use of mica in

AERO ENGINE SPARKING PLUGS

The mica used in modern aircraft sparking plugs, of which the attached section is representative, serves a triple purpose, viz.

(a) Insulation of the electric current
(b) Protection of the insulating layers from heat
(c) As an effective seal against gas leakage.

The plug consists of two parts, the body - essentially a hollow steel cylinder which carries four nickel points and screws into the engine cylinder head, and the core - likewise a hollow steel cylinder threaded at the base to be received by the upper end of the body. The core carries the spindle, or centre electrode of special heat-resisting steel, and is separated from it by mica insulation.

This spindle is a hollow turned and polished rod carrying at the base an enlarged head with a curved face corresponding to the profiles of the nickel points. The air space between the four nickel points and the shaped lower end of the spindle constitute the air gaps across which the spark is passed. The spindle is primarily insulated by a wrapping of thin films of the best quality clear muscovite known in the trade as wrappings, windings, or cigarette mica. Phlogopite may be used for this purpose and some manufacturers prefer it to muscovite attributing to it a superior degree of flexibility. Several films of mica, each not more than .0012 inch thick and usually about four inches in length the width equal to the length of the shank of the spindle, are wound on until the thickness of the wrapping equals about .030 inch. The permissible tolerance is .002 inch. Over the wrapped spindle a pack of phlogopite washers is slipped down and pressed against the shoulder at the lower end of the electrode. Next follows a tapered brass ferrule or collar. At this stage the assembly is dipped in a binding solution and inserted into the lower end of the steel sleeve which forms the outer part of the core. A column of muscovite washers, the length of column measured in a micrometer under a load equivalent to the pressure exerted in the completed plug, is inserted in the upper end of the sleeve over the wrapped spindle with a copper washer at the top. The hollow end of the spindle is then belled out over the copper washer and pack of mica washers to press them down and hold them in place. The belling of the spindle exerts on the mica a pressure equal to the load under which the pack of washers was measured. A second wrapping of muscovite films is slipped inside the upper end of the sleeve and held in place by a thin annular brass cap pressed over the top, and by the natural tendency of the coiled mica to unwind. The volatile binder is driven out by heat and the lower end of the spindle protruding from the sleeve, i.e. the phlogopite washers and electrode, turned, and if necessary, polished. The core is screwed into the body seating on a copper-asbestos gasket and the plug is completed.

Every single component is rigorously tested and checked during the course of manufacture. Each mica washer is examined over an illuminated ground glass plate and rejected if showing the slightest crack or spot. The maximum tolerance permissible in the length of the column of muscovite washers is plus or minus .0005 inch.

The complete plug is connected to an aero magneto and sparks passed across the gaps in an atmosphere of CO_2 at 150 lbs. per sq.in. to duplicate as far as possible operating conditions. The plug is also tested for gas leakage at the same pressure.

From the foregoing it will be seen that mica in the construction of sparking plugs is used in four distinct modes. First the spindle wrapping, which bears virtually the whole electrical load as there is no other insulation between the tapered brass collar and the spindle (it will be noted that the collar is in metallic contact with the body and outer electrodes). Secondly, the phlogopite washers serve to protect the wrapping from direct exposure to flame in the engine cylinder; they serve no other purpose. Thirdly, the muscovite washers above the brass collar and under considerable pressure present an effective heat resisting seal against hot gases. Fourthly, the lining of muscovite film in the upper end of the sleeve insulates the end of the high tension cable connecting the plug to the magneto. In this respect this wrapping serves the same purpose and is under the same electrical pressure as the lower one around the spindle.

AERO ENGINE SPARKING PLUGS (Cont.)

For all these purposes demands are made on all or nearly all the physical characteristics of mica. In addition to its low coefficient of expansion, which is a most important property in this application, its elasticity, which permits it to withstand constant vibration, rapid temperature changes and great pressure in assembling operations, is essential. Porcelain could not be pressed so tightly nor be used in sheets, nor could it withstand fluctuating temperatures or vibration.

H.B. Owen 1942.