METHOD OF PRODUCING SOLID METAL MATERIALS CONTAINING PRE-TENSIONED SILICA

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1 Claim. (Cl. 29—194)

This invention relates to material and has for its object the provision of means whereby the plastic creep deformation characteristics of a material are improved.

According to the present invention a plurality of non-metallic fibres are embedded in a matrix material the said fibres being prestressed by tensile loads prior to their being embedded in the matrix or being fibres which are capable of becoming stressed by tensile loads caused by an application of strain and/or heat, whereby plastic creep deformation of the matrix material will be retarded by the fibres.

The matrix may be made from any convenient material such as aluminium or other metal. The use of the term metal is to be understood as incorporating sintered metal powders which incorporate a proportion of oxide. The fibres may comprise any non-metallic material such as an inorganic silica fibre or a silicate glass fibre.

In order that the invention can be clearly understood and readily into effect three alternative methods of producing a material in accordance with the invention will now be described, by way of example only.

In one method a plurality of silica fibres of approximately 5×10^-4 ins. in diameter are held at each end in suitable clamping devices, and the clamping devices are moved relatively to each other to apply a predetermined tensile stress to the fibres, for example 100,000 lb./sq. inch.

The stress is maintained on the fibres and they are then inserted in a mould or other receptacle and aluminium or other metal poured into the mould to envelope the fibres.

When the metal has solidified sufficiently the tension applied to the fibers is released whereby the plastic creep deformation characteristics of the aluminium under high temperature conditions is improved beyond the characteristics of aluminium without the fibres, by the compressive force applied thereto by the fibres.

In an alternative method of producing a material in accordance with the invention the fibre and matrix forming materials are chosen so that there is a large difference in their thermal expansion rates, whereby the fibres will be placed under tensile stresses when the material is subjected to high temperatures, for example the fibres may have a thermal expansion rate of 5×10^-5°C, whilst the matrix material may have a thermal expansion rate of 1×10^-5°C.

In a further alternative method the fibres and matrix are produced as in the first described method, but without any tensile stress being applied to the fibres, and then the matrix is subjected to a stress which is sufficient to cause plastic flow or creep of the metal, whereby the fibres have a tensile load applied to them.

The plastic deformation of the metal causes a redistribution of stress in the system, the major portion of the load being borne by the fibres and transmitted to them by shear loads through the metal which shear loads may be arranged to be very small.

In each of the foregoing examples the fibre and matrix material have been chosen so that they both have substantially the same modulus of elasticity, but the two materials may be chosen so as to have widely differing moduli.

It will be appreciated that by employing a material in accordance with the invention excess creep tendencies in the material forming the matrix are avoided as would be the case if the stressed fibres were not employed.

What we claim is:

The method which comprises tensioning silica fibers maintained so that their longitudinal axes are substantially parallel to each other, enveloping the thus stressed fibers with a molten metal having creep characteristics and substantially the same modulus of elasticity as the fibers, allowing said metal to solidify and then releasing the tension on said fibers.

References Cited by the Examiner

UNITED STATES PATENTS

2,143,016 1/1939 Kleinschmidt ———— 55—527
2,328,302 8/1943 Simison ———— 55—527
2,609,320 9/1925 Modigliani ———— 55—527
2,616,165 11/1952 Brennan ———— 29—183
2,699,415 1/1955 Nachtman ———— 29—452
2,737,802 3/1956 Bakker ———— 29—452
2,758,952 8/1956 Toumin ———— 29—183
3,007,223 11/1961 Wehrmann ———— 29—452
3,098,723 7/1963 Micks ———— 29—183.5

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