Jan. 9, 1968 G. F. BOWDEN 3,362,676

CONCRETE WALL FORM PANEL WITH INHERENTLY REINFORCED CROSSBARS

Filed July 28, 1965 2 Sheets-Sheet 1

FIG 5

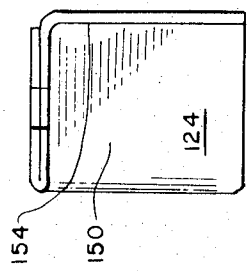


FIG 6

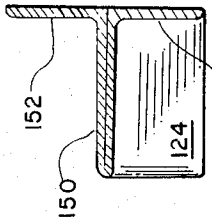


FIG 7

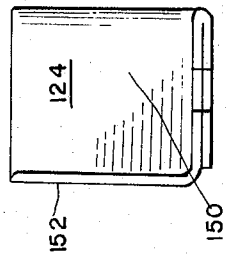
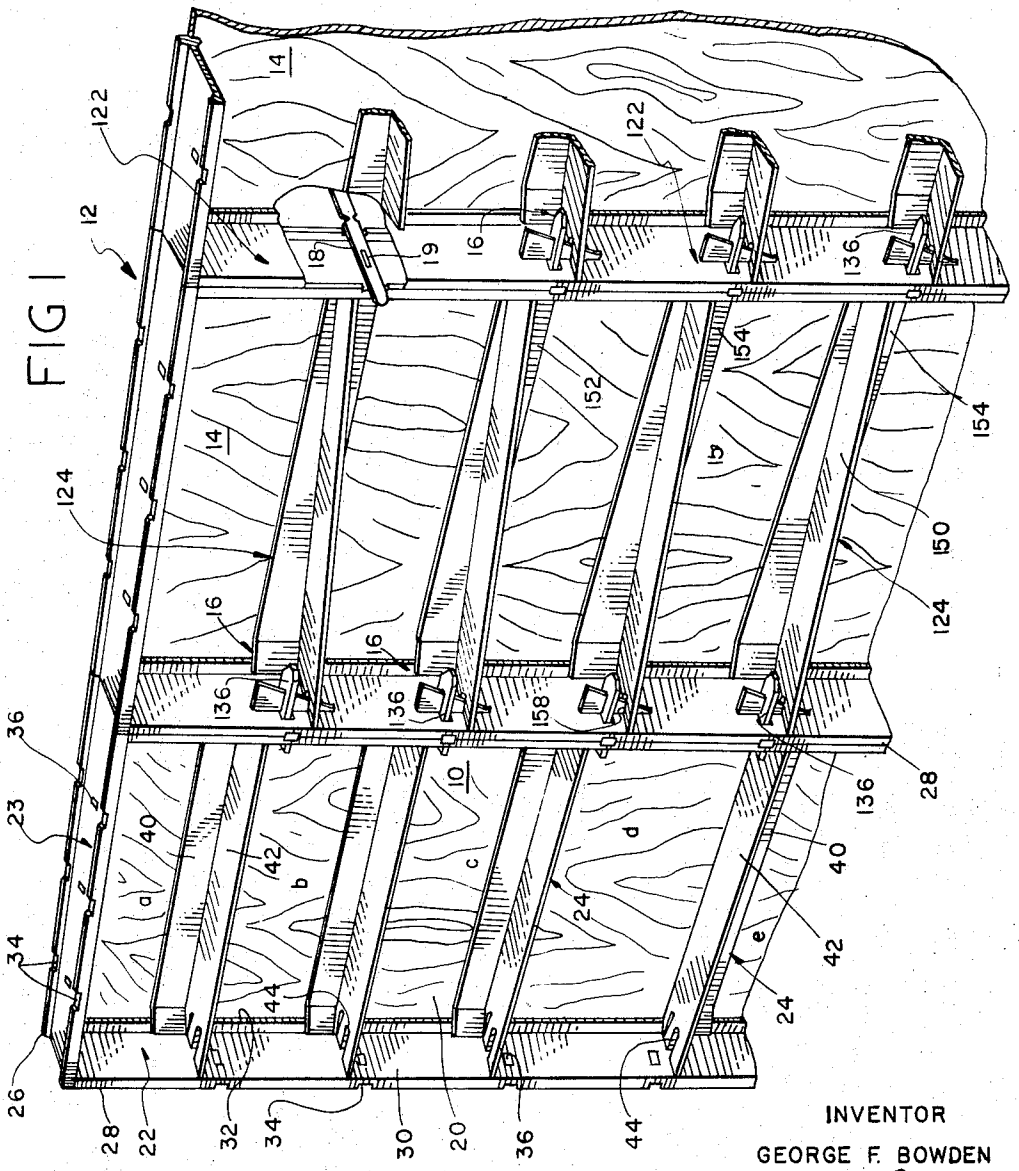


FIG 1



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FIG 2

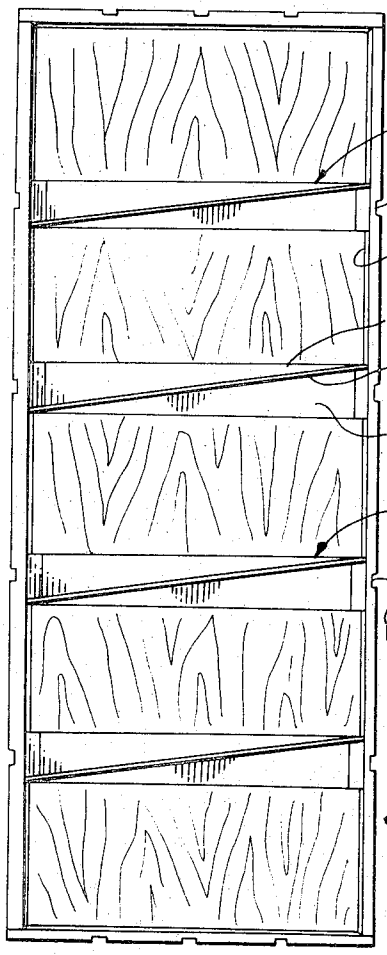


FIG 3

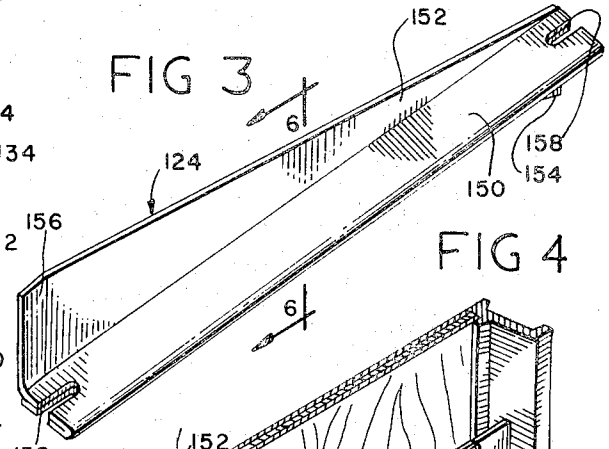


FIG 4

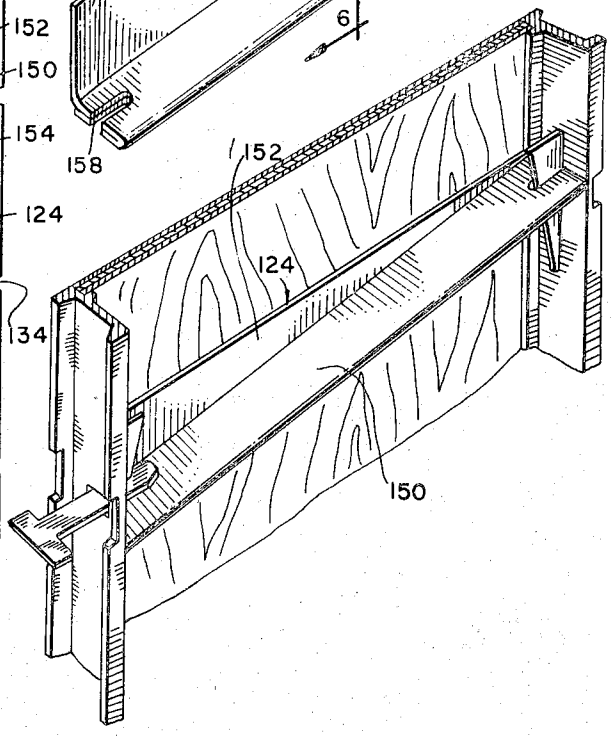
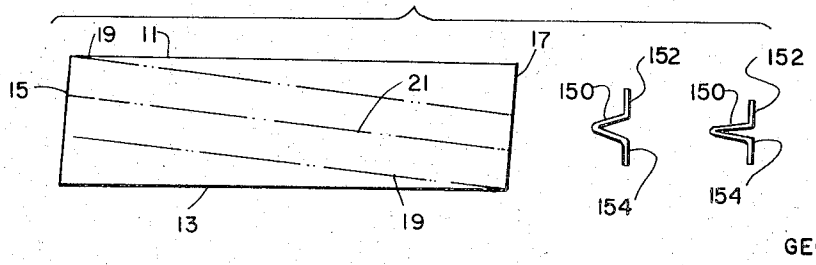


FIG 8



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United States Patent Office 3,362,676 Patented Jan. 9, 1968

3,362,676

CONCRETE WALL FORM PANEL WITH INHERENTLY REINFORCED CROSSBARS

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Filed July 28, 1965, Ser. No. 475,504
3 Claims. (Cl. 249—192)

ABSTRACT OF THE DISCLOSURE

A steel-studded concrete wall form panel reinforced by crossbars which, although they are equally spaced along the length of the panel so that adjacent crossbars subtend equal included openings therebetween, do not interfere with the use of conventional fastening bolts which are applied to the side frame members at equally spaced fixed centers therealong.

The present invention relates to a novel panel for use in conection with a concrete wall form, the panel being similar to that which is illustrated and described in United States Patent No. 3,171,186, granted on March 2, 1965, and entitled, "Wall Form Panel With Inherently Reinforced Crossbars," and having associated therewith novel reinforcing crossbars by means of which the plywood panel facing is more effectively braced against outward bulging than has heretofore been possible.

The present invention, as well as the invention of the aforesaid patent, has particular reference to a prefabricated concrete wall form panel of the type which is commonly known as a "Steel-Ply" panel and is manufactured and sold by Symons Mfg. Company of Des Plaines, Ill.

In order to accommodate the concrete hardware which is used with panels of the character under consideration, the longitudinal and transverse frame members of the reinforcing frames of the panels are formed with transverse slots therein, such slots being set at approximately one-foot centers. Most of the hardware that is employed is designed to cooperate with these slots, and included in such hardware are conventional T-bolt and wedge assemblies which are employed for drawing the adjacent edges of the edge-to-edge panels together.

In the large-sized panels which constitute as much as 95% of all the panels which are manufactured and used, it is absolutely essential that the medial regions of the plywood facings be reinforced against outward bulging under the tremendous thrust of the wet poured concrete and, accordingly, the aforementioned reinforcing crossbars are provided, and they divide the rectangular marginal reinforcing frames into a number of included frame openings which are rectangular and have their long dimension extending transversely of the panels.

In order to maintain a spacing as nearly as possible to twelve inches, the crossbars of each panel are caused to traverse the reinforcing frame slightly above or slightly below the level of the slots. To preserve end-for-end reversibility of each panel, all of the crossbars on one side of (i.e., above) a medial horizontal plane are positioned just above the level of the adjacent slots, while the crossbars on the other side of (i.e., below) such plane are positioned just below the level of the adjacent slots. This obviously establishes a medial included opening which is of greater height than the other openings. The crossbars of a Steel-Ply concrete wall form panel are ordinarily in the form of angle pieces which are L-shape in transverse cross section, and when installed, one flange of each crossbar extends vertically and lies flat against the plywood facing. The direction of extent of the various vertically disposed crossbar flanges still further modifies the height

of the included openings between crossbars. When the vertically disposed flanges extend in the same direction, the height of the included opening is reduced. When such flanges extend away from each other in opposite directions, the height of the included opening is increased.

The present invention contemplates the provision of a Steel-Ply type concrete wall form panel having associated therewith crossbars which are so designed that equal crossbar spacing is attained, thus rendering the various included openings in the rectangular marginal frame of the panel substantially the same in size or area. Still further, by such an arrangement, the effective spacing between each pair of adjacent crossbars is reduced to such an extent that in-between maximum plywood deflection is materially reduced.

The provision of a concrete wall form panel such as is briefly outlined above and possessing the stated advantages constitutes the principal object of the present invention. Other objects and advantages, not at this time enumerated, will readily suggest themselves as the following description ensues.

In the accompanying two sheets of drawings forming a part of this specification, one illustrative embodiment of the invention is shown.

In these drawings:

FIG. 1 is a fragmentary perspective view of one side of a concrete wall form, showing two of the Steel-Ply type panels of the present invention operatively connected together in edge-to-edge relationship, and also showing a standard or conventional Steel-Ply panel associated with the assembly of the two improved panels;

FIG. 2 is a rear or outside plan view of one of the panels of FIG. 1, the panel being shown without any connecting hardware in associated relation with it;

FIG. 3 is an enlarged perspective view of one of the improved crossbars which are employed in connection with the invention;

FIG. 4 is an enlarged fragmentary rear or outside perspective view of a medial portion of the concrete wall form panel of FIG. 2, such view being in the vicinity of one of the improved crossbars;

FIG. 5 is a right-hand end view of the crossbar of FIG. 3;

FIG. 6 is a vertical sectional view taken substantially on the line 6—6 of FIG. 3;

FIG. 7 is a left-hand end view of the crossbar of FIG. 3; and

FIG. 8 is a composite view illustrating in detail the manner in which the crossbar of FIG. 3 is formed.

Because of the fact that the particular concrete wall form panel of the present invention represents an improvement over a specific and recently-developed form of Steel-Ply panel, and because the last-mentioned panel is of an intricate nature involving, as it does, specific cross-sectional shapes for the marginal frame members, specific dimensions that cannot be deviated from, specific crossbar spacing which, if deviated from, renders the panel unsatisfactory in commercial use, and specific facilities for the attachment thereto of various articles of concrete wall form hardware, it is deemed necessary to illustrate in the accompanying drawings an exemplary Steel-Ply panel as it is currently manufactured and used, and to describe the same in detail to the end that reference may be had thereto for comparison purposes when a description is made of the panel of the present invention. Such an illustration has been made in FIG. 1.

Referring now to FIG. 1, a conventional Steel-Ply concrete wall form panel is illustrated in this view and designated in its entirety by the reference numeral **10**. The panel **10** is shown as forming a part of one side of a composite concrete wall form **12** and is illustrated with two improved Steel-Ply panels **14**, the latter being con-

structed according to the present invention and forming other parts of the one side of the form 12. The standard panel 10 and the two improved panels 14 are maintained in their normal edge-to-edge relationship by means of conventional T-bolt and wedge assemblies 16 and the side of the wall form 12 that is partly formed by the panels 10 and 14 is maintained in spaced parallel relationship with respect to the other concrete wall form side (not shown) by means of horizontal tie rods 18 having looped ends 19. The T-bolt and wedge assemblies 16 and the tie rods 18 are conventional items of concrete wall form hardware and their nature and function will be set forth in greater detail presently when the character of the panels 10 and 14 is better understood.

The conventional or standard panel 10 is of the prefabricated Steel-Ply type, such a panel being of open shallow tray-like design and including a rectangular plywood facing 20 and a marginal rectangular steel reinforcing frame comprising longitudinal frame members 22 and transverse frame members 23. The panel 10 is shown as being positioned with its longitudinal frame members 22 extending vertically and with its transverse frame members 23 extending horizontally and thus further reference to the panel 10 may be made on the basis of its position in the wall form 12. At appropriate levels in the panel 10, intermediate horizontal steel crossbars 24 in the form of angle pieces extend between, and are welded to, the opposed vertical frame members 22.

The frame members 22 and 23 are in the form of structural steel bars which are of shallow channel shape in cross section, and each bar includes inside and outside outwardly extending marginal ribs 26 and 28, and a connecting base or web portion 30. On the side of each web portion that is opposite to the ribs 26 and 28 is a lateral inwardly extending flange 32 on which the adjacent edge of the plywood facing 20 seats with its inside face flush with the inside edges of the frame members 22 and 23.

At vertically spaced regions along the marginal ribs 26 and 28, pairs of transversely registering notches 34 are formed and these notches, when the frame members are in contiguity, define therebetween horizontal channel voids which are adapted to receive therethrough the adjacent looped ends 19 of the tie rods 18. A rectangular slot 36 is formed in the web portion 30 of each frame member at the level of each pair of notches 34 and such slot is adapted to receive therethrough the shank portion of the T-bolt of one of the T-bolt and wedge assemblies 16 whereby the contiguous or abutting frame members of adjoining panels are drawn tightly together. The various groups of notches 34 and slots 36 in the vertical frame members 22 are ordinarily formed on twelve-inch centers and in such a manner as to insure that when end-over-end reversibility of any panel is resorted to, notch alignment between contiguous frame members 22 will be preserved.

It will be observed that in connection with the conventional Steel-Ply concrete wall form panel 10, the various crossbars 24 which, as previously stated, are in the form of angle pieces, include vertical flanges 40 and horizontal flanges 42. The various horizontal flanges 42 are formed with notches 44 in the end regions thereof in order to accommodate the wedge parts of the T-bolt and wedge assemblies 16. Thus, it is essential that the horizontal flanges 42 of each crossbar 24 be slightly offset from the horizontal plane of the adjacent slots 36 so that there will be no interference thereof with the T-bolts. This vertical offsetting of the crossbars 24 from the horizontal level of the slots 36 and the notches 44 precludes accurate placing of the crossbars on twelve-inch centers to attain the optimum condition of equal-sized included openings in the panel frame. Accordingly, and in order to preserve the possibility of end-to-end reversal of the panel in a given concrete wall form installation, the crossbars in the upper region of the panel are positioned with their vertical flanges 40 projecting upwardly, while the crossbars in the lower region of the panel are positioned with their vertical flanges 40 extending downwardly. In the illustrated form of the panel 10, there are four crossbars and five included openings in the panel frame. Thus, the two uppermost and the two lowermost included openings, labelled *a*, *b*, and *d*, *e*, respectively, are of equal height, while the medial opening, labelled *c*, is of appreciably greater height.

It is pointed out that the plywood facing that is employed in connection with a conventional Steel-Ply concrete wall form panel like the panel 10 is invariably in the form of a laminated structure of the five-ply variety with the thickness of the lamination being equal and with the over-all thickness of the facing being one-half inch so that the individual plies are each one-tenth of an inch thick. As purchased from the manufacturer for subsequent fitting operations in connection with the installation of the plywood facing in the marginal steel reinforcing frame, the grain structures of the various plies run at right angles alternately in different directions so that the outside or surface plies, as well as the center ply, have their grain structure running in the same direction. Based solely upon numerical superiority, it is obvious that a plywood facing of this character will have greater strength against flexing in one direction than it will in the other. As a matter of fact, when plywood is subjected to bending or flexing stresses across a given span, only those plies which have their grain running lengthwise of the span are considered as carrying the load. The cross plies, being stressed across the grain, are incapable of contributing any significant amount of resistance to such flexing or bending. These considerations are not altered appreciably by the fact that a concrete wall form panel facing of plywood is supported along all four marginal edges since the reinforcement offered at the marginal edges is effective only in the immediate vicinity of the panel members. For these reasons, and in order to attain the greatest resistance to flexing, it is customary to cut and install the plywood facing in the rectangular frame of a conventional Steel-Ply panel so that the predominance of plywood grain structure runs in the direction of the shortest span associated with each included opening in the frame. This fact should be borne in mind in connection with the following considerations which are given to the deflection of the plywood facing across the included openings in the frame of a standard Steel-Ply panel such as the panel 10 that is illustrated herein, the deflection arising, of course, under the pressure of wet concrete in any given concrete wall form installation.

It has been found in actual practice that the height of the included openings, *a*, *b*, *c*, *d*, and *e* in a conventional Steel-Ply panel is such that under a heavy concrete load, the previously-mentioned "pillow block" or "quilting" effect obtains in the completed concrete wall structure after the panel is removed. Under a more moderate load, this effect may not be noticeable in connection with the included openings *a*, *b*, *d* and *e*, but it is likely to be noticeable in connection with the included medial opening *c* which has an appreciably greater height than the other openings. Theoretical considerations have shown that the maximum deflection of a beam under load across a given span, i.e., the deflection at mid-span, may be represented by the equation

$$\Delta = KW1^4/EI$$

where Δ represents maximum deflection, K is a constant that varies with the type of span, W is the weight per unit of length, 1 is the length of the span, E is the modulus of elasticity of the beam, and I is the moment of inertia. From this equation, it will be seen that maximum deflection varies as a function of the fourth power of the length of the span and, consequently, any reduction in the length of the span, however small, will effect a material reduction in the amount of beam deflection.

According to the present invention, a reduction equal to the full width of the vertical flange **40** of one of the angle piece type crossbars **24** is accomplished in the effective height of the included openings corresponding to the openings *b* and *d*, and in the case of the opening which corresponds to the included opening *c*, an additional reduction is effected. These reductions amount to approximately one and three-eighths inches for the smaller openings and approximately three and three-eighths inches for the large medial opening. Comparative tests shown that maximum deflection has been substantially cut in half. Moreover, the reductions have been accomplished without adding unduly to the over-all weight of the panel. The reductions are made possible by the particular design and construction of the crossbars and a novel disposition of the crossbars within the panel frame, as will now be set forth in detail.

In the panel **14** of the present invention, the plywood facing **120** and the marginal frame members **122** and **123** remain substantially the same as in the herein illustrated conventional Steel-Ply panel **10** and, therefore, in order to avoid needless repetition of description, similar reference numerals but of a higher order have been applied to the corresponding parts as between the respective illustrations of the two panels. The wall form hardware, such as the T-bolt and wedge assemblies **16** and the tie rods **18** which are used in connection with the panel **10**, are capable of accommodation by the panel **14** and thus, wherever such hardware is illustrated in connection with either panel, identical reference numerals have been applied thereto. The only difference between the panels **10** and **14** resides in the novel construction and disposition of the various crossbars **124** which are associated with the improved panel **14**.

Each crossbar **124** is in the form of an integral structural member which is formed from an elongated flat blank B (see FIG. 8) of heavy gauge sheet steel stock, the blank being in the form of a parallelogram which is of slight angularity and has parallel side edges **11** and **13** and parallel end edges **15** and **17**. As shown in FIG. 8, the end edges **15** and **17** extend at an extremely small angle with respect to the side edges. The blank B is folded upon itself along a medial fold line **21** which extends at right angles to the end edges **15** and **17**, and it is also bent along lines **19** which also extend at right angles to these end edges and intersect the obtuse corners of the blank. The net result of this folding and bending is the crossbar **124** which is shown at the extreme right-hand side of FIG. 8 and is illustrated in further detail in FIG. 3 after certain notching and bending operations have been performed, as will be described presently.

The completed crossbar **124** thus is comprised of a folded diagonal dual-thickness rib **150** from which there extend laterally in opposite directions two right triangular flanges **152** and **154**. Each flange **152** or **154**, as the case may be, has its base coextensive with the rib **150** and has its hypotenuse extending horizontally between the two vertical frame side members **122**. The crossbar **124** is, therefore, generally of T-shape in medial transverse cross section as shown in FIG. 6, and it is generally L-shaped in transverse cross section at its end regions as shown in FIGS. 5 and 7.

As best seen in FIGS. 3 and 4, the outermost end regions of the flanges **152** and **154** are bent at a slight angle so as to form inwardly-offset parts **156**, and notches **158** are cut through the opposite end regions of the dual-thickness rib **150** for purposes that will be made clear presently.

Considering the crossbars **124** in their environment in the panel **14**, each crossbar has its flange **152** projecting upwardly and its flange **154** projecting downwardly with both flanges bearing flatly against the outer face of the plywood panel **120**. Each crossbar **124** is centered between an adjacent pair of opposed slots **136** in the vertical frame members **122** so that the left-hand end region of its dual-thickness rib **150** overlies the adjacent slot as viewed in

FIGS. 1 and 2, while the right-hand end region of the rib underlies the adjacent slot **136**. The inwardly offset end parts **156** of the two flanges **152** and **154** afford clearance for the adjacent plywood-receiving flanges **132**, while the notches **158** afford clearance for the wedge parts of the T-bolt and wedge assemblies **16**.

The crossbars **24** of the present invention in no way interfere with the use of conventional concrete wall form hardware inasmuch as the various slots **136** are not obstructed, nor are the entrance openings leading thereto on either side of the frame members **122**. The T-bolts of the assemblies **16** may be passed through the slots **136** from either side of the associated longitudinal frame member and the wedges have clearance for insertion through the T-bolts by reason of the notches **158** in the ribs **150** regardless of whether the T-bolt overlies or underlies the adjacent diagonal rib. The use of such hardware is illustrated in FIG. 4 wherein the shank part of the T-bolt of one assembly **16** overlies the adjacent diagonal rib at the right-hand side of this view so that the wedge is driven upwardly, while the shank portion of the T-bolt of another assembly **16** underlies the adjacent diagonal rib at the left-hand side of the view so that the wedge is driven downwardly.

Referring again to FIG. 1 and comparing the panel **10** with either of the panels **14**, it will be observed that the various included openings *a'*, *b'*, *c'*, *d'* and *e'* of the frame of the panel **14** present equal vertical spans, whereas in the frame of the panel **10**, the span of the included opening *c* is appreciably greater than the spans of the openings *a*, *b*, *d*, and *e*. Moreover, the span of any one of the included openings in the frame of the panel **14** is no greater than is the smallest span of any of the included openings in the frame of the panel **10**. Dimensional considerations are important to the present invention inasmuch as with a panel of any given width, there is an optimum length of span which, if exceeded, will give rise to "pillow block" effects on the finished concrete wall or other structure.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit or scope of the invention. For example, whereas the crossbars **24** of the present invention have been shown as being formed by a folding and bending operation from a flat blank of heavy gauge sheet steel, it is contemplated that, if desired, these crossbars may be in the form of integral extruded or rolled structures. Therefore, only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. A concrete wall form panel adapted to be positioned vertically and in edge-to-edge relation with like panels for purposes of forming a part of a concrete wall form, said panel comprising a rectangular plywood facing and a rectangular marginal reinforcing frame including vertical opposed parallel side members and horizontal opposed parallel end members, said side members being provided with vertically spaced pairs of opposed bolt-receiving openings at equally spaced horizontal levels, and a series of transversely extending facing reinforcing crossbars having their ends secured to the side members respectively, there being one crossbar for each pair of openings, each crossbar presenting a narrow, elongated, flat, substantially rectangular portion which bears coextensively in face-to-face contact against the plywood facing and spans the distance between the opposed vertical side members at the level of one opposed pair of bolt-receiving openings, and a medial reinforcing rib extending at a right angle to the plane of said flat, substantially rectangular portion, connected thereto, and extending diagonally thereacross so that one end region of the rib underlies one of said op-

posed bolt-receiving openings and the other end region of the rib overlies the other opposed bolt-receiving opening.

2. A concrete wall form panel as set forth in claim 1 and wherein said rib has its mid-point disposed at the horizontal level of the associated pair of opposed bolt-receiving openings.

3. A concrete wall form panel as set forth in claim 1 and wherein said rib has its mid-point disposed at the horizontal level of the associated pair of opposed bolt-

receiving openings, and wherein the distance between each pair of adjacent crossbars is equal.

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WILLIAM J. STEPHEN, *Primary Examiner.*