Jan. 25, 1966 D. CHAPMAN 3,231,042

FOLDABLE SOUND INSULATING MATERIAL AND PARTITION

Filed June 28, 1961 3 Sheets-Sheet 1

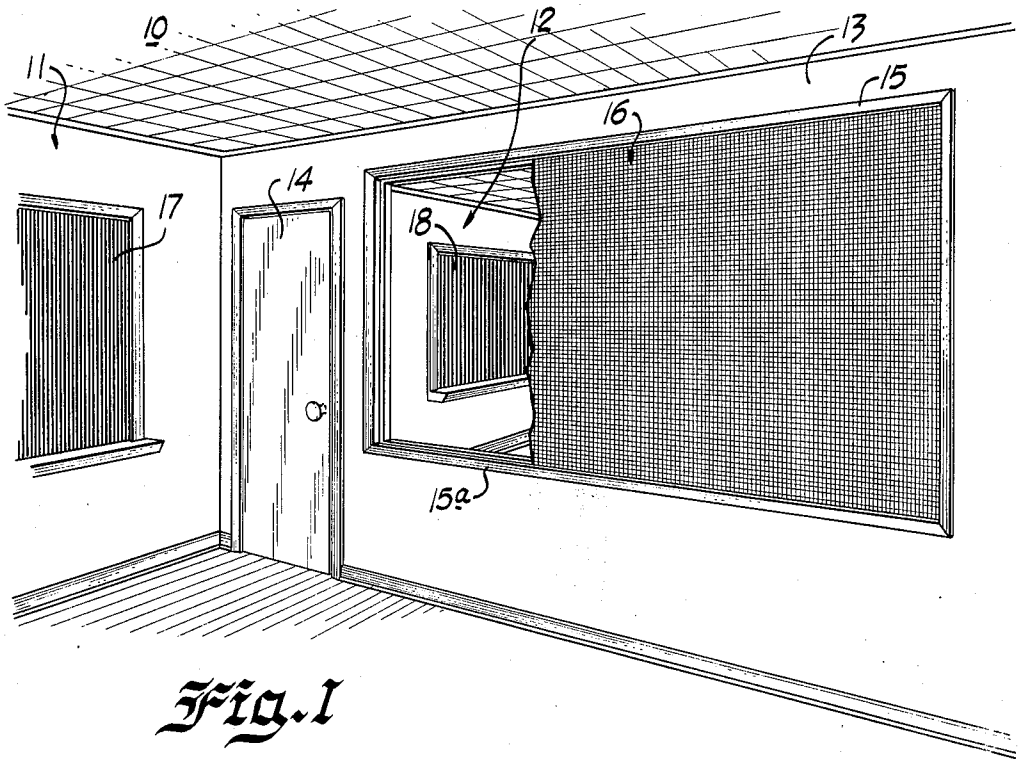


Fig. 1

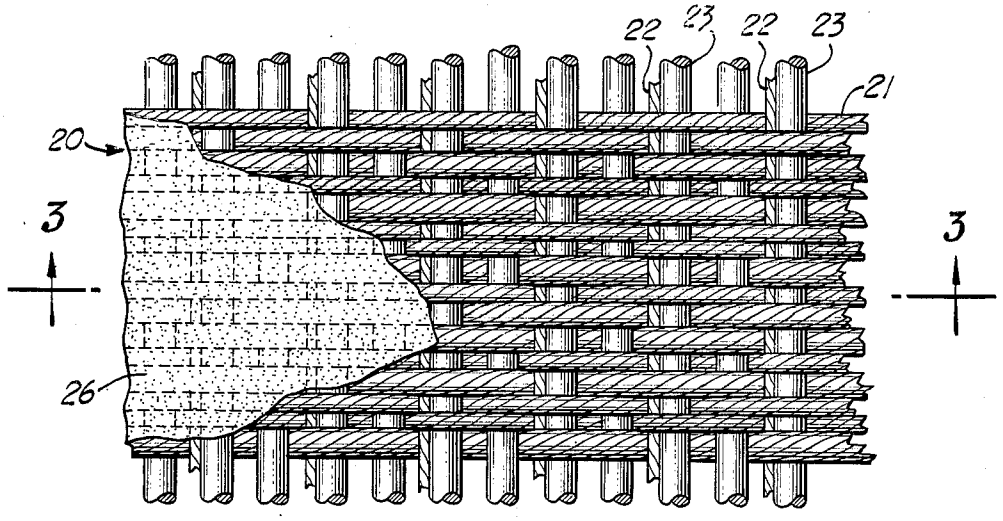


Fig. 2

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Fig. 3

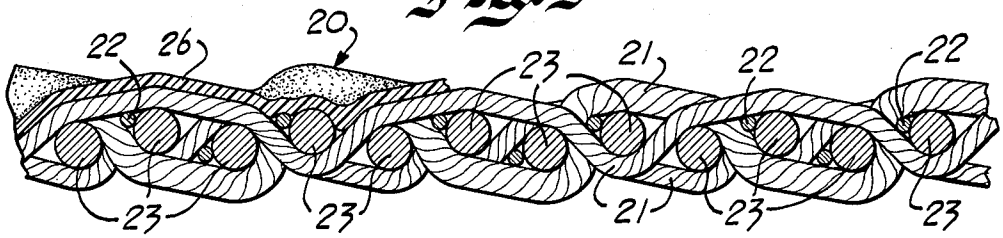


Fig. 4

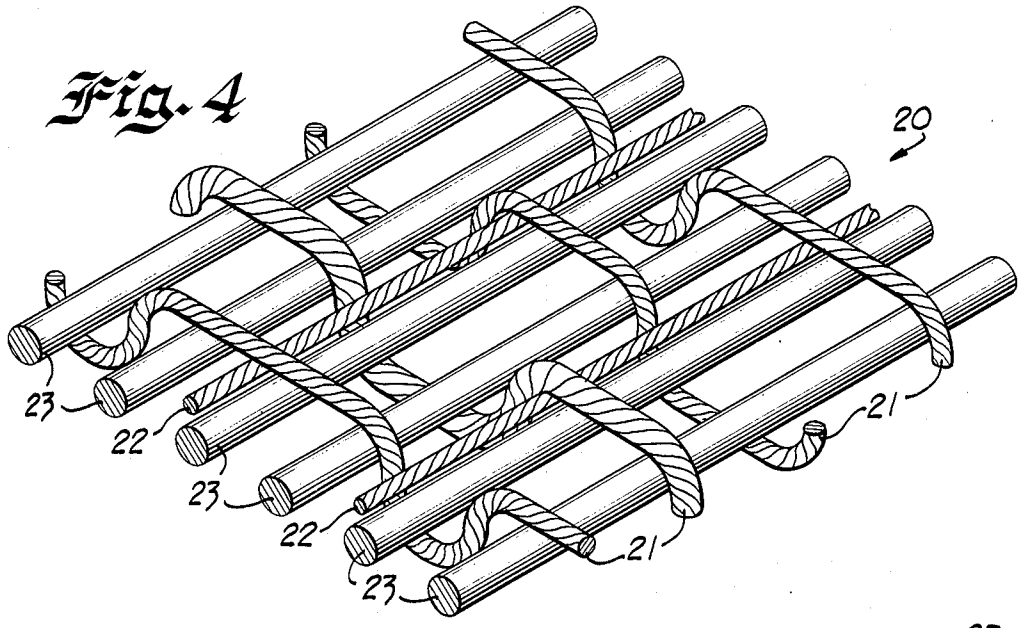


Fig. 6

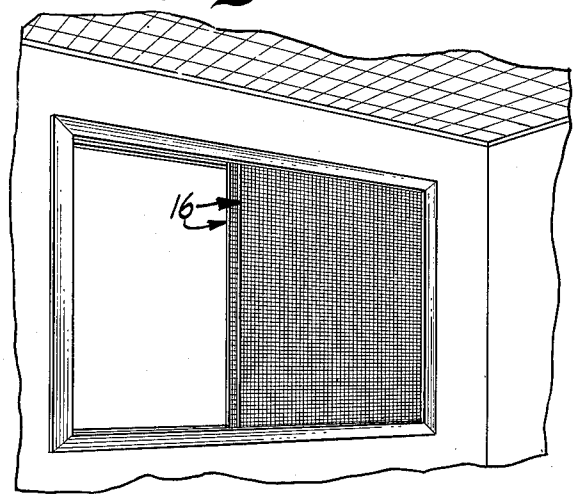
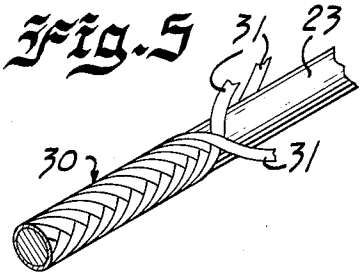


Fig. 5



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FOLDABLE SOUND INSULATING MATERIAL AND PARTITION

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Fig. 7

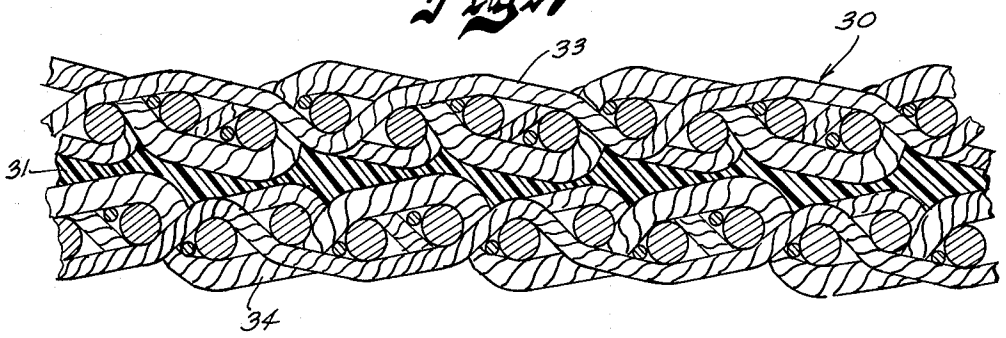


Fig. 8

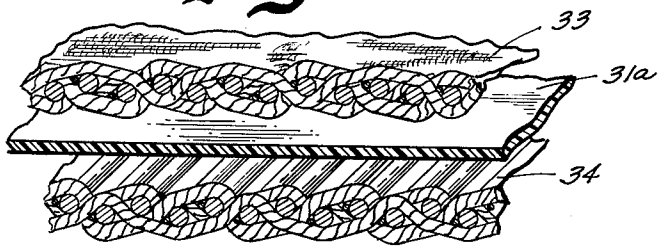
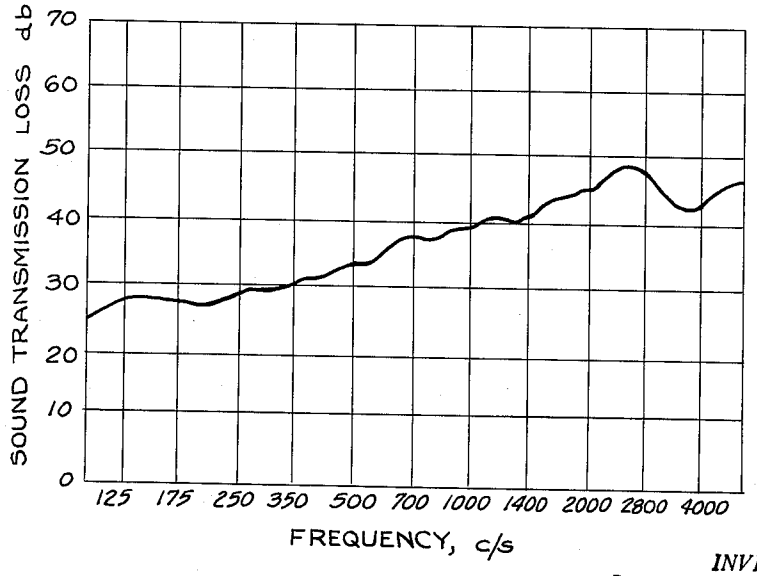


Fig. 9



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United States Patent Office 3,231,042
Patented Jan. 25, 1966

3,231,042
FOLDABLE SOUND INSULATING MATERIAL AND PARTITION

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Filed June 28, 1961, Ser. No. 124,275
13 Claims. (Cl. 181—33)

This application is a continuation-in-part of application Serial No. 49,014, filed August 11, 1960 and now abandoned.

The present invention generally relates to sound insulation, and it more particularly relates to a non-rigid, high transmission loss material and to a sound-insulating partition formed of such material.

There are many situations in which it is desirable to temporarily separate one large enclosure or area into two or more smaller enclosures or areas, for example, as where a large schoolroom functions both as a lecture hall and as two separate classrooms. Similarly, large banquet halls can be temporarily used for smaller dining rooms by the use of movable partitions. In such cases it would be desirable to employ movable partitions which are substantially opaque to both sound and light so as to prevent sounds and the like originating in one area from interfering with the normal use of the adjoining area. Many different types of movable partitions which are opaque to light are known and have been available commercially for many years. On the other hand, movable partitions which are opaque to sound are not presently available.

The types of sounds which interfere with the normal use of a room or the like may, of course, have a frequency anywhere within a bandwidth coinciding with the frequency response of the human ear, but this is rarely the case. For example, it has been determined that the range of usual classroom sounds is between a few hundred cycles per second to five thousand cycles per second a Moreover, the usual amplitude of such classroom sounds is such that within the frequency range of a few hundred cycles per second of five thousand cycles per second a transmission loss of 35 decibels between classrooms is adequate. For other applications the frequency range of sounds to be attenuated will be somewhat different, although it does not vary to any great extent in our present-day society. Moreover, because the effectiveness of a sound-insulating partition is never any better than the amount of sound which can travel around it, the maximum transmission loss which it is practical to provide in a movable partition is the minimum transmission loss of the adjoining portions of the building. For example, the walls, floors, and ceilings connecting the adjoining areas in schools have a transmission loss of the order of 35 decibels in the frequency range under consideration.

In the past, the usual approach to the design of movable sound-insulating partitions has been by way of sound-insulating panels which are suitable connected together to permit temporary disassembly of the resulting partition. However, where a relatively high transmission loss is required, the cost of such panels is prohibitive. Moreover, the time required to temporarily disassemble and to reassemble such partitions is relatively long and, in addition, is both laborious and difficult.

Because of the rapid rise in the cost of education in this country, it would be desirable to provide some means for reducing the cost of building new schools, and if more inexpensive, temporary partitions having satisfactory sound-insulating characteristics could be provided, the cost of schools could be appreciably reduced without eliminating any of the facilities normally provided in modern school buildings.

In order to visually separate one area from another, it has long been the practice to use drapery-type curtains which are foldable into sinuous pleats and which are very easily moved between open and closed positions. This could be done by a teacher in a matter of seconds. Accordingly, it would be desirable to provide a curtain which is not only opaque to light, but which also has an average sound transmission loss of at least 35 db. Such a curtain could be used in much the same manner as draperies are now used to interrupt the passage of light from one place to another. Of course, certain problems incident to the passage of sound around the edges of the curtain have to be solved, but satisfactory sound traps have been successfully built and tested for this purpose and are the subject matter of other applications assigned to the assignee of the present invention.

Therefore, a principal object of the present invention is to provide a new and improved sound and light insulating material.

Another object of the present invention is to provide a fabric which has an average transmission loss of about 35 decibels which is sufficiently flexible so that it can be folded or sinuously pleated whereby it may be readily collapsed for storage purposes.

A further object of the present invention is to provide an acoustically opaque woven fabric which has an average sound transmission loss of the order of 35 decibels.

Another object of the present invention is to provide an acoustically opaque fabric which is attractive in appearance and can be used to provide decorative effects.

Yet another object of the present invention is to provide a new and improved room divider which is substantially opaque to both sound and light, which is readily movable between a dividing and non-dividing position, and which can be stored in a relatively small area.

Briefly, the above and further objects are realized in accordance with the present invention by providing a limp, high mass fabric which includes, as its principal mass-providing component, a plurality of relatively heavy metallic wires extending parallel to one another throughout the material in sufficiently spaced-apart relationship to permit the fabric to flex between wires. Consequently, the fabric of the present invention can be folded or pleated along lines parallel to the metal wires. Moreover, an air impervious layer is provided within or coated on one side of the woven fabric and at least partially fills the interstices of the fabric. Where the fabric is woven of twisted textile threads, the coating material actually impregnates the threads. Accordingly, the impervious layer adheres to the fabric throughout an essentially continuous area which prevents small portions of the layer from vibrating as a diaphragm which would have the deleterious effect of transmitting the higher frequency sounds through the fabric, substantially unattenuated.

Further objects and advantages and a better understanding of the invention may be had by reference to the accompanying drawings in which:

FIG. 1 is a fragmentary perspective view showing two classrooms of a school building;

FIG. 2 is a greatly enlarged, plan view of a fabric embodying the present invention, in which view certain portions are partially removed to better illustrate the invention;

FIG. 3 is a fragmentary sectional view showing a portion of the fabric of FIG. 2 taken along the line 3—3 thereof;

FIG. 4 is a greatly enlarged expanded view illustrating the weave used in the fabric of FIG. 2;

FIG. 5 is a fragmentary, perspective view of a sheathed metal wire used in one embodiment of the present invention;

FIG. 6 is a fragmentary, perspective view showing a portion of a building in which an embodiment of the present invention is employed;

FIG. 7 is a sectional view of another embodiment of the present invention;

FIG. 8 is an exploded, perspective view useful in understanding the manner in which the device of FIG. 7 may be formed; and

FIG. 9 is a characteristic curve illustrating the transmission loss of the fabric **20**.

The transmission loss, T.L., of a material is an index of its sound insulation merit and is equal to the ratio of the incident sound energy to the transmitted sound energy expressed in decibels. The greater the transmission loss of a material, the greater is the sound insulation which it provides.

The principal manner in which sound passes through an imperforate partition, is by forced vibration of all or part of the partition. Consequently, the entire partition, or in some cases small portions thereof, becomes a secondary source of sound which radiates sound into the adjoining space on the other side of the partition. In other words, the partition, or separate parts of it, functions as a diaphragm.

In accordance with the teachings of the present invention a curtain-type partition, which is imperforate, is, nevertheless, prevented from functioning as a diaphragm by virtue of the fact that it is formed in such a way and of such material that it is relatively massive, having a mass in excess of the order of 2.0 lbs. per square foot of surface area. Moreover, the partition of the present invention is limp, i.e., it has a Q whose value is negligible.

The Q of a vibrating body is a figure of merit having a value indicating the energy loss in the vibrating body and the value of Q can be computed by the following equation:

$$Q = 2\pi \times \frac{\text{energy stored in the body}}{\text{energy dissipated in the body per cycle of vibration}}$$

This invention thus provides a limp, or non-elastic material which is imperforate to prevent the direct transmission of sound therethrough, which is massive to prevent diaphragm action, and which has a transmission loss equally as great as most permanent partitions.

Referring now to the drawings and particularly to FIG. 1 thereof, there is shown a portion of a building **10** which includes a room **11** in the foreground and a room **12** in the background. The rooms **11** and **12** are partially separated by a permanent vertical partition or wall **13** which includes a door **14** for permitting passage between the rooms. The wall **13** also includes an opening defined by a window frame **15** in which an acoustically opaque curtain **16** is suitably supported. In the illustration of FIG. 1, the rooms **11** and **12** are school classrooms as indicated by the chalkboards **17** and **18**, and for classroom use it is desirable to position the sill **15***a* of the frame **15** at the height of the desks in the rooms. Therefore, when the curtain **16** is drawn back into the wall **13**, since the portion of the partition **13** which is below the frame **15** is not noticeable to the students sitting at the desks and the remaining portions of the partition **13** are outside of the area of interest, the rooms **11** and **12** are for both visual and audible purposes a single room.

The partition **13** including the door **14** is suitably constructed so as to have a sound transmission loss of at least 35 decibels which has been found to provide satisfactory sound insulation between school classrooms. The curtain **16** is, likewise, constructed of a fabric having a sound transmission loss of about 35 decibels and, in addition, the curtain **16** is mounted so that the transmission loss to sound passing around its edges is at least as great as that of the curtain **16** itself. Accordingly, with the curtain **16** drawn across the frame **15**, the classrooms **11** and **12** are isolated from one another both for sound and for light and may thus be used independently.

Referring to FIG. 2, there is shown a greatly enlarged view of a woven fabric **20** from which the curtain **16** may be made. The fabric **20** comprises as its principal elements a plurality of weft threads **21**, a plurality of warp threads **22**, and a plurality of metallic wires **23**. The wires **23** are arranged in spaced-apart, parallel relationship, all lying in substantially the same plane, and extending in the direction of the warp threads **22**. Depending upon the particular weave used, it may be preferable to run the wires **23** in the direction of the weft threads rather than in the direction of the warp threads. However, since the fabric should be capable of being folded or rolled, the wires **23** should extend in only one direction.

As shown, the fabric **20** is a single, composite member and to that end the weft threads **21** are interwoven with both the warp threads **22** and the wires **23**. Accordingly, the wires **23** constitute an integral part of the fabric **20** and are not merely fastened thereto. The threads **21** and **22** may be spun from staple fibers, or they may be made of continuous filaments or of a single filament. Moreover, the threads may be formed of natural fibers, such as cotton, wool, linen or silk, or they may be made of synthetic materials, such as nylon or rayon or combinations thereof.

Although the weave shown in FIG. 2 and partially shown in FIG. 4 is unusual, any suitable weave may be for the fabric **20** so long as the wires **23** are parallel and are interwoven into the fabric in such a manner that the threads **21** and **22** form a fabric which is not movable to any appreciable extent independently of the wires **23**. By way of example, a simple plain weave, or any one of a large number of other known weaves may be used in place of the weave of FIGS. 2 and 4 to produce various decorative patterns and effects. Also, the types, sizes, and colors of the threads **21** and **22** may be varied to provide desired decorative appearances. Moreover, the threads and weave may be selected to reduce reverberation in the rooms **11** and **12**.

In order to open the curtain **16** so that the classrooms **11** and **12** of FIG. 1 are, as explained above, a single room, it is preferable that the curtain **16** be moved either horizontally into the partition **13** at one side of the frame **15** or that the curtain **16** be moved either upwardly or downwardly into the partition **13** either above or below the window frame **15**. If the curtain is to be moved sideways out of the window **15**, then the fabric **20** of FIG. 2 is arranged such that the wires **23** are disposed in a vertical direction. On the other hand, if the curtain **16** is to be moved either upwardly or downwardly out of the window **15**, the wires **23** are arranged in a horizontal direction. By so orienting the fabric **20**, the curtain **16** maye be easily folded in pleats within the partition **13** or it may be readily rolled up in the partition **13**.

Since the wires **23** are necessarily heavy, being preferably formed of a metal such as lead, copper, iron or steel, a substantial strain is placed on the fabric with a tendency to cause distortion thereof. Such distortion would be troublesome for many reasons. In the first place, if the fabric is distorted, the air-tight seal referred to hereinafter might be broken. In the second place, sagging of the fabric would make insulating of the edges extremely difficult. In the third place, distortion of the fabric would alter the appearance of a patterned fabric thereby marring its decorativeness.

It is, therefore, particularly desirable that the fabric **20** not stretch during use. Accordingly, in an application where the wires **23** extend parallel to the warp threads and are disposed in a vertical direction, it is most important that the warp threads **22** be strong in tension and not subject to cold flow. For example, if the warp threads **22** were formed of certain vinyl plastics the fabric would tend to sag due to stretching of the

plastic under the weight of the metal wires **23**. On the other hand, if the wires **23** extend perpendicular to the woof threads and are disposed in a horizontal direction, it is important that the woof threads **21** be strong in tension and not subject to cold flow or stretching. Ordinarily the fabric **20** will be used in such a manner that the metal wires **23** extend in a vertical direction and in such a case the sag problem is minimized by employing a weave in which the vertical threads which extend parallel to the wires **23** are in a substantially unbent condition. As shown in FIG. 2, this can best be accomplished by locating at least some of these warp threads, the warp threads **22** in FIG. 2, in juxtaposition with the wires **23**. In this manner, the relatively heavy rigid wires **23** serve to hold the warp threads **22** in a straight-line position both during the weaving operation and thereafter. With this type of weave, the fabric **20** can only sag if the threads **22** stretch and as pointed out hereinabove, the material from which the threads **22** are made is selected to prevent this.

After the fabric including the metallic wires **23** has been woven, a flexible, substantially non-elastic, air impervious coating **26** is applied to at least one face of the fabric. Inasmuch as the coating is airtight, the sound waves cannot pass directly through it. Since it is important that the fabric be flexible and limp, it is imperative that the coating **26** be flexible and limp. Examples of materials which are suitable for forming the coating **26** are neoprene, latex, flexible vinyl resins and flexible acrylic resins.

Another possible way for sound to be transmitted through the fabric **20** would be for the air impervious coating **26** to vibrate as a diaphragm. If such vibrations were not substantially damped, at least certain frequencies of sound within the audible range would pass through the curtain in a highly unattenuated condition thereby destroying the acoustical opacity of the fabric. Because of its high mass, the entire curtain cannot vibrate as a diaphragm and in order to prevent the low mass coating **26** from itself vibrating either in whole or in part as a diaphragm, the fabric is tightly woven and the coating **26** is impregnated into the fabric as best shown in FIG. 3 so that the coating **26** fills the interstices between the threads. Since the weave employed is sufficiently tight that the adjacent warp and woof threads are extremely close if not touching, only very small portions of the coating **26** are located between threads. However, the thickness of the coating is many times greater than the longest dimension of any free area in the plane of the fabric so that such areas cannot efficiently function as diaphragms. In one successful fabric, the maximum dimension between threads is no more than 0.0156 inch.

Where a twisted type of thread is used the coating **26** preferably impregnates the threads thereby improving the bond between the coating and the woven fabric.

In order to assure that the coating **26** impregnates the fabric, it is preferable to apply the coating material in liquid form, thereafter causing it to set up to form a skin-like coating on the face of the fabric to which it is applied. The manner in which the liquid is cured so as to set up into a solid form depends upon the type of material from which it is made and the manufacturer's recommendations in this regard should be followed.

The total weight of the wire **23** in a given surface area of fabric controls the transmission loss of the fabric. For example, it has been found that a transmission loss of the order of 35 decibels throughout the audible range is obtainable with the fabric of the present invention when the weight of the fabric per square foot of surface area is of the order of 2.5 lbs. If the mass of the curtain is increased to about 5 lbs. per square foot, the transmission loss increases substantially at the lower frequencies and to a lesser extent above 1,500 cycles per second. Since the wires **23** provide most of the mass of the fabric, the wire size and the density of wires in the fabric are chosen to provide the desired weight per square foot of surface area. Of course, fewer wires of large diameter will provide the same mass as will a greater number of wires of a smaller diameter and for a given mass the cost of using larger diameter wire is less than the cost of using smaller diameter wire. However, a large number of small diameter wires provides a greater transmission loss because the space between the wires **23** is minimized and the area of the small portions of the coating **26** and the threads **21** and **22** to which they are attached are likewise minimized. On the other hand, as the density of wires in the fabric is increased the flexibility of the fabric is decreased and since flexibility is, in most instances, an extremely important factor, too great a number of wires cannot be tolerated. Since the cost factor must always be considered, the advantages of small diameter wires as against large diameter wires must be resolved to provide the best fabric for the purpose at hand.

A fabric employing lead wires having a diameter of .072 inch arranged on three thirty-second centers has been found to have sufficient flexibility to permit draping and facile storage of the curtain while, at the same time, exhibiting an average transmission loss in excess of 35 decibels throughout the audible range. Consequently, this material finds application for classroom separation. A heavier material would be desirable for separating apartments where a transmission loss of 45 db is generally considered to be necessary.

Referring to FIG. 5, there is shown a short section of one of the wires **23** which is encased within a braided sheath **30** to increase the flexibility of the over-all fabric. The sheath **30** is formed by a plurality of filaments **31** which are braided in any suitable manner around the wires **23** prior to their being incorporated in the fabric.

In accordance with this aspect of the present invention the braided sheath **30** is loosely positioned over the wire **23** so that the wire **23** may rotate freely within the braid. Accordingly, when the braided wire **30** is woven into the fabric, increased flexibility is provided as a result of the lubricating action of the braid.

In order to prevent the wire **23** from sliding axially out of the fabric both in the embodiment shown in FIG. 2 and that shown in FIG. 5, the ends of the wires **23** are bent back upon themselves to form a U at both ends of the fabric. Preferably, this fabric is woven to the desired size, but should it become necessary to cut it into the smaller lengths, it is desirable to bend back the ends of the wires **23** where the cut is made, thereby securing the wires **23** within the fabric.

Referring to FIG. 6, there is shown a room divider which is formed of a pair of curtains **16** mounted face to face a few inches apart, thereby providing an area space between the two curtains. A room divider which is thus formed of two curtains has a transmission loss many times greater than that provided by a single curtain, and where a transmission loss of the order of 50 db is desired, it is usually more economical to use two curtains having a weight per unit surface area of the order of 2.5 lbs. per square foot, than to greatly increase the mass of a single curtain to a sufficiently high value to provide the decibel loss which is required, since, as the mass of the curtain increases, the flexibility generally decreases and the problem of mounting becomes more acute. Moreover, increasing the weight per square foot over 5 lbs. has very little effect on the transmission loss of the curtain of the present invention.

The material **20** includes the imperforate layer **26** on one face and the fabric on the other face, but in some instances, it would be preferable to provide a curtain wherein the imperforate material is within the body of the material and thus protected from possible puncture. This construction may conveniently be provided by sandwiching the imperforate layer between two layers of the fabric. With this arrangement, both faces of the

curtain are constituted by the fabric and the imperforate layer is hidden from view.

Referring to FIG. 7, there is shown an embodiment of the present invention in which the imperforate layer is located within the body of the material. The material 30 there shown comprises a thin, imperforate layer 31 of a suitable flexible material such, for example, as Mylar, which is sandwiched between two layers 33 and 34 of woven fabric, each incorporating spatially arranged mass members such, for example, as metallic wires.

As shown, the layer 31 is intimately connected to the layers 33 and 34 and follows the respective contours thereof throughout both facial areas whereby nothing but minute portions of the layer 31 may vibrate independently of the fabric layers 33 and 34.

An advantage inherent in the construction of the fabric 30 is that a high degree of flexibility may be achieved since the imperforate layer 31 may be extremely thin, inasmuch as it is protected against damage by the layers 33 and 34. For example, in one fabric constructed in accordance with this feature of the invention, the layer 31 had a thickness of 0.005 inch. Another advantage of the construction of the material 30 is that for certain decorative effects a fabric finish is provided on both faces of the material.

In order to manufacture the sound-insulating material 30, the layers 33 and 34 which are each basically the same as the woven fabric 20, may be woven separately. It should be noted, however, that the layers 33 and 34 should preferably include a lesser number, about one-half, of mass-providing wires 23, inasmuch as two such fabrics are used in the composite material 30 and the over-all mass of the material 30 need not exceed the mass of the material 20. Having thus woven the two layers 33 and 34, a sufficient quantity of a suitable plastic material such as neoprene or other rubber compound may be sprayed in liquid form onto the inner faces of the two fabrics. The two fabrics are then compressed together, as, for example, by passing the same through a set of calendering rollers to bond the layers 33 and 34 together by means of the central, imperforate layer of neoprene. Since the neoprene functions not only as the adhesive, but as the imperforate layer, a sufficient quantity must be used to insure that a complete film is provided. Otherwise, perforations might result which would provide substantial sound leaks.

Referring to FIG. 8 there is shown another way of making the material 30, wherein as imperforate sheet of a plastic material, such as Mylar, designated 31*a*, is sandwiched between the fabric layers 33 and 34, and the composite material is heated to soften the plastic as it is passed through a set of calendering rollers which compresses the three elements together and sets the plastic layer 31*a* into the layers 33 and 34, whereby the layer 31*a* closely conforms to the surface configurations of the abutting faces of the layers 33 and 34 and, when set, permanently bonds the two layers into a unitary material.

Referring to FIG. 9, there is shown a characteristic curve of a fabric material 20 having a mass of 2.38 lbs. per square foot of surface area, showing the transmission loss thereof plotted as the ordinate and frequency plotted as the abscissa. This curve covers a range of frequencies from about 100 cycles per second to 4,200 cycles per second, the range of frequencies, which, under normal circumstances, must be contended with.

It should be noted that in the embodiments shown in both FIGS. 1 and 6, the curtains 16 are substantially planar when in a drawn condition. The principal reason for so mounting the curtain 16 is that in this condition the transmission loss is substantially higher than it is when the curtain 16 is in a pleated or sinuous condition, as is common in living room drapes and the like. Moreover, the amount of fabric which is required is substantially lessened and less complex mounting arrangements may be used to prevent the passage of sound around the edges of the curtain.

There is thus provided, in accordance with the present invention, a sound-insulating material which may have a thickness of less than one-quarter of an inch, and yet have a transmission loss equal to a concrete or plaster wall having a thickness of many inches. The exact thickness of such a wall depends upon the material from which it is made. Also, the material of the present invention is flexible and can be used as a sound-insulating curtain, being easily and quickly moved between room separating and non-separating positions. Moreover, the material of the present invention is attractive in appearance and can be used in such a way as to decrease reverberation in the individual spaces which it separates.

The curtain materials 20 and 30 as described in detail hereinabove are both woven fabrics. Nevertheless, a non-woven fabric may provide the flexible base for the mass-providing members and the imperforate layer since the principal function of the fabric is a limp support for the high mass.

While the present invention has been described in connection with certain embodiments thereof, it will be understood that those skilled in the art may make many changes and modifications without departing from the true spirit and scope of the invention. Therefore, it is intended by the claims which are appended hereto and which form a part of the present specification to cover all such changes and modifications which fall within the true spirit and scope of the present invention.

What I claim as new and desire to be covered by United States Letters Patent is as follows:

1. A sound insulator comprising a foldable, limp, air-impervious woven fabric having a mass per square foot of surface area of no less than 2.0 pounds, said fabric including a plurality of metallic wires interwoven in spaced apart, parallel relationship throughout said fabric and forming the primary mass portion thereof.

2. A sound insulator as set forth in claim 1 wherein there is provided a plurality of non-stretchable threads extending parallel to said wires in a straight, unbent condition when the material is substantially flat.

3. A sound insulator as set forth in claim 1 wherein said wires are uniformly dispersed throughout the fabric to provide uniformly of transmission loss.

4. A high transmission loss material comprising a substantially nonelastic woven fabric, a plurality of metallic wires attached to and forming a part of said fabric, said wires lying in spaced apart parallel relationship, said wires being uniformly dispersed throughout said fabric and being sufficiently numerous to cause said fabric to have a mass at least of the order of 2.5 pounds per square foot of surface area, and a nonelastic, air impervious layer covering at least one face of said fabric and at least partially filling the interstices between said fibers, whereby said material is limp and has a sufficiently high mass to provide good sound insulation.

5. The invention claimed in claim 4 wherein said metallic wires are lead and are mutually separated by a distance no greater than .022 inch.

6. The invention claimed in claim 5 wherein said metallic wires are supported in said partition to permit relative movement between adjacent ones of said elements.

7. A sound insulator comprising a foldable, limp, air-impervious woven fabric having a mass per square foot of surface area of no less than 2.0 pounds, said insulator being a porous, finely woven fabric wherein the next adjacent parallel threads are in substantial mutual contact, said fabric having an imperforate material coated over at least one face of said fabric and extending within the spaces between the threads of said fabric, said coating material adhering to the threads of the fabric which it contacts and being substantially thicker than the interstices in said fabric.

8. An acoustically opaque material foldable into sinuous pleats, comprising a woven fabric wherein at least certain of the threads extending in one direction are formed from stiff metal wires loosely sheathed in non-metallic material to permit rotation of said wires in the respective sheaths, all of the threads extending in the other direction in said fabric are formed from flexible material, and a flexible, air-impervious, limp material adherently secured to the threads over one face of said fabric by impregnation therein.

9. An acoustically opaque material foldable into sinuous pleats and comprising a woven fabric wherein at least certain of the threads extending in one direction include metal filaments sheathed in non-metallic material and the remainder of the threads extending in said direction are formed of flexible non-metallic material and all of the threads extending in the other direction are formed solely from flexible non-metallic material, and a continuous film of flexible air-impervious material adherently secured to the threads, by impregnation therein, on at least one face of the woven fabric.

10. An acoustically opaque fabric foldable along parallel vertical fold lines, comprising a woven fabric in which at least certain of the warp threads are formed from metal wire and the weft threads are formed solely from non-metallic flexible material, and an air-tight, limp coating adherently attached to the threads on at least one face of the fabric and overlying said face whereby said fabric may be folded along a plurality of parallel vertical lines.

11. An acoustically opaque material foldable into sinuous pleats and comprising a woven fabric in which the warp threads are formed from metal filaments each having a sheath of braided textile threads loosely positioned thereon, and the weft strands are formed solely of non-metallic threads, and an air-tight flexible coating adherently secured to the threads on at least one face of said fabric.

12. A sound insulator comprising a first layer formed of a woven fabric having a plurality of metallic members dispersed therethrough, a second layer formed of a woven fabric having a plurality of metallic members dispersed therethrough, said metallic members being sufficiently numerous to cause said insulator to have a mass at least of the order of 2.0 pounds per square foot of surface area, and an air impervious layer interposed between said fabric layers, and means for bonding said fabric layers to said intermediate layer whereby said insulator is a unitary member.

13. The material set forth in claim 12, wherein said intermediate layer is a flexible film.

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