# UNITED STATES PATENT OFFICE.

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## INSULATING MATERIAL.

1,386,008. Specification of Letters Patent. Patented Aug. 2, 1921.

No Drawing. Application filed January 5, 1917. Serial No. 140,822.

*To all whom it may concern:*

Be it known that I, LEON McCULLOCH, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Insulating Material, of which the following is a specification.

My invention relates to composite electrical insulating material consisting of a binder and flake material such as mica, and it has for its object to provide a composite material comprising a bond of a permanent nature, which shall be unaffected by heat within normal operating ranges and shall have no tendency to soften or shrink at such operating temperatures.

The bond which I prefer to employ for the purpose indicated consists of boron trioxid or some other oxygen compound of boron, with or without the addition of fillers or other ingredients. According to one method of applying my invention, mica flakes or mica splittings are built up into a plate of the required thickness, dry powdered boric acid or a boric acid compound, such as ammonium borate, being sprinkled between the successive layers of mica. The built-up plate is then baked under pressure at a temperature of 500° C. or less, thereby fusing and substantially dehydrating the boric acid and decomposing the ammonium borate, if the latter compound is employed, leaving fused boric oxid containing only small amounts of water and gases.

The foregoing process may be varied by applying boric acid or a boric acid compound, such as ammonium borate, in admixture with a liquid such as benzin or very thin varnish which does not dissolve the boric material, but only serves as a vehicle for spreading the boric material between the mica flakes; or the boric acid, ammonium borate or other boric acid compound may be applied in solution in water, alcohol or other solvent. The vehicle or the solvent will be driven off, either wholly or in part, by the subsequent heat treatment. Other ingredients may be added to the bonding material for increasing its adhesiveness or bulk, suitable materials for this purpose being shellac or other varnish gums and finely divided inorganic materials such as clays of the bentonite type, kaolin, metallic oxids and the like.

One bonding mixture which I have employed with good results is prepared by mixing dry boric acid or ammonium borate with a small amount of bentonite filler and working to a thin paste with a water solution of glycerin. The glycerin reacts with the boric acid present to form a sticky glyceryl borate which renders the entire mixture adhesive and effectually holds the mica flakes together during the building-up process. When heat is applied to the composite material, the glycerin is driven off, and the boric oxid which remains behind acts as the final bond.

Boric oxid imparts to composite materials containing it the property of softening at moderately elevated temperatures of the order of 500° C., but since the boric oxid does not become completely fluid except at temperatures several hundred degrees above this point, the composite material is entirely coherent at all temperatures ordinarily encountered in the operation of electrical apparatus. Boric oxid binders have the further advantage that they do not exert a destructive fluxing action upon mica, as do many of the binding materials which have heretofore been employed for the purpose of making composite insulating materials.

It is to be understood that my invention is not restricted to the use of any particular proportions or materials except as indicated in the appended claims, and that the specific examples given herein are intended to be illustrative and may be widely modified without departing from the spirit and scope of my invention.

I claim as my invention:

1. A composite material comprising flake material and a lead free binder containing an oxygen compound of boron.

2. A composite material comprising flake material and a lead free binder containing boron trioxid.

3. A composite material comprising flake material and a lead free binder containing an oxygen compound of boron and a filler.

4. A composite material comprising flake material and a lead free binder comprising boron trioxid and a pulverulent filler.

5. A composite material comprising mica flakes or splittings held together by means of a lead free binder containing an oxygen compound of boron and a filler.

6. A composite material comprising mica flakes or splittings held together by means

of a lead free binder containing boron trioxid.

7. A composite material comprising mica flakes or splittings held together by means of a lead free binder containing boron trioxid and a pulverulent filler.

8. A process of making composite material that comprises associating flake material with an adhesive lead free binder containing an oxygen compound of boron, and applying heat and pressure to the said material.

9. A process of making composite material that comprises associating flake material with a binder formed by mixing boric acid, water and glycerin, and applying heat and pressure to the said material.

10. A process of making composite material that comprises superposing mica flakes or splittings coated with a binder formed by mixing boric acid, water and glycerin, and heating the superposed flakes or splittings to a temperature not exceeding 500° C.

11. A process of making composite material that comprises superposing mica flakes or splittings coated with a binder formed by mixing boric acid, water, glycerin and a pulverulent filler, and heating the superposed flakes or splittings to a temperature not exceeding 500° C.

12. A binder for use in composite materials comprising an oxygen compound of boron and a small amount of a pulverulent clay.

13. A binder for use in composite materials comprising a compound of boron, a pulverulent clay filler and glycerin.

14. A binder for use in composite materials comprising an oxygen compound of boron, a bentonite clay as a filler and glycerin.

15. The composite material resulting from subjecting to heat and pressure mica flakes or splits associated with a binder comprising an oxygen compound of boron and glycerin.

16. The composite material resulting from subjecting to heat and pressure mica flakes or splits associated with a binder comprising an oxygen compound of boron and a small amount of a pulverulent clay as a filler.

In testimony whereof, I have hereunto subscribed my name this 27th day of Dec., 1916.

LEON McCULLOCH.