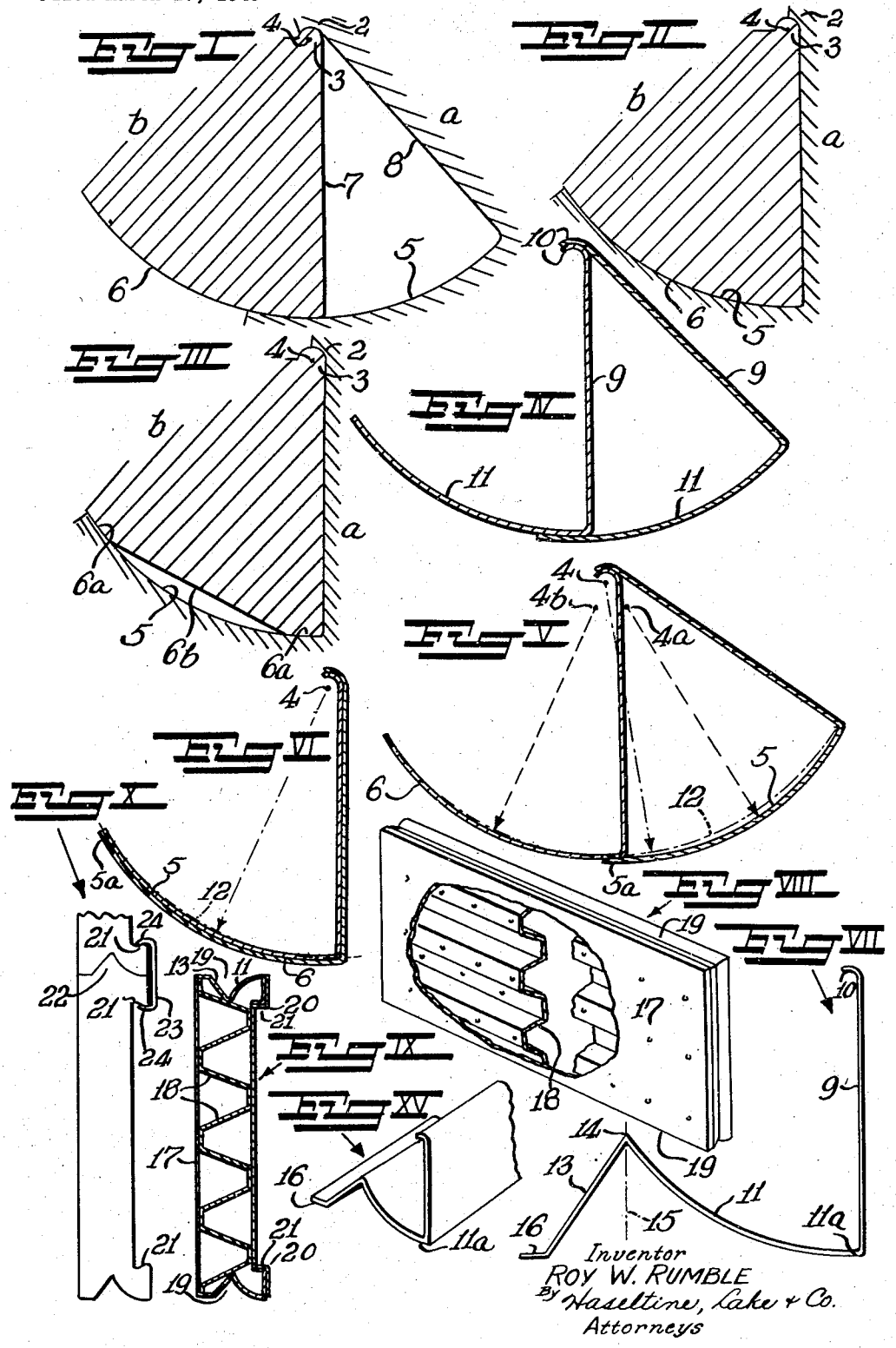
Aug. 24, 1948. R. W. RUMBLE 2,447,670

FORM FOR MOLDING CONCRETE IN SITU

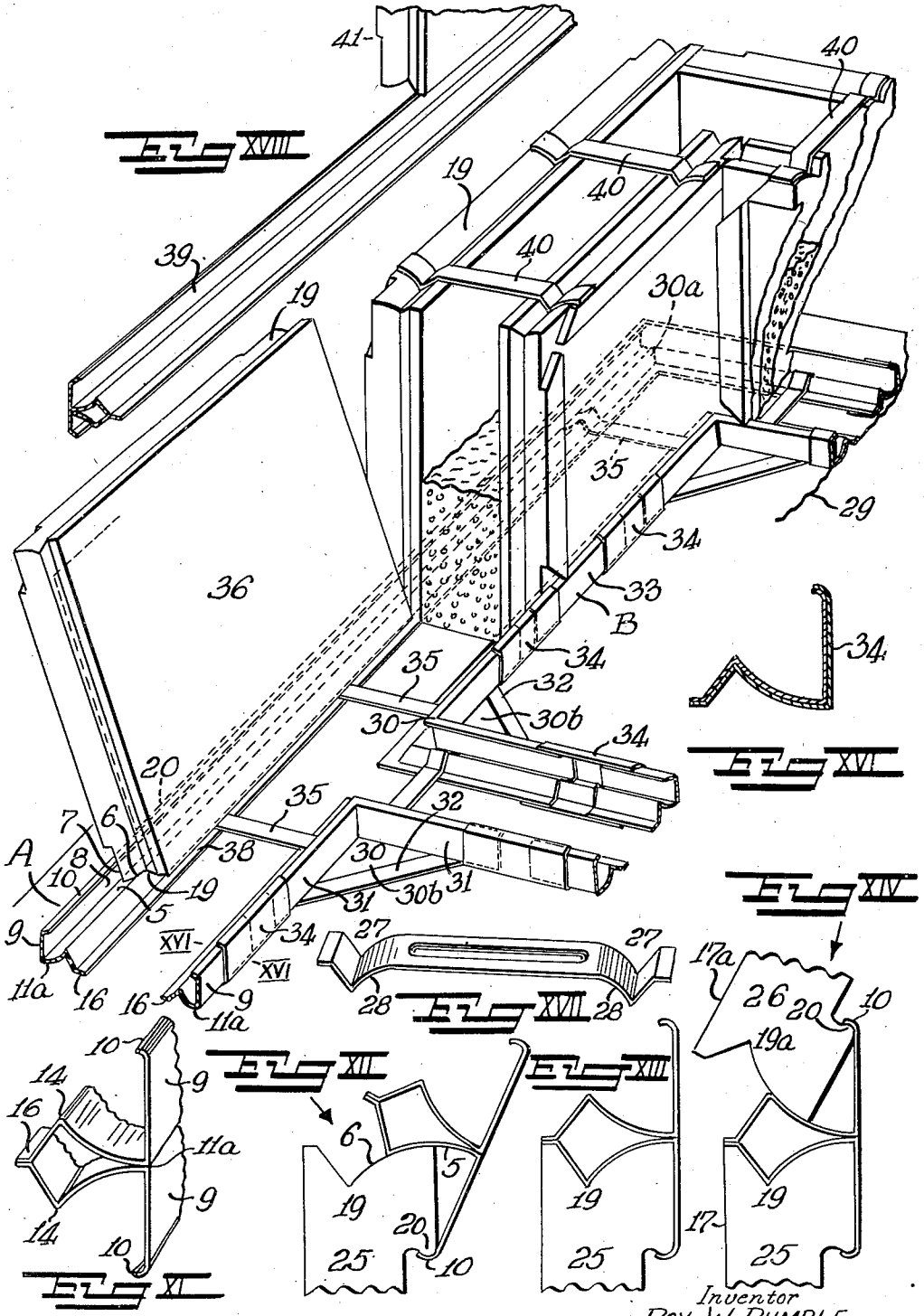
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FORM FOR MOLDING CONCRETE IN SITU

Filed March 17, 1945 2 Sheets-Sheet 2



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FORM FOR MOLDING CONCRETE IN SITU

Roy William Rumble, Pretoria, Transvaal, Union of South Africa

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Patent expires March 10, 1964

17 Claims. (Cl. 25—131)

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This invention relates to composite structure in connection with building, comprising a number of panel units each having length and width substantially greater than its thickness, so that the external surfaces defined by width and length may be regarded as faces and those in which thickness is a dimension may be regarded as edges; one at least of said faces being a rectilinear face; and the units being assembled to provide a common rectilinear face. By a "rectilinear" face is meant a face of which at least one superficial dimension is rectilinear; so that a rectilinear face is plane when its other superficial dimension is rectilinear. The term as used here however includes cylindrical or cylindroidal surfaces of small angular extent.

Such composite structure may be composed wholly of the panels mentioned; but more usually it comprises also other units such as waling members, foundation members and cross ties; and, in general, units which are positioned at or between the edges of panels or groups of panels. The invention also refers to the individual units of such a composite structure.

Composite structure of the kind described has several uses; for example use as shuttering for moulding concrete mix in situ, or as a portion of a building, such as a wall or ceiling or roof covering. The composite structure is usually required to be capable of easy disassembly to recover its individual panels and other units.

In composite structure and its units of the kind described above and to which the invention relates, the panels are connected edgewise to one another or to other adjacent units; and the present invention refers to the edge formations by which such edgewise connection is effected.

The main object of this invention is the provision of edge formations suitable to enable the rapid assembly and disassembly of such panels and other units.

Another object of this invention is to bring about positioning and rigid interlocking of such edge formations which will firmly maintain the elements in their assembled position.

A further object of this invention is the provision of such panels and other units that are provided with such edge formations.

According to this invention, the edge formations are such as to require for their interengagement, after their initial contact, relative rotation of the units about an axis parallel with the longitudinal dimensions of the edge formations.

According further to the invention, a pair of co-operating edge formations comprises an external formation and an internal formation. The external formation provides in cross-section a pivot element and a retaining surface spaced from and facing towards said pivot element. The internal formation provides in cross-section a pivot element adapted to seat loosely against the pivot element of the external formation and so that the formations of the pair may rotate relatively to one another about the axis of the co-operating pivot elements. Said internal formation further provides an element that, by such rotation, is swung into engagement with said retaining surface so that the internal formation is secured between the pivot element of the external formation and said retaining surface of the external formation.

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The retaining surface of the external formation, mentioned in the last paragraph, is preferably an arcuate surface with its concavity facing the pivot element of said external formation, and having its centre of curvature at or near the axis about which the formations relatively rotate. The element of the internal formation that swings into engagement with said retaining surface may provide a convex arcuate surface that is similar to said concave arcuate surface and that slides over the latter as the formations are relatively rotated to their interengaged positions.

In practice the edge formations are made of sheet material such as sheet steel; in which case the external and the internal formations may be of the same form subject only to the necessary allowance for the thickness of the sheet material. This form includes a first limb which may be straight: a short transverse limb at one end of the first limb and forming, with the latter, the pivot element; and another transverse limb at the other end of the first limb and on the same side thereof as the short transverse limb, said other transverse limb being arcuate to a centre in the neighborhood of the junction of the first limb and the short transverse limb and providing said retaining surface.

The formations are provided with co-operating stop surfaces that arrest the engaging rotative movement when the units with which the edge formations are associated have come to their intended engaged positions.

According further to the invention, the edge formations are such that they lock or engage securely with one another when brought by the engaging rotational movement to the position corresponding to the relative erected position of their panels or parts; for instance when such panels or parts present a common plane or cylin-

drical surface, which is the moulding surface in the case of shuttering. They may lock or engage with sufficient security to hold such panels or parts against the forces which may be expected to act in the direction of the disengaging movement. Such locking or secure engagement may be due to the edge formations being collectively resilient—as they are for instance when made of sheet material—and being sprung, by the engaging movement, out of their normal or unengaged shape, during the engaging movement; and being arranged to return more or less completely to their original form upon reaching the engaged position; so that their reluctance to being again deformed during separation constitutes an active resistance to their becoming separated. Preferably their restoration of form upon reaching the engaged position is incomplete so that the tendency towards full restoration by further movement in the engaging direction remains as a force of some magnitude actively clamping or holding the parts in their engaged position.

The edge formations are usually of the general tongue and groove type, that is, one of said formations exhibits in some or all cross sections a projection perponderatingly parallel with the plane of a panel or in other words perpendicular to the width of the edge, and the other of said formations exhibits, in corresponding cross sections, a recess having the same preponderating direction and occupied by the projection to prevent transverse play of the projection in the recess, so that the tongued member is alined with the grooved member.

The invention further consist in separate panels and other units of the composite structure, provided with edge formations as above described.

The invention is illustrated in the accompanying drawings in which

Figures I and II are diagrammatic representations of the preferred basic shape of the edge formations.

Figure III is a diagrammatic representation of a modified shape of the edge formations of Figures I and II.

Figure IV is a cross-section showing the edge formations constructed of sheet material.

Figures V and VI are cross-sections showing the basic shape modified to cause the edge formations to lock when assembled.

Figure VII is a cross-section showing the basic form extended to provide an edge formation of the general tongue and groove type.

Figure VIII is a perspective view, with parts broken away, of a panel according to the invention.

Figure IX is a vertical section of Figure VIII.

Figure X is a vertical section of a somewhat modified panel.

Figure XI is a perspective view of the end of a waling member.

Figures XII, XIII and XIV illustrate the process of assembling the panel of Figures VIII and IX with the waling member of Figure XI.

Figure XV is a perspective view of a bar having a cross sectional form according to the invention; this figure also being a view of the portion of the foundation templet shown in Figure XVIII.

Figure XVI shows two bars of the Figure XV section secured to one another by being nested together; this figure also being a section on XVI—XVI Figure XVIII.

Figure XVII is a perspective view of a cross tie according to the invention.

Figure XVIII shows shuttering for a concrete wall consisting of an assembly of the elements shown in previous figures.

Figure XIX shows a shuttering similar to that of Figure XVIII which is suitable for the production of hollow walls.

Referring to Figures I and II, the letters *a* and *b* represent the edge formations of two building units that are to be connected and that are diagrammatically shown in cross-section. The formation *a* is an external formation in the sense that its co-operating surfaces are internal; whilst the formation *b* is an internal formation in the sense that its co-operating surfaces are external.

The formation *a* provides in cross-section the hook or re-entrant corner **2** which constitutes the pivot element; and the formation *b* provides the salient corner **3** which constitutes the second pivot element that so co-operates with the element **2** as to enable the formations *a* and *b* to rotate relatively to one another about the axis **4** that is parallel with the length of the edge formations.

The formation *a* further provides the concave arcuate retaining surface **5** struck from a centre which is coincident with the axis **4** or is near to axis **4** in the cross-section. Formation *b* is formed with a similar but convex surface **5**. The formations are brought into interengagement by engaging elements **2** and **3** with one another and relatively rotating the formations about the axis **4** so that the arcuate surfaces **5** and **6** slide over one another and come to the position of Figure II where further engaging movement is arrested by stop surfaces, such as **7** and **8**, which then come into mutual contact. When the parts are in that position, the formation b is retained between the hook **2** and the concave retaining surface **5** of formation *a* and cannot be disengaged from the latter formation except by reversal of the rotating motion.

It is not essential that both the surfaces **5** and **6** should be complete arcs. As shown in Figure III the arcuate surface **6** for instance may be represented only by its end portions **6***a*—**6***a*; the intermediate portion **6***b* being flat.

In practice the edge formations are made of sheet material, for instance, sheet steel, as shown in Figure IV; in which case the cross sectional form of the internal and external formations may be identical subject to such allowance as to size as is necessitated by the thickness of the material. This form includes the limb **9** that need not be otherwise than straight: the short transverse limb **10** at one end of the limb **9**, which limb **10** performs equally well the function of the element **2** and that of the element **3**, and the transverse and arcuate limb **11** at the other end of limb **9** and on the same side thereof as limb **10**.

The fact of the edge formations being made of sheet material gives them a degree of resilience that permits them to co-operate satisfactorily even when their shapes only approximate to the basic shape described in connection with Figures I and II. In particular it enables that basic shape to be varied with the object of causing the edge formations to lock in their engaged position with some degree of positiveness so that when they are in such engaged position, they elastically resist the reverse rotary movement which separates them. Various modifications of

the Figure I shape may be made with this object: a preferred modification being one in which the centre of one or both the arcuate surfaces 5 or 6 is not coincident with the axis of rotation 4. Figures V and VI show one example, in which the axis of rotation 4 remains as described above, but the centres 4a and 4b of the surfaces 5 and 6 respectively are positioned between said surfaces and the axis 4. The result is that when the formations are relatively rotated from the Figure V position to the Figure VI position, the leading end portion 5a of surface 5 is resiliently forced out of the path indicated by the dotted line 12, which is centered at 4, and resumes or more nearly resumes, its original or unsprung position with reference to its centre 4a upon coming to the Figure VI position. When in that position, it exercises a locking effect due to its resistance to being similarly deformed or displaced by the reverse rotation of the formations. It is preferred to leave a residue of deformation at the end of the engaging movement, indicated by the non-coincidence of the chain dotted line 12 with the arcuate surface 5a in Figure VI; since this ensures the presence of a spring force tending to urge the surfaces 5 and 6 more closely in locked position; and resisting parting rotation of said surfaces.

Edge formations according to this invention are preferably of the general tongue and groove form in cross-section; to produce which the sheet metal sections are extended, as shown in Figure VII, by the addition to the end of limb 11 of a limb 13 extending from 11 at an angle such that limbs 11 and 13 form a V with its point at 14 and its perpendicular 15 about parallel with limb 9. The limb 13 may terminate in a short limb 16 which is alined with the end portion 11a of limb 11. It will be seen that the Figure VII section is that of either a tongue or a groove accordingly as it is utilized with the point 14 salient or re-entrant.

Edge formations as described above are embodied with the units, of which they form the connecting edges, in various ways according to the nature of the units.

Figures VIII and IX are respectively a perspective view and a cross-section of a panel. Said panel is suitable for assembly with others to form shuttering for concrete and provides the moulding face 17. Said moulding face as well as the other parts of the panel are made of sheet material and the sheet material providing the moulding face is stiffened by thickness structure 18. The edges 19 are made of sheet material of groove form in cross-section to engage with the corresponding tongue of another unit of the assembly; and at the back of the panel near to and parallel with each such grooved edge 19 there is a corner 20 providing a shoulder 21. Such panel is modified according to the present invention by making the sheet metal of the edge structure of the cross sectional shape of Figure VII; that is to say with its edge groove comprising the arcuate limb 11 struck from a centre which is approximately coincident with the corner 20; the latter corresponding to the corner between the limb 9 and the limb 10 of Figure VII.

In the Figure IX form of panel, both the parallel edges are grooved edges. Figure X shows a form of panel in which one of the pair of parallel edges is a grooved edge as in Figure IX; while the other of said pair of parallel edges is formed with a tongue 22 which is identical with the V tongue of Figure VII. Said tongue 22 is capable of

engaging directly with the grooved edge of an adjacent panel, without the intervention of a waling member. In that case the equivalents of the flange 9 and hooks 10 of the waling member referred to in the next paragraph, is provided by a strip which has a hooked end and may be fixed to or be made integral with the corner 20 of the panel adjacent the tongue 22. Instead of said strips, clamps 23 may be used which have hooked ends 24 and are not fixed to either of the two panels but are engaged with the shoulders 21 of both panels before the commencement of the relative rotary movement of the panels which causes them to interengage.

My prior patent application Serial No. 556,677 describes a waling member that is inserted between the edges of a number of panels such as shown in Figures VIII and IX when such panels are assembled. Figure XI shows such a waling member modified according to the present invention. According to such modification, the cross-section of the waling member is that of two of the Figure VII sections joined back to back with their respective portions 16 and their respective portions 11a united.

Figures XII to XIV illustrate the process of assembling two panels of the kind shown in Figures VIII and IX with the waling members of Figure XI. As shown in Figures XII, one of the hooks 10 of the waling member is engaged with the corner 20 of the upper edge 19 of an erected panel 25. The adjacent concave surface 5 of the waling member is engaged with the convex surface 6 of said edge 19; whereupon the waling member is rotated about said corner 20 to bring it to the position of Figures XIII. Then the panel 26 of the next upper course is presented to the waling member in a slanting position so that the corner 20 of its lower edge formation 19 is engaged with the upper hook 10 of the waling member, whereupon such upper panel 26 is swung to the upright position in which its moulding face 17a comes into the same plane as the moulding face 17 of the first mentioned panel.

Figure XV shows a bar formed of sheet metal pressed to the cross sectional shape of Figure VII and capable of various uses with building elements having the same basic cross sectional shape. A specific use of such a bar is as a bar element of the foundation templet described in my co-pending patent application Serial No. 577,898. Figure XVI is a cross-section showing two lengths of such a bar connected by being nested one within the other.

In assembling shuttering walls comprising panels with tongue and groove edges, with or without waling members in the assembly, it is desirable to connect the pair of shuttering walls by ties which engage with the edges of the panels or waling members and which may be of the kind disclosed in the aforesaid application Serial No. 556,677 and also in my co-pending application Serial No. 556,580. Such a tie is shown in Figure XVII. Its end formations 27 are bent to V form to engage between the tongued and grooved edges of the shuttering assembly; and according to the present invention one limb 28 of the V is curved to conform to the shape of the V in Figure VII.

Figure XVIII shows shuttering for a concrete wall embodying the panels, waling members, foundation templet, and ties referred to above; and illustrates the method of assembling them.

Two sets A and B of the foundation templets,

each forming a closed circuit, are laid down on a level foundation surface 29.

Each templet set comprises corner units indicated by the numeral 30 and consisting of two arms 31 rigidly fixed to one another at right angles—or in some other angular relationship in the unusual case of a building that is not rectangular. The corner units of the inner set B are principally for defining re-entrant corners between the walls. Such re-entrant corner units are indicated by 30b, and their arms 31 are made highly rigid with one another by a gusset or diagonal tie 32 between them. The corner units of the outer set A are principally for salient angles; such salient angle corner units, indicated by 30a are not usually provided with a special stiffening formation.

Each templet set also includes straight bar units 33 and coupling units 34 which connect the arms 31 of the corner units to the bars 33 and the bars 33 to one another. Said coupling units 34 are shown as sleeves or profiled fish plates that fit friction-tight and telescopically on the adjacent ends of the arms 31 and of the bars 33 and are long enough to hold said parts firmly in line across the joints between them.

The whole of the continuity structure of the templet, which includes the arms 31 of the corner units 30 and the separate bars 33, is formed of sheet metal pressed to the cross sectional shape of Figure VII. The coupling units 34 are also made of sheet metal pressed to a cross sectional form that enables them to connect the arms 31 and bars 33 telescopically; and if the bar and arm section is of a form that is suitable, the units 34 are made of the same section as the bars and arms. In using the term "the same section" it is assumed that the sheet metal is sufficiently thin relatively to the dimensions of the section for there to be no significant difference between the internal and the external profiles of the section.

In assembling the sets on the foundation surface 29, the different units composing each set such as the corner units 30 and the bar units 33, are coupled by the sleeves 34. Said sets are connected and spaced apart by the ties 35 the end formations of which fit over (or under) the V shapes of the templet elements. A panel 36 is presented to said templet with its grooved lower edge 19 downward and with the panel at such inclination that its corner 20 engages under the hook end 10 of the templet section; while its arcuate surface 6 commences to make engagement with the arcuate surface 5 of the templet section. The panel 36 is then swung to upright position at which it is stopped by contact of the surfaces 7, 8 and/or by its flat edge 37 coming into contact with the surface 38 of the templet. The frictional resistance to the sliding movement of the surfaces 5 and 6 retains the panel in the upright position, assisted, it may be, by the elastic lock explained in connection with Figures V and VI.

When the first course of panels has been thus erected the waling members 39 are connected to the upper grooved edges 19 of the panels by the process described in connection with Figures XII to XIV. Before or after the waling members are assembled the upper edges of the two panel walls are cross connected by ties 40. Next another course of panels 41 is engaged with the waling members 39 in the same way as the first described panel was engaged with the templet; viz. by presenting the panel 41 at an inclination to the waling member, interengaging their respective elements 20 and 10 and then swinging the panel 41 to the upright position.

Figure XIX shows a shuttering for hollow walls, which differs from the shuttering illustrated in Figure XVIII only by the provision of a core 42 which is held centrally in position by the cross-ties 40.

I claim:

1. Composite structure in connection with building, comprising a number of units comprising edge formations by which they are interengaged with one another edgewise, each pair of interengaging edge formations comprising an external formation and an internal formation arranged for pivotal engagement with one another and in which said edge formations are made of sheet material and the external and internal formations are materially identical in form, said form including a first limb, a short transverse limb at one end of the first limb and forming, with the latter, a pivot element, and another transverse limb at the other end of the first limb and on the same side thereof as the short transverse limb, said other transverse limb being arcuate to a centre in the neighbourhood of the junction of the first limb with the short transverse limb.

2. Composite structure in connection with building, comprising a number of units comprising edge formations by which they are interengaged with one another edgewise, each pair of interengaging edge formations comprising an external formation and an internal formation arranged for pivotal engagement with one another and in which said edge formations are made of sheet material and one of said edge formations is of a form including a first limb, a short transverse limb at one end of the first limb and forming, with the latter, a pivot element, and another transverse limb at the other end of the first limb and on the same side thereof as the short transverse limb, said other transverse limb being arcuate to a centre in the neighbourhood of the junction of the first limb with the short transverse limb.

3. The structure claimed in claim 2, in which, in cross-section of an edge formation, the arcuate limb is continued from the end of the arc distant from the vertical limb, to form with said arcuate limb an approximately V shape.

4. The structure claimed in claim 2, in which, in cross-section of one edge formation, the arcuate limb is continued, from the end of the arc distant from the vertical limb, to form with said arcuate limb an approximately V shape, and in which the other formation includes in its cross-section a V shaped portion arranged to engage with the said V shape of the first formation when said two formations are engaged with one another.

5. The structure claimed in claim 2, in which the two edge formations include in their respective cross-sections V shaped portions which are arranged to fit upon one another when said edge formations are in their engaged position.

6. The structure claimed in claim 2, in which the edge formations are shaped so to deform resiliently during engagement as to lock with one another when they come to their properly engaged position and thereby resiliently resist the rotary movement by which they are separated.

7. The structure claimed in claim 2, in which

the edge formations are shaped to be resiliently deformed during part of the pivotal engaging movement and to resume their original shape at least to a substantial extent upon reaching their fully engaged position.

8. A unit suitable as part of a composite building structure, comprising an edge formation of a form including a first limb, a short transverse limb at one end of the first limb and forming, with the latter, a pivot element, and another transverse limb at the other end of the first limb and on the same side thereof as the short transverse limb, said other transverse limb being arcuate to a centre in the neighbourhood of the junction of the first limb with the short transverse limb.

9. A bar having a cross-sectional form comprising a first limb; a short transverse limb at one end of the first limb and forming, with the latter, a pivot element; a second transverse limb at the other end of the first limb and on the same side as said short transverse limb, said second transverse limb being arcuate to a centre in the neighborhood of the junction of said first limb and said short transverse limb; and a further limb extending at an angle from the free end of said second transverse limb in the direction away from the short transverse limb and from said first limb, said further limb forming with said second transverse limb a V the perpendicular of which is materially parallel with said first limb.

10. A waling member of which the cross sectional form is equivalent to that of two bars of the cross-sectional form specified in claim 9 secured to one another back to back.

11. A panel having at least one edge of the cross-sectional form specified in claim 9.

12. A panel having at least one edge of the cross-sectional form specified in claim 9, said cross-sectional form being provided in part by the body of the panel and in part by an auxiliary member which is suitable to be attached to said body so as to provide the continuation of that part of the cross-sectional form of the edge which is provided by said body.

13. A composite panel comprising a thin plate providing a face of the panel and thickness structure attached to said plate, at least one edge of the panel having the cross-sectional form specified in claim 9.

14. Structure comprising two bars as claimed in claim 9, each limb, specified in that claim, of one bar being rigidly connected to the corresponding limb of the other bar and at an angle to it, with the two short transverse limbs in the same plane.

15. Structure comprising two bars as claimed in claim 9 having their respective first limbs fixed at an angle to one another and made rigid with one another by diagonal connecting means between them.

16. A shuttering assembly for a hollow building element, comprising external shutter walls and core shuttering for forming the cavity, said core shuttering being positioned between and spaced from the external shuttering, and being retained in position against transverse movement by cross ties detachably secured to the external shuttering and the core shuttering, in which the external shutter walls are each composed of separate units connected edgewise by edge formations, and the ties are secured to the external shutter walls by being engaged between the jointed edge formations of adjoining units, each pair of inter-engaging edge formations comprising an external formation and an internal formation, the external formation providing in cross-section a pivot element and a retaining surface spaced from and facing towards said pivot element; the internal formation providing in cross-section a pivot element adapted to seat loosely against the pivot element of the external formation and so that the formations of the pair may rotate relatively to one another about the axis of the co-operating pivot elements; said internal formation further providing an elastically deformable element that, by such rotation, is swung into engagement with said retaining surface so that the internal formation is secured between the pivot element of the external formation and said retaining surface of the external formation.

17. Composite structure comprising panels, waling members, cross-ties and templet members, in which said panels, waling members and templet members are connected edgewise by edge formations and in which each pair of co-operating edge formations comprises an external formation and an internal formation, the external formation providing in cross-section a pivot element and a retaining surface spaced from and facing towards said pivot element; the internal formation providing in cross-section a pivot element adapted to seat loosely against the pivot element of the external formation and so that the formations of the pair may rotate relatively to one another about the axis of the co-operating pivot elements; said internal formation further providing an element that, by such rotation, is swung into engagement with said retaining surface so that the internal formation is secured between the pivot element of the external formation and said retaining surface of the external formation.

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