Jan. 20, 1942. E. B. NOWOSIELSKI 2,270,765

SPARK PLUG

Filed July 18, 1940

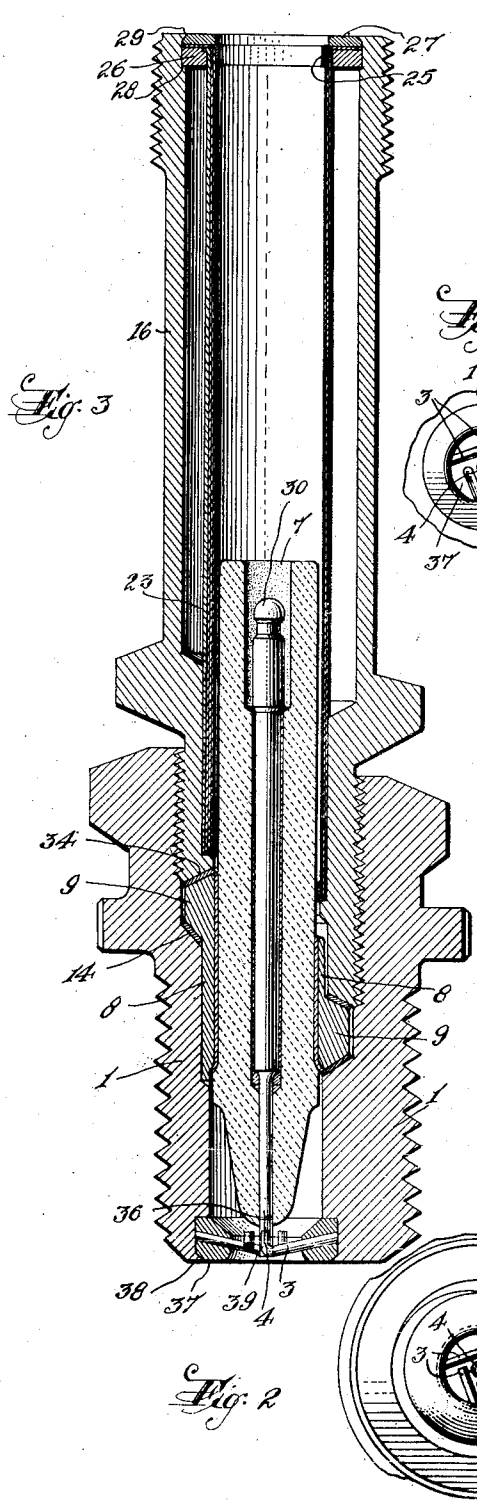


Fig. 3

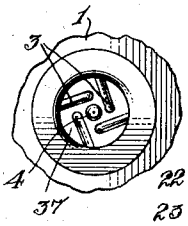


Fig. 4

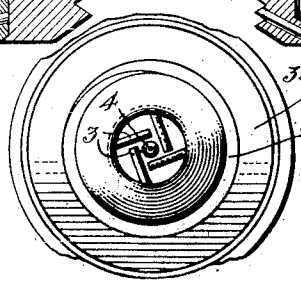


Fig. 2

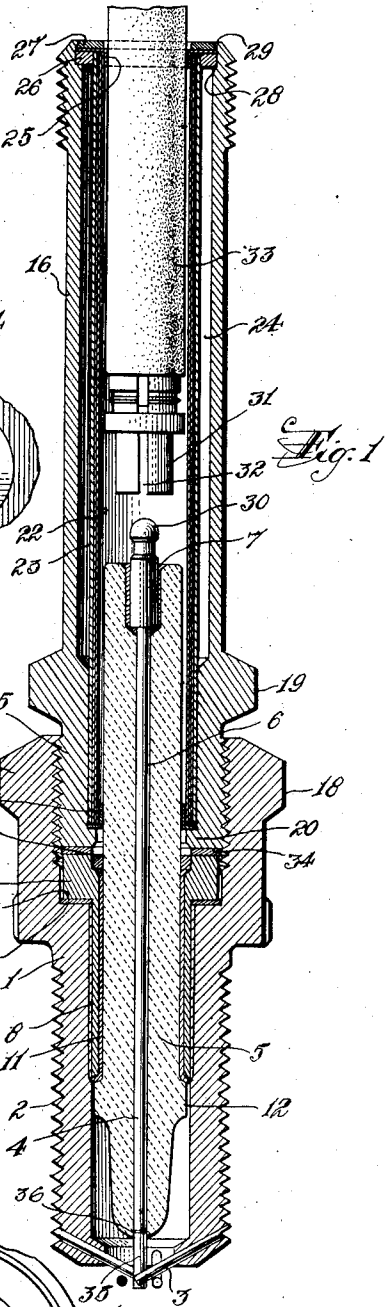


Fig. 1

INVENTOR
Edward B. Nowosielski
BY
A. D. T. Libby
ATTORNEY

Patented Jan. 20, 1942

2,270,765

UNITED STATES PATENT OFFICE

2,270,765

SPARK PLUG

Edward B. Nowosielski, Bloomfield, N. J., assignor to Edison-Splitdorf Corporation, West Orange, N. J., a corporation of New Jersey

Application July 18, 1940, Serial No. 346,115

10 Claims. (Cl. 123—169)

This invention relates to the construction of a spark plug of what may be termed a diminutive size, especially adapted for use on aeroplane engines where space, size and weight are important factors.

Aeroplane engines today are obliged to operate at approximately full load for relatively long periods of time, and as most of these engines, as now built, are of a much greater horsepower than an automobile or truck engine, the conditions imposed on the spark plugs are much more severe than in an automobile or truck.

So far as I am at present aware, no one heretofore has been able to make, for an aircraft engine, a spark plug of a ten-millimeter size, this dimension being the diameter of the threaded end of the plug which is screwed into the engine cylinder. One of the difficulties of constructing such a small plug, using a ceramic insulator for the central electrode, is that by just screwing the plug into the engine the insulator is apt to be crushed or broken due to the thin wall of the shell carrying the insulator.

It is therefore the principal object of my invention to provide a spark plug of relatively small dimensions, but one which will meet the requirement necessary in an aeroplane engine.

While producing a spark plug which will meet the exact service heretofore referred to, I have accomplished this in a relatively inexpensive manner.

My improved type of construction is set forth in the annexed drawing, wherein Figure 1 is a sectional view, on a scale between three and four times the size of the article itself, through a plug of ten-millimeter size, the ignition cable being shown in disconnected position from the central electrode.

Figure 2 is an end view of the firing end of the plug.

Figure 3 is a composite view, the side to the left of the center line being of a fourteen-millimeter size, while the part to the right of the center line illustrates the same type of plug made in eighteen-millimeter size, the scale being the same as in Figure 1.

Figure 4 is an end view of Figure 3.

In the different views, 1 is a shell having an externally threaded end 2 which is adapted to be screwed into an engine cylinder. The firing end of the plug is preferably provided with a plurality of ground electrodes 3 which, as shown in Figure 1, are inserted into holes formed at an angle in the end of the shell. These holes extend through the outer wall of the shell and after the electrodes 3 have been put in place, they are preferably brazed in position, and then the thread 2 is formed, so that the outer ends of the ground electrodes 3 form a part of the thread. This provides a direct contact between the ground electrodes 3 and the cylinder wall, so that the heat from these electrodes is transmitted not only to the shell of the plug, but directly to the wall of the engine, thereby aiding in the cooling of the electrodes which are arranged around the central electrode 4 as indicated in Figure 2.

The central electrode 4 has applied to its entire surface—except the terminal end which is positioned within a recess 7—before it is inserted into the ceramic insulator 5, a suitable enamel paste-type cement 6. Mounted on the external surface of the insulator 5 is a metallic sleeve 8 having a flange 9 which is adapted to engage a seat 10 on the outer end of the shell 1. Before mounting the sleeve 8 on the insulator, the outer surface of the insulator, which is to be engaged by the sleeve, and the internal surface of the sleeve are treated or have applied thereto a similar cement 11 as is used to cement the central electrode 4 to the insulator 5. The sleeve 8 is made of a material which has the same coefficient of expansion as the cement 6 and insulator 5 so as to prevent any breaking away of the sleeve from the insulator 5 during the baking of the ceramic insulator with the central electrode and mounting sleeve in assembled relation and at a temperature of approximately 1400 degrees F.; or during the operation of the plug in the engine.

Preferably, the insulator 5 has an annular enlargement 12 for assisting in positioning the sleeve 8 thereon, and the sleeve may have an annular recess 13 into which some of the cement may be applied. Preferably, a copper gasket 14 is used at the seat 10 so that the flange 9 will be pressed against this gasket by the threaded end 15 of an elongated gland 16. The threaded end 15 is adapted to engage threads on the outer end 17 of the shell 1 which is preferably provided with a hex formation 18 to receive a wrench. Likewise, the gland 16 is provided with a hex formation 19 for screwing the gland into the end 17 of the shell 1.

The inner end 20 of the gland 16 is formed to provide considerable area for engagement with the flange 9 of the sleeve 8; also, to provide an internal seat for a flanged collar 21 which is used for the purpose of positioning a pair of concentrically arranged tubular members 22 and 23, the tubular member 22 being of suitable insulating

material, preferably of mica wrapped in tubular form, fitting snugly within the metal tube 23 which, in turn, fits snugly within the clamping end of the gland 16. As will be seen from Figure 1, both the tubular members extend a considerable distance over the insulator 5, and a space 24 is provided between the metal tube 23 and the wall of the gland 16 for a considerable part of its length.

The outer ends of the tubular members 22 and 23 are supported by a flanged collar 25 similar to 21, the flange of the collar being held between washers 26 and 27. The washer 26 is positioned against a shoulder 28 on the gland 16, while the washer 27 is held in position by spinning over the gland at 29.

The outer end of the electrode 4 terminates in a ball-type formation 30, over which is adapted to be pressed a terminal 31 formed circular in shape and having splits 32 to give a spring effect when pushed over the ball 30. The terminal 31 is fastened to the conductor of an ignition cable 33 which preferably makes a close sliding fit with the tubular insulator 22, so that when the cable is pushed into position, whereby the terminal 31 will engage the ball 30, all of the metal parts of the live end of the plug are deeply and thoroughly concealed within the gland 16, so that there is no possibility of moisture interfering with the action of the plug, and the insulator 22 prevents any deleterious leakage from the electrode 4 to the wall of the gland 16. If desired, a gasket-type washer 34 may be used between the clamping end of the gland 16 and the flange 9 which supports the insulator 5.

With this construction, it will be seen that in the assembly of the plug, on screwing the gland 16 into the end 17 of the shell 1, the pressure is applied to the flange 9 and not to the insulator as in the ordinary type of construction, and hence the insulator 5 is not put under any strain due to the assembly operation. It may be noted that the end 35 of the central electrode 4 may be made of platinum, but welded at 36 to the electrode 4 which is made of much cheaper material.

While the electrodes themselves are relatively small and may heat up faster, on the other hand, they are cooled much quicker when a fresh charge of air and fuel is taken into the cylinder, so that there is no danger of pre-firing and the metal sleeve 8 around the insulator 5 acts to convey heat outwardly to the shell and the gland 16.

In the fourteen-millimeter construction shown in the left-half of Figure 3, the general construction is the same as in Figure 1, except that the sleeve 8 has a somewhat differently formed flange 9, this being indicated as on a bevel. Likewise, the inner end of the gland 16 is beveled to engage a gasket 34; also, the shell 1 is bored out somewhat larger at the place where the sleeve 8 is positioned so as to provide a thicker wall for the sleeve. In addition, the ground electrodes 3 are first installed in a washer or disc 37 which is held in position in the end of the shell 1 by spinning the same over at 38. In this form, the ends of the electrodes 3 are bent inwardly a distance at 39 to provide a greater firing area. Also, in Figure 3, the ball 30 is positioned within the recess 7 instead of projecting slightly without it as in Figure 1.

In the right half of Figure 3, the eighteen-millimeter construction is the same as in the left half, except that the sleeve 8 is placed in reverse position, thereby bringing the clamping pressure of the gland 16 farther down in the shell.

While I prefer to use the metal tube 23 in conjunction with the tubular member 22 which is of suitable insulating material, the metal tube may be dispensed with by making the insulating tube thicker, or not boring the inner end of the gland 16 quite so large as it is when the metal tube is used in conjunction with the insulating tube.

What I claim is:

1. A spark plug including a shell externally threaded at one end for screwing into an engine cylinder and internally threaded at its opposite end to receive a gland, and further having an annular seat adjacent the inner end of said internal threads, a ceramic insulator, a central electrode cemented longitudinally of its length within the insulator and having its cable end terminating near the end of the insulator, a sleeve cemented to the exterior surface of said insulator, the sleeve having a flange to engage said seat in the shell, an elongated gland threaded at one end to engage the internally threaded end of the shell, this end of the gland acting to apply pressure to the flange of said sleeve, a tubular insulator and a metallic tube positioned, the first-mentioned within the second, and both carried within the gland and for substantially its full length and encompassing the central electrode insulator for a considerable distance, and ground electrodes carried by the shell in operative relation to the central electrode.

2. A spark plug including a shell externally threaded at one end for screwing into an engine cylinder and internally threaded at its opposite end to receive a gland, and further having an annular seat adjacent the inner end of said internal threads, a ceramic insulator, a central electrode cemented longitudinally of its length within the insulator and having its cable end terminating near the end of the insulator, a sleeve cemented to the exterior surface of said insulator, the sleeve having a flange to engage said seat in the shell, an elongated gland threaded at one end to engage the internally threaded end of the shell, this end of the gland having an end surface of considerable area, a gasket between this end surface and the flange on said sleeve, a flanged collar within the gland and positioned against the inner part of said end surface, a pair of concentrically arranged tubular members carried within the gland and having their inner ends located by said collar, the inner tubular member being of suitable insulation, while the outer tubular member is of metal and spaced a distance from the inner wall of the gland for a considerable of its length, means for supporting the two tubular members at the outer end of said gland and at least one ground electrode carried by the free end of the shell in operative relation to the central electrode.

3. A spark plug including a shell externally threaded at one end for screwing into an engine cylinder and internally threaded at its opposite end to receive a gland, and further having an annular seat adjacent the inner end of said internal threads, a ceramic insulator, a central electrode cemented longitudinally of its length within the insulator and having its cable end terminating near the end of the insulator, a sleeve

cemented to the exterior surface of said insulator, the sleeve having a flange to engage said seat in the shell, an elongated gland threaded at one end to engage the internally threaded end of the shell, this end of the gland having an end surface of considerable area to apply pressure to the flange of said sleeve, a pair of concentrically arranged tubular members supported within and at opposite ends of the gland, the inner tubular member being of suitable insulating material, the electrode insulator projecting into the inner end of the tubular insulator and at least one ground electrode attached to the free end of the said shell in cooperative relation to the central electrode.

4. A spark plug including a shell externally threaded at one end for screwing into an engine cylinder and internally threaded at its opposite end to receive a gland, and further having an annular seat adjacent the inner end of said internal threads, a ceramic insulator, a central electrode cemented longitudinally of its length within the insulator and having its cable end terminating near the end of the insulator, a sleeve cemented to the exterior surface of said insulator, the sleeve having a flange to engage said seat in the shell, an elongated gland having two bores of different diameter and being threaded at least at the end having the smaller bore so as to fit the internally threaded end of the shell, this end also having a formation to apply pressure direct or through a gasket to the flange of said sleeve, a pair of concentrically arranged tubular members, the inner one being of insulating material and both extending with a snug fit into the smaller bore of the gland and supported therein, means at the free end of the gland for supporting the outer end of the tubular members, the central electrode insulator extending into the tubular member for only a part of its length, and at least one ground electrode carried by the shell at its free end.

5. A spark plug including a shell and an elongated gland determining the length of the cable end of the plug, the shell being threaded at one end for attachment to an engine cylinder and threaded at the opposite end to receive the gland, a seat within the gland end of the shell, an insulator and an electrode carried thereby and cemented thereto, a flanged metallic sleeve cemented to the outer wall of said insulator, the flange engaging said seat and held thereto by the inner end of said gland, at least one tubular member of suitable insulating material, such as mica, carried within the gland and surrounding the cable end of the electrode insulator and extending substantially the length of the elongated gland, means for supporting the tubular member at the free end of the gland, and at least one ground electrode carried by the shell.

6. A spark plug as defined in claim 5, further defined in that a plurality of ground electrodes are used and they extend at an angle through the end of the shell and some parts of the threads at this end of the shell are cut directly into the electrodes.

7. A spark plug as defined in claim 5, further defined in that a plurality of ground electrodes are used and each has its end adjacent the insulated electrode bent over and extends in a direction parallel to the insulated electrode.

8. A spark plug as set forth in claim 5, further defined in that the tubular member of insulating material is spaced from the wall of the gland for a greater part of its length and has a diameter so a standard ignition cable fits its inner wall very snugly, whereby when the cable is pushed therein so its terminal engages the end of the central electrode, all the bare parts in the ignition circuit are concealed well within the gland.

9. A spark plug as set forth in claim 5, further defined in that a metallic tubular member, similar to the one of insulating material, is positioned thereover and extends to the cable-entering end of the plug.

10. A spark plug including a shell externally threaded at one end for screwing into an engine cylinder and internally threaded at its opposite end to receive a gland, and further having an annular seat adjacent the inner end of said internal threads, a single-piece ceramic insulator, a central electrode cemented longitudinally of its length within the insulator and having its cable end terminating near the end of the insulator, a sleeve cemented to the exterior surface of said insulator, the sleeve having a flange to engage said seat in the shell, an elongated gland threaded at one end to engage the internally threaded end of the shell, this end of the gland acting to apply pressure to the flange of said sleeve, at least one tubular member and of insulating material carried within the gland and for the greater part of its length and encompassing the central electrode and its insulator for a distance at its cable end, and at least one ground electrode carried by the shell in operative relation to the central electrode.

EDWARD B. NOWOSIELSKI.