Nov. 2, 1937. F. W. HOCHSTETTER 2,097,694

INSULATING CELLULOSIC MEDIUM

Filed Nov. 15, 1934 2 Sheets-Sheet 1

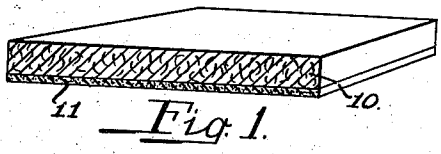


Fig. 1.

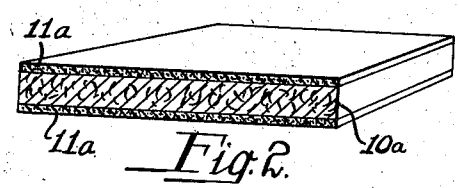


Fig. 2.

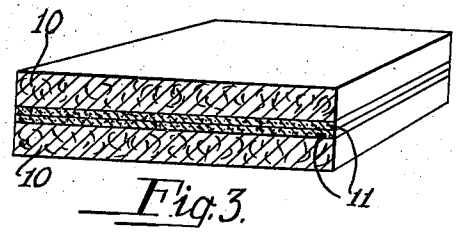


Fig. 3.

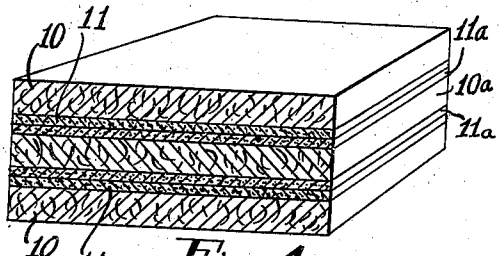


Fig. 4.

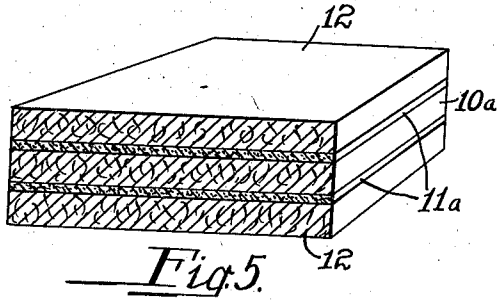


Fig. 5.

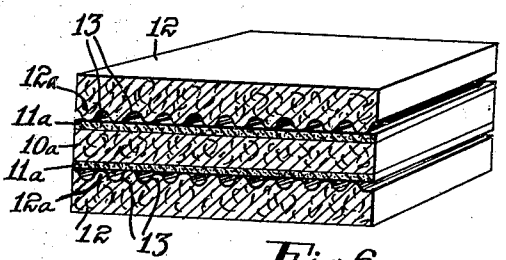


Fig. 6.

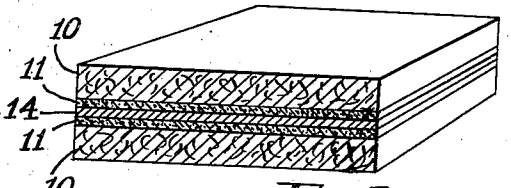


Fig. 7.

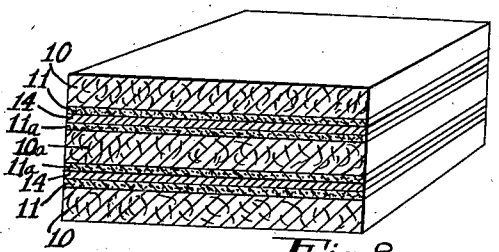


Fig. 8.

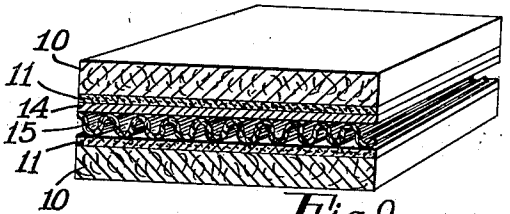


Fig. 9.

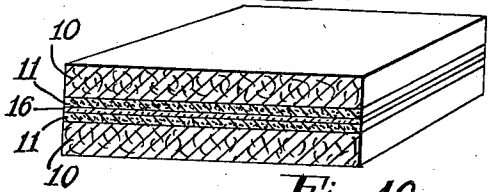


Fig. 10.

Frederick W. Hochstetter
INVENTOR
By Green & McCallister
His Attorneys

Nov. 2, 1937. F. W. HOCHSTETTER 2,097,694

INSULATING CELLULOSIC MEDIUM

Filed Nov. 15, 1934 2 Sheets-Sheet 2

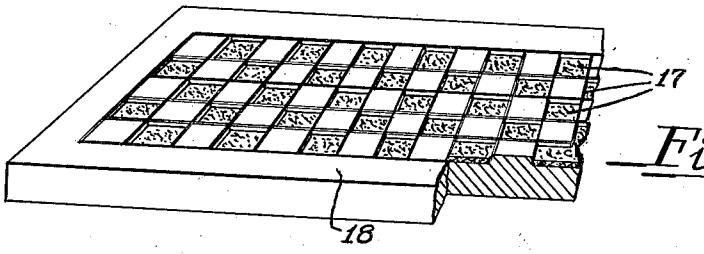


Fig. 11.

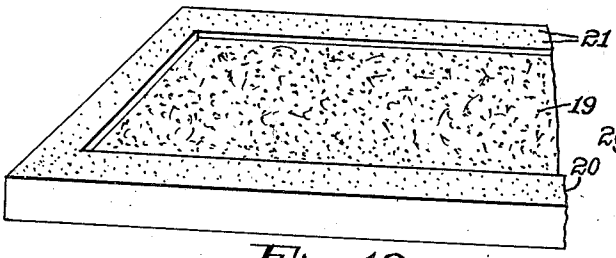


Fig. 12.

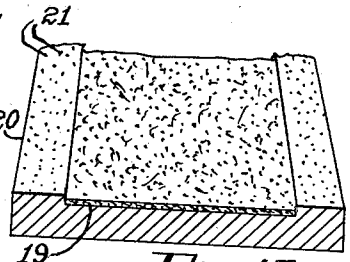


Fig. 13.

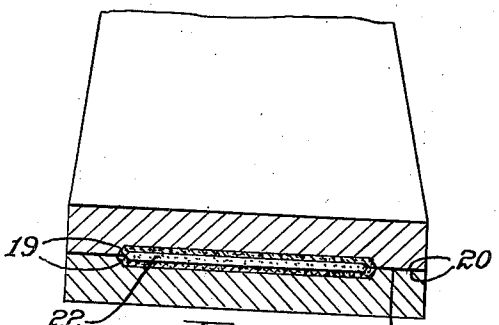


Fig. 14.

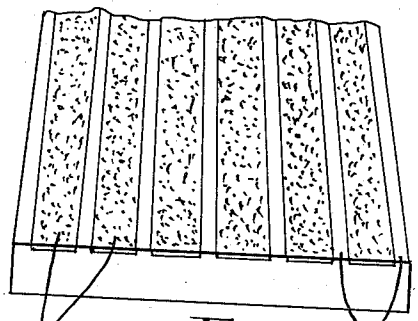


Fig. 15.

INVENTOR
Frederick W. Hochstetter
By Green & McCallister
His Attorneys

Patented Nov. 2, 1937

2,097,694

UNITED STATES PATENT OFFICE

2,097,694

INSULATING CELLULOSIC MEDIUM

Frederick W. Hochstetter, Pittsburgh, Pa.

Application November 15, 1934, Serial No. 753,206

15 Claims. (Cl. 154—28)

My present invention relates to insulating material for heat, cold, and electricity and more specifically to such a material which is of a combined cellulosic and carbonaceous nature.

There are on the market today a number of products of a cellulosic nature which are light, porous and inflammable. These products, as produced, have some value in connection with insulating against heat and cold but not for electrical insulation. Such products are, however, of such nature that they glow, ignite, or burn when subjected to flame or combustion conditions and do not have as good insulating properties as they should or could have were they specifically treated therefor. The extent of insulating ability which these materials possess is insufficient for many uses and this, together with the fire hazards involved, has very much limited their industrial application.

I have found that by treating such mediums, as will be hereinafter set forth, I can endow them with such insulating properties that they are in effect new materials and at the same time I can render them very resistant, and such accordingly constitutes one of the objects of the present invention.

Another object of my invention is to produce from known fabricated mediums of a cellulosic nature a single ply or laminated medium which has excellent insulating characteristics against heat and cold and the dielectric characteristics of which are such that they are excellent insulators for electrical purposes.

A further object of my invention resides in producing an insulating medium derived from cellulose, ligno-cellulose, woody fibres and allied products or derivatives of cellulose which is capable of being laminated into various forms such that exceptionally good insulating properties are secured for heat, cold, and electricity to meet various conditions of usage.

More specifically, an object of my invention is to carbonize or char either or both surfaces of a cellulosic medium, with or without otherwise treating the medium, to provide an insulating material which can be used as a single layer or in any combination as a laminated medium.

Other and further objects and advantages will be understood by those skilled in this art or will be apparent or pointed out hereinafter.

In the accompanying drawings, I have illustrated a number of embodiments of the present invention and in such drawings:

Figure 1 represents in perspective a portion of cellulosic medium carbonized on one side;

Fig. 2 is the same as Fig. 1, except that the cellulosic material is carbonized on both sides;

Fig. 3 is a view of two of the portions of Fig. 1 assembled with carbonized faces abutting;

Fig. 4 represents another form of the invention wherein one portion in accordance with Fig. 2 is provided on each side with one portion according to Fig. 1, carbonized surfaces abutting;

Fig. 5 represents another modification wherein a portion in accordance with Fig. 2 is provided on each side with a plain uncarbonized cellulosic layer;

Fig. 6 is the same as Fig. 5, except that the surfaces of the upper and lower cellulosic layers contiguous to the carbonized surfaces are corrugated;

Fig. 7 is the same as Fig. 3, except an insert of insulation-enhancing material such as aluminum foil is placed between the carbonized surfaces;

Fig. 8 is the same as Fig. 4, except that two insulation-enhancing inserts as per Fig. 7 have been placed between the pairs of carbonized surfaces;

Fig. 9 is the same as Fig. 7, except that between one carbonized surface and the insulation-enhancing insert a separate corrugated insert has been added;

Fig. 10 is the same as Fig. 7, except that a layer of insulation-enhancing chemical such as casein has been inserted between the carbonized surfaces;

Fig. 11 illustrates a modification of Fig. 1 wherein the carbonized surface does not extend over the entire cellulosic medium and where the carbonization is effected according to a predetermined design;

Fig. 12 illustrates another modification of Fig. 1 wherein the carbonized surface is countersunk in the medium and wherein an uncarbonized border is left around the medium which may be coated with a suitable adhesive material;

Fig. 13 is a section across Fig. 12;

Fig. 14 represents two mediums like Fig. 12 laminated in a manner analogous to Fig. 3; and

Fig. 15 is another modification of Fig. 1 wherein the surface carbonization is in the form of bars or bands.

Since all of the various modifications of the present invention are essentially built up from or derived from the fundamental section shown in Fig. 1, it will be only necessary to describe in detail the invention as shown in Fig. 1. As already stated the portion 10 is composed of fibrous material which is preferably cellulose, ligno-cellulose, woody fibre or a cellulosic derivative which may be in light, porous condition or which may be compressed or made more dense, if pre-

ferred. This material per se is well known in the form of various light, relatively porous boards, strips or sheets now produced commercially in large quantities. I may or may not, and this is optional, otherwise treat such material as by spraying, dipping or any other known way, with any well-known heat resisting compound of which there are many on the market. Chlorinated naphthalene or other non-aqueous compound may be used although I am not limited to any particular compound or type of compound. The medium may be treated while it is still in the fiber or pulp stage and prior to fabrication of the strip, web or board therefrom, or it may be treated after the fabrication of such strip, web, board, etc. For previously finished material I, of course, treat it in whatever form it may be, and for new material I may treat it either in the fiber or pulp stage or after fabrication. When such is carried out the material is endowed with such properties that it will be resistant even when directly subjected to heat. Of the various agents on the market any suitable or proper one may be selected for the particular product involved.

Whether or not I thus treat the material, and whether or not this be carried out in the pulp or fiber stage or on the finished fabricated medium, I so treat the material as to give it excellent insulating properties far beyond that which it possessed untreated. This treatment consists essentially in carbonizing or charring to a relatively slight depth either surface of the medium by subjecting it to a required heat for a required length of time, depending, of course, upon the particular material. Where the medium is still wet from formation, or where it is wet due to saturation with heat-resisting compound, I suitably dehydrate it prior to the carbonizing treatment. I have found that this carbonized surface 11 (Fig. 1) can be readily formed on the medium 10 by, for example, passing the material over or under and in some cases between (the latter when both surfaces are to be carbonized) direct sources of heat such as gas flames or electrical resistances which may be installed in the drying tunnels or chambers in which the material is normally dried. The degree of heat required depends, of course, upon the speed at which the material passes the flame or source of heat and where I treat a rapidly moving strip or web I either apply an intense flame or very hot resistance across the material at one point or a spaced series of flames or resistances at several points so that carbonization of the surface of the material to the required extent is conveniently attained without entailing any additional or extra steps in treating or handling the material and thus keeping the cost of treatment down to an almost infinitesimal figure.

The medium thus produced and illustrated in Figure 1 has new and unexpected insulating characteristics for heat, cold, and electricity in connection with which latter the dielectric properties of the material are such that practically complete insulation against electric currents is attained, and any currents which do pass are only small leakage currents of very low voltage. In a sense therefore, as an electrical insulating medium the material acts in a manner analogous to a transformer. In carrying out the carbonization I may in part utilize the principles set forth in my Patent 1,911,279, issued May 30, 1933.

As will be understood from the description of Figure 1, the medium of Fig. 2 is formed by carbonizing both surfaces of the cellulosic material 10a so that there are two carbonaceous layers 11a, between which is the uncarbonized balance of the medium. Such still further improves and/or alters the insulating properties and depending upon the conditions encountered, the medium of either Fig. 1 or Fig. 2 solves many problems. Where conditions are encountered which require greater insulating characteristics I can readily provide such by laminating, with or without additional inserts, the media of Figs. 1 and 2. Fig. 3, for example, represents two media like Figure 1, assembled with their carbonized surfaces in contact. Like Figs. 1 and 2, however, such form also provides alternate layers of cellulosic and carbonaceous material.

It will be clear upon inspection that Fig. 4 represents a further laminated effect as a result of building up the elements of Figs. 1 and 2, and no particular comment is needed thereupon except that additional and/or somewhat different insulating characteristics are provided.

In Fig. 5 the medium of Fig. 2 is provided on each side with a plain uncarbonized cellulosic layer or element 12, or this could be built up by placing two media like Fig. 1 together, carbonized surfaces not abutting, and adding a plain element or medium thereto.

In Fig. 6, I have varied the invention of Fig. 5 by corrugating at 12a one surface of each of the plain uncarbonized sections 12, thus additionally providing air columns or spaces 13 for still further enhancing and/or varying the insulating characteristics of the laminated medium. The air columns or spaces may be open-ended to allow circulation of air or may be sealed at the ends according to circumstances.

The modification shown in Fig. 7 involves the insertion between the carbonized surfaces 11 of Fig. 3 of a layer of metal or metal foil 14 such as aluminum metal or foil or any other like or equivalent material. This additionally gives different and/or varied insulating characteristics which are useful for certain applications, and this same thought has been carried out in Fig. 8 where two such inserts 14 have been made between the pairs of carbonized surfaces 11, 11a of the modification of Fig. 4.

In Fig. 9, I have combined the use of a metal or metal foil insert 14 and the use of a separate corrugated fibrous insert 15, thus providing a still further form of the invention which finds use in still other applications. The air spaces formed may be according to Fig. 6 in their treatment.

In Fig. 10, I have varied the insert of Fig. 7 by utilizing a layer 16 of casein or other insulation-enhancing chemical compound or the equivalent. Casein, itself, is known as an insulating material and is very effective in combination with my carbonized cellulosic material above described.

In connection with the modifications of Figs. 1 to 10, inclusive, the plied or laminated medium and/or the individual cellulosic elements thereof may be caused to more firmly adhere, if necessary, by utilizing a heat-proof adhesive or binder such as a special coating, adhesive or varnish of insulating character or any like or equivalent material. This is not required in many instances and of course is not required where I use the modification of Fig. 1 or Fig. 2 alone. In some cases, however, it is desirable and advantageous to cause the laminations in a plied medium to be bound together more firmly and in such cases the adhesive or varnish may be applied to the necessary cellulosic surfaces, which may also be otherwise bound, if desired, as by wiring,

stapling, etc. Again, to render exposed cellulosic surfaces impervious to moisture or immune to deterioration I may coat the medium whether it be a single layer or a plied medium so as to maintain the efficiency and effectiveness thereof for prolonged periods without requiring replacement.

By limiting the carbonized area of the cellulosic surfaces and leaving a portion or portions thereof uncarbonized I facilitate the adherence of the laminations since in such case a suitable insulating adhesive can be applied to the uncarbonized surfaces and other advantages are secured.

For example, in Fig. 11 the carbonized area 17 is like a checkerboard with an untreated margin or border 18 to which adhesive can be applied. Preferably, the area 17 is countersunk a little below the margin or border 17. Thus when two such mediums are laminated in the manner of Fig. 3 the plied medium will provide alternate carbonized and uncarbonized areas with air spaces between the opposed carbonized areas thus providing an exceptionally good insulating medium. The ratio of uncarbonized area to carbonized area may be suitably adjusted during formation so that the required or proper insulating effect is secured. This form of carbonization may be carried out by forming a wire stencil which is electrically heated and installed in the drying tunnel or oven in such manner that the hot stencil is brought into contact with the medium when desired by a suitable mechanism for lowering the stencil onto the material and exerting a pressure on the material. The carbonized area is thus simultaneously compressed somewhat and this gives the countersink thereto. If desired a stencil or several stencils may be located so that the medium passes between them and so that they act synchronously as a clamp and thus treat both sides at the same time.

In Figs. 12 and 13, I have carbonized the whole central portion 19 of the medium leaving an uncarbonized border or margin 20 on which is indicated adhesive 21. This carbonized area may be countersunk (as shown) or not, as preferred. Two such mediums as assembled in Fig. 14 provide carbonized areas with an air space 22 therebetween. The uncarbonized areas facilitate the securing together more firmly of the laminae when desirable.

In Fig. 15, the carbonized areas 23 are in the form of bands, stripes or bars leaving untreated portions 24 for uniting by adhesive. This form of carbonization is readily produced by appropriately spacing the sources of heat during carbonization according to Fig. 1, e. g., by spacing the gas flames to give the desired extent only of carbonization.

Still other variations and modifications are possible as will be understood from the above disclosure and I do not intend to limit myself only to the foregoing as other forms are comprehended within the spirit of the invention so long as they make use of the principles herein enumerated.

It is thus apparent that I have produced a novel insulating material which as to a single layer thereof comprises a light cellulosic material either or both surfaces of which are carbonized to a suitable depth without adversely affecting the porosity and the lightness of the material as a whole, and without appreciably lowering the tensile strength of such material. Such material may be plied or laminated in any desired manner to build up the material to meet all the varying conditions which might be encountered in use. I have found for example in one or other of the various forms disclosed, such insulating material is exceptionally advantageous, especially when heat-resistant, for use in heating or refrigerating systems, air conditioning systems, airplane fuselage lining, house wall fillers, and electrical installations as well as many other commercial applications where a light more or less porous material is desired and where frequently space and/or weight limitations prevent the use of other or heavier insulating materials. In using the term "cellulosic" in the claims I intend it in its broadest or most general sense as including cellulose, ligno-cellulose, and cellulosic derivatives, compounds, etc., and including woody fibres.

What I claim as new and desire to secure by Letters Patent is:

1. A cellulosic medium characterized by being a good insulator for heat, cold, and electricity comprising a body of cellulosic material provided with one or more surface-carbonized portions.

2. A cellulosic medium characterized by being heat-resistant and by properties rendering it a good insulator for heat, cold, and electricity comprising a body of heat-resistant cellulosic material with either or both of its surfaces converted to carbonized condition.

3. A laminated cellulosic medium characterized by its good insulating properties for heat, cold, and electricity comprising alternate portions of uncarbonized cellulosic material and carbonized material.

4. A laminated cellulosic medium characterized by being heat-resistant and by its good insulating properties for heat, cold, and electricity comprising a series of laminations each having a heat-resistant cellulosic body and one or two carbonized surfaces so arranged that, in effect, alternate portions of cellulosic material and carbonized material make up the laminated medium.

5. A method of making a cellulosic medium for insulating purposes comprising treating cellulosic material to make it heat-resistant, dehydrating the same and carbonizing either or both surfaces thereof by subjecting the same to sufficient heat for a sufficient time.

6. A method comprising producing a plurality of media in accordance with claim 5 and then plying the same to form a laminated medium having alternate cellulosic and carbonaceous portions.

7. A method of making a heat-resistant insulating cellulosic medium of the kind described comprising treating the cellulosic material with any suitable agent to render it heat-resistant, removing moisture from the material which would interfere with subsequent charring operations and then surface-charring the material to provide it with altered insulating characteristics.

8. An insulating medium of cellulosic character having predetermined portions of its surface carbonized and the remainder of the surface uncarbonized.

9. An insulating medium of cellulosic character provided with countersunk carbonized areas.

10. A laminated insulating medium made up of carbonized and uncarbonized cellulosic material, the laminae of which are adhesively secured

together by a suitable insulating, heat-resistant coating.

11. A method of making an insulating cellulosic medium having countersunk carbonized surface areas comprising preparing a cellulosic medium, passing into a drying tunnel and, while in such tunnel, applying thereto a heated stencil so that predetermined portions of such medium are simultaneously compressed and carbonized.

12. A method of making an insulating cellulosic medium comprising compressing and charring predetermined portions of the surface of such medium.

13. As a new article of manufacture, a non-homogeneous insulating medium composed of a fibrous base having predetermined portions thereof charred under controlled conditions.

14. As a new article of manufacture, an insulating medium composed of a predeterminedly surface charred base of cellulosic nature selected from the group: cellulose, ligno-cellulose, woody fibres, cellulosic derivatives.

15. As a new article of manufacture, an insulating medium composed of cellulosic material in sheet or strip-like form, the surface of which is predeterminedly carbonized to a relatively slight depth and the carbonized surface still retaining a substantial proportion of its inherent strength.

FREDERICK W. HOCHSTETTER.