H. F. WEISS.

COMPOSITE INSULATING MATERIAL.

APPLICATION FILED JULY 11, 1919.

1,336,404. **Patented Apr. 6, 1920.**

Fig. 1,

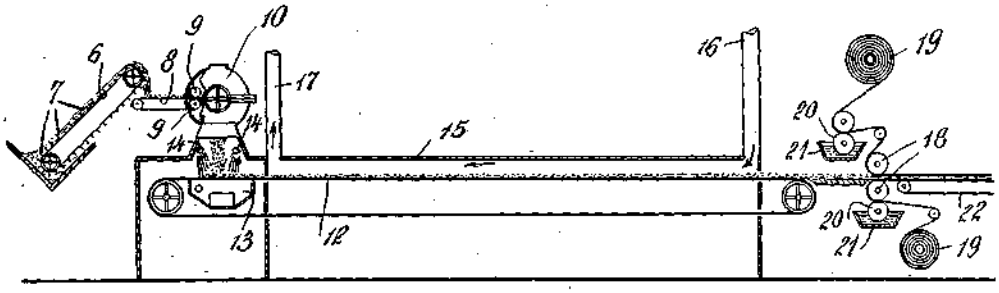


Fig. 2,

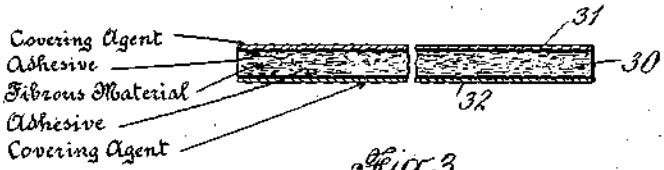
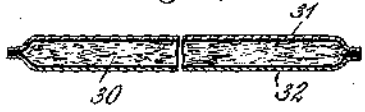


Fig. 3,

Fig. 4,

Fig. 5,



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UNITED STATES PATENT OFFICE.

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COMPOSITE INSULATING MATERIAL.

1,336,404. Specification of Letters Patent. Patented Apr. 6, 1920.

Application filed July 11, 1919. Serial No. 310,136.

To all whom it may concern:

Be it known that I, HOWARD F. WEISS, residing at Madison, in the county of Dane, State of Wisconsin, have invented certain new and useful Improvements in Composite Insulating Materials; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to composite insulating materials, and has for its objects the provision of an improved method of making the same, as well as the provision of a new article of manufacture resulting from the practice of the method of the invention.

Fibrous material confined between sheets of paper, or the like, is extensively used as a heat insulating medium particularly in building construction. It has heretofore been the general practice to sew the fibrous material between the inclosing sheets of paper. This sewing of the fibrous material between these sheets of paper has heretofore been necessary, because the fibers themselves are not cemented or fastened to each other in such a manner that they form a felt or fabricated sheet, and unless the inclosing sheets of paper were sewed, there would be no way in which the sheets of paper could be kept in place. The sewing is objectionable, first, because it is expensive, second, because it perforates the paper, thereby admitting moisture to the fibrous material, and third, because the thread frequently breaks off in the process of manufacture, thus materially reducing the speed and capacity of the manufacturing apparatus.

In my application for Letters Patent of the United States, Serial No. 237,446, filed May 31, 1918, I have described a method of producing a felt or mat of fibrous material, in which the fibers are connected or fastened together so as to form a fabric of fibers in heterogeneous arrangement and cemented together with adhesive material. I have found that a felt or mat in which the fibers are cemented or fastened together, as described in the aforementioned application, is admirably adapted as the fibrous body of a composite insulating material. Thus, I have discovered that such a mat or felt of fibrous material can be securely confined between two inclosing sheets of fabric, such as paper, or the like, by coating either the fibrous mat or the inclosing fabric with a suitable adhesive, whereby the fibrous mat is cemented to the inclosing sheets of fabric.

In my copending application for Letters Patent of the United States, Serial No. 301,218, filed June 2, 1919, I have described in detail and claimed, in its broad aspect, my invention of manufacturing composite insulating material in which a coherent fibrous body portion having the fibers thereof fastened together by adhesive is inclosed or confined between sheets of fabric by cementing the latter to the fibrous body portion. My present invention contemplates, as the source of fibrous material for forming the coherent fibrous body portion of my improved insulating material, animal fibers such, for example, as hair. Animal fiber is inherently more or less water resistant, and is on this account well adapted for the production of the coherent fibrous body portion of my insulating material. Animal fibers are, however, difficult to handle, because of the tendency of such fibers to felt together in unwieldy balls or tangled masses. For these reasons, it is difficult to sift or screen the animal fibrous material and form of it a heterogeneous layer of fibers in which the fibers can be cemented or fastened together by an adhesive to produce a coherent fibrous mat or felt. By subjecting animal fibrous material to a shredding operation, such as described in my aforementioned application No. 237,446, the fibers may be cut and knocked apart, so that the resulting shredded product can be deposited without the formation of tangled masses of fibers of uneven thickness. For this purpose, the animal fibers are cut during the shredding operation only to the extent necessary to secure good felting. I have found that very satisfactory results may be obtained by shredding the animal fibers in a hammer mill shredder in which the rotating element makes 3000 or more revolutions per minute.

Thus, in accordance with one phase of my present invention, animal fiber, such as hair, is subjected to a shredding operation for the purpose of cutting and knocking the fibers apart. Preferably, the shredding engine is arranged to discharge the shredded fibers directly on a belt conveyor in which

the supporting element is in the form of a screen or constructed of suitably perforated or foraminated material. The shredded fibers as they are deposited on this screen conveyor, are sprayed with a suitable adhesive, in accordance with the invention of my aforementioned application, Serial No. 237,446. The shredded animal fibers are accordingly cemented or fastened together by the action of this adhesive, and the resulting coherent fibrous mat is cemented between inclosing sheets of fabric as described in my aforementioned application, Serial No. 301,218.

As pointed out in my aforementioned application, Serial No. 301,218, numerous adhesive agents are available for cementing the fibrous mat between the sheets of inclosing fabric. I have found sodium silicate, asphalt, coal tar pitch, and the like, suitable adhesives for this purpose. Asphalt and pitches, such, for example, as coal tar pitch, are extremely desirable adhesives for this purpose, because they render the inclosing fabric moisture and water proof in addition to cementing the same to the fibrous mat.

By suitably selecting the adhesive for cementing the fibers together, the resulting fibrous mat can be rendered fire-proof, rat-proof and moistureproof. The adhesive may, for example, consist of a solution of sodium silicate, or sodium silicate may be incorporated with the adhesive as a fire-resistant agent. Ammonium sulfate may also be incorporated in the adhesive as a fire-resistant agent. Water-resistant glue may also be employed as the adhesive for cementing the fibers together. A water-resistant glue for the purpose may be made by adding bichromate of potassium to animal glue and exposing the mixture to strong light. A solution of tar or pitch in a volatile solvent, such as benzol or the like, can also be used as the adhesive. I have found a solution of coal tar pitch, or asphalt pitch, in carbontetrachlorid, a very suitable adhesive for cementing together animal fibers.

The fibrous mat or body portion of the insulating material may be made rat and vermin proof by incorporating therein barium carbonate or beta naphthol or other suitable chemicals. This result can be satisfactorily accomplished by incorporating the desired chemical in the adhesive for cementing the fibers together, or the desired chemical may be otherwise incorporated in the fibrous mat in any appropriate manner. Similarly, the fire-proofing agent may be incorporated in the fibrous mat in any appropriate manner, and I have herein mentioned incorporating these chemicals or agents in the adhesive, merely for the purpose of illustrating one way in which the desired result may be accomplished.

Animal fiber or hair possesses certain characteristic properties which peculiarly adapt it for the body portion of an insulating material of the kind herein described. Thus, for example, a light resilient felted mat of animal hair can be submerged in water and subsequently removed and dried without losing its light and resilient characteristics. On the other hand, a similar mat of wood fibers subjected to the same treatment would form upon drying a dense mass of fibers resembling blotting paper, and would have none of its original characteristics of a light resilient mat with fibers in heterogeneous arrangement. Because of this difference between animal hair or fiber and wood or bark fibers, animal fiber may be successfully treated to secure a light resilient felt or mat in a number of different ways, which are not so well adapted for the treatment of wood or bark fibers. I will, therefore, now briefly refer to certain modifications in the hereinbefore described procedure of producing the light resilient felt or mat of animal hair or fiber contemplated by the present invention.

The animal hair or fiber may be shredded or combed in a shredding engine, or the like, and deposited upon a suitable support, such as a conveyor or foraminated belt. The fibers will form in a light resilient fabric with the fibers in heterogeneous arrangement, but not cemented together. This uniformly distributed mass of shredded animal fibers is then dipped into or otherwise appropriately treated with a solution containing adhesive, whereby the fibers are cemented together, and, upon drying or setting of the adhesive, there results a product similar to the fibrous mat hereinbefore described.

The shredded animal fibers may be deposited upon a wire screen, or similar foraminated support, and an adhesive solution or agent poured or flowed upon or over the deposited mass of fibers. Most of this adhesive solution will pass through the fibrous mass and drain off through the interstices of the support, but a sufficient amount of the adhesive solution will remain within the fibrous mass to cement the fibers together and give a product similar to that hereinbefore described.

A solid adhesive agent may be mixed with animal fibers, and the mixture subjected to treatment in a shredding engine in substantially the same manner as described in my application for Letters Patent of the United States, Serial No. 292,677 filed April 25, 1919. As the solid adhesive agent or binder coal tar pitch, asphalt, and the like may be used. The shredded fibers and more or less pulverized binder are deposited on an appropriate support, such as a belt conveyor, in the form of a loose resilient heterogeneous mass of animal fibers of substantially uniform thickness, throughout which a very large number of extremely fine solid adhe-

sive particles are present. The deposited mixture of shredded fibers and finely divided adhesive is next passed through a heating chamber in which a sufficiently high temperature is maintained to melt or sufficiently soften the adhesive particles, so that upon cooling these adhesive particles will cement the fibers together. There is thus produced a light resilient mat or felt well adapted for the purposes of the present invention.

In the case of animal fibers, it is not necessary that the adhesive agent or binder mixed with the fibrous material and subjected to treatment in a shredding engine be solid or dry, as mentioned in the preceding paragraph. Thus, a liquid adhesive agent, such, for example, as an aqueous solution of sodium silicate, or a solution of pitch or tar in chloroform or other appropriate volatile solvent, may be mixed with the animal fibers in the shredding engine, and the mixture deposited from the engine onto a suitable support in the form of a uniform layer of fibers in heterogeneous arrangement, the fibers being coated with an adhesive in solvent. Upon evaporation or removal of the solvent and drying of the adhesive, the fibers will be cemented together and the resulting product will be similar to the fibrous mats hereinbefore described. The volatile solvents may, of course, be volatilized and recovered and thus used over and over again.

The light resilient mat or felt of animal fibers cemented together in any of the ways hereinbefore described may be coated with a layer of asphalt, pitch, rubber, or the like, instead of being inclosed between sheets of fabric, such as paper, or the like. Thus, for example, the fibrous mat with the fibers cemented together may be passed through suitable coating rolls, appropriately fed from tanks containing the coating liquid, which will spread a film or coating of asphalt, coal tar pitch, or the like, of the desired thickness onto the exposed surfaces of the fibrous mat, thus forming a moisture and air resisting covering agent which is directly cemented to the fibers of the mat. Such a treatment, of course, eliminates the necessity of the hereinbefore described inclosing sheets of paper, cloth, and the like.

The shredding operation to which the animal fibers are subjected prior to their deposition on the support is designed to separate the fibers into individual particles, and I have throughout this specification and the appended claims employed the term "shredding" and its derivatives, in a generic sense, to describe the operation of so treating the fibers that each fiber is substantially free from any other fiber. Animal fibers are relatively long and this property is of advantage in the formation of a monolithic fabric such as the light resilient fibrous mat of my improved insulating material. Accordingly, the shredding operation should be conducted with the view of cutting the fibers as little as possible, and only to the extent necessary to secure satisfactory felting. In practice, the shredding of the animal fibers will usually be most satisfactorily effected in a shredding engine, but the desired result may be secured in other ways, as, for example, by brushing or combing. For example, a stiff wire brush revolving at a high rate of speed and coming in contact with the fibrous material will separate the fibers into individual particles of the desired character to effect satisfactory felting.

In Figure 1 of the accompanying drawing, there is diagrammatically illustrated in elevation one form of apparatus for carrying out the invention, but the showing is purely diagrammatic and is given merely to facilitate a complete understanding of the invention. For this reason, the precise structural details of the apparatus are omitted, as forming no part whatever of the present invention.

Figs. 2, 3, 4 and 5 of the drawing illustrate various modifications in the form of the composite insulating material produced in accordance with the invention.

Referring to Fig. 1 of the drawing, there is shown a shredding engine 10 for cutting the animal fibers and knocking them apart. The purpose of this shredding operation is to separate the fibers into individual particles of such a character that they can be deposited on a support to form a more or less flocculent layer of heterogeneously arranged fibers adapted to be cemented or fastened together by an adhesive agent to form a coherent fibrous mat. During this shredding operation, the fibers are only cut to the extent necessary to facilitate their deposition in a layer of the character contemplated. I have found that hair may be satisfactorily shredded for the purposes of the present invention, without balling or tangling up, in a hammer mill shredder rotating at 3000 or more R. P. M.

The animal fiber, such as hair, is fed into the shredding engine 10 from an endless belt or conveyor 6 provided with transversely arranged baffles or paddles 7 for the purpose of keeping the fiber on the belt of approximately uniform thickness. The belt 6 carries the fiber to the mouth of the shredding engine where it is fed, by a conveyor 8, into the shredder 10 between rolls 9.

The shredding engine 10 is arranged to discharge the shredded animal fibers on to a belt conveyor 12, preferably of the form of a screen conveyor. The animal fibers are thus cut, to the necessary extent, and knocked apart in the engine 10, and, falling through the discharge thereof, the so-treated fibers are deposited on the conveyor 12 to form a more or less flocculent layer of the

desired thickness. I find it desirable to subject the fibers to a slight suction during and directly after their deposition on the conveyor 10. To this end, a suction chamber 13 is arranged below the shredder 10, and directly beneath the supporting screen surface of the conveyor 12. The conveyor 12 may be in the form of a screen of suitable mesh or its supporting surface may be composed of a suitably perforated or foraminated material, so that the fibers deposited on the conveyor may be subjected to the action of the suction applied beneath the conveyor.

Sprayers 14 are suitably arranged for spraying the fibers with an adhesive agent as they are deposited on the conveyor 12. The sprayers 14 serve to discharge the adhesive, either directly upon the fibers deposited upon the conveyor or outwardly in the form of a spray or mist through which the fibers fall. These sprayers may be placed directly under the discharge of the shredder 10, or to one side thereof, either arrangement proving satisfactory. In either case, the adhesive serves to bind or cement the fibers together, but I have found that when these fibers fall through a mist or spray of the adhesive, a somewhat firmer mat or felt containing fewer loose fibers is produced. In some instances, it has also been found desirable to deposit a very thin layer of dried fibers upon the conveyor before the application of the adhesive solution, to provide a cushion, which will act to prevent the fibers from sticking to the conveyor.

The layer of shredded fibers deposited on the conveyor 12 is borne along by the conveyer to a drying chamber 15. A suitable drying medium may be passed through the chamber 15 for the purpose of drying the layer of fibers carried along by the conveyor 12. The chamber 15 is thus represented in the drawing as having an entrance conduit 16 and an exit conduit 17 for passing a drying or heating medium such as heated air, through the chamber 15. Where the adhesive for cementing the fibers together contains a volatile solvent, it will be observed that the solvent may be removed while the fibrous mat is passing through the drying chamber 15 and may be recovered by suitably treating the vapor passing from the chamber 15 through the exit conduit 17. When using an adhesive which dries or sets quickly, the drier 15 can, if desired, be entirely omitted, although its use is preferred. Thus, for example, with such adhesives as sodium silicate, I find that drying in a room is sufficient, but that a drier speeds up the rate of drying and for this reason is desirable.

The mat or felt of fibrous material, formed in the manner just described, is next confined or inclosed between sheets of fabric in order to produce the insulating material of the invention. The fibrous mat or felt, after passing through the heating chamber 15, is accordingly passed between two rolls 18 over which are passed sheets of paper, or the like, from the feed rolls 19. In Fig. 1 of the drawing, I have shown coating rolls 20, coöperating with troughs 21, containing a liquid adhesive agent, for coating with adhesive material one surface of each sheet of the inclosing fabric. The two sheets of inclosing fabric are therefore coated on their adjacent surfaces with adhesive material when they pass over the rolls 18 and the pressure produced by the rolls 18 is sufficient to secure the fastening or cementing of the inclosing sheets of fabric to the fibrous body mat. Thus, the completed insulating material passes from the rolls 18 onto a conveyor 22, whereafter it is wound into a roll or disposed of in any desired manner.

The finished product produced in the manner hereinbefore described comprises a body portion of animal fibers, in which the fibers are cemented or fastened together, confined or inclosed between sheets of fabric, which are also cemented to the fibrous body portion. In Figs. 2, 3, 4 and 5 of the drawing, the fibrous body portion of the insulating material is represented by reference character 30, and the sheets of the inclosing fabric are represented by reference characters 31 and 32. Where it is desired to inclose the side edges of the insulating material, the fabric sheets 31 and 32 may be folded over to form a seal at the sides of the insulating material. Thus, in Fig. 3, the upper fabric sheet 31 is folded over one edge of the insulating felt and secured to the lower fabric sheet 32 in any suitable manner, while the lower fabric sheet 32 is similarly folded over the other edge of the insulating felt and secured to the fabric sheet 31. As shown in Fig. 4, the edges of the insulating felt may be sealed or inclosed by a strip of fabric 33 folded over the edge and secured to both the top and bottom inclosing sheets in any suitable manner. In Fig. 5, I have shown the edges of the insulating felt sealed or closed by compressing a relatively narrow strip along each edge thereof. This operation may be conveniently performed before the adhesive coating on the sheets 31 and 32 has dried or set.

As the fibers drop from the discharge of the shredder 10 on to the screen conveyor 12, they arrange themselves in a loose heterogeneous mass, with the fibers extending in all three cubical dimensions. The suction applied through the chamber 13 is so regulated as not to form the fibers in too firm a mass. The adhesive agent sprayed on these fibers by the sprayers 14 serves to fasten the fibers

together in such a manner that the resulting felt or mat of fibrous material is a coherent monolithic fabric in which the fibers are so cemented together that the individual fibers are not easily dislodged. As a result of these characteristics of the fibrous body portion of my improved insulating material, I am able to cement thereto covering agents, such as sheets of fabric, or moisture and air resisting coatings, thus entirely eliminating the necessity of sewing covering sheets to the fibrous material or to each other.

Greatest cubical lightness and resiliency are secured by drying the fibers with a minimum of pressure on them and preferably with no pressure at all. Thus, in practising the invention, pressure on the fibers after they have been formed into the heterogeneous resilient fabric is kept at a minimum until after the adhesive has set or hardened and the fibers thereby cemented together. As previously pointed out, one of the characteristic features of the fibrous mat or felt of my improved insulating material resides in the fact that the fibers extend in all three cubical dimensions, whereby a single layer or monolithic fabric of cemented-together fibers is obtained. Such a monolithic fabric in which the fibers are cemented together in heterogeneous arrangement to form a light and resilient fibrous mat or felt is admirably adapted as the body portion of an insulating material and when inclosed between appropriate covering agents, such as sheets of fabric or coatings of asphalt, pitch, rubber or the like, as hereinbefore described, produces an improved insulating material superior to any prior product of this general character with which I am acquainted.

I claim:

1. The method of manufacturing composite insulating material, which comprises depositing animal fibers upon a support to form a layer of the desired thickness, treating the fibers with an adhesive to cement them together, and cementing a covering agent to one or more surfaces of the fibrous mat so produced; substantially as described.

2. The method of manufacturing composite insulating material, which comprises subjecting hair to a shredding operation for cutting and knocking apart the fibers, depositing the so-treated hair upon a support to form a layer of the desired thickness and treating the same with an adhesive to cement the fibers together, and cementing a covering agent to one or more surfaces of the fibrous mat so produced; substantially as described.

3. The method of manufacturing composite insulating material, which comprises subjecting animal fibers to a shredding operation for knocking the fibers apart, forming the so-treated hair into a monolithic fabric by cementing the fibers thereof together with a water resistant adhesive, and cementing a covering sheet to one or more surfaces of said fabric by means of a water resistant adhesive; substantially as described.

4. The method of manufacturing composite insulating material, which comprises forming a monolithic fabric of animal fibers cemented together in heterogeneous arrangement, and cementing a covering agent to one or more surfaces of said fabric, substantially as described.

5. As a new article of manufacture, a composite insulating material comprising a fabric of animal fibers cemented together by an adhesive and having one or more surfaces thereof secured to a covering agent; substantially as described.

6. As a new article of manufacture, a composite insulating material comprising a fabric of animal fibers cemented together by a water resistant adhesive and having one or more surfaces thereof secured to a covering sheet by means of a water resistant adhesive; substantially as described.

7. As a new article of manufacture, a composite insulating material comprising a body portion of cemented together animal fiber having its front and back surfaces covered by an adhesive, and covering sheets secured to the front and back surfaces of said body portion by said adhesive; substantially as described.

8. As a new article of manufacture, a composite insulating material comprising a body portion of hair having at least one surface thereof covered by a water resistant adhesive, and a covering sheet secured to said body portion by said adhesive; substantially as described.

9. As a new article of manufacture, a composite insulating material comprising a body portion composed of hair particles cemented together with an adhesive, and a covering sheet secured to one or more surfaces of said body portion by means of an adhesive; substantially as described.

10. As a new article of manufacture, a composite insulating material comprising a body portion composed of hair particles cemented together with a water resistant adhesive, and a covering sheet secured to one or more surfaces of said body portion by means of a water resistant adhesive; substantially as described.

11. As a new article of manufacture, a composite insulating material comprising a monolithic fabric of animal fibers cemented together in heterogeneous arrangement and having a covering agent cemented to one or more surfaces thereof; substantially as described.

12. As a new article of manufacture, a composite insulating material comprising a resilient mat of cemented-together animal fibers having a covering agent cemented to

one or more surfaces thereof; substantially as described.

13. The method of manufacturing composite insulating material, which comprises subjecting hair to a shredding operation for cutting and knocking apart the fibers, depositing the so-treated hair upon a support to form a layer of the desired thickness and spraying the same with an adhesive while the hairs are being deposited and immediately after they are deposited on a support to cement the fibers together, and cementing a covering agent to one or more surfaces of the fibrous mat so produced; substantially as described.

In testimony whereof I affix my signature.

HOWARD F. WEISS.