March 22, 1966 E. R. LAWRENCE 3,241,802

BUILDING FORM FOR CONCRETE WALLS

Filed April 10, 1963 3 Sheets-Sheet 1

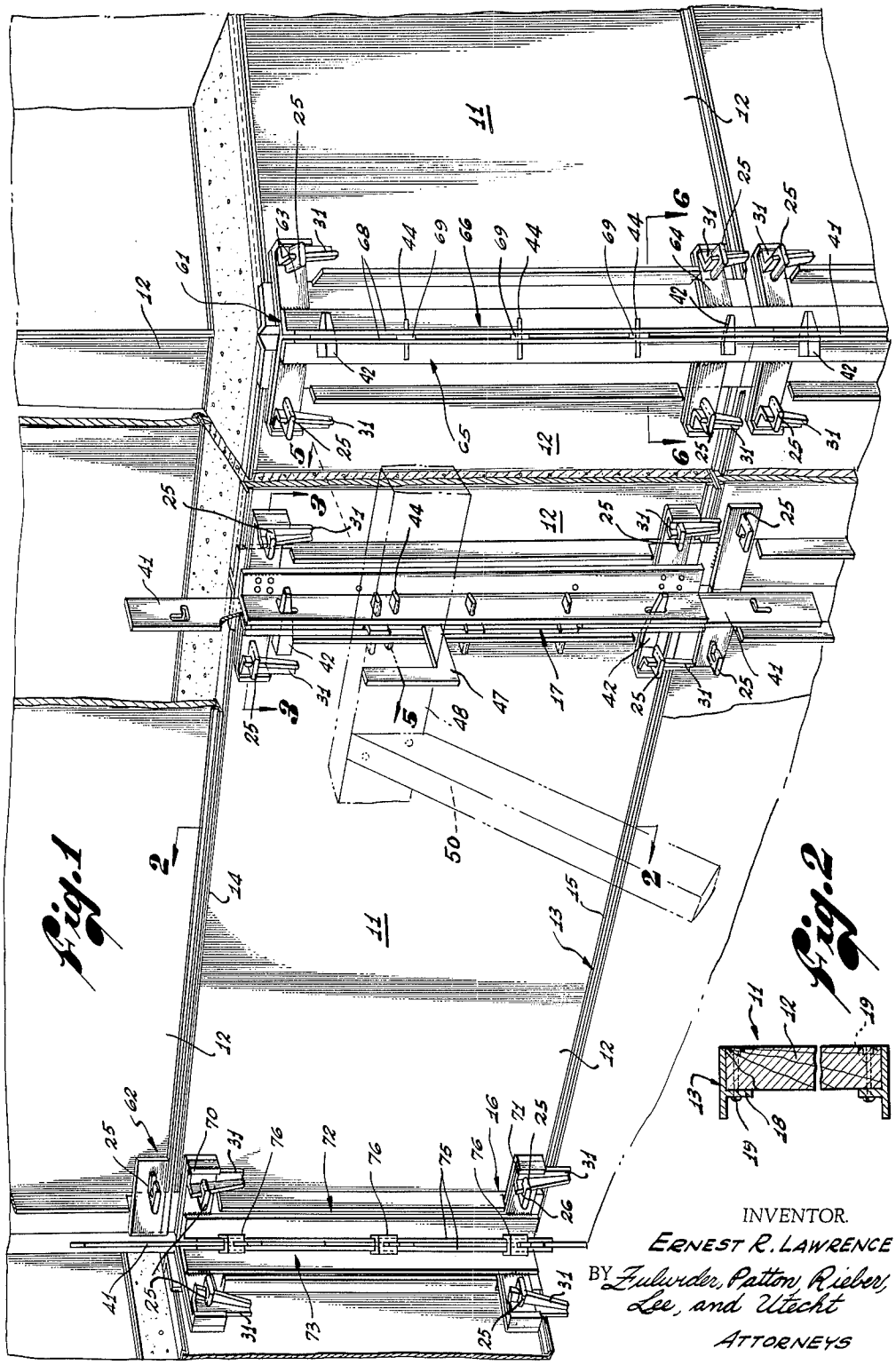


Fig. 1



Fig. 2

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Filed April 10, 1963 3 Sheets-Sheet 2

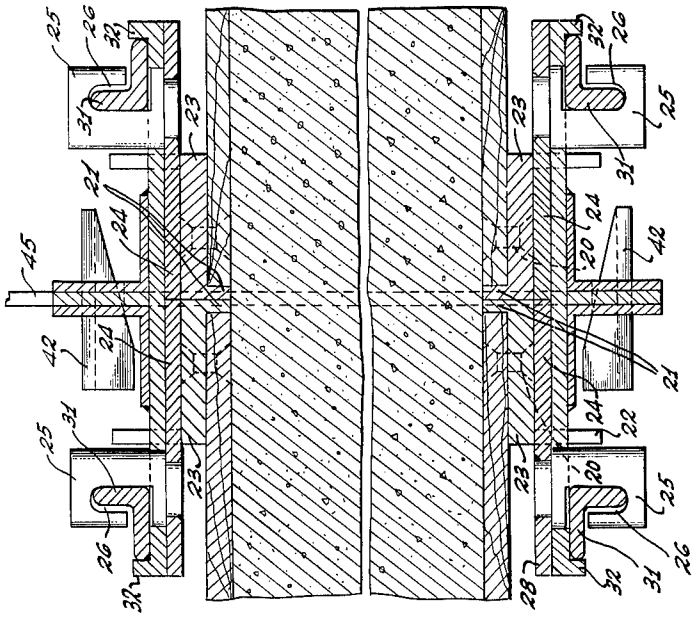


Fig. 3

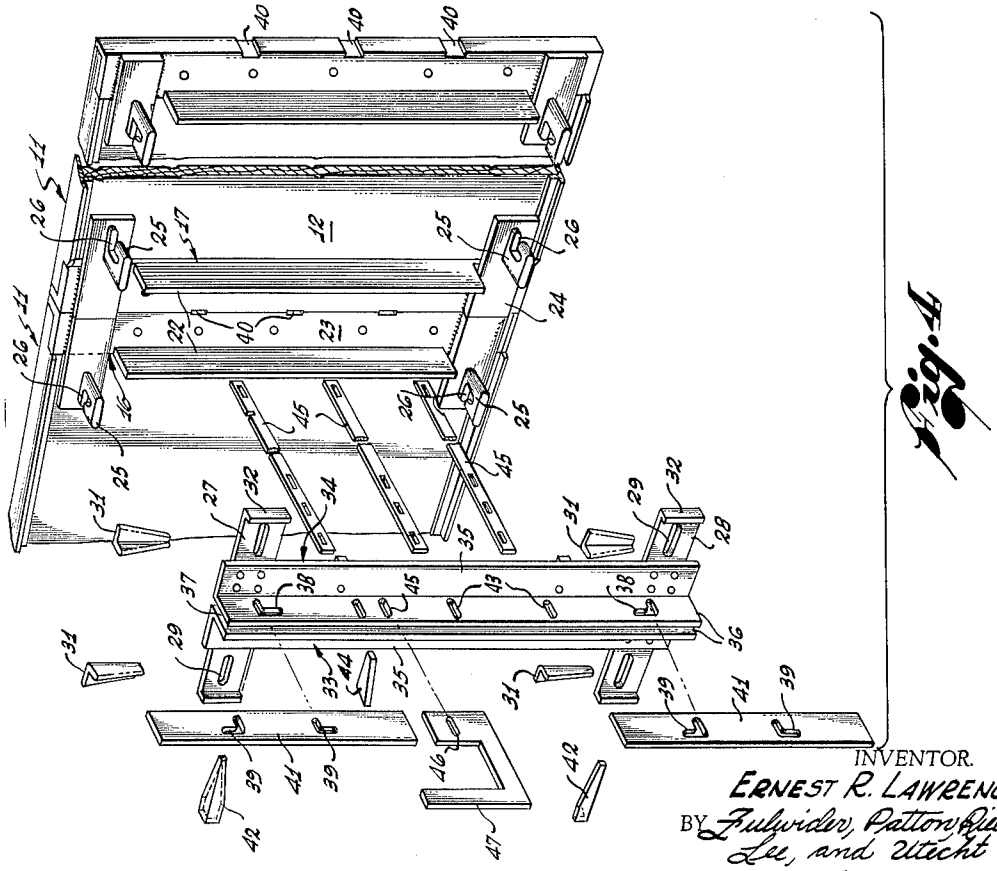


Fig. 4

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Filed April 10, 1963 3 Sheets-Sheet 3

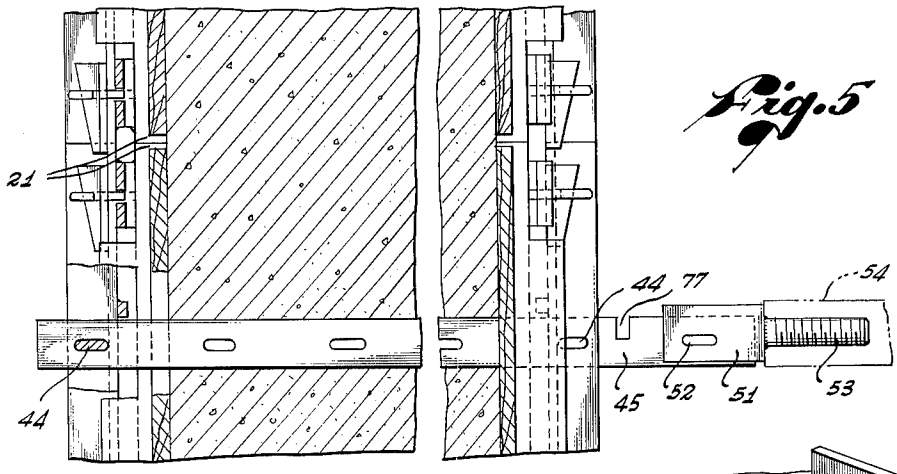



Fig. 5

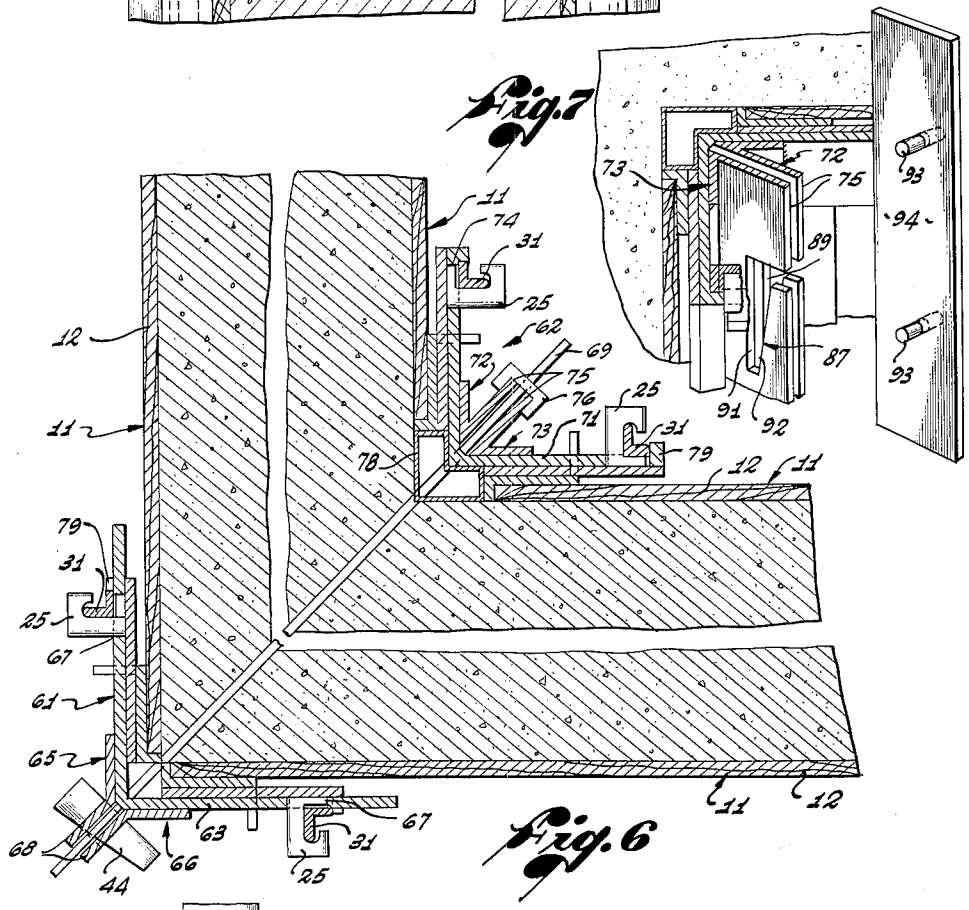



Fig. 6




Fig. 7

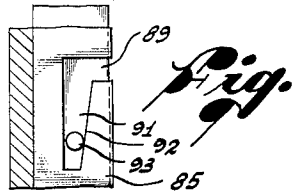



Fig. 8

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3,241,802

# BUILDING FORM FOR CONCRETE WALLS

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7 Claims. (Cl. 249—192)

The present invention relates generally to building forms for poured concrete walls, and more particularly to concrete wall forms of the panel type wherein the opposed form walls are each constructed of a group of substantially standard rectangular panels assembled in edge to edge relation to establish a form wall against which the wet concrete is poured. In casting concrete walls and columns in place, it is customary to establish spaced form walls interconnected by tie rods and to pour the wet concrete into the space provided between the form walls.

Panels commonly employed in this type of concrete wall form have a facing of plywood provided with a stiffening and strengthening frame, with the face of the plywood establishing the surface against which the wet concrete is poured. It is further customary to strengthen and maintain the panels in longitudinal alignment by means of relatively heavy stringers or walers which extend horizontally across the outer sides of the panels and which have associated therewith beams or like wedging means for holding the walers in positions to properly locate the panels forming the form walls.

The present invention is particularly directed to improved standardized panel constructions, and tie means for joining the panels together both horizontally and vertically without the use of nails or bolts so that they may be readily assembled to make up a form and disassembled after the concrete poured in the form has set. The present invention further includes novel inside and outside corner arrangements for the form by which the panels at the corners of the walls are connected together.

Further according to the present invention, all connections between the panels, both horizontally and vertically, and at the corners, are made by means of wedges which align the panels and draw them together and which facilitate the assembly and disassembly of the standard panels making up the form walls.

It is therefore an object of the present invention to provide an improved panel type form for poured concrete walls.

Another object of this invention is the provision of an improved standardized panel for form walls for poured concrete, having provisions facilitating the interconnection of the panels at their edges by readily manipulatable means.

Another object of this invention is the provision of an improved joint between panels assembled together to provide a form wall for poured concrete.

A further object of this invention is an improved standardized corner construction for panel form walls for poured concrete.

A still further object of this invention is an improved form for poured concrete, assembled from panels and having improved tie means between the spaced walls of the form and between vertically adjacent panels forming the walls.

Yet another object of the invention is the provision of an improved form for poured concrete, assembled from standardized flat panels and embodying novel means for joining the edges of the panels together, tying the spaced walls of the form together at the panel joints, and tying the joints of vertically adjacent panels together in simplified, readily releasable, temporary fashion to facilitate the assembly and disassembly of the form walls.

These and other objects and features of the invention



will be readily apparent to those skilled in the art from the following specification and the appended drawings, in which:

FIGURE 1 is a broken-away perspective view of a form according to the present invention for poured concrete walls, showing standard and corner joints between the panels of the form;

FIGURE 2 is a broken transverse sectional view through a form panel on the line 2—2 of FIGURE 1;

FIGURE 3 is a partial sectional view transversely through the vertical joints between the edges of adjacent panels in the form walls, taken on line 3—3 of FIGURE 1;

FIGURE 4 is an exploded view of the elements of a standard joint between form panels;

FIGURE 5 is a partial vertical sectional view through a standard panel joint taken at line 5—5 of FIGURE 1;

FIGURE 6 is a transverse sectional view through a corner joint between form panels taken on the line 6—6 of FIGURE 1;

FIGURE 7 is a view, partly in section and partly in perspective, of details of an inside corner joint; and

FIGURE 8 is a view of an inside corner detail.

The poured concrete wall form according to the present invention is made up of standardized panels 11 comprised of a relatively large area plywood sheet 12 mounted in an outer metallic frame 13. The frame 13 is preferably formed of an extruded or rolled metal, such as aluminum, although it may equally as well be formed of steel or other structural material. The frame 13 is preferably rectangular in form with upper and lower horizontal sides 14 and 15 rigidly connected to opposite vertical sides 16 and 17. The horizontal frame sides 14 and 15 preferably include angularly extending stiffening legs 18 which form ledges against which the plywood sheets 12 are assembled in the frame and to which they may be relatively permanently attached, as by riveting at 19. The vertical sides 16 and 17 are of generally S-shape with forwardly and rearwardly directed stiffening legs 21 and 22, respectively, and a flat side 23 against which the plywood 12 is riveted, as at 20. The frame 13 and plywood 12 thereby form a substantially rigid and self-sustaining panel 11.

Adjacant to the top and bottom of the vertical frame sides 16 and 17 are mounted inwardly extending plates 24, as by welding, brazing or riveting, and upon the plates 24 adjacent their inner ends are mounted connection posts 25 projecting rearwardly of the panels and having substantially L-shaped transverse slots 26 therein open to the inner edges thereof. For adjacent panels 11 the legs 21 and plates 24 are mounted in abutting relation, as shown more particularly in FIGURES 2, 3 and 4. The connection posts 25 on adjacent panels 11 are connected together by vertically spaced bracket plates 27 and 28 having horizontally extending slots at their opposite ends through which extend the connection posts 25 when the adjacent panels are in assembled relation. L-shaped wedges 31 are thereafter received in the slots 26 and serve to tie the adjacent panel sections rigidly together and also to align them in the same vertical plane by the action of the wedges in the slots 26 and against the rearward faces of the plates 27 and 28 and the flanges 32 at the opposite sides of the plates.

The plates 27 and 28 are connected together in spaced relation by spaced angles 33 and 34 having flat legs 35 connected by welding, brazing or riveting to the plates 27, 28 and having rearwardly extending legs 36 spaced apart to form a slot 37 therebetween. The bracket plates 27, 28 and angles 33 and 34 form a unitary rigid structure. Adjacent the top and bottom of the spaced angle legs 36 are L-shaped slots 38 adapted to align with L-shaped slots 39 in vertical tie bars 41 disposed in the slot 37. L-shaped

wedges 42 are received in the aligned slots 38 and 39 to tie the rows of panels 11 together vertically.

The angle legs 36 are also provided with aligned, horizontally extending slots 43 to receive tie pins 44 which also extend through aligned slots in tie bars 45 which extend between opposite joints in the opposed walls of the form to maintain them in proper spaced relation to cast the desired concrete wall therebetween.

The edges of one or both of the vertical frame sides 16, 17 are provided with notches 40 to permit passage of the tie bars 45 therethrough into location between the legs 36 of the angles 33 and 34.

The angle legs 36 may be provided with additional horizontal slots 45 adapted to mate with slots 46 in one leg of generally U-shaped brackets 47 supporting horizontal stringers or walers 48. The stringers or walers 48 serve to maintain the panels in proper relation and to hold the form upright by the mounting thereto of conventional inclined supporting posts which wedge the forms erect.

It will therefore be seen that at the standard joints the adjacent ends of the form panels 11 in a horizontal row are connected together by the bracket plates 27, 28 which receive the connection post 25 and which are interconnected therewith by the L-shaped wedges 31. This not only pulls the panels 11 tightly together but also serves to align their adjacent ends in a common plane. The tie bars 45 thereafter secured to the angles 33 and 34 serve to hold the opposed form walls in the desired spaced relation and prevent the walls from moving either toward or away from each other. The vertical tie bars 41 are securely attached to the superposed angles 33, 34 of the joints in superposed horizontal rows so that the rows and the panels forming them are securely tide together vertically by the passage of the L-shaped wedges 42 through the slots 38 and 39.

Therefore, the standard joint serves to secure the adjacent ends of the panels 11 together in horizontal rows and also to rigidly secure the horizontal rows together against vertical separation. The angles 33 and 34 also support the brackets 47 in which are secured the horizontally extended stringers or walers 48 by which the form walls are structurally braced to maintain them in their desired vertical position against the weight of the wet concrete poured therein.

Referring more particularly to FIGURE 5, the tie bar 45 therein is shown as having a puller head 51 secured on one end thereof, as by a cross pin 52. The head 51 has a threaded shank 53 extending therefrom to which may be attached a tool 54 for pulling the bar 45 from the set concrete between the form walls.

Reference is now made to the corner joints between the panels 11, shown in FIGURES 1 and 6. An exterior joint is indicated at 61 and an interior joint at 62. The exterior joint 61 includes a pair of vertically spaced right angle brackets 63 and 64 which perform the functions of the bracket plates 27 and 28 in the standard joint. The brackets 63 and 64 are rigidly connected in vertically spaced relation by abtuse angles 65 and 66 rigidly secured thereto, as be welding, brazing or riveting. The legs of the right angle brackets 63 and 64 are provided with slots 67 through which extend the connection posts 25 to be secured therein by the wedges 31. The obtuse angles 65 and 66 include legs 68 which extend outwardly from the joint in spaced relation to receive therebetween the cross tie bars 69, secured to the outer joint by pins 44. Vertical tie bars 41 held by wedges 42 extend between superposed legs 68 to secure the horizontal rows of panels together vertically.

The inner corner joint 62 is comprised of a pair of vertically spaced right angle brackets 70 and 71 connected together in spaced relation by acute angles 72 and 73 rigidly secured thereto. The legs of the right angle brackets 70 and 71 have slots 74 through their free ends through which extend the connection posts 25 secured therein by wedges 31. The acute angles 72 and 73 have vertically extending parallel legs 75 between which are



secured the cross tie bars 69. Due to the location of the legs 75 interiorly of the right angle brackets 70 and 71, the cross tie bars 69 cannot be readily pinned to the angle legs and are connected thereto, for example, by U-shaped retainers 76 which interlock with slots such as shown at 77 in the tie bar 45 of FIGURE 5, and with the legs of the retainer 76 embracing the edges of the legs 75.

The ends of the right angle brackets 63, 64 and 70, 71 are provided with flanges 79 to be engaged by the wedges 41 to correspond in wedging function to that performed by the flanges 32 on the bracket plates 27 and 28.

To fill in the space between the ends of the adjacent panels 11 at the interior corner joints 62, there are provided vertically extending hollow column members 78 of right angled L-shape. The members 78 have their interior angular walls rigidly secured to the apices of the right angle brackets 70 and 71, as by welding or brazing, and their exterior angular form continuations of the planar surfaces of the panels 11, as shown more particularly in FIGURE 6. The edges of the panels 11 will then abut against the ends of the legs of the columns 78.

The form panels 11 are preferably standardized in size so as to be interchangeable and may be of any desired convenient dimension. For example, for small easily handled panels, they may be rectangular and substantially 2 ft. x 4 ft. in size. At the corner joints, either the inner or the outer panels must be of non-standard length to properly locate the panel junctions at the corners while still permitting location of the standard joints opposite each other for reception of the tie bars 45.

The manipulation of the form according to the present invention by assembly and disassembly of the elements thereof to establish a wall cavity bounded by form walls into which wet concrete is to be poured, and the disassembly of the elements after the concrete is set, will now be described.

The form walls are made up of a plurality of substantially standard panels 11 connected in end-to-end relation by standard joints to form planar walls. These walls will then be ordinarily arranged in spaced relation, as shown in the drawings, to established a space therebetween into which the wet concrete is poured to form a concrete wall. The end-to-end panels make up horizontal rows which are superposed and tied together vertically. The standard joints for the panels 11 in the horizontal rows are secured by the units formed by the bracket plates 27, 28 and the angles 33, 34. The connection posts 25 at the panel corners are passed through the slots 29 in the bracket plates 27, 28 and secured therein by L-shaped wedges 31. The wedge shape serves to draw the adjacent edges of the panels tightly together and to hold them in rigid relationship, while at the same time pulling them into and maintaining a common planar arrangement.

The standard joints in the opposed walls of the form are arranged opposite each other and the space between the form walls is spanned by tie bars 45 which serve to space the walls in proper relationship to define the thickness of the concrete wall desired. The tie bars 45 pass through the notches 40 in the edges of the panels and are secured to the angles 33, 34 by pins 44 extending through mating slots in the ends of the tie bars 45 and the slots 43 in the legs 36 of the angles 33, 34.

The staging brackets 47 are mounted at the joints by pins 44 passing through the mating slots 45 and 46. The longitudinally extending horizontal stringers or walers 48 are mounted in the brackets 47 and nailed or otherwise connected to inclined supporting posts 50 to structurally support the form wall against the weight of the wet concrete poured therein, the longitudinally extending stringers also serving to maintain the alignment of the individual panels and insure the accuracy of the wall location.

Superposed horizontal rows of panels **11** are tied together at the standard joints by means of vertical tie bars **41** which extend between the superposed angles **33, 34,** being located between the legs **36** thereof and tied thereto by the L-shaped wedges **42** passing through the aligned slots **38, 39.** The wedging action of the wedges **42** serves to securely pull the horizontal rows of panels together and maintain the continuity of the form walls.

A the corners of the form walls, either inner or the outer panels **11** are non-standard in length to give the proper location for the standard corner joints. At the outside corner the connection posts **25** are projected through the slots **67** in the right angle brackets **63, 64** and secured by the angle wedges **31.** The outer corner joints are vertically tied together by means of vertical tie bars **41** which extend between the legs **68** on the obtuse angles **65, 66** and are pinned thereto by the L-shaped wedges **42.**

The inner corners **62** are similarly connected by projecting the connection posts **25** through the slots **74** in the right angle brackets **70** and **71** and connecting them therein by the L-shaped wedges **31** to bring the ends of the adjacent inner panels **11** against the ends of the vertical columns **78** extending between the brackets **70** and **71.** Tie bars **69** are then connected between the outer and inner corner joints **61, 62** by first interlocking retainers **76** in slots **77** adjacent the ends of the tie bars bars and embracing the legs **75** on the angles **72, 73** by the legs of the retainers. Then the outer ends of the tie bars **69** are pinned to the legs **68** on the obtuse anangles **65, 66** by pins **44.** The column **78** is provided with suitable slots through its central portion to permit passage of the tie rods **69.**

The arrangement of the vertical ties between the horizontal panel rows at the inner corner joints is shown in FIGURES 7 and 8. Here the angle legs **75** of angles **72** and **73** are provided with slots **88** of generally inverted L-shaped, having horizontal legs **89** and vertical legs **91.** The vertical slot legs **91** have inclined defining surfaces **92** adapted to be engaged by pins **93** which extend transversely of vertical tie bars **94.** With the tie bars **94** inserted between the angle legs **75** of superposed joints, the pins **93** thereon are moved through the slot legs **89** and wedged downwardly in the slot legs **91** against the inclined walls **92** to insure proper alignment of the joints.

The form walls need not be built initiatlly to their full vertical height since the concerete wall can be progressively poured. After a vertical section of the concrete has set, the panels **11** may be stripped from the lower courses and only the uppermost horizontal row of panels **11** left in place. Then the panels removed from the lower horizontal rows may in turn to be mounted on the retained row to extend the form walls upwardly and permit pouring of another concrete course or section. In this way, by each time stripping the lower panels from a set concrete section, the concrete wall can be built up to any desired height while using a minimum number of panel sections so that the investment in forms and hardware is lessened.

In stripping the panels of the form walls from the set concrete, the joints are readily disassembled by removing the wedges **31, 42,** the pins **44,** and the retainers **76.** With the wedges and pins removed, the joint elements may be separated into their components, as exploded in FIGURE 4, and the panel sections individually removed for use at another location or for reassembly at the top of the form to extend the vertical height of the form walls for another concrete pour. With disassembly of the joints and panels of the form, the tie bars **45** and **69** will remain embedded in the concrete wall, with their ends projecting therefrom. These tie bars can then readily be driven toward one side of the wall, thus breaking any interlock between the concrete and the tie bars. The tie bars may be coated, if desired, to lessen the adhesion of the concrete thereto. Each tie bar may then be fully withdrawn from the concrete wall by mounting the pulling head **51** on the end of the tie bar by a pin **52** and attaching a pulling tool **54** to the stud **53** on the pulling head. With the removal of the tie bars **45, 69,** all elements of the forms will be removed from the concrete wall.



While the drawing and description have been so far directed to the forming of flat planar walls, it will be readily understood that the top and bottom horizontal sides **14** and **15** of the frame **13** may be curved and the plywood sheet **12** will be thereby curved to conform thereto, and the panels **11** resulting from this construction will present a curved form surface against which the wet concrete will be poured. Such curved forms may be used in the construction of curved walls, such as above or below ground silos and other curved constructions.

While certain preferred embodiments of the invention have been specifically illustrated and described, it will be understood that the invention is not limited thereto as many variations will be apparent to those skilled in the art, and the invention is to be given its broadest interpretation under the terms of the following claims.

I claim:

**1.** A sectional form for poured concrete, vertical walls comprising: a plurality of substantially standardized panels arranged in edge to edge relation to form a substantially horizontal row; a plurality of said rows being arranged in superposed relation to form a vertical surface against which a main wall surface is cast; outwardly projecting connection posts mounted adjacent the corners of said panels; joining means extending across adjacent vertical panel edges and receiving said posts therethrough; means interlocking said joining means with said connection posts to hold the panels together in a horizontal row; and means interlocking with superposed joining means in vertically adjacent rows to hold the rows together vertically.

**2.** A sectional form for poured concrete, vertical walls comprising: a plurality of substantially standardized panels arranged in edge to edge relation to form a substantially horizontal row, a plurality of said rows being arranged in superposed relation to form a vertical surface against which a main wall surface is cast; outwardly projecting connection posts mounted adjacent the corners of said panels and having attachment slots therethrough; joining means extending across adjacent vertical panel edges with said posts projecting therethrough; means interlocking said joining means with said connection posts to hold the panels together in a horizontal row; and means interlocking with superposed joining means in vertically adjacent rows to hold the rows together vertically, said last mentioned means and the joining means having transversely aligned slots therein, said interlocking means including wedge-shaped members received in said slots and operating when tightened to hold the panels together both horizontally and vertically.

**3.** A sectional form for poured concrete, vertical walls comprising: a plurality of substantially standardized panels arranged in edge to edge relation to form a substantially horizontal row presenting a substantially vertical surface against which a main wall surface is cast; outwardly projecting connection posts rigidly mounted adjacent to the corners of said panels; connecting means for horizontally adjacent panel edges comprising vertically spaced bracket plates and vertically extending means rigidly connected to said plates, said plates having horizontally spaced slots therein receiving said connection posts to extend therethrough; and interlocking means engaging said connection posts behind said bracket plates to hold adjacent panels in the horizontal row together.

**4.** A sectional form for poured concrete, vertical walls comprising: a plurality of substantially standardized panels arranged in edge to edge relation to form a substantially horizontal row presenting a substantially verti-

cal surface against which a main wall surface is cast; outwardly projecting connection posts rigidly mounted adjacent to the corners of said panels; connecting means horizontally adjacent panel edges comprising vertically spaced bracket plates and vertically extending spaced angles rigidly connected to said plates, said plates having horizontally spaced slots therein receiving said connection posts to extend therethrough; interlocking means engaging said connection posts behind said bracket plates to hold adjacent panels in the horizontal row together, said angles including outwardly extending, spaced legs defining a slot therebetween; tie bars mounted in the slots between said panel legs and extending forwardly of the panel joint to span the space between opposed form walls; and readily releasable means interlocking said tie bars with said angle legs.

5. A sectional form for poured concrete, vertical walls comprising: a plurality of substantially standardized panels arranged in edge to edge relation to form a substantially horizontal row presenting a substantially vertical surface against which a main wall surface is cast; outwardly projecting connection posts rigidly mounted adjacent to the corners of said panel; connecting means for horizontally adjacent panel edges comprising vertically spaced bracket plates and vertically extending spaced angles rigidly connected to said plates, said plates having horizontally spaced slots therein receiving said connection posts to extend therethrough; interlocking means engaging said connection posts behind said bracket plates to hold adjacent panels in the horizontal row together, said angles including outwardly extending spaced legs defining a slot therebetween, vertically extending tie bars mounted in the slots between said angle legs and extending above and below the panels for connection to similar angle legs in vertically adjacent panel rows; and readily releasable means interlocking said tie bars with said angle legs.

6. A sectional form for poured concrete, vertical walls comprising: a plurality of substantially standardized panels arranged in edge to edge relation to form a substantially horizontal row presenting a substantially vertical surface against which a main wall surface is cast, a plurality of said rows being arranged in superposed relation to form a vertical wall and the junctions between vertical panel edges being substantially superposed in the form walls; outwardly projecting connection posts rigidly mounted adjacent to the corners of said panels; means connecting horizontally adjacent panel edges together comprising vertically spaced bracket plates and vertically extending means permanently connected to said bracket plates; slots in said bracket plates receiving said connection posts to extend therethrough; means at the back of said bracket plates for interlocking said connection posts against withdrawal therefrom; and means interlocking the superposed joints on vertically adjacent horizontal rows of panels.

7. A sectional form for poured concrete, vertical walls comprising: a plurality of substantially standardized panels arranged in edge to edge relation to form a substantially horizontal row, a plurality of said rows being arranged in superposed relation to form a vertical surface against which a main wall surface is cast and the junctions between vertical panel edges being substantially superposed in the form; outwardly projecting connection posts rigidly mounted adjacent to the corners of said panels; means connecting horizontally adjacent panel edges together comprising vertically spaced bracket plates and vertically extending means permanently connected to said bracket plates, said bracket plates having openings therethrough through which said connection posts extend; interlocking means at the back of said bracket plates releasably interconnecting the plates and said connection posts, the vertically extending means between said bracket plates comprising horizontally spaced angles having outwardly extending legs forming a slot therebetween; tie bars disposed in the slots between said angle legs and extending vertically into the slots between superposed angle legs in vertically adjacent panel rows; and means interlocking said tie bars with said angle legs to tie the panel rows together vertically.

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