Feb. 8, 1944. F. KAPP 2,340,963

SPARK PLUG

Filed April 6, 1942

Fig. 1.

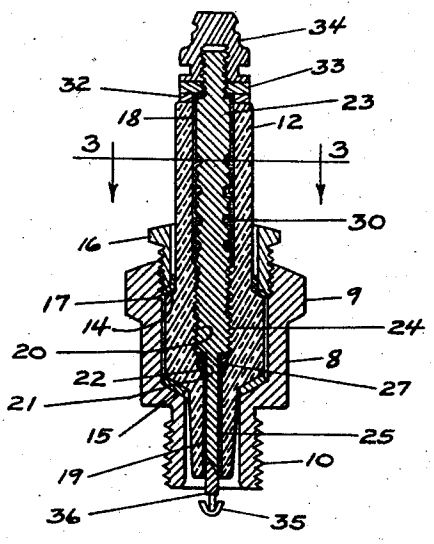


Fig. 2.

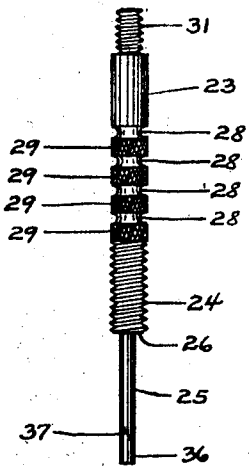


Fig. 3.

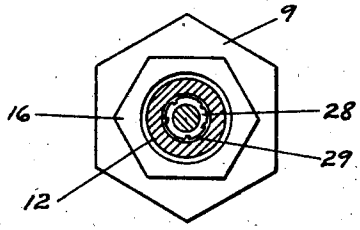


Fig. 4.

Fig. 5.

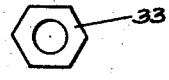
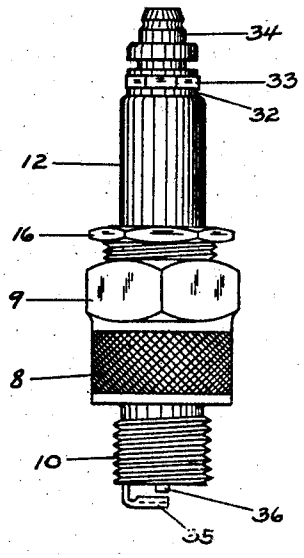


Fig. 6.



INVENTOR.
FRED KAPP

BY Edward C. Healy
ATTORNEY

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2,340,963

SPARK PLUG

Fred Kapp, Oakland, Calif.

Application April 6, 1942, Serial No. 437,773

1 Claim. (Cl. 123—169)

This invention relates to improvements in spark plugs for internal combustion engines and particularly relates to an improvement over my Patent No. 2,226,414, issued on Dec. 24, 1940, and which pertains to a triple sealed central electrode in spark plugs of two piece construction type.

One of the objects of the present invention is to improve the first compression seal in spark plugs of that type, whereby the higher explosive pressures are kept under safe control and prevented from breaking through and causing undue plug over-heating that results in the rapid destruction of the insulator tip and electrode, the said improved first seal consisting of a short small piece of soft metal tubing, such as copper or aluminum tubing, and in forming the insulator and central electrode in a manner that will provide a space for receiving the soft metal tubing when the parts are assembled, and in also forming a shoulder on the central electrode and an inner seat in the insulator that will cause the soft metal tubing to imbed itself into and completely cover all rough surfaces in the lower portion of the insulator, not otherwise reachable, thus providing a positive gas-tight seal when the central electrode is tightly screwed into the insulator.

Another object of the present invention is to form a series of circumferential grooves into and around the central electrode above the threaded portion thereof and to also form angular or knurled roughened portions on the central electrode between the grooves and to apply a suitable spark plug sealing cement on the threaded portion of the central electrode and into the grooves and roughened portions thereof, whereby the cement becomes absorbed around the threads and into and around the roughened portions, thereby forming a series of positive gas-tight compression seals that will withstand the highest pressure and the severest use.

An additional object of the present invention is to eliminate the conventional flange at the top portion of the central electrode and to provide a soft metal gasket, such as a copper gasket, and a threaded nut on the terminal post of the electrode, thus enabling a tight seal to be provided onto the top of the insulator without interfering with the proper sealing of the first seal hereinbefore mentioned.

An additional object of the present invention is to form the larger and upper part of the central electrode out of a machined steel shaft and to weld an electrode nickel wire extension on the lower end and to form a lap joint on said ends for enabling the parts to be properly welded together.

A further additional object of the present invention is to provide a central electrode in a spark plug that is simple in construction and very economical to manufacture and wherein the life thereof is prolonged because of the improved structure and the unique combination and arrangement of the parts employed.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawing forming a part of this specification and in which like numerals are employed to designate like parts throughout the same,

Fig. 1 is a central vertical longitudinal assembly view of a spark plug embodying my invention;

Fig. 2 is a side elevational view of my improved central electrode;

Fig. 3 is a horizontal sectional plan view taken on line 3—3 of Fig. 1, looking in the direction of the arrows, the sealing cement not being disclosed in order to better illustrate the outer roughened edge of the groove.

Fig. 4 is a perspective view of an especially constructed soft metal tube that forms the first gas tight compression seal for my triple sealed central electrode;

Fig. 5 is a plan view of an especially constructed nut that is adapted to be threadedly secured onto the terminal post of the central electrode; and

Fig. 6 is a view in elevation of my improved spark plug.

Referring in detail to the different parts, the numeral 8 designates the outer metal casing preferably forming a cylindrical shell having an enlarged hexagon upper end portion 9 and a reduced externally threaded lower end portion 10 that is adapted to be threadedly secured into the conventional spark plug threaded openings provided in the cylinders of internal combustion engines. The insulating member 12 is preferably made of porcelain, but can be made of any other suitable material and has an enlarged central portion as shown in Fig. 1. Suitable gaskets 14 and 15 are provided at the upper and lower tapered ends of the enlarged portion and a gland nut 16 is threadedly screwed into the upper internally threaded portion 17 of the casing 8 and serves to tightly hold the insulator 12 in said casing.

The insulator has an enlarged bore 18, a reduced bore 19, an internally threaded portion 20 and a space 21 underneath the internally threaded portion forming a tapered shoulder 22. The improved central electrode, designated as a whole by the numeral 23 is formed with a central threaded portion 24 that is adapted to engage in the internally threaded portion 20 of the insulator. The diameter of the lower extending portion of the central electrode is reduced as shown at 25 forming a shoulder 26 directly at the bottom end of the threaded portion 24 as shown in Fig. 2.

As shown to advantage in Fig. 1 a new and improved primary compression seal is produced by providing a piece of copper or aluminum tubing 27 onto the electrode reduced extension 25 and against the shoulder 26, the lower tapered end of said tubing being tightly forced against the tapered shoulder 22 of the insulator 12 when the central electrode is screwed into the insulator. The soft copper or aluminum tubing as thus interposed between the opposing shoulders 22 and 26 will become imbedded into the surfaces of said shoulders and into the inner walls forming the space 21 in the insulator, producing an absolute gas-tight primary compression seal.

The secondary seal is produced by providing a spark plug sealing cement around the threaded portion 24 of the central electrode. The third compression seal is accomplished by providing the central electrode, above said threaded portion, with a series of circumferential grooves 28 and a series of roughened or knurled portions 29 as shown in Fig. 2 and by applying sealing cement 30 in said grooves and knurled portions as shown in Fig. 1. The terminal post of the central electrode is threaded as indicated at 31 and a copper gasket 32 is mounted thereon and held tightly sealed against the top of the insulator 12 by a hexagon nut 33. The numeral 34 designates the terminal cap to which the high tension current is delivered through a current conducting cable and connections not shown. The numeral 35 designates my V-type grounded electrode that is fixed to the lower end portion 10 of the casing 8.

In constructing the central electrode embodied in the present invention the upper part is made of a steel shaft machined to the form illustrated and is provided with a short electrode nickel wire 36 at the lower end portion as shown in Figs. 1 and 2. The connecting ends of the lower central electrode portions 25 and 36 are formed on a bias providing a lap joint as indicated at 37 and the two members are substantially welded together. This construction not only saves a large quantity of nickel but the lap joint makes a better weld between the steel and the nickel wire.

From the foregoing description taken in conjunction with the drawing illustrating the present invention it will be particularly observed that certain definite improvements have been accomplished in the construction of spark plugs. The use of a copper or aluminum gasket 32 tightened firmly onto the top of the insulator 12 by the nut 33 prevents moisture from reaching the inside of the insulator and shorting the spark plug. The providing of the copper or aluminum tube 27 and by interposing the same between the shoulder 22 and and 26 of the insulator and central electrode, respectively, I effect a positive gas-tight seal in a manner not heretofore accomplished in any spark plug and I also prevent the soft applied sealing cement on the central electrode threads and the other roughened parts from running down into the insulator firing tip, which must be free from the sealing cement to avoid tip breakage when in use. The elimination of the flange at the terminal end portion of the central electrode and substitution of the gasket 32 and nut 33 for sealing the top end of the insulator 12 enables that end of the insulator to be positively sealed without interfering with the proper sealing of the soft metal tubing 27. It is obvious that two seals of that character could not be effected in any other manner. By forming the central electrode of two different materials accomplishes a three-fold result. In order to produce the most efficient spark it is necessary for the central electrode to be made of a high electric conducting material such as nickel. However, in order to effect the most efficient seal with the copper or aluminum tubing 27 it is necessary to make the central electrode of a metal harder than copper or aluminum, such as steel. By thus constructing the major portion of the central electrode of machined steel and the inner end extension of nickel there is provided a most efficient seal with the soft metal tube. Furthermore, a most efficient spark is produced and at the same time I decrease the amount of nickel used, thus effect a saving in material.

Attention is directed to the tubular member and the ways and means in which it can be used and shaped to accomplish a perfect gas tight metallic first compression seal around my particular formed spark plug center wire, and in the threaded internal lower shoulder center portion of my spark plug insulator, as herein referred to. My main object is to seal and keep sealed the insulator of my particular spark plug. The said tubular member 27 when properly assembled and tightened into my insulator will form a metallic compression seal in my previously patented triple sealed spark plug, Patent No. 2,226,414. It is to be noted that when my spark plug insulator is first molded, formed or cast to its proper size and shape, this tubular member having on its outside a roughened, grooved, barbed, distored or knurled surface as a means to anchor or imbed and to stay permanently tight in the internal threaded lower shoulder center portion of my particular spark plug insulator, after the same is finished.

The sealing tubular member will also have a suitable inside thread. This thread may be straight or slightly cone shaped on both ends to receive any portion of a special fitted or threaded portion of a spark plug central electrode, which may be attached to this tube from both sides and screwed tightly into the tube. By doing so it forces the tube tight against the internal insulator shoulder wall and also tight around the spark plug center electrode wire. Thus there is realized a metallic compression seal and a gas tight spark plug, not accomplished with spark plug sealing cement or other methods of sealing.

I have particularly selected the lower insulator shoulder center as a means for the proper sealing place, because the lower insulator shoulder is the strongest part and the insulator will withstand the greatest tightening pressure necessary to accomplish a metallic gas tight spark plug compression seal.

When the center electrode is assembled as I have described, it will at all times make a solid contact with the insulator firing tip. Accordingly, the tremendous heat of the tip and the

center electrode will be dissipated much faster.

It is a well known fact that compression leakage around a spark plug central electrode also increases the plug temperature, creates an unbalanced heat range, expands the shell faster, loosens the insulator lower seat gasket, in some cases burns the gasket out entirely, and causes a waste in proper motor performance.

Having thus described my invention, I claim:

In a spark plug equipped with a metal housing and an insulator positioned within said housing and sealed thereto, a central electrode having a threaded portion threadedly secured into said insulator and a reduced portion extending from said threaded portion and forming a shoulder at the termination of the threaded portion, a seat formed into the insulator and positioned to oppose said shoulder, a gasket interposed between said seat and shoulder to form the first compression seal in the insulator, a sealing medium applied to the threaded portion of the central electrode to form the second compression seal in the insulator, a series of circumferential grooves formed into and around the central electrode beyond said threaded portion, the peripheral surface of the central electrode being roughened between said grooves, a sealing medium provided onto said roughened surface and into said grooves forming a series of additional compression seals into the insulator, a gasket positioned on the outer end portion of the central electrode and against the outermost end of the insulator, and a nut threadedly secured onto the outer end portion of the central electrode and applied against the gasket thereon whereby the outer end of the insulator is sealed.

FRED KAPP.