

April 28, 1942.

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2,280,972

SPARK PLUG CONSTRUCTION

Filed Aug. 21, 1940

Fig. 1.

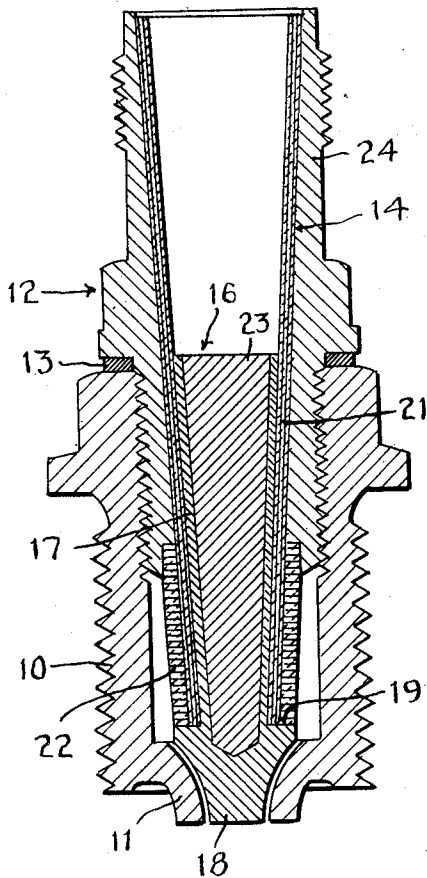


Fig. 2.

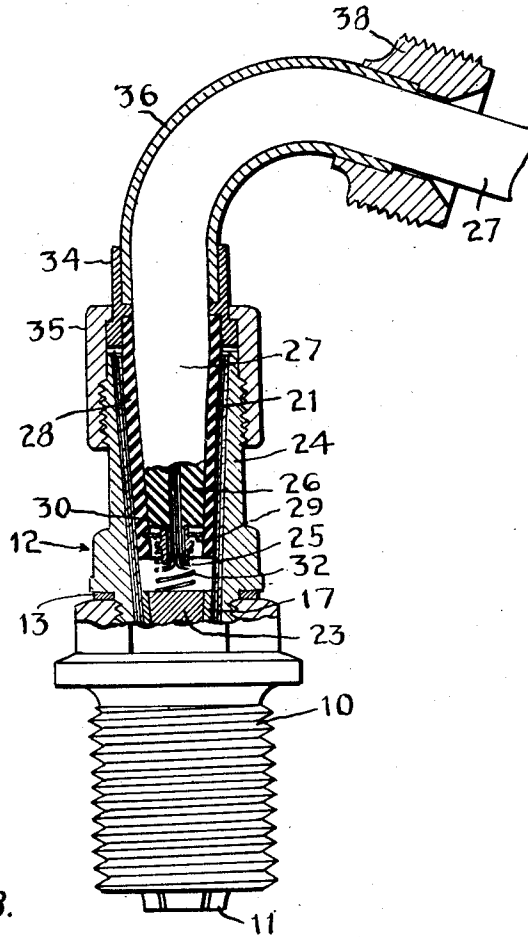
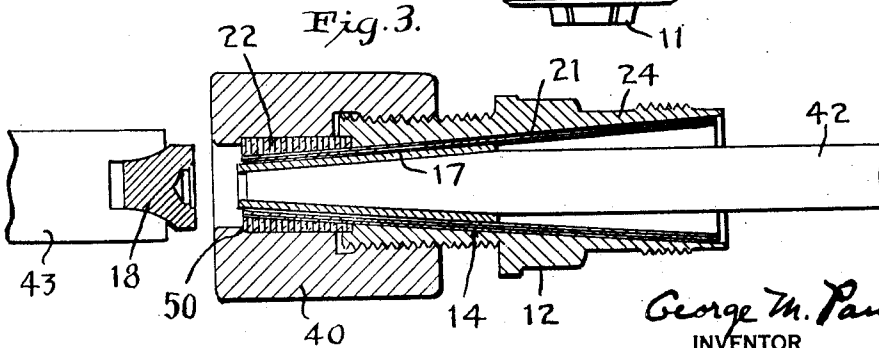


Fig. 3.



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2,280,972

SPARK-PLUG CONSTRUCTION

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Application August 21, 1940, Serial No. 353,445

12 Claims. (Cl. 123-169)

This invention comprises an improved spark-plug construction.

The invention relates more especially to radio-shielded plugs, and to those capable of service in aviation engines.

It is an object of the invention to provide an improved spark-plug which has relatively few parts and in which there is little possibility of electrical leakage. Another object is to provide a shielded-type spark-plug construction which may be of reduced over-all length without reduction in the length of possible electrical leakage or flash-over paths, or which may be of conventional length with longer possible electrical leakage or flash-over paths.

In a more specific aspect, the invention relates to mica-insulated spark-plugs. It affords a construction in which a mica sleeve or cigarette, which is disposed around the spindle, can be wound more tightly without injury to the mica. It also affords a construction in which a closer fit can be obtained between this mica sleeve and a stack of mica washers in the lower portion of the plug. An advantage of tight wind of the mica cigarette, and likewise of close fit between the cigarette and the washers, is the elimination or minimization of electrical leakage through ionized air, or other gases.

Another object of the invention is to eliminate the localized compression heretofore applied to the mica sleeve or cigarette to prevent gas-leakage.

Another object of the invention is to provide a construction which is advantageous in respect to the dissipation of heat.

Other objects, features and advantages of the invention will appear or be pointed out as the specification proceeds.

In the accompanying drawing, forming a part hereof:

Fig. 1 is a longitudinal sectional view of a spark-plug made in accordance with this invention.

Fig. 2 is a reduced-scale view, mostly in section, showing a conductor lead attached to the spark-plug of Fig. 1.

Fig. 3 is a sectional view illustrating the method of making the core assembly of the spark-plug shown in Fig. 1.

The spark-plug shown in the drawing has a metal lower body or shell 10 provided with ground electrodes 11, and an upper metal body 12 which threads into the shell 10 and compresses a gasket 13 against the top of the shell. The lower part of this upper body corresponds to what, in

spark-plug construction, is sometimes referred to as a coupling nut. An opening 14 through the upper metal body 12 tapers toward its lower end, i. e. the diameter of the opening 14 becomes progressively smaller toward its lower end.

A downwardly tapering spindle 16 has a head 18, constituting a center electrode, welded to its lower end. This head is large enough to form an annular shoulder 19 on the spindle. An insulating sleeve or cigarette 21 of mica insulation, tightly wrapped, is directly interposed between the tapered surfaces of the spindle 16 and the opening 14. This sleeve or cigarette extends from the shoulder 19 to the top of the part 12 of the body of the plug.

An additional body of insulation, preferably consisting of a stack of mica washers 22, is held under compression between the shoulder 19 and a recessed face at the bottom of the body part 12, and closely surrounds the lower portion of the mica cigarette 21.

The spindle 16 preferably consists of a tube 17 of steel or other suitable metal, which tapers both outside and inside, and a tapered insert 23 of copper or other material of relatively high heat conductivity. Such inserts aid in conducting heat away from the center electrode 18, and the upwardly increasing section of this spindle facilitates heat conduction and radiation.

The upper end of the spindle 16 terminates well below the upper end of the body 12, leaving a shielding barrel 24 at the upper region of the spark-plug, lined by the insulating cigarette 21, to receive an insulated conductor 27 shown in Fig. 2. The conductor includes wires 25 surrounded by insulation 26, which terminates some distance back from the ends of the wires and is tapered along its lower portion to fit into the tapered socket of the barrel.

Matters relating to the conductor or lead 27 and its electrical contact with the spindle 16 are not novel in this invention but will be described briefly. A tube 28 of paper-base Bakelite or similar material is disposed around the part of the conductor insulation 26 inside the barrel and preferably holds an annular disc 29. The wires 25 extend through the disc 29, and through a ferrule 30, and are bent back around the ferrule. A spring 32 held by the ferrule 30 serves as the electrical connection between the wires 25 and the spindle 16. The tube 28 abuts at its upper end against a thimble 34, and a nut 35 engages the thimble and screws onto the barrel 24. A metal elbow 36 attached to the thimble 34 shields the conductor immediately above the spark-plug,

and there is another coupling 38 at the other end of the elbow for connection with a metal sheath (not shown) for shielding the remainder of the conductor.

The method by which the core assembly is put together during manufacture is partly illustrated by Fig. 3. The core assembly may be said to include the metal body part 12, the spindle 16, or its element 17, the spindle head 18, and the insulation 21 and 22.

An important feature of the method is that the insulation 21, 22 is associated with the spindle, or the spindle element 17 before the head 18 is welded to the spindle, and is in place when the welding operation is performed. This makes unnecessary a subsequent machining operation to remove external flash, or extruded metal, at the junction between the spindle and the spindle head. In former practice, spindle heads were welded to spindles before the insulation was applied, and it was necessary to machine away the flash in order that, thereafter, the insulation might make a good fit with the lower end of the spindle and the shoulder of the spindle head. In the method of this invention the small amount of flash that is formed tends to fill any air space that there may be at this region, and to that extent is beneficial.

The method of assembling and securing the core elements will now be more particularly described, but it will be understood that details may be varied.

The stack of washers 22 is placed in a clamping nut 40, which does not form part of the spark-plug. This nut and the body element 12 are then screwed together, the nut engaging the threads which later connect the body 12 with the lower body or shell 10. The stack of washers is held in position, and is tightly compressed endwise of the stack between a shoulder 50 in the clamping nut and the recessed end face of the body 12. The bore of the stack of washers is taper reamed so that it will fit the tapered cigarette.

The cigarette 21 is tightly wrapped about a mandrel having the same taper as the spindle 16. This mandrel with the cigarette on it is inserted into the tapered opening of the body 12 and the tapered bore of the stack of washers. The mandrel is then removed, leaving the cigarette in place. At a suitable time the ends of the cigarette are trimmed.

Now the hollow spindle element 17 is inserted into the cigarette. The parts are then as shown in Fig. 3. This assembly is placed on an electric resistance welding machine by slipping the spindle element 17 over a tapered electrode 42 of the welding machine. The spindle head 18 is held by a chuck 43, which is the second electrode of the welding machine. One or both of the electrodes of the welding machine move toward and from the other in a manner well understood in the art, and the opening in the end of the clamping nut 40 serves as a guide for accurately positioning the head 18 with respect to the hollow spindle as the two are brought together for welding.

The spindle head is pressed forcibly against the end of the hollow spindle and the current is turned on. The heat and pressure cause metal to flow forming a certain amount of external flash which is accommodated by the mica insulation and helps to close any air space. However, the amount of flash is relatively small, and not sufficient to injure the insulation, since the stack

of washers 22 acts as a stop for the head 18 in the welding operation and limits the amount of metal that is extruded. The pressure on the spindle head in the welding operation places some additional compression on the stack of washers, though this need not be the case. In any event the stack is now clamped between the head 18 and the body 12.

The assembly is then removed from the electrode 42, and the nut 40 is removed from the body 12. The stack of washers is then preferably machined to the external taper shown in Fig. 1. The insert 23 is driven into the hollow spindle element 17.

When the body 12 is screwed into the shell 10 the construction of the spark-plug proper is complete.

In former practice it was customary to wrap a mica cigarette about a cylindrical spindle having either an integral head or a head united to the spindle before the cigarette was wrapped. In that operation it was not easy to get a good fit between the lower end of the cigarette and the shoulder of the head. With the construction and method which have been described in this specification the cigarette need not be wound with its end against a shoulder. In the welding operation the shoulder of the head is brought tight against the lower end of the cigarette as well as against the lower end of the stack of mica washers.

Because of the tapered construction the mica cigarette can be more tightly wrapped than the customary cylindrical cigarette, also a tighter fit can be obtained between the cigarette and the bore of the stack of washers. In the core-assembly the cigarette is held tightly between the tapered spindle and the tapered opening in the body 12. It is tight against the washers and tight against the spindle head.

For full disclosure the preferred embodiment of the invention has been described in detail, but it will be understood by those skilled in the art that details may be varied and that there may be substitutions of material.

Advantages of the invention may be readily comprehended by comparing the construction shown and described herein with that disclosed in Patent 1,930,322. It will be observed, for example, that I have succeeded in eliminating one mica cigarette and a top stack of mica washers, and two of four possible electrical leakage paths, also a soft metal cone with its compressive method of sealing against gas leakage. Other advantages and improvements have been pointed out.

The body of insulation 22 is preferably composed of a stack of mica washers, as herein described. However, the invention, in a broader aspect, is not necessarily limited to this type of insulation, since insulation of other material or construction could be substituted.

Terms of orientation, such as upper and lower, refer to the position of the spark-plug shown in the drawing, not to the position which it may occupy in use. The lower end of the spark-plug is the inward end in relation to the engine cylinder, and the upper end is the outward end.

I claim:

1. In a spark-plug, a coupling nut having a downwardly tapered opening, a tapered spindle held in said opening and extending downward from the coupling nut, a shoulder on the spindle, and insulation clamped between the shoulder and a surface of the coupling nut and holding the

spindle against upward displacement in the coupling nut.

2. A spark-plug including a metal body in which is an opening that tapers toward its lower end, a tapered spindle in the opening, a sleeve of insulating material around the spindle, a shoulder on the lower portion of the spindle, and other insulating material clamped between the shoulder and a surface of the metal body.

3. A spark-plug including a metal body having an opening that tapers toward its lower end, an insulating cigarette lining the opening, and a tapered spindle in the opening but confined to the lower part of the opening so that there is an insulation-lined socket in the metal body above the spindle to receive a conductor, the lower portion of said cigarette being interposed directly between the outside of the tapered spindle and the tapered inside of the metal body.

4. A spark-plug construction including a metal body, a tapered spindle therein, said spindle decreasing in cross-section toward its lower end, insulation surrounding the lower part of the tapered spindle and contacting with a face of the metal body, a head connected to the lower end of the tapered portion of the spindle, and a shoulder formed by the head in position to clamp said insulation against said face of the metal body.

5. A spark-plug comprising a shell, a spindle having a head, a shoulder at the upper end of the head, the spindle above said shoulder increasing in cross-section upwardly, a coupling nut threaded into the shell and having a tapered opening in which the spindle is held, and insulation surrounding the spindle and clamped between said shoulder and a surface of the coupling nut.

6. A core assembly for a spark-plug including a metal body with an opening that tapers to a smaller size toward the bottom of the metal body, a tapered spindle held in the opening of the metal body, a sleeve of mica wrapped around the spindle and insulating said spindle from the sides of the opening in the metal body, other insulation around a portion of the spindle and below a surface of the metal body, and a shoulder on the lower portion of the spindle clamping said other insulation against said surface and holding the spindle, insulation, and metal body in assembled relation.

7. A spark-plug construction in which a downwardly tapered spindle is surrounded by an insulating sleeve and held securely in a tapered opening of a metal body by insulation compressed between a lower portion of the metal body and a shoulder of the spindle.

8. A spark-plug core assembly comprising a metal body in which is a downwardly tapered opening, a single sleeve of insulating material lining both the upper and lower portions of said

opening and extending downward below the metal body, a tapered spindle in the lower portion of the opening, leaving the upper portion of the opening to serve as a socket for reception of a conductor, said spindle extending downward below the end of the metal body and having a shoulder near its lower end, a stack of insulating washers around the lower portion of the sleeve and compressed between the shoulder of the spindle and a surface of the metal body, said washers and sleeve constituting the insulation of the core assembly.

9. A shielded spark-plug including a body the lower portion of which is threaded, said body having a uniformly tapered opening with its largest diameter at its upper end, a mica sleeve lining said opening, a tapered spindle in the lower portion of the opening, leaving the upper portion of the opening to serve as a socket for the reception of a conductor, said spindle and mica sleeve extending below the body, a shoulder on the spindle at the end of the mica sleeve, a stack of mica washers surrounding the mica sleeve and compressed between the shoulder and a bottom face of the body, and a shell into which said body is screwed.

10. A spark-plug construction including a metal body having a downwardly tapered opening, a correspondingly tapered spindle, and an insulating cigarette interposed directly between the tapered outside of said spindle and the tapered inside of said body.

11. A spark-plug construction including a metal body having a downwardly tapered opening, a correspondingly tapered spindle, an insulating cigarette interposed directly between the tapered outside of said spindle and the tapered inside of said body, a head secured to the lower end of said spindle, and additional insulation about the lower portion of said cigarette and held under compression between said head and said body.

12. A shielded spark-plug construction including a metal body having a downwardly tapered opening, a downwardly tapered spindle occupying the lower portion of said opening, the upper portion of said metal body constituting a socket for the insertion of a conductor, a tapered insulating sleeve surrounding said spindle and directly interposed between the outside of the same and the inside of said metal body, said sleeve extending upward above said spindle to line said socket, a body of insulation having a tapered interior fitting the lower portion of said sleeve, and a head secured to the lower end of said spindle in close contact with the lower ends of said cigarette and said body of insulation, said body of insulation being held tightly between the shoulder of said head and the lower end of said metal body.

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