively shielded to prevent electrical disturbances set up by the ignition system of an aeroplane, automobile, motor boat, farm lighting plant or the like, from affecting radio communication therewith or in the vicinity thereof.

A further object of the invention is to provide a spark plug construction which affords sufficient cooling for the heating elements thereof to prevent pre-ignition in the engine cylinders, at the same time leaving sufficient heat in the plug to prevent fouling.

A further object of the invention is to provide a spark plug construction of the above character having a large surface for sparking and having means for readily adjusting the spark gap to provide a gap of the proper dimension between unused portions of the electrodes, when continued use has caused the burning away of the electrodes at any one point.

A further object of the invention is to provide a shielded spark plug which is water-tight and is constructd in such manner that a positive contact between the ignition system wire and the center electrode in the plug is afforded.

A further object of the invention is to provide a spark plug of the character described, for use on military or naval combat planes, which will not be short-circuited by the collection of powder from machine guns on the surface of the plug.

A further object of the invention is to provide a spark plug which is constructed of elements which are simple and inexpensive to manufacture and are readily assembled and taken down.

A further object of the invention is to provide a sturdy plug with parts of sufficient strength to withstand rough handling and the stresses imposed under operation.

Further objects, not specifically enumerated above, will be apparent as the invention is described in greater detail in connection with the accompanying drawing, wherein:

Figure 1 is a view in section, taken on line 1—1 of Figure 2, and looking in the direction of the arrows.

Figure 2 is a bottom view of the spark plug shown in Figure 1.

Referring to the above drawing, a designates a spark plug shell which is threaded at a' to engage the cylinder head of an engine. An enlarged portion a^2 is internally threaded at a^3 and receives a compression nut b. An annular electrode a^4 is mounted within the shell a', its opening eccentric with respect to the axis thereof, and is secured in position by a turned over portion a^5 of the shell a'.

A metallic shield or jacket c, preferably made of brass, or other good heat conducting material, is formed with a flanged portion c' which is secured between the compression nut b and a restricted portion of the shell a'. An axial passage c^2 is formed adjacent the flange c' and is enlarged at c^3 to receive the elements to be described hereinafter. A circumferential groove c^4 is formed adjacent the top of the shield and receives the extremity d' of a cap d, which extremity is preferably rolled into the groove c^4. The cap d is formed with a split head d^2 which carries a clamping device d^3 to compress the split portions of the head about a wire e which is part of an ignition system, as well as to secure the metallic covering or shielding e' of the wire e. It will be understood that all of the elements belonging to the high tension ignition system are shielded, including the ignition wires which are covered with a metallic braiding or the like.

A spindle f carries a desired number of layers of mica f' and is received within the axial passage c^2. The lower extremity of the spindle carries an eccentric central electrode f^2 which lies in the plane of the annular electrode a^4. Mica discs f^3 are mounted between the head f^2 and the flanged portion c' of the shield. The upper extremity of the spindle f is formed with a conical point f^4, at the base of which is a shoulder f^5. Additional sheets of mica g' and mica discs g are

mounted within the shield c to provide the desired insulation and a metal washer f^6 is placed over the end of the spindle f. The portion of the shield adjacent the flange c' is placed under a high compression and the diameter thereof reduced to secure the spindle and mica therewithin. Prior to such compression, the washer f^6 and the spindle head f^2 are placed under compression to secure the mica discs f^3 in a desired manner, as well as the mica discs g, and the shoulder f^5 is peened over to secure the disc f^6 in such position. In this manner, it will be seen that the elements of the core are effectively secured in position.

The core assembly, constituting the shield, the spindle, and the parts secured therewithin is secured to the shell by means of the compression nut b, as clearly shown in Figure 1. It will be seen that no gasket is used, and the proper cooling of the inner portions of the plugs is thus facilitated, by reason of the good heat conducting path offered by the metal to metal contact. The metallic covering e' of the ignition wire e is cut back as shown, the wire e being forced downwardly through the cap until the strands thereof are engaged and spread by the point f^4. At the same time the metallic covering c' is arranged over the outside of the cap as shown, at which time the clamp d^3 effectively secures not only the metallic covering to the cap, but the wire within the cap. In this manner the shielding of the plug and the connecting ignition wire is complete and unbroken, and by reason of the rolled engagement of the portion d' of the cap d with the groove c^4, a watertight connection is also secured.

With reference to Figure 2 which is a bottom view of the spark plug shown in Figure 1, the geometrical center of the spark plug is the center line of the spindle f and is indicated by the reference character h. The opening h' in the annular electrode a^4 is circular in form and has its center h^2 offset from the geometrical center h as shown. The central electrode f^2, which lies in the plane of the annular electrode a^4, is also circular in form and has its center h^3 likewise offset from the geometrical center h. In Figure 2 the central electrode is shown in the position to give the desired initial spark gap setting h^4. It will be noted that the two electrodes approach each other somewhat closely over a considerable portion of the circumference and this fact, coupled with the fact that the annular electrode and the central electrode may be made as thick as desirable, permits the formation of a fat spark with a minimum of burning away of the electrodes. When the spark gap becomes appreciably changed by reason of such burning, the plug can be removed, the compression nut loosened and the core assembly rotated until the desired spark gap is again obtained, this adjustment being made possible by reason of the displacement of the centers of the two electrodes. It will of course be evident that the central and annular electrodes must be made of high arcing resistance material and that they may or may not be integral with the spindle and the shell respectively.

Reference has already been made to the fact that previous types of shielded spark plugs have failed in practice due to their overheating with resulting pre-ignition.

The success of the present invention is due to the provision of a good heat conducting path from the interior of the engine cylinder to the external atmosphere. With this end in view, the shield c is preferably made of brass or other good heat conducting material and is brought into close relation with the spindle f. The shield is also preferably secured to the shell a, or its equivalent, by a metal to metal joint, as gaskets tend to impede the flow of heat.

It will be appreciated that the present invention is extremely efficient in respect of maintaining a low operating temperature and preventing pre-ignition, so that care must be taken lest too much heat be conducted away with consequent fouling of the plug due to too low an operating temperature. With this end in view, sufficient material is left in the plug to permit the retention of the necessary operating temperature.

While the invention is not to be understood as limited with respect to the insulating material employed, it should be noted that mica has been used because of its high dielectric strength and also because of its physical strength and durability, whereby it may be placed under high compression to make a tight joint against the compression in the engine cylinders, at the same time permitting, by reason of such high compression, a good heat conducting path between the various elements employed.

While the invention has been described with specific reference to the construction shown in the accompanying drawing, it is not to be limited, save as defined in the appended claims.

What I claim is:

1. In a spark plug, the combination of means comprising a tubular metallic shell for mounting the plug in an engine cylinder, said shell provided adjacent its inner end with an electrode, a long tubular metallic jacket of high heat conducting capacity having one end intruded into the bore at the outer end of the shell, terminating in spaced relation to the electrode and in metal-to-metal contact with the shell to facilitate heat transference from the shell to the inner end of the jacket, means for demountably securing the jacket to the shell, said jacket projecting exteriorly from the shell and from said securing means and the portion thereof exteriorly of the shell having a thin wall and providing on its outer side a large area continuous heat radiating surface exposed to the cooling effect of the external atmosphere, a thin spindle capable of carrying high tension electric current and having small heat storing capacity with its upper end portion centered in the jacket and its lower end portion projecting therefrom into the bore of the shell and provided at its lower end with a head constituting a coacting electrode with the first named electrode, the upper end of the spindle contained within the outline of the jacket and spaced from its upper end, and the upper end of the jacket adapted to receive a flexible electrode lead intruded into the same for engagement with the upper end of the spindle, relatively massive insulating means surrounding the portion of the spindle between the electrode head and the intruded end of the jacket, acting to minimize direct heat transference from the interior of the shell to the spindle and to the jacket, and other long tubular insulating means extending above the upper end of the spindle, continuous at its lower end with the said massive insulating means, fitting snugly between the jacket and the portion of the spindle which is contained within the jacket to facilitate heat transference therebetween, said other insulating means being of relatively thin cross section with a thickness sufficient to provide a dielectric between the spindle and jacket while pro-

viding for maximum heat conductivity between the heat radiating jacket and the portion of the spindle contained therein.

2. In a spark plug, the combination of a tubular shell provided with external threads for securing the same to an engine cylinder and having the upper end of its bore enlarged to provide a seat and the portion above the seat being internally threaded, a replaceable unit adapted to be fitted into the bore of said shell, said unit comprising a metal cylindrical jacket provided at one end with an outstanding mounting flange adapted to rest on said seat, a spindle extending axially of the jacket and projecting from the end thereof provided with the flange, means for securing the spindle to the jacket, the projecting end of the spindle provided with an electrode forming head adapted to coact with the shell below said seat to form a spark gap and having its outer periphery eccentric relative to the axis of rotary movement of the unit and an annular nut having one end engaging the flange and in threaded engagement with the internal threads of the shell, with the portion of the jacket adjacent its flange journalled for rotary movement in the bore of the nut and said nut with its unit mounted therein adapted to be screwed into the shell and said nut in its bearing engagement with the flange adapted to secure the replaceable unit fixed against rotation in the shell thereby to set the periphery of the electrode fixed in its adjustable relation to the shell.

3. In a device of the class described, the combination of a tubular shell provided with external threads for mounting the same in an engine cylinder and having the upper portion of its bore enlarged to form an upwardly facing seat, the lower portion of the bore provided with an annular electrode, a unit adapted to be placed in the shell, said unit including a metal jacket having a flange at its lower end demountably positioned on said seat, a nut in threaded engagement with the shell and in bearing engagement with the upper side of the flange to secure the unit to the seat of the shell, said nut providing a bearing in which the jacket is mounted for rotary movement and by means of which the unit is mounted for rotary movement about its own axis and secured in the axis of the shell, said unit including a spindle extending axially of the jacket, shell and nut and projecting from the jacket into the opening in the annular electrode, means for securing the spindle centered axially in the jacket, said spindle provided at its lower end with a head contained in the plane of the annular electrode and positioned with its perimeter eccentric relative to said axis thereby to form an annular gap between the two electrodes and whereby when the unit is rotated in the bearing provided by the nut different portions of the electrode head will be caused to approach the annular electrode.

4. In a device of the class described, the combination of an annular nut, a brass sleeve fitting in the bore of the nut for rotary movement about the axis of the nut, said sleeve provided at one end with a flange fitting against one end of the nut, said nut provided externally of the axially projected outlines of the flange with a cylindrical portion externally threaded for engagement with a shell, a spindle extending axially of the sleeve provided at one end with means for engaging with an electric lead and having its other end projecting beyond the sleeve, and means for insulating the spindle from and for securing the spindle fixed in the sleeve, the projecting end of the spindle provided with a flat cylindrical head constituting an electrode and the center of the circle forming the perimeter of said head being offset from the axis of rotation of the sleeve in the nut.

5. In a device of the class described, the combination of a tubular shell provided with threads for mounting it in an engine cylinder and having the upper end of its bore enlarged to provide a seat, a long tubular metal jacket provided at its lower end with a flange engaging said seat, a nut through which the jacket projects and in which the jacket is adapted to be mounted for rotary movement, said nut being in threaded engagement with the shell and adapted when screwed into tight engagement with the flange to secure the jacket non-rotatably to the shell, a spindle extending axially of the jacket and projecting therefrom into the lower portion of the bore of the shell, the spindle and shell provided with coacting electrodes, means surrounding the portion of the spindle which projects below the jacket for spacing the head from the adjacent end of the jacket and means between the spindle and jacket for centering the spindle in the jacket, said jacket, spindle and the last two means being fixedly secured together as a unit.

6. A spark plug comprising three major parts, a shell adapted to secure the plug to an engine cylinder and provided with an electrode, a unit provided with a coacting electrode and a nut through which the unit extends, said nut being in threaded engagement with the shell and bearing on the unit for securing the unit to the shell, the portion of the unit engaging the shell and nut comprising an outer brass jacket provided at its lower end with a flange on which the nut bears, a spindle extending axially of the jacket, insulated therefrom and projecting beyond one end thereof, the coacting electrode being at the projecting end of the spindle, and means at the other end of the spindle for engaging an electric lead.

7. In a spark plug, the combination of a shell provided with an electrode, a unit having its lower end demountably fitted into said shell and projecting above the same, an annular nut encircling the lower portion of the unit and securing the same to the shell, said unit comprising an outer metal jacket open at its upper end and having its lower end fitted in the bore of the nut, a spindle extending axially of the jacket, means for securing the spindle entered in and insulated from the jacket, the upper end of the spindle provided with means for engaging an electric lead extending into the upper open end of the jacket, and the lower end of the spindle provided with a head forming a coacting electrode.

8. In a spark plug, the combination of a tubular shell provided with a restricted lower part externally threaded for engaging in an engine cylinder and having an enlarged upper part adapted to be disposed exteriorly of the engine and with the bore in the enlarged part defined by a seat at its lower end, and said enlarged part of the bore being internally threaded, an annular electrode adjacent the lower end of the bore, a unit adapted to be intruded in to the shell through the upper enlarged end of its bore, the exposed portion of the unit being of metal and providing a water-tight surface throughout its length, said unit adjacent its lower end provided with a mounting flange engaging said seat, an annular nut in the bore of which the unit snugly fits with a slight freedom of rotary movement, said nut

provided exteriorly with threads for engaging the internal threads of the shell and adapted to bear on the flange for securing the unit to the seat, electric conducting means extending axially entirely through the unit and provided at its inner intruded end with a coacting electrode disposed in the plane of the annular electrode, said unit with its nut adapted to be withdrawn together from the shell when the nut is loosened in order to permit an inspection of the intruded coacting electrode.

9. In a spark plug, the combination of a tubular shell provided with a lower part externally threaded for engaging in an engine cylinder and having an upper part adapted to be disposed exteriorly of the engine and with the bore internally threaded and enlarged to provide a seat, an annular electrode adjacent the lower end of the bore, a unit adapted to be intruded into the shell through the upper enlarged end of its bore, said unit provided adjacent its lower end with a mounting flange engaging said seat, an annular nut in the bore of which the unit snugly fits with a slight freedom of rotary movement, said nut provided exteriorly with threads for engaging the internal threads of the shell and adapted to bear on the flange for securing the nut to the seat, electric conducting means extending axially entirely through the unit and provided at its inner intruded end with a coacting electrode disposed in the plane of the annular electrode, said unit with its nut adapted to be withdrawn from the shell when the nut is loosened in order to permit an inspection of the intruded coacting electrode.

10. In a spark plug, the combination of a tubular metallic jacket open at its upper end and provided with insulating material lining the upper portion of its bore, a spindle extending axially of the jacket, having its upper end spaced below the open top of the jacket, and having its lower end projecting below the jacket and provided at its lower end with an electrode, a cap secured to the upper open end of the jacket and provided with a sleeve projecting above the jacket and adapted to have an electric lead extend therethrough and through the open end of the jacket for engagement with the upper end of the spindle.

11. A spark plug including a shell, a unit carried by the shell and comprising a tubular metal jacket open at its upper end, a spindle having its upper end contained in the jacket below its upper open end and adapted to be connected to an electric lead, a cap secured in water-tight engagement with said open end, said cap provided with an upward extension in the form of a split sleeve having a bore forming a continuation of the bore of the jacket above the spindle and a clamping device encircling the split sleeve.

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