March 21, 1950 B. P. KUNZ 2,501,180

CORRUGATED STRUCTURE

Filed April 1, 1946 2 Sheets-Sheet 1

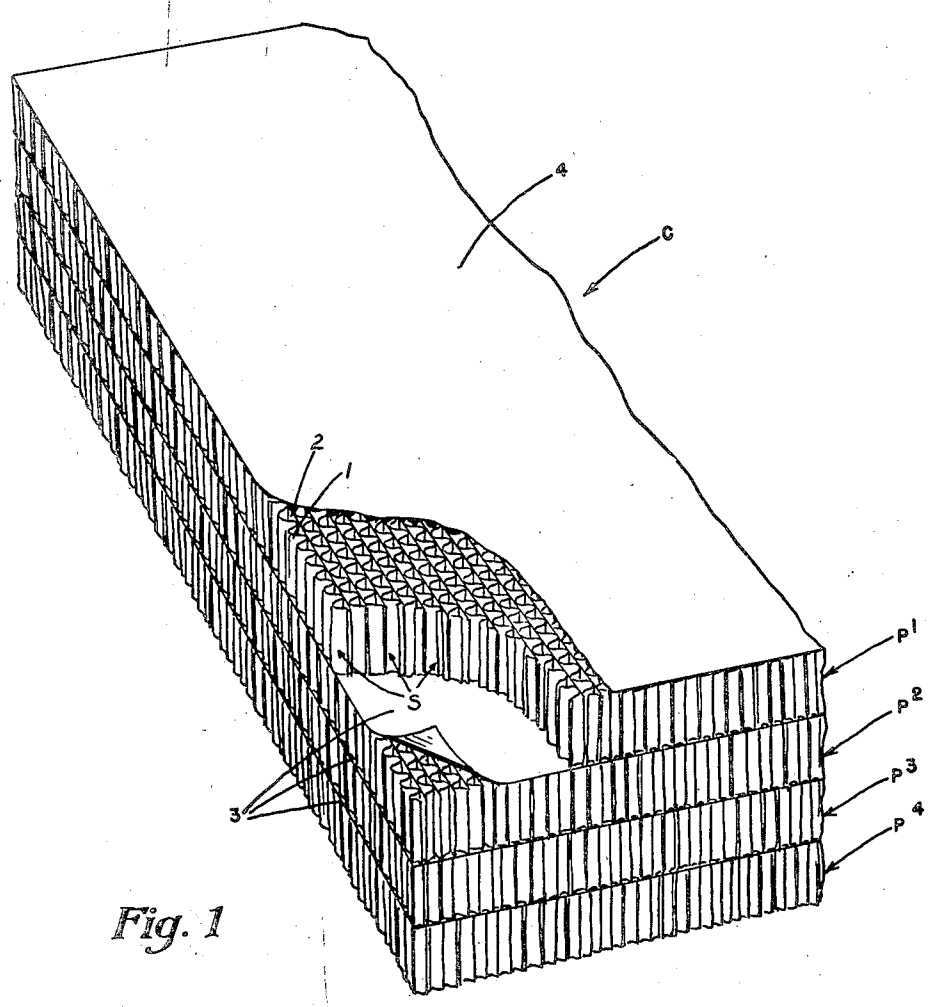


Fig. 1

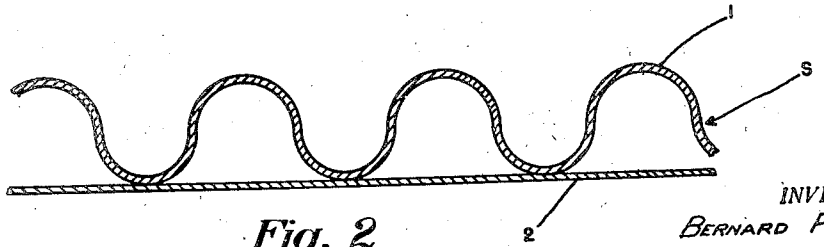


Fig. 2

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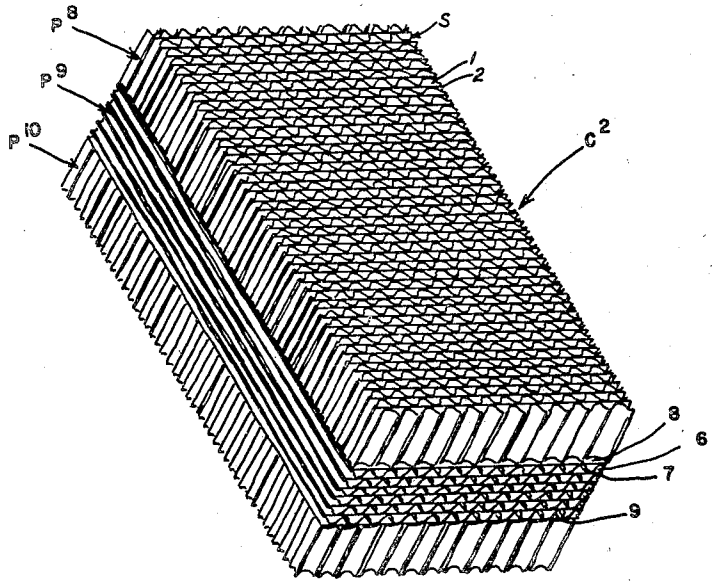


Fig. 4

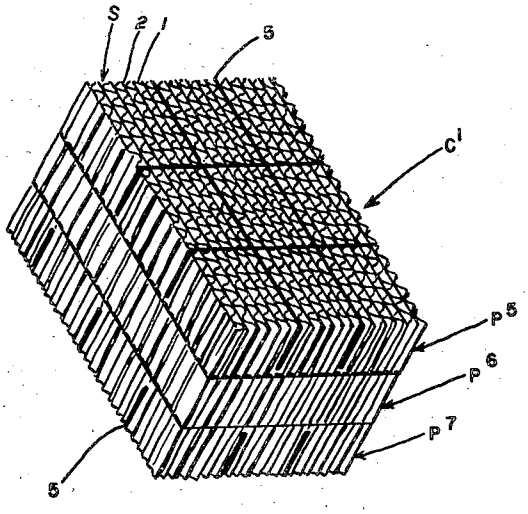


Fig. 3

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2,501,180

CORRUGATED STRUCTURE

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Application April 1, 1946, Serial No. 658,851

3 Claims. (Cl. 154—55)

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This invention relates to a corrugated structure and more particularly to a structure built up from a plurality of corrugated sheets of suitable material.

One of the objects of my invention is to so construct from a plurality of corrugated sheets of material a structure which will be rigid and capable of withstanding large compression forces.

A further object is to produce a structure from corrugated material that will have excellent insulation characteristics.

Yet another object is to so construct panels from corrugated and flat sheets of material and then associate said panels with each other that the resulting structure will have a considerably lower thermal conductivity than a like thickness of a single panel.

A still further object is to produce a corrugated structure which can be so constructed as to produce varying insulation characteristics as desired.

A more specific object is to produce an improved corrugated structure by laminating panels constructed from sheets of flat and corrugated materials.

A further object is to produce an improved structure from corrugated fibre material such as corrugated paper.

Yet a further and more specific object is to so associate panels made from corrugated fibre material that a structure will be produced which will withstand large compression forces applied in several directions.

Other objects will become apparent from the following description taken in connection with the accompanying drawing showing two different structures embodying my invention.

In the drawings:

Figure 1 is an isometric view of a corrugated structure embodying my invention;

Figure 2 is a section view of a corrugated sheet of material from which the panels of the structure of Figure 1 are constructed;

Figure 3 is an isometric view of a slightly modified corrugated structure; and

Figure 4 is an isometric view showing another corrugated structure embodying my invention.

Referring to the drawings in detail and first to Figures 1 and 2, there is disclosed an improved corrugated structure C which is constructed from any suitable corrugated material and flat sheets of material, one suitable material being a fibre material such as paper. The structure is built up from a plurality of panels of like construction indicated by P^1, P^2, P^3 and P^4. Four panels are

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shown as comprising the structure, but fewer or more panels may be employed as desired. Each of the panels is made from a plurality of strips S comprising a corrugated strip 1 having adhered to the crowns of the corrugations on one side of the strip a flat strip of paper 2 as clearly indicated in Figure 2. The strips S can be formed by stripping a large sheet of corrugated paper which has a sheet secured to one side thereof. The strips S are all of equal width and are arranged on edge in parallel relations so that in the resulting panel the axes of the corrugations will be at right angles to the major face surfaces of the panel. When the strips are placed in parallel relation, the flat strip 2 of each strip S is arranged to be adjacent the side of a next strip S which does not have adhered to it any flat paper strip. With this arrangement of the strips they are adhered together in the manner indicated in Figure 1 by any suitable adhesive material. The built up panel will then comprise alternate corrugated strips 1 and flat strips 2, the edges of which form the major face surfaces of the panel.

To construct the corrugated structure C from these built up panels, the panels are arranged in stacked relation with major face surfaces in opposed relation. Between the opposed face surfaces of adjacent panels are placed flat sheets 3 of suitable material such as fibre material, preferably paper, although a cloth may be used if desired. The dividing sheets 3 between the panels are adhered to the major face surfaces of the panels by means of any suitable adhesive. If desired, the outer face surfaces of the outer panels may have secured thereto covering sheets of material as, for example, the sheet 4 shown in Figure 1. These covering sheets 4 may be left off when the corrugated structure is desired to be faced by some plastic, mastic or mortar type of material.

The corrugated structure C which has been built up from the plurality of panels such as, for example, the panels P^1 to P^4 as shown in Figure 1, is very rigid and is capable of withstanding very high compressive forces, particularly when applied to the major exposed surfaces of the two outer panels. Tests have shown that a corrugated structure built from paper is able to withstand as high as 200 pounds per square inch pressure when applied to the outer face surfaces of the outer panels. Tests of the corrugated structure C also clearly demonstrate that it has very high thermal insulating values and these values are directly the result of the innumerable number of cells in each panel, together with the divi-

sion of the cells of one panel from the cells of an adjacent panel by the use of the interposed flat sheets 3 between the panels. The high insulating values of the corrugated structure C is apparent when the "K factor" of a single panel having a predetermined thickness is compared with the "K factor" of a corrugated structure which is built up from a plurality of panels in the manner disclosed in Figure 1 and having the same thickness as the single panel. The former has a high "K factor," whereas the structure C has a good low "K factor." The "K factor" referred to is a standard insulating value and is defined as "the thermal conductivity in B. t. u. per hour per square foot and temperature gradient of one degree Fahrenheit per inch of thickness." The lower the "K factor" the better is the insulating value of the material. The wide difference in the "K factor" of a single panel and applicant's new corrugated structure results from the advantage of the latter in breaking the radiation effect through the material and also the use of the dividing sheets 3 between the panels through which conduction must take place. In a single panel the cells formed by the strips S embodying the corrugated strips 1 and the flat strips 2 extend unbroken from one face of the panel to the other face of the panel and thus heat can be radiated directly through these cells. When a plurality of panels are associated together and divided by sheets 3, as in the corrugated structure C, the heat which is radiated through the cells in one panel must then be conducted through the sheets 3 before it can be re-radiated through the cells of the next panel. Thus this "hindering" of radiation increases the insulation value of applicant's corrugated structure over a single panel structure such as any of the panels from which the corrugated structure C is built.

Not only in insulating value is the corrugated structure C superior to single panel structures, but it is also more rigid, less subject to warpage and handling becomes easier. Another advantage the corrugated structure C has over a single panel structure is that the insulation value for a given thickness can be varied as desired. If a certain thickness of panel is necessary and it is required to have a certain "K factor," then the "K factor" can be properly obtained by using the desired number of panels, each of a desired thickness, to obtain the over all thickness and insulation value as required. If a single panel only were employed, having the desired thickness, then it would probably be impossible to obtain the desired "K factor," particularly if the "K factor" was to be low, that is, a good insulating value.

If it is found necessary to have the corrugated structure C embodying applicant's invention either fireproof or moistureproof, or both, this result can be attained by impregnating the paper, if paper is used, with any suitable fireproof material or moistureproof material or material having both characteristics. In building up the corrugated structure C the panels, if desired, can be arranged so that the flat strips 2 of the strip S of one panel will be crosswise of those of adjacent panels. This will give greater strength against bending during handling.

When the corrugated structure C is to be covered with a moisture containing material such as mortar, it has been found that some warpage may occur. This warpage is caused by some moisture being absorbed by the paper at the outer surface of the outer panel which has the moisture containing material placed thereon. As the paper dries there may occur some shrinkage and this will cause warpage of the corrugated structure. I have found that this warpage can be prevented by providing slits in the outer panels of the corrugated structure. This slit arrangement is illustrated in Figure 3 wherein the corrugated structure C^1 comprising the three panels P^5, P^6 and P^7 and interposed sheets as already described has embodied in its two outer panels, P^5 and P^7, crossed slits 5. The slits are cut into the panels as by a saw and they extend inwardly at right angles to the outer face surface of the panel. The extent to which these slits 5 extend into the panel structure is greater than at least half the thickness of the panel and they can extend substantially the entire thickness of the panel if found desirable. The slits may be provided only in one of the outer panels or in both the panels as indicated in Figure 3. If the slits are placed in both outer panels, then at least some of the slits in one panel should be in a plane other than any plane in which slits of the other panel are placed, all as illustrated.

In building up a corrugated structure it is highly desirable that more than two panels be employed and that there be an odd number of panels, such as the three panels shown in Figure 3. These odd number of panels in the built up structure will be such that the neutral axis of the structure will lie in the center panel between the face surfaces thereof. Furthermore, the divider sheets between panels will all be spaced from the neutral axis and be positioned either on one side or the other side of said neutral axis, thereby permitting said sheets to be capable of acting both in tension and compression and thus provide additional means to resist bending loads acting upon the complete structure. The entire built up corrugated structure will thus be more rigid than a structure built from a single panel or a structure built from an even number of panels.

Another type of corrugated structure is shown in Figure 4. As disclosed, this structure C^2 has three panels P^8, P^9 and P^{10}. The two outer panels P^8 and P^{10} are constructed in a manner identical with the panels of the corrugated structure C shown in Figure 1. The intermediate panel P^9, however, is constructed of corrugated paper but in a different manner than the outer panels. As shown, this panel P^9 is built up from stacking a plurality of sheets 6 comprising a corrugated sheet 7 and a flat sheet 8 secured to one side of the corrugated sheet. When these sheets 6 are stacked and secured together, the open crown side of the corrugated sheet of each sheet 6 will be adhered to the flat sheet of the adjacent sheet 6. After the sheets 6 are all placed together the face surface which has its corrugations exposed will be covered by a flat sheet such as the sheet shown at 9. Thus the panel P^9 will have flat sheets of paper, or other suitable material, on both of its outer face surfaces and these face surfaces can have secured to them the panels P^8 and P^{10}.

A corrugated structure constructed in the manner shown in Figure 4 is primarily useful in increasing the resistance to compression in the lengthwise direction of the corrugated structure, since the axes of the corrugations of the intermediate panel P^9 extend at right angles to the axes of the corrugations of the panels P^8 and P^{10}. It is seen that these corrugations of the panel P^9 will increase the strength of the corrugated structure in the direction of the axes

of the central panel. Although the corrugated structure shown in Figure 4 has only three panels, it is possible to build a similar structure with more panels and employ a panel such as the panel P^9 in alternate arrangement with respect to panels such as P^8 and P^{10}. The alternate panels, such as P^9, can be placed so that the longitudinal axes of the corrugations will be at right angles to each other. Thus resistance to compression in two directions will be obtained by the alternate panels P^9.

Being aware of the possibility of modification in the corrugated structures shown and described without departing from the fundamental principles of my invention, I do not intend that the scope of the invention be limited in any manner except in accordance with the appended claims.

What is claimed is:

1. In a corrugated structure, a plurality of panels in excess of two constructed of corrugated paper, each panel of said structure comprising strips of corrugated paper of like widths so arranged in parallel relation that the thickness of the panel will correspond to the width of the strips and the axes of the corrugations will be at right angles to the face surfaces of the panel, and a flat strip of paper interposed between adjacent strips of corrugated paper and adhered to crowns of the corrugations of said strips, and means for securing the panels together in stacked relation with face surfaces of adjacent panels in opposed relation, said securing means comprising a sheet of fibre material interposed between each pair of opposed face surfaces of the panels and adhesive material securing the face surfaces to the sheets, said two outer panels only of the corrugated structure being provided with slits extending at right angles to the face surfaces thereof and from the outer face surface of each outer panel a distance inwardly greater than half the thickness of the panel, but short of the sheet between the outer panel and the next inner panel.

2. In a corrugated structure, a plurality of panels in excess of two constructed of corrugated paper, each panel of said structure comprising strips of corrugated paper of like widths so arranged in parallel relation that the thickness of the panel will correspond to the width of the strips and the axes of the corrugations will be at right angles to the face surfaces of the panel, and a flat strip of paper interposed between adjacent strips of corrugated paper and adhered to crowns of the corrugations of said strips, and means for securing the panels together in stacked relation

with face surfaces of adjacent panels in opposed relation, said securing means comprising a sheet of fibre material interposed between each pair of opposed face surfaces of the panels and adhesive material securing the face surfaces to the sheet, said two outer panels only of the corrugated structure being provided with crossing slits extending at right angles to the face surfaces thereof and from the outer face surface of each outer panel a distance inwardly greater than half the thickness of the panel but short of the sheet between the outer panel and the next inner panel, at least some of the slits in one outer panel lying in different planes than any slits in the other outer panel.

3. In a corrugated structure, a plurality of panels constructed of corrugated material, each of said panels being formed from a plurality of corrugated strips of like width and arranged in parallel relation, said strips having the axes of their corrugations arranged at right angles to the face surfaces of the panels, and flat strips of material secured to and interposed between adjacent corrugated strips, and means for securing said panels together with their face surfaces in parallel relation, said securing means comprising a sheet of material interposed between adjacent face surfaces of panels and adhered thereto, said panels forming the structure being an odd number so that the neutral axis of the complete structure will lie between the face surfaces of the center panel and all the sheets forming a part of the means for securing the panels together will be spaced on opposite sides of the neutral axis and thereby resist bending loads by acting in tension or compression.

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