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C. HERING

PROCESS OF MAKING FIBROUS MATERIAL

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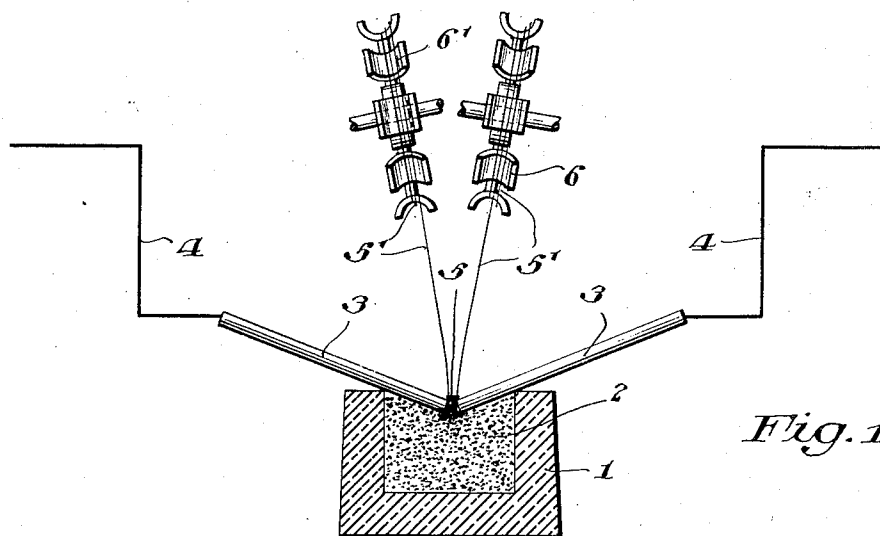


Fig. 1.

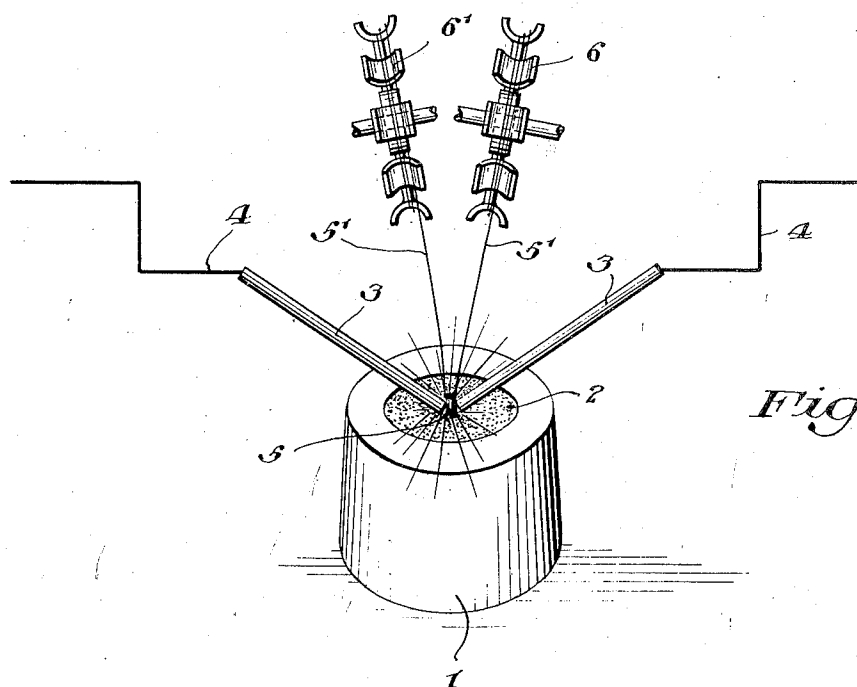


Fig. 2.

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UNITED STATES PATENT OFFICE.

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PROCESS OF MAKING FIBROUS MATERIAL.

Application filed September 2, 1924. Serial No. 735,232.

To all whom it may concern:

Be it known that I, CARL HERING, a citizen of the United States, residing in the city of Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented Improved Processes of Making Fibrous Material, of which the following is a specification.

My invention is designed to effect the simple, rapid and economical production of extremely fine mineral fibres or filaments, particularly from difficultly fusible substances, such fibres being spun into threads and woven into fabrics which may be so treated after weaving as to eliminate stresses in the fibres and give them a natural "set" in their woven form, as claimed in my divisional application Serial No. 82,157.

The fineness of mineral fibres is dependent primarily upon the fusion point of the substance from which they are formed and the rapidity with which the fibres are drawn. Fibres drawn from very refractory minerals, such as quartz (SiO_2), corundum (Al_2O_3), or magnesia (MgO), having very high melting points are much finer than fibres drawn from glass, being almost invisible, yet have a tensile strength said to be greater than that of steel, possess almost perfect elasticity and great flexibility. Fabrics woven from such fibres have a high luster, are very strong, non-absorbent, incombustible and practically imperishable. They may be disinfected or deodorized by exposure to high heat or usual antiseptics without injury, may be rendered translucent by treatment with a suitable filler or coating, and are especially suitable for use in the manufacture of the wings of aeroplanes.

The mineral substances from which fibres are formed in accordance with this invention become electrical conductors of high resistivity when heated to fusion but at normal temperatures are insulators or non-conductors of electricity. In accordance with my improvements, I utilize these characteristics of the material to generate within it, by passing an electric current therethrough, the heat necessary to maintain a liquid pool or globule of the material and to provide for the conducting liquid pool thus formed a hearth or bed preventing the destruction of the crucible or container or the short circuiting of the heating current. Preferably the liquid pool is maintained as a small globule from which one or more threads

may be drawn and the bed is formed of granulated or pulverized solid material from which the globule may be replenished as threads are drawn therefrom. Any number of furnace-forming globules may be maintained in a bed of suitable size or each furnace-forming globule may be in a separate crucible or container.

The heat necessary for the initial formation of the conducting pool is preferably supplied by striking and maintaining an arc between two electrodes in contact with the granular material of the bed. As soon as the heat of the arc fuses sufficient adjacent granules or raises them to conducting temperature, the current flows through the liquid conductor thus formed and the arc is extinguished. By suitably regulating the flow of current, the heat generated by the resistivity of the liquid conductor connecting the electrodes may be raised to and maintained at any desired degree. The conversion of electrical energy into heat is instantaneous and practically 100% efficient; the heat is generated directly in the substance being treated, without the losses incident to heating by conduction or convection; and the heat losses by radiation are small since the heat passing into the bed or hearth serves to preheat and prepare the material thereof for fusion in the pool. The generation of the heat within the fused material, so that the highest heat of the furnace is within and not around the liquefied material, is of great importance as it permits the drawn fibres to immediately solidify and avoids the exposure thereof to fusing temperatures after leaving the pool, thereby obviating the breakages which occur where the fusing heat is supplied from without the fused material, as by an electric arc.

A fibre of material is drawn rapidly from the fused globule, preferably by engagement with a rapidly rotating reel, and a plurality of such drawn fibres may be spun together to form a thread of desired thickness. The elasticity of such fibres is so great that it is sometimes desirable to coat them before or during spinning with a temporary adhesive to hold them in their twisted relation.

The fabric woven from such spun fibres may be heated to a temperature which will soften, without melting, the fibres to eliminate stresses therein and so that the fibres when again cooled will normally maintain

their woven positions, with the production of a fabric of considerable elasticity. The adhesive applied to the fibres may be burned off in this heat treatment or removed by a suitable solvent.

The fabric thus formed may be rendered translucent by impregnating or coating it with a suitable filler, such as varnish, or may be colored in any suitable manner, as by coating with pigments, exposure to light rays, or by coloring the raw material. Seams or joints in such fabrics may be made by sewing or by the use of fusible or other cements.

In the accompanying drawings, Fig. 1 is a transverse sectional view illustrating diagrammatically apparatus adapted for the practice of my improved process; and Fig. 2 is a perspective view thereof.

As shown in the drawings, a crucible 1 contains a bed or hearth of granular or powdered quartz 2 in which are embedded electrodes 3 connected in an electric circuit 4. In the preferred practice of my process, these electrodes are initially brought sufficiently close together to form an arc immediately adjacent to the upper layer of quartz particles. When the heat of the arc has fused a globule of quartz 5 sufficiently large to bridge over the space between the electrodes 4, the current will flow through the material thus rendered conducting, but of high resistivity, and heat it to any desired degree. When the globule has attained the requisite temperature, a thread 5' is drawn therefrom by dipping therein and quickly withdrawing a cold quartz fragment, to which a filament of molten quartz adheres. The filament is thrown on the periphery of the rapidly rotating sectional reel 6 which may, if desired, be coated with an adhesive to secure the engagement therewith of the end of the drawn fibre. The rotation of the reel at high speed draws from the globule a continuous very fine thread or fibre, which may be taken off the reel in the form of a skein by separating the reel sections.

A second thread may, in like manner, be drawn from the globule and reeled upon a reel 6', care being taken to draw the threads from the globule at points sufficiently spaced apart to prevent adhesion or coalescence of the fibres being drawn.

The globule 5 is maintained at a substantially constant temperature by regulating the wattage of the current and may be maintained of substantially constant size by the addition of granulated or pulverized quartz from the bed or from any suitable source of supply.

Having described my invention, I claim:

1. The process which consists in forming a bed of material rendered electrically conducting by heat, fusing a portion of said bed, and passing through the fused portion an electric current insulated by the unfused portion of said bed.

2. The process which comprises forming an electrically insulating bed of fusible material, electrically fusing a portion only of said bed, and withdrawing a fibre from such fused portion.

3. The process which comprises forming an electrically insulating bed of fusible material, fusing a portion of said bed, passing through said fused portion an electric current insulated by the unfused portion of said bed, withdrawing a fibre from the fused portion and replenishing the latter from the unfused portion.

4. The process which comprises heating a fusible substance by passing an electric current therethrough and drawing a fibre from such fused substance.

5. The process which comprises heating a fusible substance from within the body thereof and drawing a thread from such fused substance.

6. The process which comprises forming a bed of quartz, forming an arc adjacent to said bed, and supporting a globule of quartz fused by said arc in solid quartz of said bed.

7. The process which comprises forming an electric arc and thereby liquefying a substance rendered electrically conducting by heat, short circuiting said arc through said liquefied substance, and heating said substance by the flow of current therethrough.

8. The process which comprises forming an electric arc, heating thereby a substance rendered electrically conductive by heat, and short circuiting said arc through said heated substance.

9. The process which comprises liquefying a substance rendered conducting by heat by the passage of a current therethrough, and regulating the temperature of the liquefied substance by varying the wattage of the current flow.

10. The process which comprises liquefying a globule of fusible material in a bed thereof, connecting a fibre drawn from said globule with a reel, and rapidly revolving said reel to draw a continuous fibre from said globule.

In witness whereof I have hereunto set my name this 27th day of August, 1924.

CARL HERING.