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C. A. FOURNESS

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LAMINATED CREPE CELLULOSIC PRODUCT

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*Fig. 1*

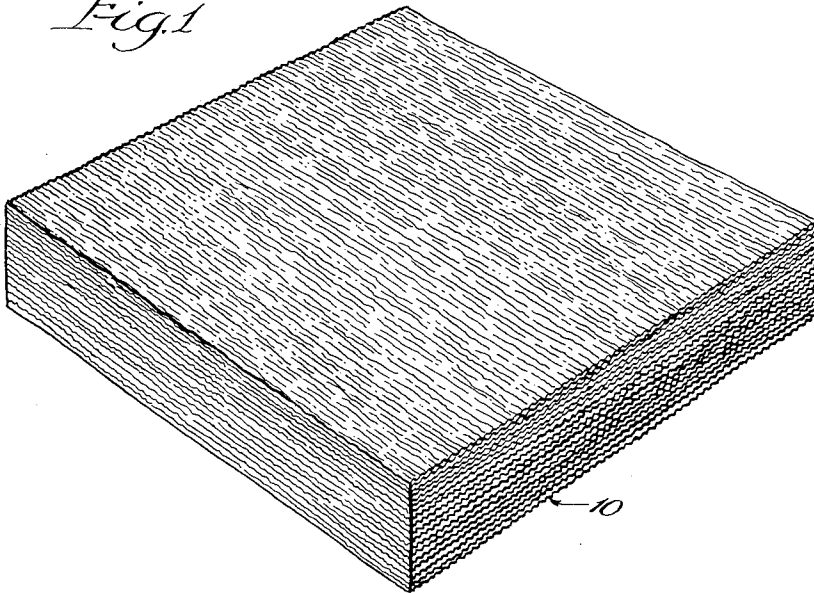
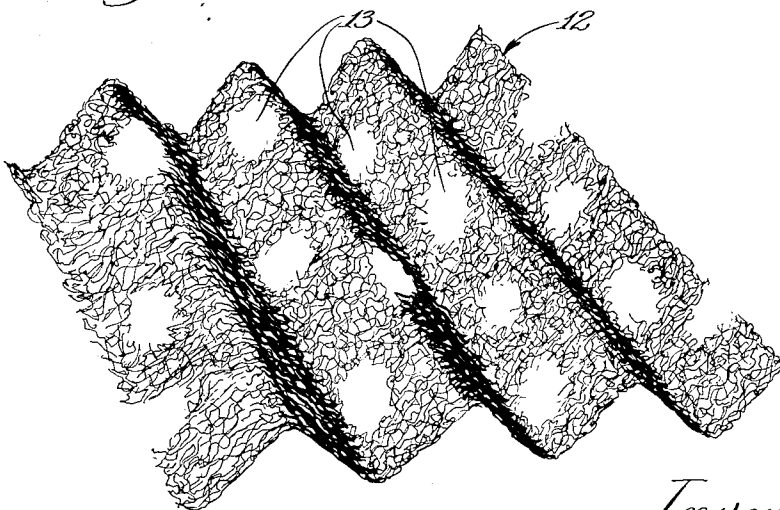


*Fig. 2*



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## UNITED STATES PATENT OFFICE

2,170,655

LAMINATED CREPE CELLULOSIC  
PRODUCT

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poration of Wisconsin

Application September 5, 1936, Serial No. 99,520

2 Claims. (Cl. 154-44)

My invention relates to cellulosic sheet prod-  
ucts and particularly to products of this type  
which may be arranged into multi-ply pads or  
bats for use as a sound or heat insulating me-  
5 dium or the like. The present application is in  
part a continuation of my abandoned applica-  
tion Serial No. 668,205 which was filed on April  
27, 1933, and which is assigned to the assignee  
of the present application.

10 Generally stated, the objects of the present  
invention are to provide an improved, low den-  
sity, bulky, cellulosic product of great porosity  
which inherently accomplishes intimate contact  
between the individual fibers making up the  
15 product and the surrounding air or other me-  
dium so as to produce a resultant product of very  
high thermal and very high sound insulating  
ability; to produce a bulky, porous, low density,  
cellulosic product wherein the individual fibers  
20 shall be unequally weighted or loaded with a  
thermo-plastic material or like substance in  
the form of small discrete particles which are  
individually attached to the individual fibers or  
groups of fibers of the product, so as to cause  
25 the sound reflecting properties of the individual  
fibers of the product to vary within wide limits  
and thereby accomplish effective and efficient  
sound absorption by the product over a wide  
range of sound frequencies; to produce a por-  
30 ous, low density product of the subject type, the  
properties of which may be varied from stiff  
through resilient to soft and dead by changes  
in the kind, arrangement, and distribution of  
the weighting or loading material, thus permit-  
35 ting control of the sound absorption and other  
properties of the product over a wide range; and  
to provide a multi-ply, bulky, water resistant  
product of the subject type which shall be  
stronger, more resilient, and capable of sustain-  
40 ing greater loads without material diminution  
of bulk than any of the products heretofore  
known to the art.

Other objects of the invention are to provide  
an improved cellulosic sheet suitable for use in  
45 products of the previously described type which  
is itself inherently water resistant and which  
can be readily manufactured at low cost upon  
existing paper making machines; to provide an  
improved cellulosic sheet of this type which shall  
50 be lighter and more bulky while at the same  
time being stronger, sturdier, more resilient, and  
must more permanent than the products here-  
tofore known to the art; to provide a cellulosic  
sheet in accordance with the above stated ob-  
55 jects which can be readily creped to increase  
its bulk and resilience; to provide an improved  
water resistant cellulosic sheet of the subject  
type which can be fireproofed without injury to  
60 the desirable physical properties and character-

istics thereof; and in brief, to provide an im-  
proved cellulosic sheet product.

A preferred form of the invention is illustrated  
in the accompanying drawing wherein—

Figure 1 is a perspective view showing a plu-  
5 rality of cellulosic sheets according to the pres-  
ent invention combined into a pad or bat; and

Figure 2 is an enlarged, fragmentary perspec-  
10 tive view of a portion of one of the sheets mak-  
ing up the pad or bat illustrated in Figure 1.

It is to be understood that the use of multi-  
15 ply pads or bats consisting of a plurality of thin,  
superposed cellulosic sheets is not in itself new.  
In fact, multi-ply pads or bats of such sheets  
have been extensively used as packing material  
and to some extent for heat and sound insulat-  
20 ing purposes prior to the present invention. For  
example, multi-ply wadding comprising a plu-  
rality of plies or layers of creped cellulosic sheets  
of gossamer-like thinness held together with or  
without embossing has been and is being used  
most extensively as packing material.

In contrast with packing materials, heat and  
sound insulating materials are ordinarily used  
under extremely adverse conditions and must  
possess a long useful life. Such materials are  
25 frequently exposed to moisture and insects, and  
to satisfactorily accomplish their function over  
a long period of time, the individual plies must  
not only be very permanent but must possess  
considerable mechanical strength and resiliency  
30 in addition to high insulating ability. The prod-  
ucts heretofore known to the art have failed to  
fully satisfy these requirements, and their use  
as insulating materials for sound and heat in-  
sulating purposes has been accompanied with  
35 serious disadvantages in part due to the inher-  
ent lack of strength and permanence of those  
products, their inability to withstand moisture,  
etc. These disadvantages are entirely overcome  
40 by the present invention.

Reduced to its simplest form, the present in-  
vention consists in the provision of a multi-ply  
product comprising a plurality of superposed,  
45 very thin, gossamer-like, creped, cellulosic sheets  
having a basis weight (i. e. weight in the flat or  
uncreped state) of from 4 to 9 pounds for 480  
sheets 24 x 36 inches and containing from 10%  
to 50% by weight of an asphalt or other thermo-  
50 plastic material which is in the form of small  
discrete particles of widely differing dimensions  
attached to the individual fibers of the sheet  
preferably by fusion thereon. By virtue of the  
differing sizes of these particles and their more  
55 or less indiscriminate attachments to the fibers,  
the individual fibers of the sheet are differently  
weighted or loaded, and as a result have widely  
differing sound reflection and absorption charac-  
teristics. The resultant product, seemingly due  
60 to this variable weighting or loading of the fibers

thereof, has most remarkable sound insulating ability. In addition, the product is a very efficient thermal insulator, and has a number of most desirable physical properties, outstanding among which is the remarkable low stable density of the product, which likewise appear to result from the presence of this weighting or loading material.

Various thermo-plastic materials within the classification of bitumens, pyro-bitumens, pyrogenous distillates, and pyrogenous residues may be used for accomplishing this desired weighting or loading of the individual fibers of the sheet. The important considerations in the selection of the weighting or loading material, as will appear more clearly in subsequent paragraphs, are that the material shall be capable of being introduced into the furnish for the paper making machine so as to cause small discrete particles of widely varying size to adhere to the individual fibers of the web during its formation, that the material shall not foul the machine during the manufacture of the web, that the material shall be relatively brittle and not sticky at ordinary room temperatures, and that the material shall be of sufficiently low viscosity at the temperature of the drier to adhere thereto. In brief, these considerations are primarily concerned with the manufacture of the article, although various properties of the resultant sheet, such as stiffness, may be varied very substantially by a proper selection of the weighting or loading medium.

Tests indicate that most of the thermo-plastic materials within the above described classifications which have a ball and ring melting point within the range of 140° F. to 200° F. and which are relatively brittle at room temperatures, i. e. are relatively hard and have good penetration resistance at such temperatures, are suitable for accomplishing the desired weighting or loading of the individual web fibers. It is to be understood, however, that this classification is of a very general nature and that all thermo-plastics having the above defined physical properties may not be satisfactory for the purposes of the invention. It is believed, however, that the further description of the principles and features of the invention appearing herein will clearly indicate to those skilled in the art which materials are suitable for the purposes of the invention and the course to be followed in selecting such materials.

Following considerable experimentation, it has been ascertained that particularly desirable results are accomplished if the weighting and loading material constitutes an asphalt having the above specified properties, i. e. is relatively brittle at room temperatures (of low penetration), and which has a ball and ring melting point within the range of 140° F. to 200° F. Particularly, asphalt of this type may readily be caused to subdivide into the small discrete particles which accomplish the loading of the web fibers during the manufacture of the sheet. Further, cellulosic sheets containing asphalt of this type can be readily manufactured upon existing paper making equipment and are found to possess remarkable mechanical strength and resilience superior to many of the other known thermo-plastics. At the same time the sheets are very porous and bulky and can be readily combined into relatively sturdy, multi-ply pads or bats which have very desirable physical characteristics, such as prolonged resistance to compression and very low stable density.

In fact, under ordinary manufacturing con-

ditions the completed pad or bat product made by superposing a plurality of the above described cellulosic sheets (i. e. sheets having a basis weight of from about 4 to 9 pounds for 480 sheets 24 x 36 inches and containing from 10% to 50% by weight of an asphalt which is relatively hard or brittle at room temperatures and which has a melting point within the range of 140° F. to 200° F., the asphalt being in the form of very small, discrete particles of widely varying dimensions attached to the individual fibers or groups of fibers constituting the sheet) will have a stable density within the range of about 1.25 to 2.00 pounds per cubic foot. The attainment of this very low stable density is a most important feature of the present invention, for the reason that the lowest stable density obtainable in a similar pad or bat product made from similar creped cellulosic sheets which do not contain asphalt, or which do not contain asphalt of the particular type and in the particular amounts and in the particular particle form specified above, is in excess of about 3.0 pounds per cubic foot.

Moreover, multi-ply bats or pads of sheets containing asphalt of the type and in the amounts hereinbefore specified may be embossed without the use of additional adhesive, and even when the product is not embossed, the presence of the great numbers of discrete particles of asphalt or other thermo-plastic material which accomplish the weighting or loading of the individual fibers of the sheets accomplishes much better ply adhesion than that found in products made from non-weighted sheets. The weighting or loading material by virtue of its presence in the product as small discrete particles of widely varying size which are fused to individual fibers or groups of fibers also effects remarkable improvement of the thermal insulating characteristics of the product, as compared with non-weighted sheets, probably due to the fact that the number of fiber to fiber contacts in the weighted product is materially reduced, and insulating contacts are substituted therefor. Variation in the dimensions of the particles of asphalt or other thermo-plastic material and in the amount, kind, and type of such materials permits the accomplishment of considerable variation in the sound absorbing properties of the product. The thermo-plastic weighting or loading material constitutes a convenient medium for impregnating the product with water insoluble germicides, bactericides, insecticides or fungicides.

If the basis weight of the sheet is materially increased over the amount above stated, many of the advantages of the present invention are lost, the sheet becomes unduly expensive to manufacture, and there is a very marked decrease in the heat and sound insulating characteristic, probably due to the fact that the unequal weighting or loading of the individual fibers of the web cannot conveniently be accomplished in such heavier sheets.

As mentioned previously, cellulosic sheets according to the present invention may be manufactured upon paper making machines such as are ordinarily employed for manufacturing the thin cellulosic sheets used for packing wadding and similar products. The drying of the web in such machines is accomplished, and in fact due to the flimsiness of the web must be accomplished, on a Yankee type drier, i. e. upon a single large drying cylinder. At the conclusion of the drying operation, the web is removed from the drying cylinder by a creping doctor which thereby ac-

compleishes the creping thereof. The thermo-plastic material which may be of the particular type of asphalt discussed above is added to the furnish to the paper making machine and so processed that it is introduced into the web as small discrete particles of widely varying dimensions which adhere to the individual fibers of the web during the manufacturing operation. The processes described in Stevenson and Buron Patent No. 1,771,150 issued July 22, 1930 and the processes disclosed in Kirschbraun Patent No. 1,606,427, issued November 9, 1926 can be successfully used for introducing the thermo-plastic materials such as asphalt of the above described type into the furnish, either process being capable of forming the large number of small, separate particles of the thermo-plastic material which accomplishes the desired unequal loading of the web fibers. To attain maximum permanency of the finished product, it is desirable that the incorporation of the material into the web fibers be accomplished prior to the felting of the fibers on the paper making machines.

Sufficient of the thermo-plastic material is added to the furnish to produce a finished product which shall contain from 10% to 50% thereof by weight. For certain uses, as mentioned previously, the material is preferably asphalt of a type which is relatively brittle, i. e. has low penetration, at ordinary temperatures and which has a ball and ring melting point within the range of 140° F. to 200° F., this particular type asphalt assuring the attainment of all of the novel and beneficial characteristics of the subject invention. Percentages of the thermo-plastic material between 10% and 50% by weight of the finished sheet are capable of rendering such sheets highly water resistant. At the same time if the weighting and loading material is relatively brittle at room temperatures, its presence in the sheet serves to effect a remarkable increase in the strength, weight carrying ability, and inherent resilience of that sheet as compared with sheets not containing such material, and thereby serves to maintain the sheet in its normal creped condition throughout the useful life thereof.

To accomplish satisfactory creping, the thermo-plastic material must be of sufficiently low viscosity and sufficiently tacky at the temperatures encountered at the surface of the drying cylinder to secure good adhesion between the web and the surface of the drying roll, and hence good creping, as the web is removed by the creping doctor.

The melting point of the thermo-plastic material is generally a fairly good index of the viscosity and adhesiveness of the material at the temperature of the drier. Hence this characteristic of the material is of great importance, for the reason that unless it is within the specified range, 140° F. to 200° F., the sheet probably cannot be manufactured upon conventional paper making machines without possible serious contamination of the felt and rolls or unsatisfactory creping of the web as it is removed from the drying cylinder.

From this it follows that if the melting point of the thermo-plastic material is above the specified range, satisfactory creping of the sheet is extremely difficult of attainment, and if the melting point is below the specified range with an accompanying reduction in viscosity, the sheet does not possess the desirable resilience, strength and body at ordinary room temperatures, and during the formation of the web serious contamination of the felts and rolls may occur. Asphalt having the characteristics hereinbefore

specified meets all of these requirements most satisfactorily.

The amount of thermo-plastic material is likewise of considerable importance, the optimum amount probably being in the neighborhood of 20% to 30% by weight. Amounts up to 50% may be used, however, with good results, particularly when extremely high moisture resistance is required, but if an attempt is made to go much beyond this amount, it will be found that the sheet loses its desirable qualities of strength and resilience. It would appear that a certain optimum balancing of the amounts of asphalt and fiber is attained within this specified range, and to use either materially more or materially less asphalt disturbs this balance with most undesirable results.

The use of the particular type asphalt defined above for rendering the sheet material water resistant and for imparting sound absorption characteristics thereto has certain other advantages, for the reason that a web containing asphalt of the type and in the amounts hereinbefore specified, may be fireproofed during the drying operation through the simple expedient of spraying suitable fireproofing solutions upon the web. A satisfactory method for accomplishing this is disclosed in Patent No. 2,132,016 to Horace A. Du Bois, which is assigned to the assignee of the present invention. Ordinary non-asphalt containing cellulosic sheets containing sufficient rosin size to render those sheets water resistant cannot be fireproofed by the conventional salt solutions without destroying the water resistance of such sheets, i. e. in effect, destroying the size characteristic. Further, alkaline adhesive solutions such as sodium silicate may be applied to the asphalt containing products of the present invention without seriously affecting the water resistant characteristics of such products. Such adhesives cannot be used without disastrous effect upon the water resistant characteristics of sheets containing resin or like sizes.

In one commercial process for manufacturing cellulosic sheets of the subject type, two parts of a commercial asphalt which is relatively brittle at room temperatures, and has a melting point not less than 140° F. nor greater than 200° F., is intimately mixed with one part of ground wood and one part of unbleached sulphite fiber substantially in accordance with the method described in Stevenson and Buron Patent No. 1,771,150 to form what is termed a "thermo-plastic mix". To make cellulosic sheets containing 20% asphalt by weight the furnish used for supplying the beater is substantially as follows:

|                               | Pounds |
|-------------------------------|--------|
| "Thermo-plastic mix"-----     | 400    |
| Unbleached sulphite pulp----- | 300    |
| Ground wood-----              | 300    |

To make cellulosic sheets containing 10% asphalt, the beater is supplied with the following:

|                               | Pounds |
|-------------------------------|--------|
| "Thermo-plastic mix"-----     | 200    |
| and                           |        |
| Unbleached sulphite pulp----- | 800    |

In either case sufficient water is mixed with the furnish in the beaters to produce pulp suspension of about 3%, which mixture is pumped directly to the paper making machine. Here the mixture may be thinned with additional circulating water and fed onto the wire as a very thin suspension of fiber in the usual manner. The

resultant web is carried by the felt or felts from the wire to the drying cylinder from which it is removed as a creped sheet by the creping doctor. The asphalt will be found to intimately adhere to individual fibers of the web in the form of minute discrete particles of widely varying size which are apparently fused to the web fibers.

Any number of sheets may, of course, be superposed to form a bat or pad suitable for the purposes of the invention. As stated previously, under ordinary manufacturing conditions the completed pad or bat product ready for use as an insulating material will have a stable density within the range of about 1.25 to 2.00 pounds per cubic foot. Single bats comprising 20 to 50 separate sheets will be found of sufficient bulk for most ordinary uses.

Various modifications may be made in the invention without departing from the novel principles disclosed in the foregoing. It is my intention, therefore, that the accompanying claims shall be accorded the broadest reasonable construction consistent with the state of the art.

I claim the following as my invention:

1. A bulky, porous, multi-ply pad or bat particularly suitable for use as an insulating material, comprising a plurality of superposed, thin, creped, cellulosic sheets each of which contains from 10% to 50% by weight of an asphalt which is relatively brittle at room temperatures, and which has a melting point within the range of

140° F. to 200° F., said asphalt being in the form of small, discrete particles of widely varying dimensions, and substantially all of said particles being individually attached to individual fibers or groups of the fibers making up each of said sheets, whereby the individual fibers in said pad or bat are unequally loaded or weighted, said pad or bat having a stable density under ordinary manufacturing conditions within the range of 1.25 to 2.00 pounds per cubic foot.

2. A bulky, porous, multi-ply pad or bat particularly suitable for use as an insulating material, comprising a plurality of superposed, creped, cellulosic sheets, each of which has a basis weight of from 4 to 9 pounds for 480 sheets 24 x 36 inches, and each of which contains from 10% to 50% by weight of an asphalt which is relatively brittle at room temperatures and which has a melting point between the range of 140° F. to 200° F., said asphalt being in the form of very small, discrete particles of widely varying dimensions, substantially all of said particles being individually attached to individual fibers or groups of the fibers making up said sheets, whereby the individual fibers of each of said sheets are unequally loaded or weighted, said pad or bat having a stable density under ordinary manufacturing conditions within the range of 1.25 to 2.00 pounds per cubic foot.

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