UNITED STATES PATENT OFFICE.

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ELECTRICAL INSULATOR.

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To all whom it may concern:

Be it known that we, HENRY H. BUCKMAN, a resident of Jacksonville, Florida, and GEORGE A. PRITCHARD, a resident of New York, N. Y., and being both citizens of the United States, have jointly invented certain new and useful Improvements in Electrical Insulators, of which the following is a specification.

Our present invention relates to electric-insulator appliances, including particularly those employed for high tension electrical transmission as, for example, as an insulating member of what is now commonly designated as "spark plugs", such member being the "spark-plug porcelain", thereof and principally used in the cylinders of internal combustion engines, but our improved appliances are also useful for many other kindred purposes, and the objects of our invention comprise provision of such insulating, or relatively non-electrically conductive, appliances with greater economy than heretofore, and possessed of novel or desirable properties some of which are hereinafter referred to and which render them more desirable for many purposes than are their predecessors in the art.

Our invention is based upon the demonstration by aid of our researches and tests that zircon, *i. e.*, zirconium silicate, ($ZrSiO_4$), preferably as found in nature, but also as it may be synthetically produced, possesses hitherto unrecognized properties and behaviors which distinctively qualify it, in greater or less proportions, (say preferably not less than 5% by weight), to act with superior results either by itself, or as an important, or the essential, or altogether predominant, constituent of a part, or of the whole, of the constituent mass of the insulating appliances referred to, particularly when these are, in use, or otherwise, exposed to extremely high temperatures, and correspondingly as a constituent of such heat-compacted wares as are usually designated porcelains, or ceramics, when so employed as part, or the whole, of such insulators, or otherwise.

We believe that our referred to experiments and tests have now demonstrated that zircon, *i. e.*, zirconium silicate, possesses in more or less greater, or different, degree than is possessed by any other to us known compound of zirconium, including particularly zirconium oxid, the following, among other, distinctive properties:

(1) Exceptionally great chemical inertness—this characteristic of zircon being preëminently in excess of any similar characteristic of any other compound of zirconium;

(2) A very high melting point;

(3) An extremely low co-efficient of expansion;

(4) Exceptionally great resistance, both integral and surface, to the passage of electric current at high temperatures;

(5) Exceptionally great resistance to the transmission therethrough of heat; and

(6) A remarkable capacity for auto cementation, or agglomeration, when reduced to a state of fine comminution.

We have discovered that, when relatively finely comminuted, the zircon, or zirconium silicate, is mixed with water, or other suitable liquid, or moisture-impartive, vehicle, and made into a "batch" from which shapes are, owing to its aforesaid auto-cementation or agglomeration, fashionable, that even moderate temperatures, for example as low as 800° C., will cause such shapes to become heat-compacted, or baked, to a hard, durable mass, although the true fusion temperature, or melting point, of said zircon, or zirconium silicate, is much higher. It is not necessary that the entire mass of zircon, or zirconium silicate, thus used be very finely comminuted, so long as a substantial portion thereof is in this condition. When zircon, or zirconium silicate, is to be used by itself alone for the purposes above mentioned, it is essential that part of it at least be finely comminuted. If, on the other hand, it is to be used in association with other materials in the batch, the function of a binding agent may be supplied either by a certain amount of finely comminuted zircon, or by one of such other materials.

In order to describe more fully our invention and to enable others skilled in the art to practise it, we give the following examples of procedures qualified to realize our improvements.

If we desire to make an electric insulator appliance consisting entirely of zircon, or zirconium silicate, we take finely comminuted, (say 200 mesh, or smaller), zircon,

and coarser, (say 90 mesh, or larger), zircon and mix the comminutions intimately. The proportions of fine to coarser material we prefer are, at present, about 75 to 25, but other proportions may be successfully used, and useful insulators can be made entirely from finely comminuted material. The mixture may be made either wet or dry. We prefer to have it slightly moist. It is then thoroughly worked in a mill, and then pressed, or molded, into shapes. These shapes are carefully dried and then fired, after the manner well known in the art.

If we desire to make an electric insulator appliance consisting partly of zircon, or zirconium silicate, and partly of a porcelain-like, *i. e.*, ceramic body, we prefer to proceed as in the usual manufacture of porcelain, for example except that instead of the china clay, or kaolin, usually employed, we use finely comminuted zircon, or zirconium silicate. This material is, in whole, or in part, substituted, weight for weight, for the china clay or kaolin, and from this point we proceed after the manner well known in the ceramic art. Other proportions may be successfully employed. Also the zircon, or zirconium silicate, may be correspondingly substituted, in whole or in part, for other usual ingredients of the batch, as for example for the flint, instead of for the kaolin etc.; or the zircon, or zirconium silicate, may be used as an addition to, or as a substitute for, a fraction of, the usual batch employed in production of the particular kind of ceramic insulator appliance desired.

Our insulator appliances when used in spark plugs or as spark plug porcelains as above referred to are, as compared with others, less susceptible to the formation of cracks, and their surfaces are better preserved under the conditions of temperature, pressure and atmosphere which prevail in the cylinder of an internal combustion engine. Their low electrical conductivity, even at the temperatures in such cylinders, allows less of the current to be diverted from the spark-gap, and permits the attainment of a high degree of ignition efficiency. This is especially true of aeroplane, and high-speed, heavy duty, motors in general.

Another usual application of our insulatoring appliances is in the electric furnace, where such appliances heretofore used to surround the electrodes become heated and allow the waste of much current by conduction away through the heated insulating medium itself. In such service, our appliances will obviate much of such losses, and the danger from cracking will be minimized.

The term zircon employed in our hereinafter made claims is to be understood in each instance as referring to a chemical combination of zirconium silicon and oxygen designatable by the formula $ZrSiO_4$ and irrespective of its origin being either natural or synthetic.

Having now described our invention, what we claim as new and desire to secure by Letters Patent is the following, viz:

1. As a new article of manufacture, an electric-insulator appliance of which zircon is a component.

2. As a new article of manufacture, an electric-insulator appliance containing zircon in proportion not less than five per cent. by weight.

3. As a new article of manufacture, an electric-insulator appliance containing a preponderance by weight of zircon.

4. As a new article of manufacture, an electric-insulator appliance consisting of co-cemented particles of zircon.

5. As a new article of manufacture, an electric-insulator appliance containing heat-compacted zircon particles.

6. A spark plug comprising an electric-insulator member, consisting of co-cemented particles of zircon.

7. A spark plug comprising an electric-insulator member containing zircon.

8. A spark plug comprising an electric-insulator member containing a preponderance of zircon.

9. A spark plug comprising an electric-insulator member containing not less than five per cent. by weight of zircon.

10. A ceramic electric-insulator appliance comprising zircon.

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