Sept. 29, 1959 L. PERAS 2,906,907

PROCESS FOR THE MANUFACTURE OF LOW TENSION SPARKING PLUGS

Filed July 25, 1956

Fig. 1.

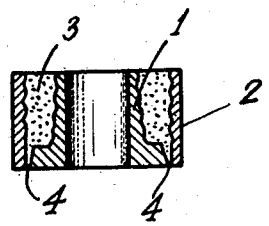
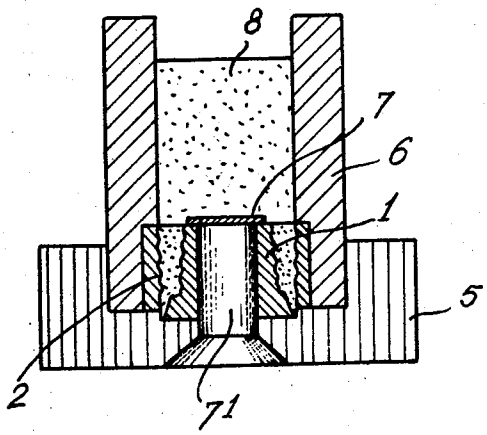


Fig. 2



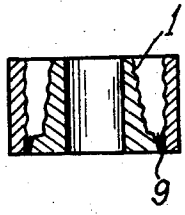


Fig. 3.

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PROCESS FOR THE MANUFACTURE OF LOW TENSION SPARKING PLUGS

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4 Claims. (Cl. 313—131)

The present invention relates to a process for the manufacture of low tension sparking plugs used in internal combustion engines.

It is known for the sparking element of plugs which effect ignition by a capacity discharge in internal combustion engines, to be constituted by two coaxial cylindrical electrodes which are insulated from one another by an insulating material. The spark jumps between two circular lips formed respectively on each electrode, the distance between the lips being generally 0.1 and 0.3 mm. The assembly consisting of the two electrodes and their sealing material will be referred to as the "cartridge" in the following description.

The invention is concerned with improvements in the usual processes of manufacture for the plugs of the type defined hereinbefore, and more particularly relates to improvements by means of which the operational life of such plugs in internal combustion engines and more particularly in motor car engines, is improved very considerably relatively to hitherto known sparking elements.

In the "cartridges" according to the invention, the electrodes which are subjected to the sparking are advantageously constituted of pure tungsten, according to the applicant's patent application Ser. No. 485,180 of January 31, 1955, the volume of tungsten being very slightly greater than that which is subjected to the sparking operation. The cartridge is formed from the electrodes, irrespective of the material of which they are composed, by disposing the said electrodes in a mounting which holds them relatively to one another in the strictly predetermined coaxial position, then filling the interelectrode space with a powdered or granulated mineral compound having a base of boric anhydride and litharge and finally by heating the assembly in an inert atmosphere at a temperature sufficient for the cement to melt and occupy the entire inter-electrode space. The assembly is then allowed to cool, after which the cartridge is separated from its mounting.

The heating atmosphere must not be a reducing atmosphere and for this reason it must be free of hydrogen or carbon monoxide; it must be only slightly oxidising or non-oxidising and it must not contain any oxygen or at the most less than 2%.

After the operation described hereinbefore, the electrodes are securely sealed by a homogeneous vitreous or opalescent mass.

The composition of the mineral compound which is intended to constitute the insulating sealing cement lies in the following range:

	Percent by weight
Lead oxide PbO (litharge) content comprised between	50 and 90
Boric anhydride B_2O_3 content comprised between	5 and 30
Silica SiO_2 content comprised between	0 and 20
Titanium oxide TiO_2 content comprised between	0 and 10

Alumina Al_2O_3 content comprised between	0 and 20
Zinc oxide ZnO content comprised between	0 and 10
Alkaline oxides (Na_2O, K_2O) content comprised between	0 and 2

The composition may also contain, in the state of impurities, small quantities of alkaline-earth oxides, lime, or magnesia, of contents less than 1%.

Several satisfactory compositions from which a selection can be made according to conditions of use, will now be quoted by way of example:

I

	Percent by weight
PbO	85
B_2O_3	15
	100

II

PbO	76.5
B_2O_3	13.5
Al_2O_3	10.0
	100

III

PbO	71.6
B_2O_3	12.6
Al_2O_3	10.55
SiO_2	5.25
	100

IV

PbO	63
B_2O_3	18
Al_2O_3	9
TiO_2	8
SiO_2	2
	100

V

PbO	63
B_2O_3	18
Al_2O_3	9
ZnO	4
SiO_2	6
	100

VI

PbO	63
B_2O_3	18
Al_2O_3	10
SiO_2	9
	100

The factors governing choice of composition are facility of application and behaviour during use. The various compositions given as examples succeed one another in the order of decreasing fusibility. It is not possible to characterise by a melting point these vitreous substances whose viscosity decreases progressively when the temperature increases, but which do not have a distinct melting point, but for example compositions I and II can be put in position in heating to 600° C. It is necessary to achieve 650 to 700° C. in order to effect this operation when using composition III, 700 to 750° C. for IV and V and finally, 800° C. in the case of composition VI. For sparking plugs which do not heat up too much during use, either because they are used in low speed engines, or because they benefit from an active cooling system, the most fusible compositions will suffice, which can be applied at a lower temperature and consequently at less cost. On the contrary, when there is

considerable heating during use, one or other of the other compositions will be resorted to according to the particular case.

The cement is prepared by simple heating to 850°, for example in a graphite crucible heated by electric induction, of an intimate mixture of the constituents in powder form. When the mass is melted and very homogeneous, it is poured, cooled and then crushed and finely powdered. If the mass contains black veins, this will be because lead has been formed by reduction of its oxide in contact with the graphite, and it is sufficient to heat the mass to about 500 or 600° C. in air to bring about the necessary re-oxidation.

Instead of starting from definite chemical species, it is possible for reasons of handiness to use industrial mixtures. For example, it is advantageous to prepare compositions bordering on VI by using, not silica, but crystal glass which is constituted essentially, as is known, of lead oxide and silica. In this case the cement contains small quantities of alkaline oxides.

Another method of carrying the process into effect, which is applicable to compositions which contain alumina, and by means of which a particularly strong cement is obtained, consists in melting together all the constituents other than alumina, grinding the mass obtained, mixing it intimately with calcined alumina in powder form, and introducing the mixture into the mounting.

The "cartridge" which is to be manufactured is illustrated on a large scale in Fig. 1. 1 is the central electrode or core, 2 is the annulus or peripheral electrode, and the sealing insulating mass is to be positioned at 3. Sparking is carried out along the circle 4 between the lips formed on the annulus and the core.

The two electrodes are placed in the steel mounting illustrated in Fig. 2, which comprises a base 5 and a cylinder 6. The annulus 2 is embedded without any clearance in the part 6 and rests on the base 5. The core 1 is positioned on a small circular cavity in the base, which holds the said core perfectly centered. Before the core 1 is pushed in position, care has been taken to place on top of it a small steel plate 7 which obturates the central hole 7^1. It has also been possible to stop the hole by filling it completely with silver, copper or an alloy having a base of these metals, which is brought into position in the melted state. The cement or powder is then introduced at 8 and can be packed, for example, by vibration. The mounting assembly is placed in a furnace. A current of argon is then introduced into the furnace chamber and heating is carried out progressively up to the desired temperature, which is maintained for an hour. The parts are then gradually cooled. The operation is carried out industrially in a continuous process, using a continuous furnace.

After this operation, the cartridge is separated from the mounting and the surplus material on the upper and lower faces of the cartridge is removed with a grinding wheel.

In a modified method, after positioning the electrodes in the mounting, they can be connected in a known manner by forcing into the sparking gap a small mica cylinder 9 constituted by a roll of it in foil to constitute the assembly illustrated in Fig. 3. It being understood that the thin foil of mica acts as a spacer and is left therein during assembly of the electrodes.

The electrodes are preferably made of compact pure tungsten, of a density greater than 17.5, the volume of the tungsten being very substantially greater than that which is subjected to sparking.

I claim:

1. A method for manufacturing spark plug assemblies of the low voltage surface discharge type which comprises, providing two assembled electrodes consisting of an inner and an outer electrode mounted coaxially in radially spaced relationship defining a predetermined space between the two electrodes and the electrodes having jointly two radially spaced discharge faces cooperative in operation in forming a surface discharge thereon, filling the space between the two electrodes with a pulverulent, electrically non-conductive fusible sealing material to form a discharge surface between said two faces, confining excess fusible material axially of said electrodes in communication with the fusible material filling said space, compacting the confined fusible material into said space so as to densify the material in said space, heating the assembly in an inert atmosphere to a temperature between 500° C. and 900° C. sufficiently for the fusible sealing material to melt, cooling the spark plug assembly so that the sealing material forms a solid mass of electrically non-conductive sealing material surrounding the center electrode and completely filling the space between the inner and outer electrodes.

2. A method according to claim 1, in which the electrodes define a predetermined annular spark gap and in which prior to filling said space of the spark plug assembly with pulverulent sealing material, a mica annular member is disposed between the electrodes thereby to define the spark gap and to maintain the predetermined spaced relationship of the electrodes during subsequent operations.

3. A spark plug assembly of the low voltage surface discharge type comprising, a center electrode, an outer electrode coaxial with the center electrode and spaced therefrom forming an annular space between both electrodes, the electrodes having co-planar discharge end faces, a solid mass of electrically non-conductive sealing material disposed between said faces surrounding the center electrode and completely filling the space between the center and outer electrode to form a discharge surface between said end faces produced by heating a composition of compacted pulverulent material in an inert atmosphere sufficiently to melt it and subsequently cooling it, said solid mass consisting of lead oxide which comprises substantially from 50 to 90 percent, by weight, of the sealing material, and at least one other constituent of a group consisting of boric anhydride which comprises substantially 5 to 30 percent, by weight, of the sealing material, silica which comprises up to 20 percent, by weight of the sealing material, titanium oxide which comprises up to 10 percent, by weight, of the sealing material, alumina which comprises up to 20 percent, by weight, of the sealing material, zinc oxide which comprises up to 10 percent, by weight, of the sealing material, and alkaline oxides which comprise up to 2 percent, by weight, of the sealing material, and the amounts of said lead oxide, boric anhydride, silica, titanium oxide, alumina, zinc oxide, alkaline oxides totaling 100 percent.

4. A spark plug assembly of the low voltage discharge type according to claim 3, in which said center and outer electrodes consist of pure tungsten.

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