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MOLDED MATERIAL

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This invention has for its object a molded material having great mechanical strength, and to objects made from said material.

In the present state of the art relating to rigid molded materials it has as yet not been possible to produce such materials capable of standing very heavy mechanical strains.

In order to increase their mechanical strength it has been proposed to incorporate in plastic materials certain fibers generally vegetable fibers or even a metal reenforce, but so far without obtaining the desired result.

Cotton fibers which also are often used do not produce, under the most favorable conditions, molded objects possessing a resistance to traction exceeding about 1500 kilograms per square centimeter. On the other hand it has also been proposed to reenforce objects by means of threads of metal or metal trellis work relatively coarse, but the objects thus manufactured are coarse and lacking in homogeneousness so that the resistance to traction varies from one plane to another.

The result is that in order to secure a rigid molded body possessing great mechanical strength it is not sufficient to reenforce it, nor to reenforce it with strong threads.

The invention and its aims and objects will be readily understood from the following description of embodiments thereof herein given for illustrative purposes, the true scope of the invention being more particularly pointed out in the appended claims.

In accordance with our invention a molded material is obtained composed essentially or exclusively of fibers and a binder, and possessing mechanical strength of a much higher order than that possessed by known materials by using at least 30% by volume of inorganic and artificial threads, each consisting of one or a plurality of unitary fibers of a diameter less than 10 microns, the greater portion of said threads being directed in the same direction, said material being produced in a rigid state by molding under pressure or by impregnation of the reenforce of threads under pressure.

It has been stated above that the greater portion of the threads is directed in one and the same direction. However, in accordance with our invention molded objects may be made in which layers of directed threads are used in alternation either with layers of woven threads or with layers of threads directed perpendicularly or otherwise or even disposed in bulk, provided that the majority of the fibers are directed in one and the same direction.

Among the threads of various materials which can be used in accordance with our invention may be cited fibers of glass, of silica, of quartz or of metal.

The use of glass fibers imbedded in plastic material is already known in the case of electric insulations, and it has also been recommended in cases where incombustibility and a higher resistance to chemical agents are necessary. But heretofore no one had imagined that it would be possible, by a judicious use of such fibers, to produce not an insulating material but a material of rigid construction possessing a very high mechanical strength and which could be made in any shape desired by molding. The field of application of molded objects is thus greatly extended.

In preparing a material for molding comprising a high percentage of ordered threads formed of fibers so fine, as above stated, it will be noted that said fibers mix excessively well with the binder which is entirely retained at the surface of said fibers and particularly in the capillary spaces between said fibers. If, while maintaining a given volume of fibers the diameter of the fibers be reduced, one witnesses a sudden increase in mechanical strength; thus a mixture of phenolic resin and glass fibers of 15 to 18 microns produces a quite brittle and weak product, while with fibers of from 4 to 5 microns the material produced is of extraordinary strength and acts like a more homogeneous material. This rather sudden change in physical properties as soon as a certain degree of fineness and a certain division of the fibers and of the binder is attained would seem to indicate the intervention at a certain point of new forces due to the small dimensions of the bodies present or to the great development of their surfaces, such as surface tensions, adhesive tensions, absorption, etc. Similar phenomena are met with when uniting two surfaces with the aid of an adhesive, the adherence being all the more strong the thinner the intermediate layer of adhesive, for example in application of hydraulic cements, in the pliable rubber industry which uses colloidal charges, called "active" for obtaining very tenacious materials, etc.

Material embodying the present invention made of parallel glass fibers of a diameter of 4 to 5 microns and phenolic resin possesses a tensile strength in the direction of said fibers equal to more than 3000 kilograms per square centimeter. Said material is therefore much stronger than all the molded materials known.

Another important feature of the invention

resides in the choice of a binder that is less rigid or at most as rigid as said fibers. In other words it is advantageous to have the modulus of elasticity of the binder inferior or at most equal to that of said fibers. Materials are thus obtained possessing a high limit of elasticity, close to the rupturing charge. These materials may be subjected for an unlimited time and in perfect safety to mechanical stresses much higher which in the long run would wear out and disintegrate any other known molded material.

Said threads may be formed of parallel, twisted, or braided fibers or fibers in the form of cables.

It is advantageous to use very long unitary fibers, such as those obtained by drawing. However the shorter fibers obtained for example by the dispersion of melted glass in a steam jet may also be suitable. The glass, metal or other threads may be used each sort alone or mixed with one another or mixed with other fibers or charges.

The adherence between said fibers and the binder may be improved by chemically treating said fibers to roughen their surface or by depositing thereon an uneven substance, or by varnishing or suitably lubricating said threads.

The binder used may consist of any suitable plastic material, a material for example having as a base natural or synthetic rubber or a synthetic resin of the type of phenol-formol, cresol-formol, urea-formol, glycerin phthalic acid, vinylic glycerin acid, or the like.

The materials embodying the present invention are made either by molding under pressure the mass of the fibers and binder or by impregnation of a previously formed fibrous reenforce and subjected to pressure, an operation which is also a form of molding.

The exceptional mechanical strength of the rigid molded materials embodying the present invention enables them to be used for the manufacture of parts which are subjected to very heavy mechanical stresses; attempts to apply molded materials heretofore known to such uses have invariably failed, said known molded materials having proved wholly inadequate.

We are aware that the present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and we therefore desire the present embodiments to be considered in all respects as illustrative and not restrictive.

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