

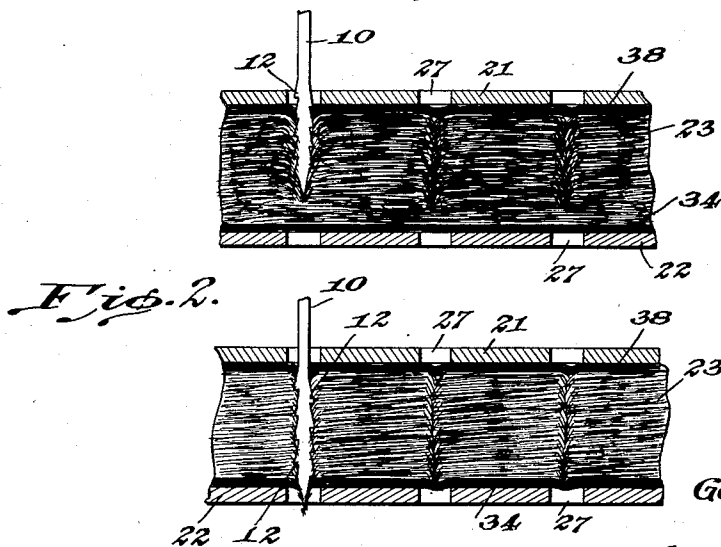
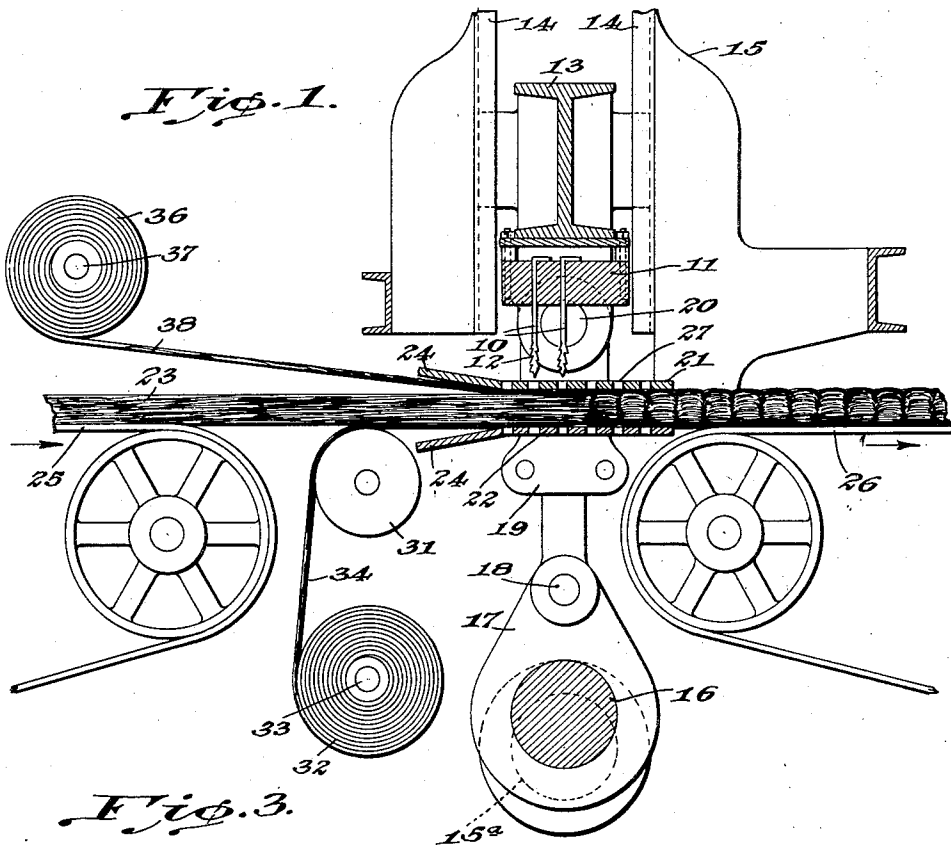
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FIBROUS GLASS PRODUCT

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## UNITED STATES PATENT OFFICE

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## FIBROUS GLASS PRODUCT

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5 Claims. (Cl. 28-79)

My invention relates to novel products made by needling fibrous materials into matted form.

In the manufacture of felted products such as felts for horse blankets, rug pads, automotive insulation, etc., it has long been the practice to use a needle loom to knit a fibrous mass into a felted batting and by the same operation attach it to a backing of burlap or the like. This needling is accomplished by pushing barbed needles through the fibrous mass and juxtaposed backing material and then withdrawing them. The needle barbs hook some of the surrounding fibers and carry them through the mass of loose fibers and backing material and thereby tie the mass of fibers into the form of a felt and at the same time bond the felted material to the woven fabric or the like used as a backing. It is common practice, for example, to needle coarse vegetable fibers such as jute or hemp onto a burlap backing.

I have found that mats of matted glass fibers may be needled with advantageous results in the way of greatly increased density of the mats, thus improving the thermal insulating properties of the mats and adding to the number of applications of glass fiber mats. These needled mats, however, may have roughened surfaces because of the needling operation and may have less than the desired degree of strength measured in directions generally parallel with the major faces of the mats.

Also, coarser glass fibers, that is, fibers in the neighborhood of .0007 inch in diameter are more economical to produce and are therefore preferable for many heat-insulating purposes. Mats of fibers of this size, however, are more difficult to needle because of the likelihood of breakage of the fibers into shorter lengths with consequent decrease in the coherence and strength of the finished mat.

An object of the invention is to provide a mat of glass fibers needled to greatly increase its density and having smooth surfaces and increased strength and coherence. In accordance with the present invention this is obtained by facing the mat on one or both of its major faces with a thin web of very fine glass fibers of great length needled to the mat. The fine long fibers of the web are needled into the mat, serving not only to hold the web to the mat but also increasing the coherence of the mat.

A further object of the invention is to provide a novel needled product of glass fibers in the form of an integrated mat of fibers without a backing of woven fabric or other supporting material, capable of being handled and applied.

A further object of the invention is to provide a needled mat of inorganic fibers having mass integrity and strength in all directions.

A further object of the invention is to provide

an integrated bat of inorganic fibers, said bat being of predetermined shape maintained without the use of an adhesive bonding material or other extraneous means.

- 5 A further object of the invention is to provide a mat or bat adapted for high temperature insulation purposes which is free from organic binders or other materials which, when the insulation is subjected to high temperatures, would
- 10 cause smoke, objectionable odors or gases.

A further object of the invention is to provide a novel form of integrated mat or bat in which the usual heat treating and curing operations are rendered unnecessary.

- 15 A further object of the invention is to provide a needled mat and method of making the same, by which the use of the usual paper and thread as in stitching methods is eliminated.

- A further object of the invention is to provide
- 20 as a product of manufacture, a needled mat of mineral fibers which is fireproof and vermin proof.

A further object of the invention is to provide a novel form of battery plate separator consisting of matted glass wool, and a novel method and apparatus for making the separator.

- 25 A further object of the invention is to provide a novel form of heat insulating product which may comprise a bat or the like consisting of matted glass fibers with a bonding material to give the mat the needed strength and rigidity for handling while being installed, in combination with a matting of the fibers in such manner that the material will be self-supporting and retain
- 30 its shape when subjected to high temperature by which the adhesive bonding material is burned out or destroyed in whole or in part.

Other objects of the invention will appear hereinafter.

- 40 Referring to the accompanying drawing:

Figure 1 is a partly diagrammatic sectional elevational of a needling apparatus for use in practicing the present invention;

- 45 Figure 2 is a fragmentary sectional elevation on a larger scale illustrating a portion of a needled mat and also showing the manner in which the needles operate; and

- Figure 3 is a similar view showing a somewhat modified operation in which the needles are projected only part way through the mat.

- 50 The needling machine may be of conventional construction. As shown in Figure 1 it comprises a battery of needles 10 mounted in a supporting plate 11 of wood or other material. The needles may be arranged in rows and uniformly spaced. Each needle is formed with a multiplicity of downwardly projecting barbs 12 (Figure 2). The plate 11 is mounted on a carrier 13 which is adapted to reciprocate vertically in guides 14 on the machine frame 15. The carrier 13 is re-

reciprocated by means of a rotating crank shaft 15<sup>a</sup> and crank 16. A pitman 17 journaled on the crank is pivoted at 18 to a connecting frame 19, the latter having a pivotal connection 20 with the reciprocating carrier 13.

Upper and lower stripper plates 21 and 22 have a stationary mounting in the machine frame and are spaced apart to permit the passage therebetween of a mat or work-piece 23. The upper stripper plate 21 is adjustable up and down to accommodate work-pieces of various thicknesses. The stripper plates are preferably made of sheet metal and as shown are provided with inclined marginal portions or flanges 24 providing a flared entrance for the mat 23.

The stripper plates are provided each with a multiplicity of perforations 27 arranged in rows and spaced to correspond with the spacing of the needles. These openings are preferably circular and of slightly larger diameter than the needles. The construction herein shown and specifically that of the stripper plates is particularly adapted for use in needling mats or masses of inorganic fibers and especially mats or webs consisting of very fine glass fibers. It has been found that conventional needling machines which are ordinarily provided with spaced stripper bars and in which the needles operate in the open spaces between the bars, are unsuited for needling glass fiber mats or other mats of inorganic materials. By the provision of stripper plates provided with perforations such as herein disclosed, highly satisfactory results are obtained in the needling of mats consisting of inorganic fibers and particularly mats comprising very fine glass fibers which are preferably of considerable length.

The mat as it advances toward the needling machine is supported on an endless conveyor or belt 25 and after passing beyond the machine is carried on a conveyor 26. The conveyors travel in the direction indicated by the arrows to feed the web through the machine. Between the end of the conveyor 25 and the lower stripper plate 22, a roller 31 is rotatably mounted in suitable manner and rotated by suitable power means. A roll 32 of a web of long fine glass fibers is supported on a spindle 33 beneath the roller 31. The web 34 is fed from the roll 32, over the roller 31 and onto the lower stripper plate beneath the mat 23 as the mat is fed onto the stripper plate.

A second roll 36 of a web of glass fibers is mounted on a spindle 37 above the conveyor 25 and may be power driven in any suitable manner. The web 38 from the roll 36 is fed onto the top surface of the mat 23 and passes with the mat beneath the upper stripper plate 21. In this way the mat is faced on both major surfaces with the webs 34 and 38 which are needled to the mat 23 by the needling machine. If desired in the interest of economy, either one of the faces of the mat 23 may be covered with a web of long fine glass fibers instead of both being covered as disclosed in the drawing.

The fibers of the webs 34 and 38 are of great length being substantially continuous in length throughout the length of the webs. They are also of very small diameters, in the range of .0002 or less to .0004 inch in diameter. The fibers of the mat 23 are relatively much coarser than the fibers of the webs, being in the neighborhood of from .0006 to .0010 inch in diameter. In the needling operation the long, fine fibers of the webs are carried well into the body of the

mat 23 and thus intermingled with the fibers of the mat to increase greatly the coherence of the mat. Their increased flexibility permits the fibers of the web to be bent from their normal positions without undue breakage and rearranged to extend substantial distances into the mat.

In the manufacture of a mat 23 the individual glass fibers extend predominantly in substantially horizontal directions due to the manner in which the fibers as they are produced are deposited on a continuously traveling horizontal support or conveyor. The fibers as they accumulate are intermingled and built into the continuously forming web or mat. Thus in the completed mat as it reaches the needling machine, the glass fibers are arranged mainly in substantial parallelism with the major faces of the mat but are haphazardly arranged in planes parallel with the major faces.

As the needles descend and perforate the mat, the downwardly projecting barbs 12 hook the surrounding fibers in the web and also some fibers of the mat itself and draw them downwardly through or part way through the mat. If the needles are projected through and beyond the lower stripper plate, some of the fibers may be carried therewith so as to extend through the plate. By this process each needle draws a multiplicity of the surrounding fibers downwardly, causing them to interlace with the main body of fibers and serve as ties for felting and tying the body of fibers together in the form of a felted mat. When the needles are withdrawn they are stripped free of the fibers, each needle being stripped individually. The resulting product is a mat of coarser fibers held in compacted relation and reinforced with pluralities of finer fibers extending transversely of the major faces of the mat and through or part way through the mat at spaced regions. Such a product is economical to produce while being adaptable to a wide number of uses by reason of its improved properties.

The above described method of needling also serves to compact the mat to a greater or less extent depending in a measure upon the spacing of the stripper plates and also on the speed with which the mat is fed through the machine. If the speed is slow, the needling is effected at comparatively short intervals resulting in a mat of greater density than where comparatively wide spacing is used. As the needled portion of the mat passes beyond the machine it may be cut into individual bats or units of any desired size and shape.

As indicated in the drawing, the mat 23 may be of considerable thickness, although I have found that the present method is suited for felting comparatively thin mats also. Very satisfactory results have been attained by this method of felting or needling webs ranging in thickness from .006 to .100 inch or more to mats of a fraction up to several inches in thickness and having a final density of 6 to 12.7 pounds and more per cubic foot. With mats of greater thickness, a lighter density is often desirable, as, for example, in a mat one inch thick, the density may be 6 pounds per cubic foot or less. These figures, however, are given merely as examples of what has proved satisfactory and not as limitations.

Figure 3 illustrates a modified operation in which the needles penetrate only part way through the mat. After needling the mat in this manner, it may be reversed and again needled by causing the needles to enter the opposite side to complete the felting so that it is extended

entirely through the mat. By the use of this method none of the fibers is drawn downward beyond the surface of the mat. This avoids any unevenness or fuzziness of the lower surface in the mat such as is sometimes produced by operating in the manner shown in Figure 2. The Figure 3 method is adapted for any but very thin composite mats.

It is to be observed that the needling method illustrated in Figures 2 and 3 provides a felted composite mat without any extraneous backing or supporting material. The present invention renders unnecessary the usual woven fabric or other supporting material to which mats of organic fibers are needled in conventional operations. There is thus herein provided a felted mat or mass consisting wholly of glass fibers without any organic or other binding material.

For some purposes it is desirable to provide a needled mat or bat which in addition to the needling is bonded throughout by an adhesive binder. As an example, a mat designed for use as a high temperature insulation may be bonded with an adhesive material which gives needed strength and rigidity for handling, shipping, installing, etc. When such mat has been installed for insulating a stove, furnace, hot pipe or the like, the bonding material or that portion thereof which is subjected to high temperatures may be destroyed by the heat without impairing the mechanical bonding which has been effected by the needling operation. The insulating material is thus held intact and in position after the adhesive binder has been impaired or destroyed. For some purposes the webs 34 and 38 may be in the form of a thin mat of glass fibers bonded together by an adhesive binding material such as latex, shellac, starch, ammonium alginate, or other bonding material.

This application is a continuation-in-part of my copending application Serial Number 274,660, filed May 19, 1939.

Modifications may be resorted to within the spirit and scope of my invention.

I claim:

1. As an article of manufacture, a composite fibrous structure comprising a mat of glass fibers, the majority of the fibers extending in parallelism with the major faces of the mat, said mat being faced on opposite major faces with webs of glass fibers that are finer than the fibers of said mat, said webs being substantially less in thickness than the mat, and fibers of said webs at spaced regions being arranged transversely to the major faces of said mat and to extend into the body of the mat substantial distances to hold the mat and facing webs in a unitary structure.

2. As an article of manufacture, a composite fibrous structure comprising a mat of glass fibers having needled to opposite faces thereof thinner webs of glass fibers that are substantially finer than the fibers of said mat and that extend substantially continuously throughout the lengths of the webs.

3. As an article of manufacture, a composite fibrous structure comprising a mat of glass fibers, the majority of the fibers extending in parallelism with the major faces of the mat, said mat having needled to opposite faces thereof thinner webs of glass fibers that are one and one-half to five times thinner than the fibers of said mat, the finer fibers of said webs extending at localized points substantial distances into said mat to mechanically bond the mat together, and binding material throughout said mat aiding in holding the fibers together.

4. As an article of manufacture, a mat of glass fibers, the majority of the fibers extending in parallelism with the major faces of the mat, other of the fibers of the mat extending transversely of the mat at localized points distributed throughout the mat and thereby mechanically bonding the mass of fibers into an integrated mat having strength and mass integrity, and a web of glass fibers that is substantially thinner than the mat overlying the mat, said web being composed of glass fibers substantially finer than the fibers of said mat and bonded together with a binding material, the fibers of said web at said localized points extending substantial distances into the body of fibers forming said mat to thereby hold the web to the mat and mechanically bond the mat into an integral structure.

5. A heat insulating mat comprising a bat of fine glass fibers, the majority of the fibers extending in directions substantially parallel with the major faces of the mat, a web of glass fibers covering a major face of said mat, said web being thinner than said mat and being composed of fibers that extend substantially continuously throughout the web and that are substantially finer than the fibers of said mat, and bonding material dispersed throughout the mat and bonding the fibers together, localized groups of the fibers of the mat and of the web extending transversely through the mat and transversely to the remainder of the fibers of the web and mat to thereby mechanically bond the mat into an integral body and fix the web to the mat, thereby preventing disintegration of said mat and separation of said web therefrom upon destruction of said bonding material.

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