

Feb. 19, 1963

B. W. PEEBLES ET AL
SOUND INSULATING SHEET MATERIAL

3,077,947

Filed June 29, 1961

FIG. 1

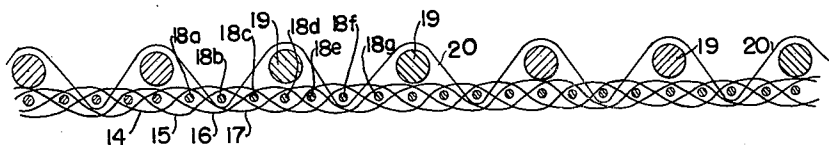


FIG. 2

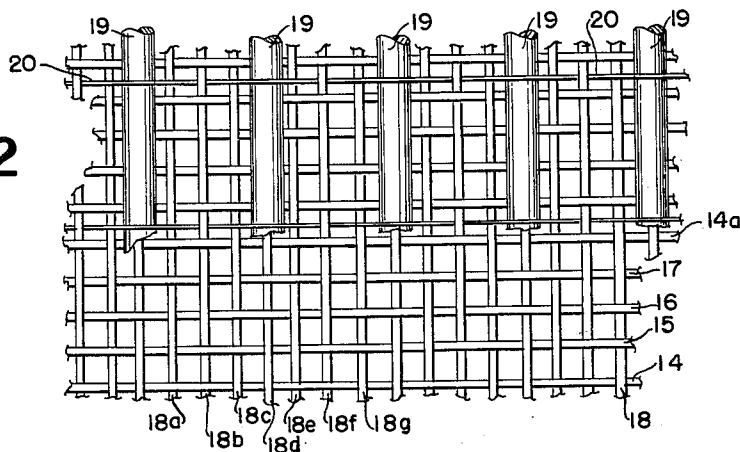


FIG. 3

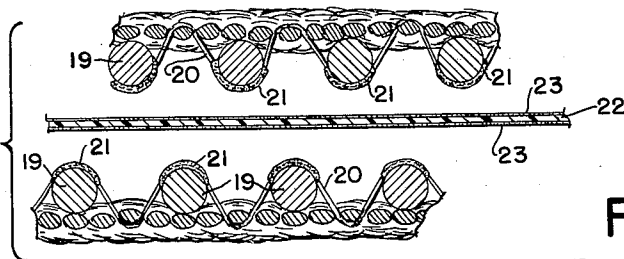


FIG. 4

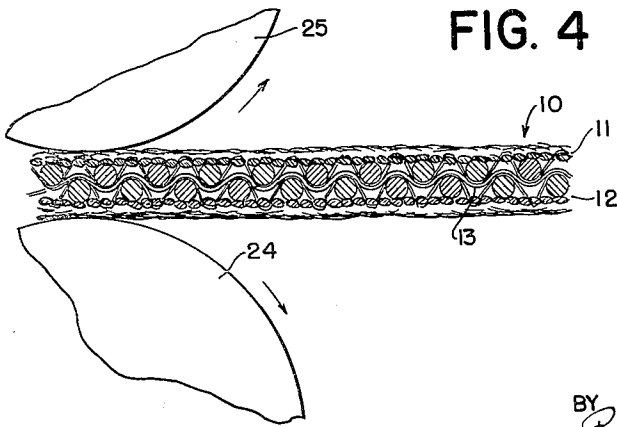


FIG. 5

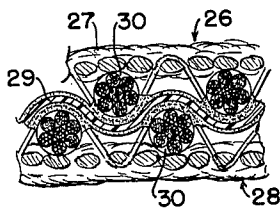
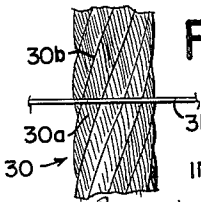


FIG. 6



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3,077,947

SOUND INSULATING SHEET MATERIAL

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Filed June 29, 1961, Ser. No. 120,772

11 Claims. (Cl. 181-33)

This invention relates to materials useful for sound insulating purposes and is concerned more particularly with a novel sound insulating material of sheet form, which is especially adapted for use as a temporary partition. The new sound insulator has a high sound transmission loss and it is flexible so that it may be hung as a curtain, which can be rolled or folded into a small volume for storage and easily and quickly moved between its stored and extended positions. The insulator may thus be advantageously used for temporarily subdividing a large working or instruction area into separate smaller ones, as in the conversion of a school lecture hall into classrooms, and it may have decorated or patterned surfaces on both faces giving it an attractive appearance.

A sound insulator of sheet form, which is suitable for use as a movable partition, is disclosed in the co-pending application of Dave Chapman, Serial No. 49,014, filed August 11, 1950, now abandoned. The Chapman insulator has a high mass per unit of surface area and is foldable or rollable, air-impervious, and limp, that is, of such physical characteristics that the ratio of the energy stored to the energy dissipated in the material per cycle of vibration is a negligible quantity. The insulator is made of a fabric of fibrous material through which are distributed metallic wires extending in one direction only and lying in spaced relation, the wires being of such size and used in such a number as to give the fabric the desired mass. In one form, the fabric is made of interwoven warp and filling yarns and the wires extend in one direction through the fabric and are interlaced with the yarns extending in the other direction through the fabric. The fabric is made air-impervious as by being coated on one face with a suitable material, such as a natural or synthetic latex.

The present invention is directed to the provision of a sound insulator of the Chapman type which is made of two plies of a fabric provided with metallic strands imparting to it the desired mass, the strands being secured against one face of the fabric by yarns raised from the body of the fabric. The invention also includes a method by which the fabric can be converted into a sound insulator.

For a better understanding of the invention, reference may be made to the accompanying drawing, in which

FIG. 1 is a diagrammatic view in longitudinal section through the fabric employed in the production of the sound insulator of the invention;

FIG. 2 is an exploded plan view of the fabric of FIG. 1;

FIG. 3 is an exploded longitudinal sectional view showing the components of one form of the insulator;

FIG. 4 is a sectional view illustrating the manner of combining the components shown in FIG. 3 to form the insulating sheet;

FIG. 5 is a longitudinal sectional view of a modified form of the sound insulator; and

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FIG. 6 is an enlarged fragmentary plan view showing a metallic component of the insulator of FIG. 5.

The sound insulator 10 of the invention is shown in FIG. 1 as comprising an upper ply 11 and a lower ply 12 of a fabric with an impervious synthetic film 13 disposed between the plies. The fabric comprises a plurality of warp yarns 14, 15, 16, and 17 interwoven with weft or filling yarns 18 to form a base fabric. In the fabric, the warp and weft yarns may be interlaced in various ways and, in the fabric illustrated, the weave is a two-up two-down straight twill. Thus, the warp yarn 14 passes over the weft yarns 18a, 18b and under the weft yarns 18c, 18d and then starts the cycle again by passing over the weft yarns 18e, 18f. The twill effect is obtained in that the adjacent warp yarn 15 passes over the weft yarns 18b, 18c and under the weft yarns 18d, 18e and then starts the cycle again by passing over the weft yarns 18f, 18g. Similarly, the next adjacent weft yarn 16 passes over the weft yarns 18c and 18d and under the weft yarns 18e and 18f, while the weft yarn 17 passes over the weft yarns 18d and 18e and under the weft yarns 18f and 18g. The warp yarn 14a next beyond the warp yarn 17 is manipulated in the same way as the warp yarn 14. Such a twill weave is merely representative of many weaves, which may be used in the base fabric, and, by the use of the proper weave and warp and weft yarns of appropriate kind and color, the fabric may have an attractive appearance on both faces.

In order that a sound insulator made of the fabric may have the desired mass, that is, a mass in excess of the order of 2.0 lbs. per square foot of surface area, as disclosed in the Chapman application, a plurality of metallic components 19 in the form of wires are secured against one face of the base fabric by catcher warp yarns 20, which are bound beneath spaced weft yarns. In the fabric shown each catcher warp yarn is floated over three weft yarns between the weft yarns, which bind it, and each float of the catcher warp yarn passes over a wire 19 and holds it in place against the surface of the base fabric. As disclosed in the Chapman application, the wires employed may be of any suitable metal, such as lead, iron, copper, etc., and they are of such size and used in such a number as to give the insulator the desired mass.

In making an insulator of the fabric described, two plies of the fabric of the shape and size of the insulator are provided with the wires extending parallel to the lines, on which the insulator is to be folded, or parallel to the axis, on which it is to be rolled. A suitable form of the fabric may contain lead wires of a diameter of 0.072" with 5½ wires per inch of the fabric, the use of two plies of such a fabric giving the insulator a mass of about 3.25 lbs. per sq. ft. The plies of the fabric are first laid on a flat surface with the wires uppermost and are lightly coated with an adhesive of the dry combining type. The adhesive is preferably applied by a roller, so that adhesive coatings indicated at 21 are applied to the upper surfaces of the wires and the catcher warp yarns 20 crossing the wires and little or none of the adhesive reaches the areas of the fabric between adjacent wires. A thin flexible air-impervious membrane 22 of approximately the size and shape of the finished insulator is then given coatings 23 of the adhesive on both surfaces and the coatings on the plies of the fabric and on the

membrane are allowed to dry. The membrane may be a thin woven or non-woven fabric having an air-impervious coating of a suitable latex or it may be a film of a synthetic material. Such a film may vary considerably in thickness, as, for example, between .001" and .010", so long as it is of good flexibility. A polyethylene film of a thickness of 0.004" has been found to be satisfactory. After the adhesive coatings on the plies of the fabric and on the film have dried, the film is placed on top of one of the plies in contact with the coated surfaces of the wires. The other ply is then turned upside down and placed with its wires against the upper surface of the film and the assembly of plies and film is then passed between a pair of compression rolls 24, 25 which squeeze the plies and film together. In this operation, the wires on one ply enter the spaces between the wires on the other ply and give the film a corrugated shape, as shown in FIG. 4. As a result of the compressing action, the adhesive coatings on the plies and on the film unite so that the plies and film are bound tightly together and the film forms a continuous impervious sound barrier within the insulator.

If desired, the insulator may be made of a single length of the fabric of the width of the insulator and twice as long and with the wires extending transversely. Such a piece of the fabric is laid flat with the wires uppermost and a coating of the adhesive is applied by a roller to the wires and catcher warp yarns. A film of the width of the fabric and half its length is then coated with the adhesive on both faces. When the adhesive coatings have dried, the film is laid on the fabric in contact with the wires to cover half the fabric at one end thereof, after which the fabric is folded upon itself along a line between a pair of adjacent wires and the reversely folded ply is placed in contact with the film. The assembly is then subjected to compression between rolls, as above described.

The modified form 26 of the insulator, which is shown in FIG. 5, is formed of an upper ply 27 and a lower ply 28 of a fabric with a membrane 29 in the form of a film between the plies. The fabric used in the modified construction is the same as that employed in the plies 11 and 12 except that the metallic components 30 are wire cables instead of solid wires like the components 19. The cables used may be of various constructions and those illustrated are formed of seven strands 30a plied together with a Z-twist with each strand formed of seven fine steel wires 30b plied together with an S-twist. The cables are bound in the fabric by catcher warp yarns 31 and the plies of the fabric are secured together with their faces carrying the wires opposed and with the membrane between the plies and secured to the cables and the catcher warp yarns. The use of steel wire cables of the type described is advantageous in that such cables may be both flexible and resilient. Accordingly, if the insulator is deformed by bending along lines transverse to the metallic components, it will return to its original shape when released. Also, the flexible steel cables are easier to manipulate than solid steel wires in the production of the fabric.

By proper selection of yarns and the use of the appropriate weave in making the fabric, a sound insulating sheet made of two plies of the fabric as described may be given an appearance, which harmonizes with the color scheme of the walls of the space, in which the insulator is to be used. The insulator may be given the desired sound transmission loss by the use in the fabric of metallic components of the appropriate metal, diameter, and spacing and, when the plies are secured together by the adhesion of the metallic component and catcher warp yarns to the membrane, the insulator may be sufficiently flexible so that it can be folded along lines parallel to the metallic components and similarly rolled up.

A fabric with the metallic components anchored to one face of the base by catcher warp yarns is especially satis-

factory for use in the sound insulator of the invention, in that, when the two plies of the fabric are secured together with the membrane between them as described, the corrugated shape imparted to the membrane by the metallic components on the respective plies causes a good adhesion of the plies to the membrane. At the same time, little adhesive reaches the fabric surfaces between the metallic components and thus the use of the adhesive for connecting the plies of the fabric and the membrane does not stiffen the fabric.

The fabric described can be readily made on a chenille carpet loom and can also be made on a velvet carpet loom equipped with the necessary number of heddle frames and with suitable means for inserting the metallic components in the proper warp sheds.

We claim:

1. A sound insulating sheet, which comprises a pair of plies of a fibrous material, each ply having metallic strands secured to one face thereof and extending in spaced parallel relation in one direction only relative to the ply and the plies lying face to face with the strands on one ply lying in the spaces between the strands on the other ply, and a thin flexible air-impervious membrane lying between and adhesively secured to the plies.
2. The sound insulating sheet of claim 1, in which the membrane is a film of a synthetic resin.
3. The sound insulating sheet of claim 1, in which the film is of polyethylene and has a thickness in the range from .001" to .010".
4. The sound insulating sheet of claim 1, in which the metallic strands are wires.
5. The sound insulating sheet of claim 1, in which the metallic strands are cables.
6. The sound insulating sheet of claim 1, in which each ply is a fabric formed of interwoven warp and filling yarns and the metallic strands are secured in place by catcher warp yarns bound beneath filling yarns spaced along the fabric and raised out of the fabric between adjacent binding filling yarns to overlie individual strands.
7. The sound insulating sheet of claim 6, in which the membrane is a synthetic film and the adhesive coats the metallic strands and the raised portions of the catcher warps of the plies and both faces of the film.
8. A method of making a sound insulating sheet, which comprises providing a web of fibrous material having metallic strands secured to one face thereof and extending in spaced parallel relation in one direction only, placing a thin flexible air-impervious membrane on the web in contact with the strands and securing the membrane to the web by means of an adhesive, securing a second web of the construction of the first web to the outer face of the membrane by an adhesive with the strands on the second web lying in contact with the membrane, and subjecting the webs and membrane to pressure to force the strands on each web into the spaces between the strands of the other web and give the membrane a corrugated form.
9. The method of claim 8, in which the webs are made of a fabric of interwoven warp and filling yarns with the metallic strands held in place by catcher warp yarns floated on one face of the fabric between spaced binding filling yarns.
10. The method of claim 8, in which the membrane is a synthetic film.
11. A method of making a sound insulating sheet which comprises providing a web of fibrous material having metallic strands secured to one face thereof and extending in spaced parallel relation in one direction only, the web having a length transverse to the strands, which is about twice that of the desired final sound insulating sheet, and a width about equal to that of the sheet, providing a thin flexible air-impervious membrane of about half the length and about the width of the web, securing the membrane to the web by an adhesive so that the membrane covers half the web at one end thereof, folding

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the web upon itself parallel to the strands and securing the reversely folded ply to the top of the membrane by an adhesive, and subjecting the webs and membrane to pressure to force the strands on each ply into the spaces between the strands of the other ply and to give the membrane a corrugated form.

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