METHOD OF PRODUCING PADS OR MATS OF MINERAL FIBERS

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ABSTRACT OF THE DISCLOSURE

The production of a mat of glass fibers of improved structural integrity, cohesiveness, increased density, resilience and tractive resistance in longitudinal and transverse directions by combining with the mat a thin layer of connecting fibers having stretch and pliability characteristics greater than those of the glass fibers, and "needling" the combined mat with needles provided with barbs which entrain the connecting fibers into the mat in a transverse direction relative to the mat surfaces, which bind the glass fiber into a well integrated mat useful for thermal and acoustic insulation, structural members, laminates for fabric and other sheet material, packing plastic reinforcements, filters, and other industrial applications.

The term "needling" signifies a process which involves passing a plurality of needles provided with roughenings through a pad or mat of fibers dispersed in a direction which preferably extend parallel to the surfaces of the mat, so as to carry along, by movement of the needles, a certain number of fibers to arrange them in a direction perpendicular to the surfaces of the mat. This process results in a cohesion of the pad and imparts thereto a resistance to traction in all directions, as well as a density greater than it had before the operation.

However, this process can be utilized only in the case where the fibers are pliable and have high elongation or stretch characteristics. Practically, it is employed only for mats or cushions of jute or similar fibers, or of organic synthetic fibers. When the attempt has been made to apply this process to a pad or mat of mineral fibers, such as glass fibers, the obtained results have been bad. If the needling is slight, that is, if the number of perforations of the mat per unit of surface area is reduced, and if the roughenings or barbs of the needles are few in number and indistinct, the resulting cohesion of the pad is weak. On the other hand, if the needling is more intense, the fibers break. The density of the pad is then increased, but without noticeable effect on its cohesion, and the plasticity or resilience is eliminated from the product.

It is the object of the present invention to provide a method of needling which makes possible the obtaining of mats of mineral fibers, particularly glass fibers, having good cohesion and increased density, and possessing good characteristics of resistance to traction in longitudinal and transverse directions. This method consists in combining with the mineral fibers of the mat, fibers which are designated hereinafter as "connecting fibers," having stretch and pliability characteristics greater than those of the fibers of the mat, and in actuating the needles, which, by their movement, entrain these connecting fibers through the mat. Excellent results are obtained by the practice of this method, the resulting mat being characterized especially by excellent cohesion.

To serve as connecting fibers, use may be made of organic fibers such as superpolyamides, polyester, vinyl chloride, natural or regenerated cellulose, etc. Metallic fibers may also be used, for example, copper, aluminum, etc.

According to another characteristic of the invention, the connecting fibers may be arranged in heterogeneous fashion with respect to the constituent fibers of the mat, these connecting fibers in that case being carried along by the movement of the needles. For example, in the case of needles having barbs directed toward the point, the connecting fibers may be scattered at the upper part of the mat without any specially favored orientation, in such a way that the action of the needle barbs is exerted chiefly on the connecting fibers, and these traverse the mat. Conversely, the connecting fibers may be disposed at the lower part of the mat when the needles with inversely directed barbs tend to carry along said fibers in their ascending movement.

According to another characteristic of the invention, the layer of connecting fibers may be arranged in the middle of the mat. Depending on the direction of the needle barbs, the needling operation takes place principally in one or the other parts of the mat. This mode of execution of the invention allows retaining on one part of the mat thickness a layer almost exclusively constituted by mineral fibers.

The quantity of connecting fibers to be used may vary in large proportions according to the number of needles per unit of surface, the nature of the needles, the nature of the connecting fibers, and the desired result. From 1% to 90% of connecting fibers may be used. Excellent results have been obtained by placing 10% of "Nylon" fibers on the mat of glass fibers. The thickness and length of the connecting fibers are determined so as to obtain the best results as a function of type of needles, their stroke, the density of needling, etc.

In the case where thermoplastic fibers are used, the part of the mat where the connecting fibers are located may be reheated, in order, for example, to facilitate their elongation. This reheating may be effected, for example, by means of infra-red rays directed toward the mat just before its entry into the needling machine.

The connecting fibers may assume the form of a regular mat without cohesion distributed in an air or hydraulic path, for example, by means of a machine called a "Curlator" comprising a fan sucking the fibers issuing from a wool-comber and depositing them in the form of a thin mat. This mat of connecting fibers may be put in place, by action of conveyor belts above, below, or at the interior of the mat of mineral fibers.

If it is desired to be able to manipulate the mat of connecting fibers without tearing it, it may be bound together by subjecting it to a needling operation. The fibers may also be joined together by means of a product acting as a hot or cold polymerizable glue. Such a coherent mat may be used in this form, or on the other hand, it may be subjected to a treatment which suppresses binding or linking before use.

According to another characteristic of the invention, a reinforcement or coating layer may be attached to the mat of mineral fibers having the effect of increasing its resistance in the longitudinal or transverse directions. This reinforcement may be located at any desired place of the mat, for example, on the surface or in a central region. For this reinforcement, a cloth of polyamide or jute, a non-woven tissue, metallic cloth, etc., may be used, or again plastic, latex, polyvinyl chloride material, or the like, may be used.

Also, underlayers of mineral fibers, particularly glass fibers, and latex, such as those described in United States application Ser. No. 747,583, filed July 25, 1968, may be used. In addition to the tenacity resulting from this reinforcement, in the longitudinal and transverse directions,
It engenders better hooking of the connecting fibers which are also joined to this reinforcement. Particularly advantageous results are obtained by disposing the connecting fibers on one surface of the mat of fibers, and the reinforcement, such as cloth, on the other surface of the mat.

In order to facilitate the needling operation, it is advantageous to utilize glass fibers which have received a light oil or grease coating, for example, 2% oil, or a light sizing, for example, 1% to 2%, which has been polymerized before the needling operation.

One mode of execution of the invention is set forth below, as an example.

The mat is constituted by a felt of glass fibers derived from filaments issuing by centrifugal force from orifices provided in the band of a rotating body, these filaments being transformed into fibers by attenuation, as is well known in the art. These fibers have been oiled with 2.5% of an oily coating. The mat produced from these fibers may have a surface weight of 1100 grams per square meter. It may be covered with a mat of nylon fibers produced by a machine known as a "Curlator," and the weight of this last-mentioned mat may be 150 grams per square meter.

A reinforcement of nylon tissue, may be applied under the lower part of the mat of glass fibers, of the marquissette type, the weight of which may amount to approximately 20 grams per square meter.

This assembly is placed in a "Bowater" needling device, equipped with "standard" type barbed needles. The number of piercings per square centimeter of the mat may be about 12 to 15, the course of the needles being such that all the barbs practically traverse the mat assembly. It should be noted that the quantity of nylon comprising the mat is very slight. The result is that in case of an elevation of temperature of the mat which produces fusion of the nylon, the heat is not transmitted, and the incombustible property of the mat is thus preserved.

Other objects and purposes will appear from the description of the invention following hereinafter, taken in conjunction with the accompanying drawings, wherein

FIGS. 1 to 3 are sectional views of a mat of glass fibers at three different stages of the needling operation;

FIG. 4 is a sectional view of another embodiment of the invention; and

FIG. 5 is a sectional view of still another preferred embodiment of the invention.

The attached drawing, in FIGS. 1 to 3, shows the needling operation. The mat 1 of mineral fibers, particularly glass fibers, is superposed by a layer 2 of connecting fibers which may be of a polyamide resin, for example. FIG. 1 shows a needle 3 of the needling machine, with barbs 4, before its introduction into the mat. FIG. 2 shows the needle in the course of penetrating the pad and entraining the connecting fibers by the needle barbs. FIG. 3 shows the mat after the needling operation and after a predetermined number of connecting fibers have traversed the mat and thus assuring its cohesion.

FIG. 4 shows a mat in accordance with the invention comprising, in addition, an underlayer 5 joined to the mat by the connecting fibers.

FIG. 5 shows the mat of mineral fibers 1 with the layer 2 of connecting fibers of synthetic resin disposed at an intermediate level of the mat in the interior thereof as described above, before the needling operation. The needling of the composite mat with barbed needles moving vertically, preferably at a single station, effects the transfer of the connecting fibers from the layer 2 to the portions of the mat of mineral fibers above and below the layer to integrate effectively the component layers of the mat by the ascending and descending movements of the barbed needles, without injury to the mineral fibers.

The products obtained by the process according to the invention are capable of numerous and very diverse applications. These may include coverings for thermal and acoustic insulation, particularly for walls and floors, vehicle structures and the like, floating floors, filters, packing, and protective tarpaulins or tents, with a fabric combined with the mat.

I claim:

1. The method of producing a mat of glass fibers of increased density and improved cohesive and tractile-resistant properties which comprises combining with the glass fibers of the mat additional connecting fibers of organic synthetic resinous material having elongation and pliability characteristics greater than that of the glass fibers constituting the mat, said additional fibers being in the form of an integrated pad located in the interior of the mat of glass fibers between the opposite faces thereof, coating the mineral fibers with a sizing or oily composition to facilitate the penetration of the piercing needles and the passage of the connecting fibers therethrough, piercing the assembly with needles with roughenings and thereby entraining by their movement said organic connecting fibers in the interior of the mat and simultaneously interengaging said organic fibers with the layers of glass fibers on the outer portions of the mat, and preheating the connecting fibers immediately before the needle-piercing operation to render them more pliable.

2. The method set forth in claim 1, wherein the needle-piercing step is executed by descending and ascending movements of the piercing needles relative to the mat of fibers at the station undergoing needling.

3. The method set forth in claim 1, wherein the connecting fibers of synthetic organic material are selected from the group consisting of polyamides, polyesters, vinyl chloride, natural cellulose and regenerated cellulose.

4. The method set forth in claim 1, wherein the last-mentioned step of preheating the connecting fibers is executed with infra-red rays directed onto said composite mat of fibers.

5. The method set forth in claim 1, including the step of combining a reinforcing layer of material with the mineral fibers to increase the tractive resistance thereof, which layer is integrated together with the mineral fibers of said mat by said connecting fibers.

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