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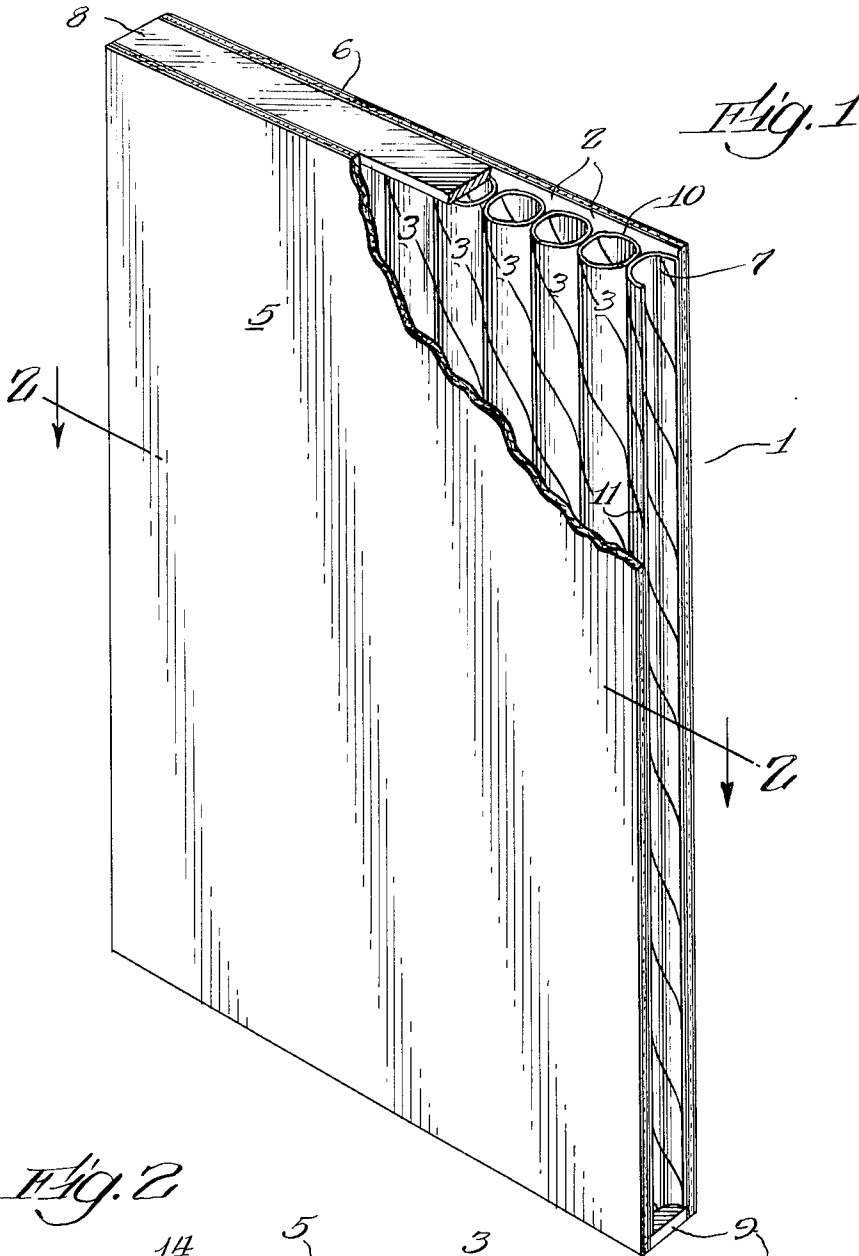
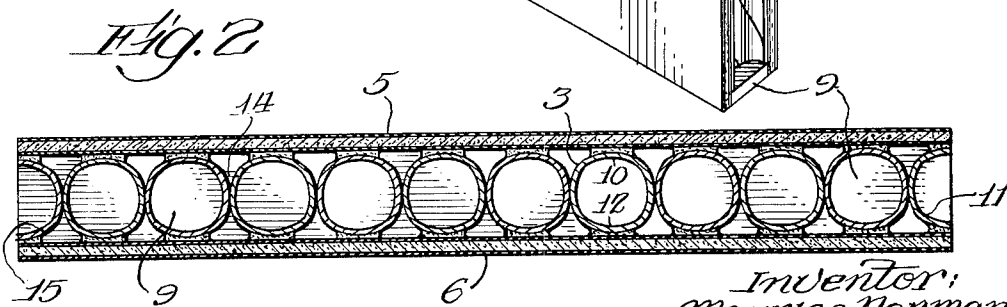
M. NORMAN

3,228,822

TUBULAR CORE PARTITION PANEL

Filed April 24, 1961

2 Sheets-Sheet 1



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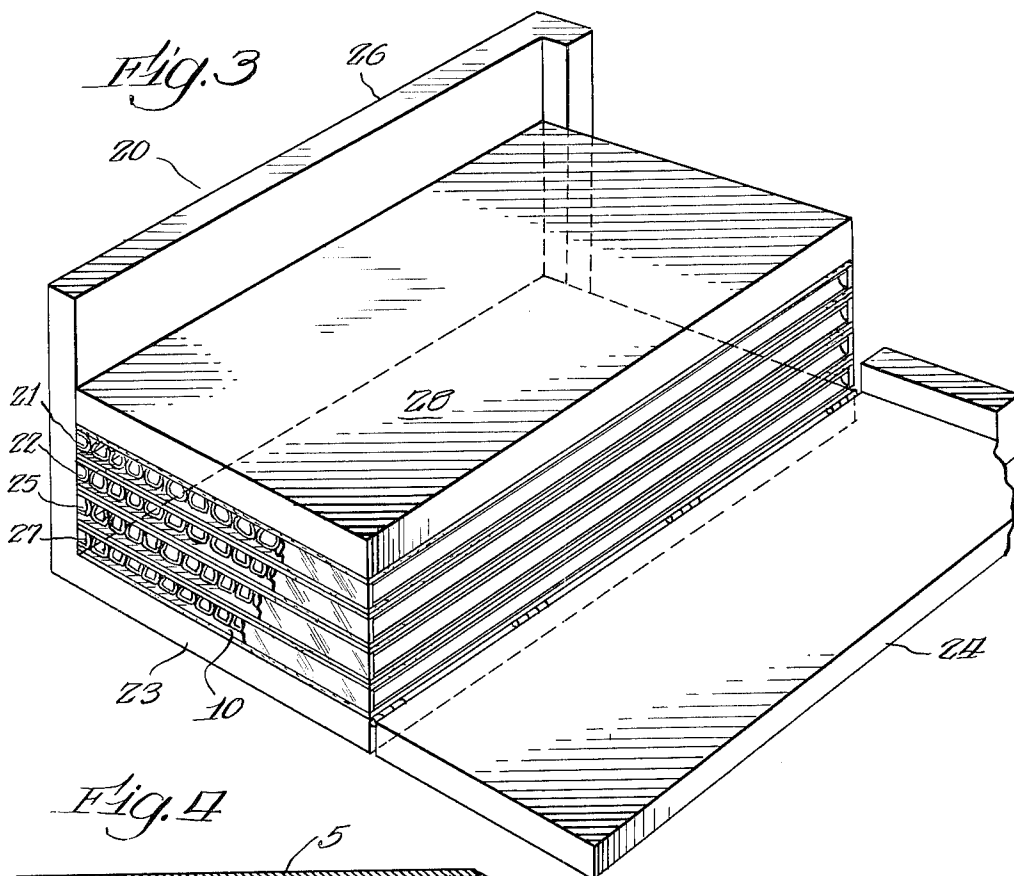
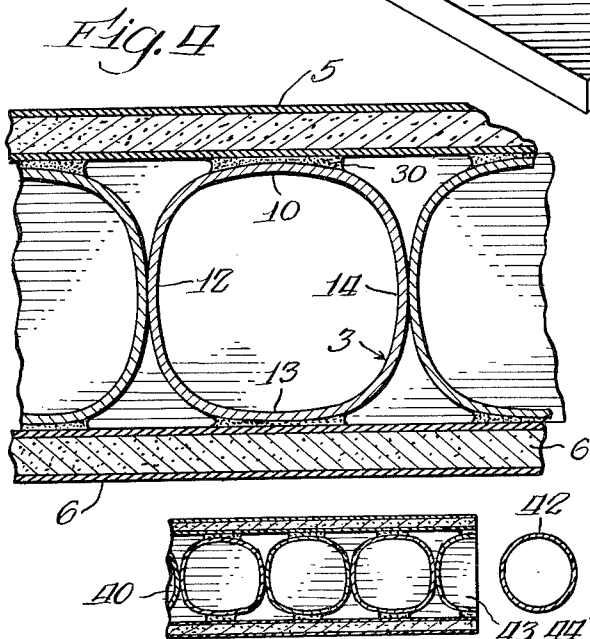
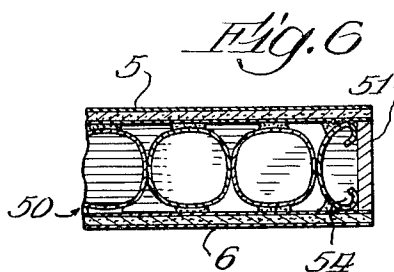
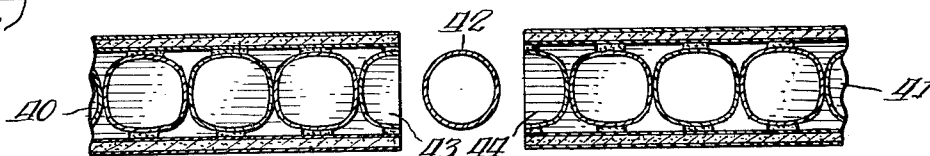
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TUBULAR CORE PARTITION PANEL

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2 Sheets-Sheet 2



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3,228,822

TUBULAR CORE PARTITION PANEL

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3 Claims. (Cl. 161-139)

This invention pertains to prefabricated panels and, more particularly, to a prefabricated panel having a tubular core disposed between a pair of facing sheets, and the method of making the same.

Heretofore, many prefabricated panels have been constructed to meet the constantly growing demand for prefabricated construction materials. Though many panels have been constructed to meet this demand, the majority of such panels have failed to provide many of the features necessary in an acceptable and practical prefabricated panel. To receive acceptance as a prefabricated construction material, a panel must be economical, strong, easily fabricated, adaptable to continuous production, and easily erected on the job site. Moreover, prefabricated panels of necessity must provide for the placement of electrical conduits, plumbing lines, and the like, within the panel itself.

Therefore, one of the primary objects of this invention is to provide a panel that is economical and lends itself well to continuous production.

Another object is to provide a panel that is structurally sound; comparable in many respects to conventional wooden stud construction erected on the job site.

Another object is to provide a panel that is easily aligned and adjoined to another panel of like description.

A further object is to provide a prefabricated panel that provides for the passage of plumbing, electrical conduits, and the like, within the panel itself.

A still further object is to provide a prefabrication construction that is resilient and light in weight.

Further objects and advantages will become apparent from the description, drawings, and appended claims.

Generally stated, this invention contemplates a panel comprised of a pair of spaced facing sheets of aluminum, steel, hardboard, gypsum board, or the like, having substantially cylindrical elongate tubular members disposed therebetween. (As used in this specification and the appended claims, the terms "cylinder" and "cylindrical" refer to a right circular cylinder. The tubular members may be comprised of such materials as plastic, paper, bagasse, asbestos, or the like. In order for the tubular members to function structurally within the panel they are arranged in a substantially adjacent parallel manner with bonding means, such as adhesives, providing the attachment with the face sheets. It has been found that a structurally sound and improved panel is achieved by deforming the tubular members to an out-of-round or non-circular shape in cross section by use of pressure during the fabrication process. The cylindrical tubular members are placed in juxtaposed relation between the facing sheets and pressure applied thereto. This results in spaced elongated flattened portions being formed on the tubular members in the area of contact with the face sheets. While under pressure, the tubular members are adhered to the facing sheets at these elongated flattened portions. This provides a panel which is structurally sound and, in many respects, comparable to conventional wooden stud construction.

In order to facilitate the description and understanding of this invention, reference is made to the appended drawings in which:

FIGURE 1 is a perspective view of the panel with a portion cut away to expose an area of the tubular core;

FIGURE 2 is a sectional view taken along line 2-2 of FIGURE 2;

FIGURE 3 is a perspective view of panels within a form used in assembling the panel of this invention;

FIGURE 4 is a fragmentary view of a panel showing the area of adhesion between a tubular member and the face sheets;

FIGURE 5 is a fragmentary sectional view showing end portions of two panels and a jointer tube prior to being adjoined; and

FIGURE 6 is a fragmentary end view of a several panel showing a spacer member inserted between the face sheets.

Referring now to FIGURE 1, a panel 1, with a portion cut away to expose an area of the tubular core 2 is illustrated. The panel 1 is provided with a plurality of elongate resilient tubular members 3 arranged in substantially abutting coplanar relationship between a pair of spaced apart face sheets, 5 and 6. The face sheets may be comprised of aluminum, steel, hardboard, gypsum board, or any like material, and are preferably of a size which can be easily handled and erected. The tubular members 3 are of a length slightly less than the length of the face sheets, 5 and 6, and are positioned therebetween in such a manner that slight recessed portions, only recess portion 7 is shown, are formed between the face sheets, 5 and 6, at each end. The tubular members 3 may be comprised of plastic, paper, asbestos, bagasse, fiberboard and the like, and are of any appropriate size which would form, with face sheets, a panel of conventional size. The marginal free edge tubular members, only member 11 is shown, are half-tube sections conveniently formed by cutting a tubular member along its elongate axis into substantially a pair of semicircular sections. The half-tube sections are positioned between the edges of the face sheets with the concave portions exposed. The core of tubular members 2 is placed under pressure in order that each individual cylindrical tubular member is deformed to an out-of-round shape with spaced elongated flattened portions 10 formed substantially parallel to the face sheets. Bonding means, such as adhesives, secure the spaced elongated flattened portions 10 on each tubular member 3 to the face sheets, 5 and 6. Spacer members, 8 and 9, such as wooden strips or like material, are positioned within the recessed portions of which only 7 is shown. The spacer members, 8 and 9, are secured to the face sheets by either bonding means, such as adhesives, or by fasteners, such as nails or screws. Primarily, these members function as built-in runner elements for the panel and thereby utilized in securing the panel to the floor and ceiling structure. In addition, end damage to the face sheets is minimized since the members reinforce the ends of the panel.

In one preferred embodiment, the prefabricated panel is provided with face sheets 4' x 8', made of 1/4" thick gypsum wallboard; a plurality of spirally wound jute paper tubes of 2.52" outside diameter, wall thickness of .04" and length of 95 inches, arranged in abutting coplanar relationship therebetween; and wooden spacer members 1/2" x 2 1/2" inserted along substantially the width of the panel at each end. The tubular members are deformed out-of-round to the extent that the spaced elongated flattened portions on each tube in juxtaposition with the face sheets are approximately 3/8" wide. Polyvinyl acetate emulsion disposed over the spaced elongated flattened portions and along the elongate axis of each tube secure the tubular members between the face sheets. In addition, adhesive means also secures the spacer members in position between the face sheets.

As can be appreciated, such a panel is comparatively light in weight and fabricated from economical materials. The tubular members of the core form convenient passages for receiving plumbing, electrical conduits, and the like, within the panel itself. In addition, it is apparent

that the panel already described could be used as a core for another panel by laminating face sheet layers over the existing face sheets.

FIGURE 2 is a sectional view taken along line 2—2 of FIGURE 1. As shown, a plurality of adjacent resilient tubular members 3 are arranged between a pair of spaced apart face layers, 5 and 6. Each resilient tubular member 3 has spaced elongated flattened portions, 10 and 12, which are adhered to the face sheets by adhesive means. Each tubular member may be attached to adjacent members by adhesive means along the area of contact, 14, between adjacent members. The edge members, 11 and 15, are half-tube sections with the concave portions thereof exposed in order to provide a novel means of adjoining adjacent panels in the erection of a wall construction. It is apparent, however, that the edges of the panels could be formed in any appropriate manner which would allow an acceptable method of adjoining adjacent panels.

Heretofore, tubular members have been used in building construction to either lighten the construction, since each member encompasses a void space, or to act as thermal insulation by sealing off the ends of the individual tube members in order to entrap the air within the members. It is believed obvious that the panel already described utilizes the tubular members in an entirely different and unique manner, i.e., for structural purposes. In order to provide a structurally sound panel which utilizes tubular members for structural purposes, it is necessary that the members function collectively to resist any force which is applied to the face sheets. For example, a load applied normal to an area on the face sheet is transmitted to the immediate tubular members in substantial registration with the load area and is further transmitted by these members to adjacent members which successively act to buffer or resist the load. In effect, therefore, each tubular member acts to not only restrain the face sheet in the area in which it is adhered to, but also to restrain adjacent tubular members. It will thus be apparent that the deformation of the tubes must be less than that which would cause a tube so contact the face sheet over 25% of the tube periphery, or expressed another way, face sheet to tube contact over substantially all the face sheet area. Preferably, the deformation is considerably below this limit, and the term "elongated flattened portion" used herein is to be understood and construed to result from a deformation below this limiting value. Except at the elongated flattened portion, the wall of the tube remains in a curved shape.

It has been found that a structurally sound and improved panel is achieved by deforming the tubular members to an out-of-round or non-circular shape in cross section by use of pressure. In FIGURE 3 a form 20 is shown which is used to restrain the panels 21, 22, 25, and 27 when pressure is being applied thereto. After the tubular members have been adhered to the face sheets, but before the adhesive is set, the panel is placed within the form 20. The form 20 is preferably constructed with a bottom 23 and two upright side members, 24 and 26. One side member, 24, is movable so as to allow a degree of clearance for the placement of the panels within the form 20. As shown, the form 20 is preferably constructed to receive a plurality of superimposed panels. After the panels have been disposed within the form 20, the movable side member, 24, is positioned upright to align the panels. Pressure is exerted on the exposed face sheet of the topmost panel by controlled means 28, such as weights, clamps, etc., and is retained until the adhesive has set. When this condition has occurred, the pressure is withdrawn and the panels, 21, 22, 25 and 27, are removed from the form 20. By applying this pressure, the tubular members within each panel are compressed slightly out-of-round and because they are somewhat restrained by adjacent members, an elongated flattened portion 10 is formed on each member at its contact area with the face

sheets, as well as between adjacent members. The adhesion between the tubular members and the face sheets results in the members being held in a deformed state as described.

As can be appreciated, the pressure process also embodies the advantageous features of accurately aligning the panels and controlling the thickness of each individual panel. Since certain of the members within the panel may vary in size to a slight degree, such as the face sheets and the tubular members, it is essential that the effects of such be minimized as such as possible. It is apparent that each panel must be structurally true within certain tolerances in order to be easily and rapidly erected. By controlled pressure the panel can be easily and rapidly fabricated within the necessary tolerances. In addition, the process lends itself to continuous production which, of course, is one of the features necessary in an acceptable and practical prefabricated panel.

FIGURE 4 shows the area of adhesion 30, accentuated, between a tubular member 3 and the face sheets, 5 and 6. As shown, the tubular member 3 is deformed with spaced elongated flattened portions 10, 12, 13 and 14, positioned at intervals around the wall of the member. The adhesive layer provides the attachment of the tubular member 3 between the face sheets, 5 and 6. As can be appreciated, the area of bonding is extremely important to the structural soundness of the panel. It has been found that the bonding area should not be of a width less than .21 inch for a panel previously described as a preferred embodiment. This is believed necessary in order for the bond to resist without failure shear stresses produced by minimal impact loads. In the preferred embodiment previously described, the bonding area is $\frac{3}{8}$ inch wide in order to provide a structurally sound panel which is comparable to conventional wooden stud partitions. However, it is believed apparent that the minimal and preferred bonding areas vary according to the materials used as face sheets and tubular members.

FIGURE 5 shows a portion of a pair of panels, 40 and 41, and a jointer member 42 prior to being joined. The side edge of each panel, 40 and 41, is provided with a half-tube section, 43 and 44, respectively, having their concave portions exposed. A jointer member 42 is used in the alignment and attachment of the adjacent panels, 40 and 41. Preferably, the jointer member 42 is a cylindrical elongate tube of the same material as the tubular members of the panel. In order to provide a firm and secure joint between adjacent panels, the outside diameter of the jointer member 42 should be substantially the same as the inner diameter of the half-tube sections, 43 and 44.

One method of erecting panels to form a conventional wall construction is to position the panel in an upright position with the tubular members extending vertically and the spacer members in contact with the floor and ceiling structure. To secure the upright panel to the floor and ceiling structure nails are driven at an angle through the spacer members into the supporting structure. To join adjacent panels the jointer member 42 is adhesively bonded within the concave portion of the half-tube section 43 of one panel 40. Adhesive is also applied to the exposed portion of the jointer member and the adjoining panel 41 is positioned to receive the exposed portion of the jointer within its half-tube section 44. With face sheets of gypsum board or the like, the joint between adjacent panels may be treated in the conventional drywall manner by a suitable joint tape and cement. However, it is believed obvious that the abutting edges of the face sheets could be shaped in various ways, such as a bevelled edge, to provide an exposed joint of pleasing appearance.

A joint between adjacent panels constructed in the manner just described has been found to exhibit structural properties equal to or better than the panels which it adjoins. As can be appreciated, a wall surface provided with structurally sound prefabricated panels and

means for attaching the panels, would satisfy a long felt need in the building industry.

By use of the jointer member, it is also apparent that the panels are easily and rapidly aligned. Therefore, with prefabricated panels constructed with controlled dimensions and the use of jointer members to align adjacent panels, the erection of the wall construction is but a simple and rapid procedure.

It is, of course, obvious that the panels may be adjoined by other means, such as utilizing a jointer member of the same dimension as the tubular members of the core of the panel. The panels are constructed in substantially the same manner as described but without the half-tube sections. Therefore, when the panels are to be adjoined, the tubular member is inserted between the face sheets and adhesively bonded thereto. However, such an adjoining means requires greater time and effort on the part of the erector to properly align and position adjacent panels, and is thus believed to be a less desirable method.

FIGURE 6 shows a panel 50 with a side spacer member 51 inserted along the side edge thereof and between the face sheets, 5 and 6. The panel 50, as shown, is severed along the vertical elongate axis of any tubular

The second test was an impact load resistance test. The panels in each case were supported as in the previous test. A 60-pound bag of sand with a 10" diameter face was dropped at the strongest point on the face of the panel from heights beginning at 6" and increased 6" increments until failure of the outer sheet occurred or the panel broke. The height of drop at failure is listed in inches.

The third test made on the panels was a concentrated load test. In this test, a steel disc having a diameter of 1" was brought to bear against the face of the panel at the weakest point. Force was applied to the disc and recorded in pounds. The pressure was recorded at the point when the outer sheet failed.

The fourth and last test was a column load or axial compressive load test. In this test, the panels were placed vertically in a test frame with the lower end resting on a steel plate. A compressive load was applied uniformly along a line parallel to and spaced one-third the distance of the thickness of the panel from one face. The load recorded was the maximum load which the panel could support.

Table A

Type of 4' x 8' Partition Panel Tested	Thickness, inches	Weight, lbs.	Mid-Point Load (1st Test), lbs./inch	Impact Load (2nd Test), inches	Conc. Load (3rd Test), lbs.	Column Load (4th Test), lbs.
(1) Spiral wound jute paper tubes, .04" wall thickness, 2.52" outside diameter, tubes adjacent, pressure deformed with $\frac{3}{8}$ " area of adhesion, $\frac{1}{4}$ " gypsum board face sheets, $\frac{1}{2}$ " x $2\frac{1}{2}$ " top and bottom wood spacers	3	85	1,700	36	130	18,000
(2) Same as (1) except with $\frac{3}{8}$ " gypsum board face sheets	$3\frac{1}{4}$	120	2,000	42	200	19,000
(3) 2" x 3" wood studs, 16" O.C., $\frac{3}{8}$ " gypsum board applied vertically, standard wallboard nails 8" O.C.	$3\frac{3}{8}$	125	1,600	30	135	19,000
(4) 1" cell 99# kraft paper honeycomb core, $\frac{3}{8}$ " gypsum board face sheets	$2\frac{1}{2}$	110	1,100	30	215	13,000
(5) 2" foamed polystyrene core, $\frac{1}{4}$ " gypsum board face sheets, $1\frac{1}{2}$ x $1\frac{1}{2}$ top and bottom wood spacers	$2\frac{1}{2}$	85	615	42	200	8,000

member 54 at any appropriate position on the panel. The remaining portion of the severed tubular member 54 within the panel is deformed to allow a side spacer member 51, such as a wooden strip, to be inserted between the face sheets, 5 and 6, along substantially the entire edge of the panel. The spacer member 51 is secured by bonding means, such as adhesives or fasteners, such as nails. The side spacer member 51 provides an abutting surface to be positioned against a wall or other vertical surface, such as a door jamb, door frame, or the like, and is secured thereto by nails or other equivalent means. As can be appreciated, this provides a prefabricated panel that is easily and readily adaptable to receive necessary vertical members, such as door frames and the like, which are necessary for a finished wall construction. It is believed apparent that the means of severing panels, as described, of the preferred embodiment or the like, can be accomplished by a hand saw or other appropriate conventional severing means.

Panels made in accordance with the foregoing description of this invention have been tested and compared with other comparable building panels having usage. Tests have been made in accordance with ASTM Testing Procedures described under "Strength Test for Panels or Building Construction—ASTM E-72-55." In each test, panels of conventional size 4' x 8' were used. The first test is designated as a transverse load resistance test. In conducting this test, panels were horizontally positioned and simply supported 1" from each end by means of a roller support resulting in a test span of 94". Load was applied to rollers bearing down at quarter-points, i.e., at two points approximately 23" from the supports on each end. The panels in each case were deflected $\frac{1}{2}$ " or approximately L/200, L being the length of span, with deflection being measured at the mid-point by a deflection gauge.

It will be noted from the above table that a panel made in accordance with this invention, panel 1, is structurally comparable to 2" x 3" wood stud wall construction, panel 3. The increased benefits in structural properties, by utilizing the concepts of this invention, are dramatically illustrated by a comparison of the tubular core panel, panel 1, with conventional prefabricated panels, panels 4 and 5. In practically every test conducted, panels 1 and 2 showed marked increased structural characteristics over panels 4 and 5. In comparing the panels and test results listed, the thickness and weight of the respective panels should also be considered. Again it is apparent that panels 1 and 2 are comparable in thickness and weight to panels 4 and 5. It is believed that a lightweight panel, such as panel 1, constructed of economical materials and exhibiting structural characteristics comparable to conventional wood stud wall construction would offer many advantages over prefabricated panels commonly encountered.

As can be appreciated, a panel constructed in accordance with the inventive concepts as set forth embodies the practical and acceptable features necessary for prefabricated panels. The panel is economical, strong, easily fabricated adapted to continuous production, and easily erected on the job site. In view of the many modifications which may be made and which will still remain within the inventive concepts herein disclosed, it is intended that the invention be limited only by the scope of the appended claims.

I claim:

1. A prefabricated construction panel comprising two parallel spaced face sheets, a core unit disposed between said sheets comprised of a plurality of nearly cylindrical resilient tubular members, said members having their longitudinal axes parallel to the planes of the face sheets, each of said members having at least two elongated

flattened portions extending substantially uniformly along its length and spaced equally about its periphery, each said member secured at said elongated flattened portions to the face sheets.

2. A prefabricated construction panel comprising two parallel spaced gypsum board face sheets, a core unit disposed between said sheets comprised of a plurality of nearly cylindrical resilient fibrous tubular members, said members having their longitudinal axes parallel to the planes of the face sheets, each of said members having at least two elongated flattened portions extending substantially uniformly along its length and spaced equally about its periphery, said members adhered at said elongated flattened portions to the gypsum board face sheets, the area of adhesive contact totaling between about 8% and about 15% of the area of the face sheets.

3. A prefabricated construction panel comprising two parallel spaced gypsum board face sheets, a core unit disposed between said sheets comprised of a plurality of abutting resilient fibrous tubular members with their longitudinal axes parallel to the planes of the face sheets, said members rendered out-of-round in cross section by at least two elongated flattened portions extending substantially uniformly along the length of said members and spaced equally about their peripheries, said members being adhered at said elongated flattened portions to the gypsum board face sheets.

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