Feb. 2, 1943. V. A. SCHLENKER 2,310,154

ACOUSTIC SCREEN

Filed Aug. 9, 1941

Fig. 1.

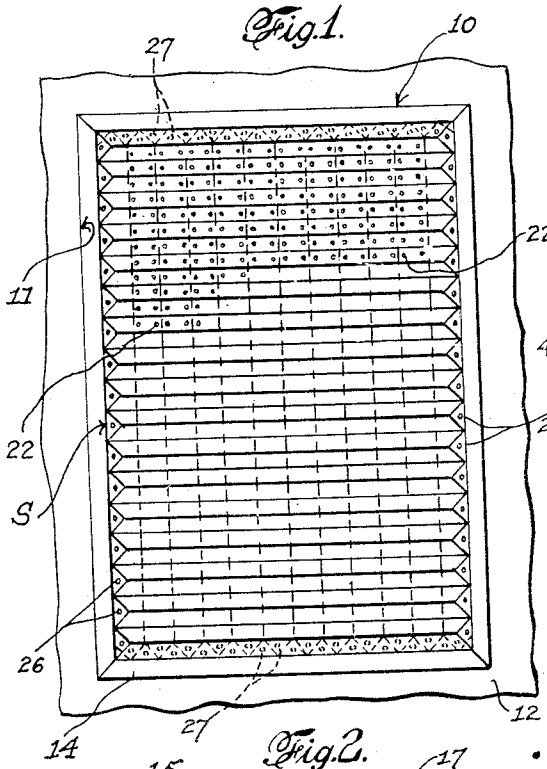


Fig. 3.

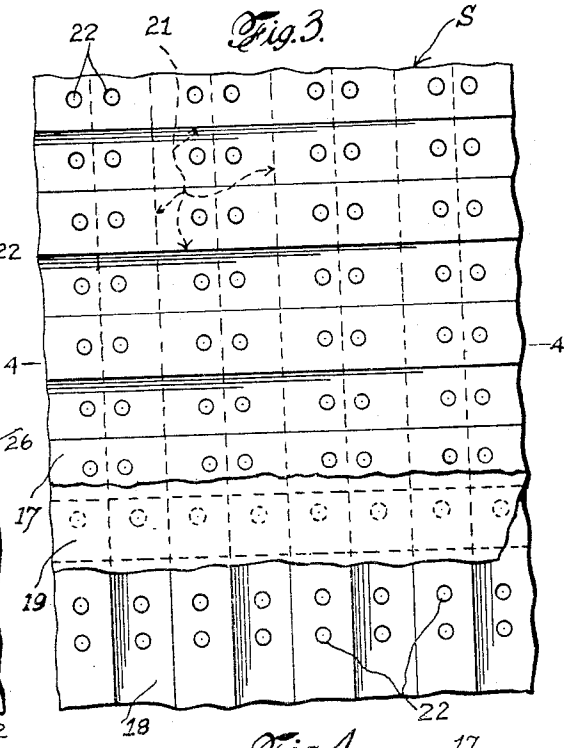


Fig. 2.



Fig. 4.

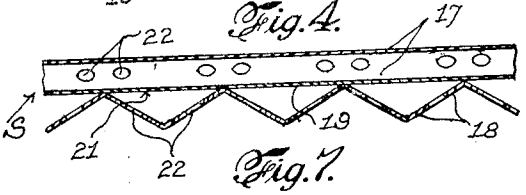


Fig. 5.

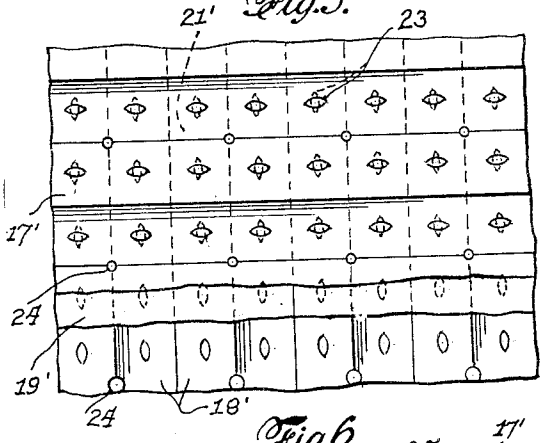


Fig. 7.

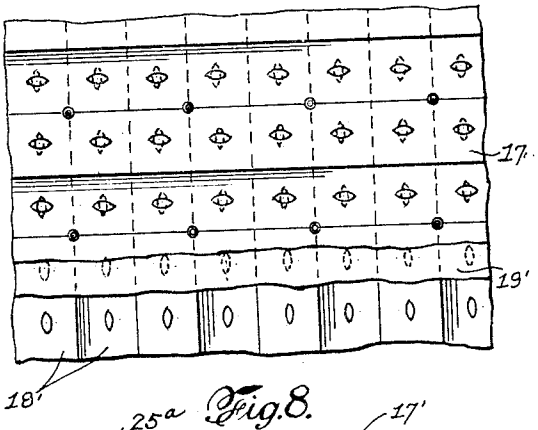


Fig. 6.

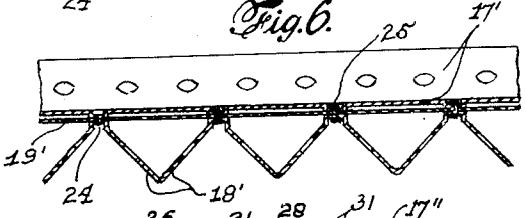


Fig. 8.

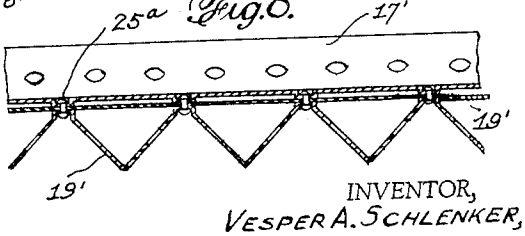
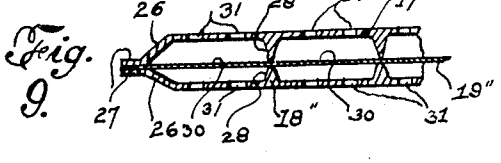


Fig. 9.



INVENTOR,
VESPER A. SCHLENKER,

BY Augustus M. Henry

ATTORNEY.

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ACOUSTIC SCREEN

Vesper A. Schlenker, New York, N. Y.

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4 Claims. (Cl. 181—31)

The subject of this invention is a novel and valuable acoustical device, which, by its structure and mode of operation, provides at once a protective partition between a speaker and his auditor, and, at the same time, a means for transmitting to the auditor, clearly and distinctly, the words of the speaker, even when uttered in such low tones or with such little volume of sound that a third person fairly close by can not distinguish their import even if deliberately eavesdropping.

The new device has a further advantage in that it incorporates a two-way characteristic as a communication means, that is, the speech of a person on either side of the partition is transmitted to the person on the other side thereof; so that a question and answer type of conversation, for instance, can be conducted between the two persons separated by the partition.

As a protective partition aforesaid, the invention can be carried out in a way to have any one or more of several protective attributes, to wit:

(A) Full, or substantially full, transparency, or complete or substantially complete opacity or any type of transpicuity other than transparency, such as a greater or less extent of mere translucency;

(B) Effectiveness completely to prevent passage through the partition of unpleasant breath and body odors, germs liable to be emitted from the oral or nasal cavities during speech, injurious air-drafts, or anything else except sounds generated for the purpose of carrying on a required or desired conversation, consultation or the like;

(C) Extremely high efficiency in transmitting sound distinctly therethrough, particularly the parts of speech which are most important to be heard clearly in distinguishing the typical audible pattern of one word or phrase from another, to the end that the most nearly inaudible murmur will be intelligible, equally as well if not better than, were the sound-screen of the present invention not in place; and

(D) Physical impenetrability, when desired.

The invention has been primarily made with the idea of providing a sound-screen for use in the religious confessional, but with the idea of also providing a sound-screen having many other real uses.

In the Catholic confessional, for instance, a cubicle occupied by the priest or confessor is separated, as is well known, from an adjoining cubicle to be occupied by a penitent, by a partition having an opening at a suitable height from the floor, and of appropriate area, to allow the confessor, regardless of whether or not the penitent be child or adult, to place his ear closely enough near the lips of the penitent, or to place his mouth closely enough near the ears of the penitent, to allow talk between the two while preventing anyone else nearby from hearing what is being said.

In the confessional, it is important also that the penitent be not recognizable, at least visually, by the priest. To insure this, the practice heretofore has been to close in the cubicle occupied by the penitent all around and at top and bottom, except for an entrance and exit portal for the penitent, and to arrange for the closing of this portal by a hinged door or by heavy drapes; so that during the confession the interior of said cubicle will be very dimly lighted if at all. Also, to avoid any chance that natural or artificial light somehow entering the interior of the penitent's cubicle from the exterior of the confessional may expose the penitent to the chance of accidental recognition by the priest, it is usual to shield said opening in the partition between priest and penitent by setting therein a fine-mesh wire screen or the like, by hanging therein a curtain or veil, or by placing over the opening some other sort of sound-transmitting but non-clear-vision barrier.

Because occasionally there is a priest in the confessional who is hard of hearing, and because occasionally due to nervous, mental or physical causes, the penitent is unable to speak in much above a whisper, said curtain or veil is arranged for displacement to inoperative position when required. In very hot weather, particularly, the curtain or veil must sometimes be thus displaced; and in the same kind of weather, a penitent will often leave the portal of his cubicle open following his entrance thereinto. Furthermore, in very hot weather, it is customary to endeavor to cool the church by using electric fans to set up an artificial breeze; and undesirable and strong air-drafts are often thus maintained. These drafts are sometimes quite strong through the confessional, from one cubicle into the other, by way of passage through said opening in the partition between the two cubicles.

Keeping in mind in connection with what has just been said that a priest usually is in the confessional for an uninterrupted period of about two and a half to three hours, merely to mention the unpleasantness of offensive breath is sufficient.

While attempts have been heretofore made to solve the various problems involved, including those above mentioned, an acoustic screen according to the present invention, as has been

proved in practice, seems the only solution, and the perfect one; by virtue of the fact that such a screen can be made comparatively inexpensively, and can be easily installed in a confessional already built, and, even so, incorporates all the protective and acoustic advantages hereinabove mentioned under (A), (B), (C) and (D). As a sound-screen for a confessional, the attributes (A), (B) and (C) are exceedingly important. In some installations, however, even for the use last referred to, the attribute (D) would be valuable; that is, in a parish where penitents are of certain nationalities known for the primitiveness of their passions, in view of the chance that one or more of these might at the time of confession be under such extreme religious hysteria or other emotional stress as likely to exhibit itself in a sudden paranoic desire to do physical injury to a stern confessor.

The invention, as has been already pointed out, and as will be understood very clearly from what follows, is, it is emphasized, not to be limited to the special and very important use just discussed; on the contrary, other fields of utility of the invention which occur readily to mind should be mentioned, such as for installation at the windows of information, ticket-selling and change-making booths in transportation, at tellers' and similar windows in a bank, and for installation in the entrance doors of private dwellings, as apartments and homes, and in the entrance doors of prisons, convents, and public institutions of all kinds; etc.; etc.

Referring now to the accompanying drawing, which shows an embodiment of the invention as now favored—such embodiment, as will be understood to be taken merely as illustrative and not as delimitative of the invention—

Fig. 1 is a view in elevation, showing such embodiment;

Fig. 2 is a transverse section through the sound-screen;

Fig. 3 is a fragmentary enlarged elevational view, showing a portion of the screen-proper of Figs. 1 and 2, with parts broken away;

Fig. 4 is a section taken on the line 4—4 of Fig. 3;

Fig. 5 is a view similar to Fig. 3, but showing a modification;

Fig. 6 shows said modification in transverse section;

Fig. 7 is a view similar to Figs. 3 and 5, but showing still another modification; and

Fig. 8 shows the modification last mentioned in transverse section. And Fig. 9 is a fragmentary transverse section, showing a further modification.

Referring now in detail to the exemplifying embodiment of Figs. 1 through 4, the same, marked generally 10, is shown as suitably set in an accommodatting opening 11 in a main structure 12, which latter can be, for instance, the aforesaid partition in a confessional.

The screen 10, as would be convenient, is shown as comprising a frame 14 of any suitable material, type or structure. The said frame is here also shown as quadrilateral and composed of a main female frame member 15, and a lesser male frame member 16, these members, with one nested in the other, being secured together in any desired way, as by a suitable adhesive, so as marginally to grip the edge portions of the acoustically-acting structure or screen-proper marked generally S.

In the present case, the screen-proper is shown as made of a parallelly corrugated element or sheet member 17, hereinafter for convenience called the upper member, a similarly corrugated element or sheet member 18, hereinafter for convenience called the lower member, and, sandwiched in between these two members, a preferably uniplanar sheet member 19, hereinafter for convenience called the membrane.

It is preferred, for facilitating easy and inexpensive fabrication of the screen-proper S, to form the members 17 and 18 so that the corrugations of one extend at right angles to the corrugations of the other. Aside from other very important advantages herein explained, such an arrangement facilitates a ready assembly of the three elements 17, 18 and 19 into a sheet-structure terminating in marginal or edge portions of three-ply thickness, all uniplanar with each other and parallel with the general central plane of said sheet-structure, and with these edge portions backed all around the sheet-structure by bevelled or slantingly receding areas. Referring to these areas as provided by either the member 17 or 18, both of two opposite sides of said sheet-structure are subtended by such areas which are of truncated triangular outline and rib-like or continuous along each of said sides, and both of the two other opposite sides of said sheet-structure are subtended by such areas which are relatively small and of full triangular outline and so placed that a line of them extends along each of the last mentioned sides of said sheet-structure. Due to the perpendicular relations between the corrugations of the two members 17 and 18, each of the four sides of the screen-proper is subtended on one side of the central membrane 19 by a rib-like bevel as just pointed out, and on the other side of said membrane, by a line of triangular bevels.

The uniplanar edge portions aforesaid, marked 20 in Fig. 2, are readily clampable between the frame members 15 and 16 incidental to assembly of the frame about the screen-proper to establish the screen 10.

The members 17 and 18 are corrugated, not only to give stiffness and prevent buckling, but also for other advantageous purposes, an important one of which latter is to make it possible, incidental to a convenient manner of fixing the membrane 19 between the members 17 and 18, to transform a single sound-transmitting main diaphragm, to wit, said membrane, into a multiplicity of cumulatively and cooperantly acting sound-transmitting instrumentalities, each established by a polygonal areal sub-division of said membrane. In the case illustrated in the drawing, showing as a preferred arrangement like corrugations in both members 17 and 18, and with these in the final assembly mounted at right angles as aforesaid, these sub-diaphragms, as they may be called, are square. Such a sub-diaphragm, identical with each of its fellows, is marked 21 in Figs. 3 and 4. In effect, such sub-diaphragm is clamped against stretch in any direction of expanse, because while the crests of the corrugations of one of the members 17 and 18 are secured to two of the opposite sides of the sub-diaphragm, along the entire lengths of these sides, the crests of the corrugations of the other of said members 17 and 18 are similarly secured to the two opposite sides of said sub-diaphragm.

As indicated at 22, each of the two corrugated members 17 and 18 is perforated, by a suitable number of holes, suitably located. As here shown, the arrangement of the perforations is such as

to provide a group of four thereof, in facing relation to each of the two opposite sides of a sub-diaphragm 21.

Such line securement of the corrugations to bounding lines of the sub-diaphragms has been most successfully practiced by using an adhesive appropriate to the nature of the materials of which the members 17, 18 and 19 are made.

Referring to Figs. 5 and 6, the modification here shown illustrates, as one feature, a shape of the perforations which is not circular as in Figs. 1 through 4, but which is, as indicated at 23, elliptical or elongated, and with the directions of elongation different as between the upper and lower members 17 and 18, and, as another feature, a method of co-attachment of the elements 17', 18' and 19' (corresponding respectively to the elements 17, 18 and 19 of Figs. 1 through 4), whereby the areas of the central membrane 19', which provide the subdiaphragms or elementary diaphragms, one of the latter here marked 21', can be drawn taut in all directions of expanse to obtain diaphragmatic action of maximum efficiency, yet with only point, or substantially point, securement between the corrugated members and the bounding lines of said elementary diaphragms. This point securement is at the four corners of the square outlines of said elementary diaphragms, when as shown in the drawing, the latter are established as squares as a result of employing the preferred shaping of the corrugated members as hereinabove explained. For best acoustical operation, point securement for the elementary diaphragms as just explained, is in a sense superior to line securement thereof as say pursuant to Figs. 1 through 4, as in the former case they will have more natural nodes of vibration than in the latter case, thereby obtaining a much smoother transmission characteristic.

Of the possible ways of effecting this point securement, two now preferred are illustrated, one in Figs. 5 and 6 and also in Figs. 7 and 8, and the other in Fig. 9.

In both of Figs. 5 and 6, and Figs. 7 and 8, at the predetermined loci of the corners referred to in the second paragraph preceding, the corrugated members are formed with integral cup-like or hollow bosses 24, having their closed bottoms so placed that when the parts are assembled as shown in these views, said bottoms flatwisely contact in pairs. These bosses or cups as shown are centrally apertured, and so that the apertures of a pair of mating bosses register when the sound-screen 10 is set up for assembly; and the central membrane is similarly apertured, that is, so that each aperture therein will line up with the matching boss-apertures of such set-up. But, whereas in Figs. 5 and 6, the inter-securement of the mating bosses and the contiguous points on the membrane are effected by gobs 25 of a suitable adhesive dropped into one of the matching bosses at each securement location so that due to the viscosity of such adhesive, it can be easily so applied as finally to set into a rivet-like entity as shown in Fig. 6, in Figs. 7 and 8 actual rivets 25a, as metal ones, are substituted.

Further, in regard to structural features, it may be desirable, and it is recommended, that any embodiment of the invention be provided with openings analogous, as to location and purpose, to the holes marked 26 and 27 in Fig. 1, so that the sound-screen proper, without removal from its frame 15 or the like, can be easily cleansed by washing, and easily dried by draining. An applied water stream, entering the holes 26 and 27, will flush out the tunnel-like passages on both sides of the central membrane, and will drain therefrom following the washing if the sound-screen be disposed with its general plane at an angle to the horizontal.

Best results have been obtained when the corrugated members are about .01''–.02'' thick, and the central membrane has a thinness of the order of .001''. Any of the well-known plastics is suitable, such, for instance, as lumarith, particularly where a transpicuous sound-screen is to be provided.

Very good results have been obtained with a plastic of the acetate type, as manufactured by du Pont or Eastman; about .015'' thick.

In many cases, the plastic selected will be one which because it is transparent, either from its nature or by virtue of the manner of its manufacture, will provide a sound-screen which is transparent. The uses where this would be desirable readily suggest themselves.

In other cases, a certain degree of non-transparency or obscured-translucency will be most desired; as for use in the confessional, so that partial recognition of the penitent may be had by the confessor, for instance, as to whether or not the penitent is male or female, child or adult. Any one or more or all of the sheet members can be made of other material than a plastic, as a sheet metal. Where corrugated metal sheets are used, these corrugations can be formed in the sheet by readily operable tools. Where the corrugated sheets are of plastic or other readily moldable material, they can be molded; or the sheets can be taken as made flat by the manufacturer, and bent to establish the corrugations, either with or without linear softening, by solvents or the like, along the lines of intended fold, according to practice familiar in the art of specially shaping plastic sheets. As for the modifications of Figs. 5 through 8, with the integral bosses, the most feasible thing would be to mold the corrugated plastic sheets. Where the corrugated sheets are of metal or the like, the bosses or equivalents can be drawn from the sheet.

The acoustic values of the new sound-screen are remarkable. An object attained by the invention is the provision of a structure which clarifies speech. The lower-frequency components of speech are reduced or attenuated more than the higher-frequency ones, during acoustic transmission through the screen. Consequently, the vowels are reduced in intensity more than the consonants, thereby producing increased articulation. By articulation, there is meant, in the nomenclature of acoustical engineering, syllable-articulation, which is defined by the percentage of syllables of speech which are correctly understood by the listener under standard acoustical conditions. It is mathematically calculable; and is expressed as a percentage.

Due to the multiplicity of elementary diaphragms afforded by the structures illustrated in the drawing, and the relatively small area of each of such diaphragms, quite a large plurality thereof are vibratile for sound transmission no matter where the mouth of the speaker be placed within the limits of the frame 16. This gives the unique advantage that different diaphragms can respond especially to different portions of the wave-front of the sound coming from the person speaking. Moreover, the acoustic characteristic of an elementary diaphragm is such that it transmits frequencies in the upper register with very

little attenuation, or to an extent of about the order of one decibel; whereas the frequencies in the lower register are attenuated and reduced, by about five decibels or more, depending on the frequency. This results in a net accentuation of the high-frequency components. While best articulation or intelligible audibility depends upon transmission of both the higher and lower frequencies, the higher frequency range, since within it are most of the consonants, is primarily responsible for 85% of articulation; leaving the lower frequency range, wherein lie the vowels, ordinarily to contribute not more than 15% toward articulation.

The perforations in the corrugated sheets or the like also act beneficially, as they permit the sounds of all important frequencies in the speech range to be transmitted for passage through said sheets for undistorted impingement on the elementary diaphragms of the central membrane.

Referring finally in detail to Fig. 9, this shows another way, out of the many possible ones, of mounting an elementary diaphragm by point securement, as at the four corners of a quadrilateral such diaphragm (which as here shown may be assumed to be a square one). Such an arrangement is especially feasible, and is recommended because now though to offer what may be one of the most efficient embodiments of the invention, where the sound screen, includes, in addition to the membrane subdivided into the elementary diaphragms, such membrane here marked 19'', oppositely offset auxiliaries which are moulded from a plastic mterial as aforesaid, and which auxiliaries are not corrugated. Then such auxiliaries, here marked 17'' and 18'', provide areal portions which, as to acoustical behavior and as contributing aids in mechanically assembling the screen, correspond in function to the apertured corrugations and other elements of Figs. 1 through 8. Sheets 17'' and 18'' are so made that the first of the two last-named kinds of portions thereof are all in the same plane in one sheet, merging into downwardly outwardly inclined skirts 26 running all around the periphery of the screen, with these skirts in turn merging into band-like extensions 27 between which the margins of the membrane 19'' may be sandwiched. Integrally moulded with these sheets are bosses 28 here shown as of spike form, arranged in rows both along and across the screen, and desirably being positioned so that when the screen is assembled as indicated in Fig. 9, a spike on one sheet is aligned with a spike on the other, so that as shown the free ends thereof coact to make a point securement of a corner of an elementary diaphragm 30; opposite each of which diaphragms each sheet 17'' and 18'' is shown as carrying four perforations 31.

In all the forms of the invention shown in the drawing good results have been obtained when the central membrane was not so tautened or stretched as to be under appreciable tension.

Aside from those hereinabove specially mentioned, other variations and modifications are possible within the scope of the invention as defined by the appended claims; and parts of the improvements can be used without others. As will be understood, the invention is not to be limited beyond the express terms of said claims, interpreted as broadly as is consistent with the prior art.

I claim:

1. An acoustic device for interposition between one speaker and another to act as a partition between the two but permitting the transmission of speech between them, comprising a pair of corrugated sheet members, the corrugations on one of the sheet members being disposed at an angle to those in the other member, a flat sheet member sandwiched between the corrugated sheet members, said corrugated sheet members being attached to the flat sheet at the crests of the corrugations only, the corrugated sheet members being provided with apertures located between the points of attachment of said members to the flat sheet.

2. An acoustic device for interposition between one speaker and another to act as a partition between the two but permitting the transmission of speech between them, comprising a pair of corrugated sheet members, the corrugations on one of the sheet members being disposed at an angle to those in the other member, a flat sheet member sandwiched between the corrugated sheet members, said corrugated sheet members being attached to the flat sheet at the crests of the corrugations only, the corrugated sheet members being provided with apertures located between the points of attachment of said members to the flat sheet, the flat sheet being wholly imperforate.

3. An acoustic device for interposition between one speaker and another to act as a partition between the two but permit the transmission of speech between them, comprising, a pair of overlying corrugated sheet members, the corrugations of one of said members extending substantially at right angles to those of the second member, a flat uncorrugated sheet sandwiched between the corrugated members and connected thereto at spaced intervals, said flat sheet being attached to the corrugated sheet members at the crests of the corrugations in said members to provide unsecured substantially square diaphragm sections in said flat sheet, the corrugated sheet members being each provided with a plurality of openings, the openings in one of said members being substantially in alignment with those in the other sheet, the interposed flat sheet being imperforate.

4. A device of the character described comprising, two perforated corrugated sheet members having a flat imperforate diaphragm member sandwiched between and secured at spaced points to them, the marginal edge portions of the corrugated sheet members and the flat diaphragm being brought flatwisely together, and means surrounding said edges and holding the same in such flatwise relationship.

VESPER A. SCHLENKER.