United States Patent

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a part interest

[54] **BUILDING WALL APPARATUS**
4 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** **249/13,**
25/131, 249/27, 249/162, 264/31
[51] **Int. Cl.** **B28b 7/22**
[50] **Field of Search** 249/27, 28,
161, 162, 36, 137, 146, 152, 33, 18, 13, 144;
25/131Z, EY, 131B, 130B; 264/31, 334, 336

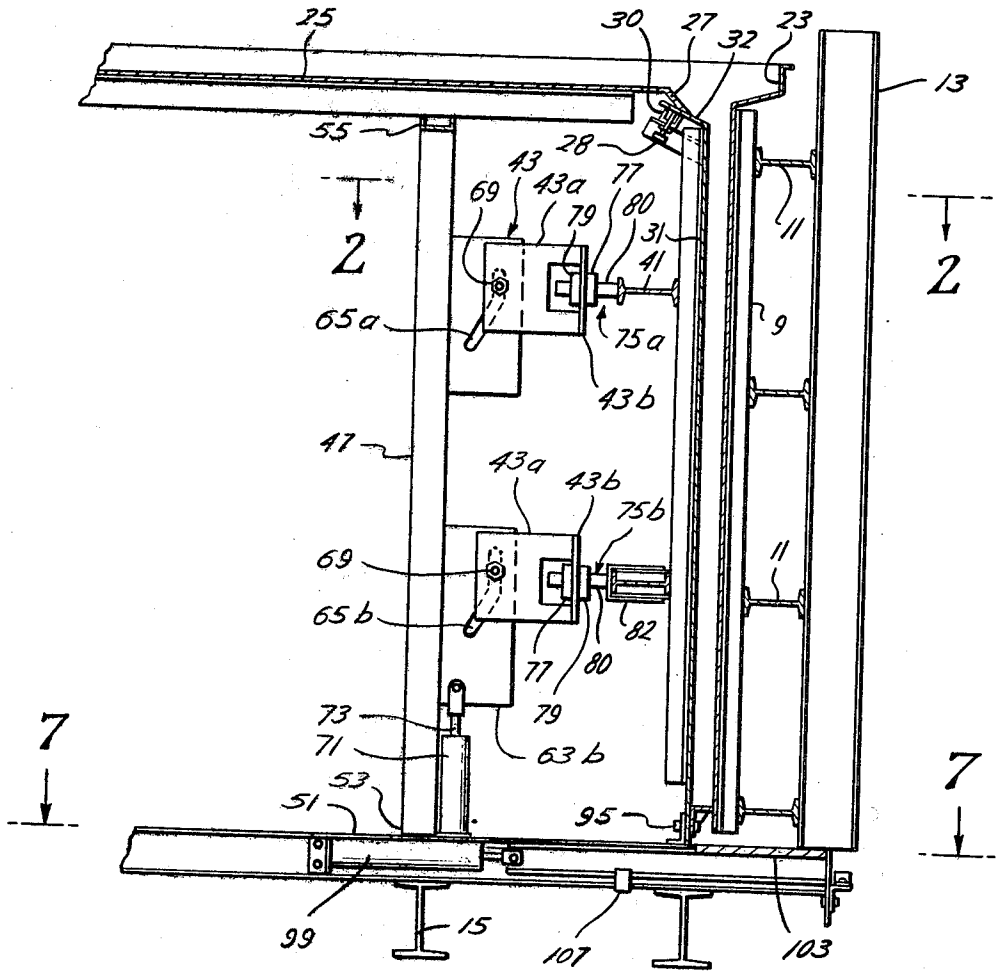
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Attorney—R. Werlin

ABSTRACT: A building wall forming apparatus for constructing a complete room or building section in monolithic form. The apparatus, which is of unitary construction, includes spaced inner and outer wall means supported on a common framework with the volume between the wall means being adapted to receive a cementatious material. The ceiling is defined by an upper plate supported above the inner wall means in contacting relation therewith. The inner wall means also includes inner corner wall means. Both the inner wall means and inner corner wall means are fixedly connected to cam-operated actuator units, there being an actuator unit disposed at each interior corner of the apparatus. The actuator units are hydraulically operated to cause simultaneous retraction of the inner wall means and the inner corner wall means pivotally about their corner edges. Similarly, the outer wall means are operatively connected in movable manner to support sections, the support sections being adapted to expand or move outwardly by operation of hydraulic pistons. After pouring and curing of the cementatious material, the inner wall means and inner corner wall means are retracted by the cam operated actuator units and the outer wall means are expanded by operation of the hydraulic pistons, thereby permitting removal of the monolithic cementatious body from the apparatus. Due to the unitary construction of the apparatus and consequent portability, it may be moved from one job site to another both quickly and easily.



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SHEET 1 OF 5

Fig. 1

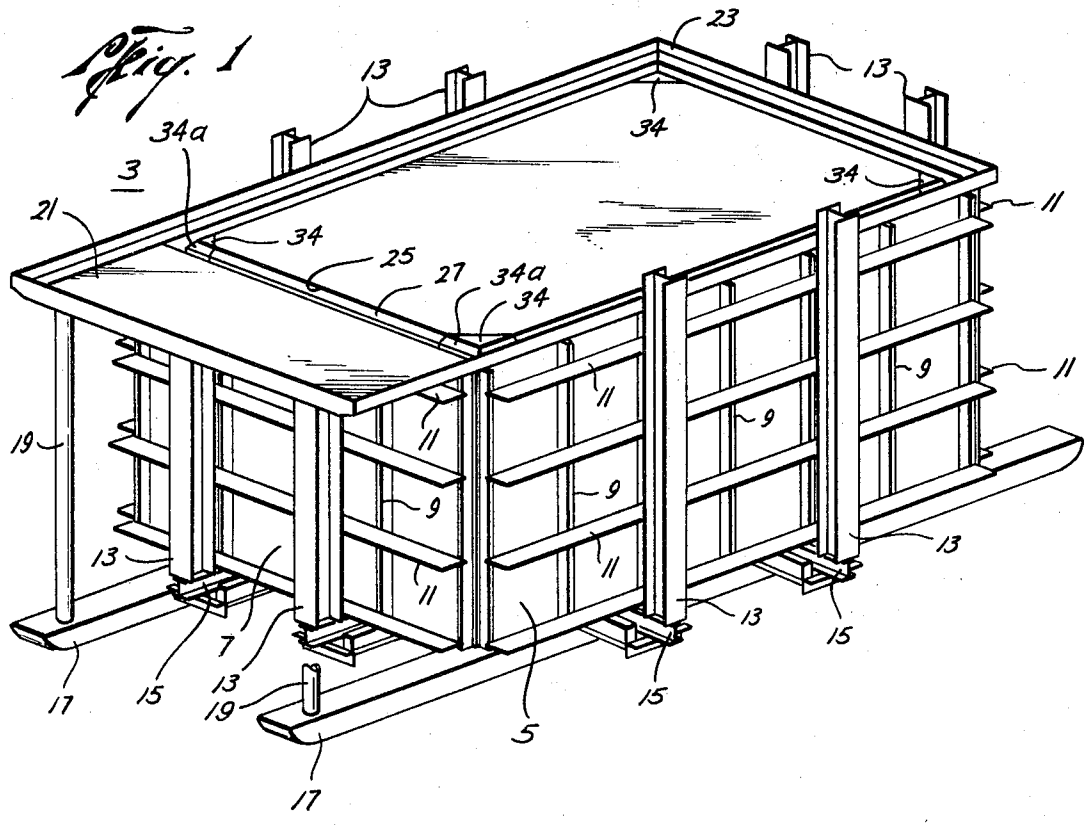
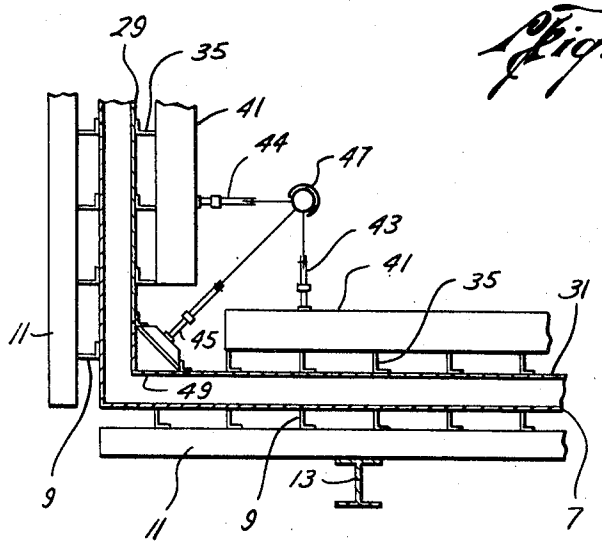
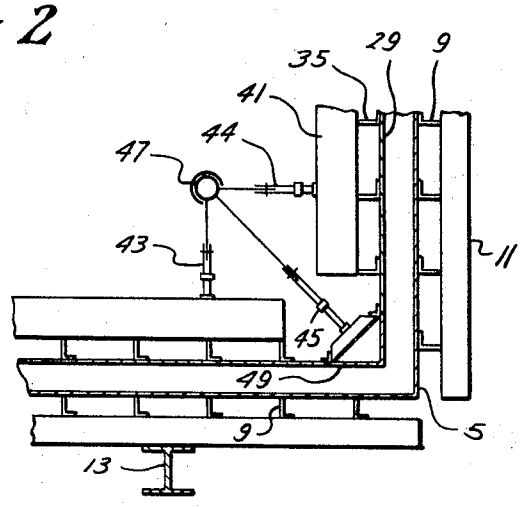


Fig. 2





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Fig. 3

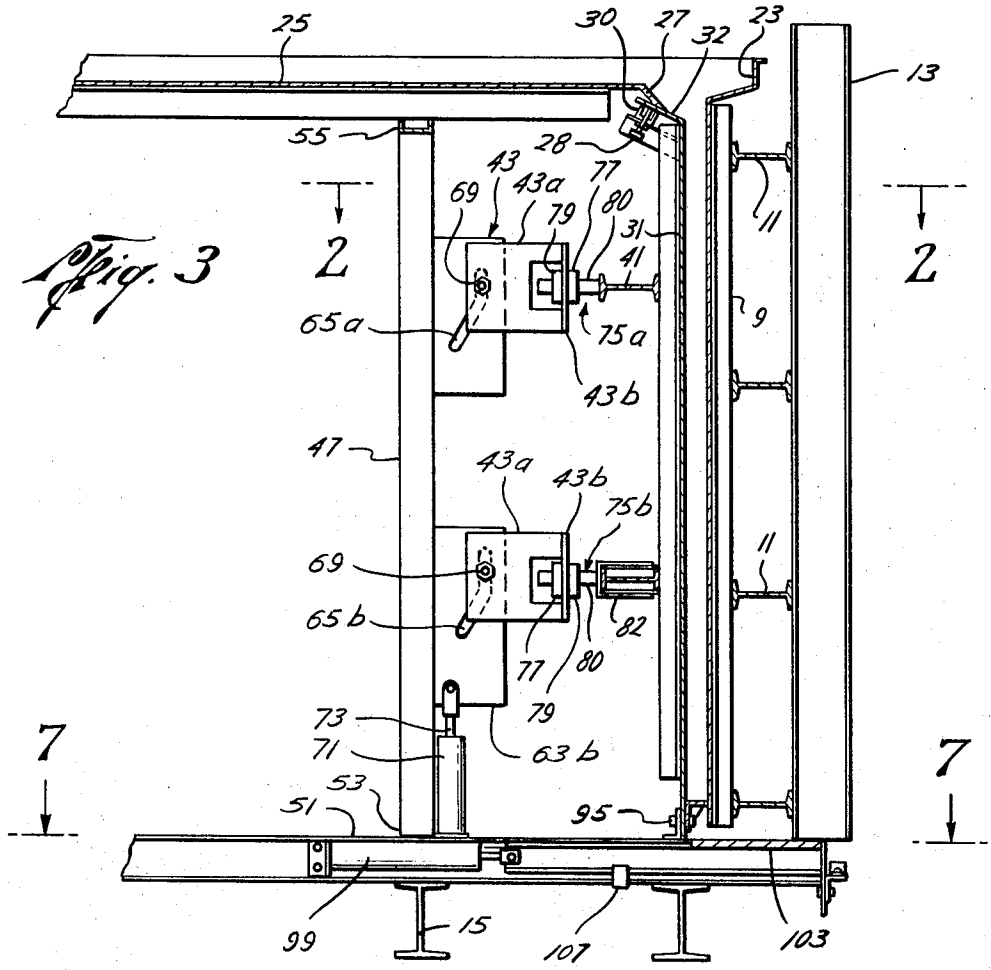
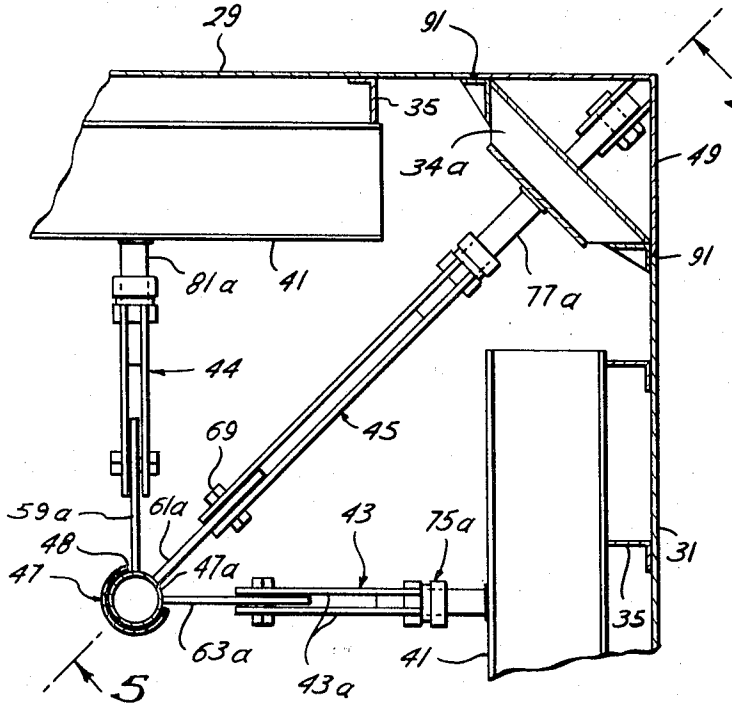


Fig. 4



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Fig. 6

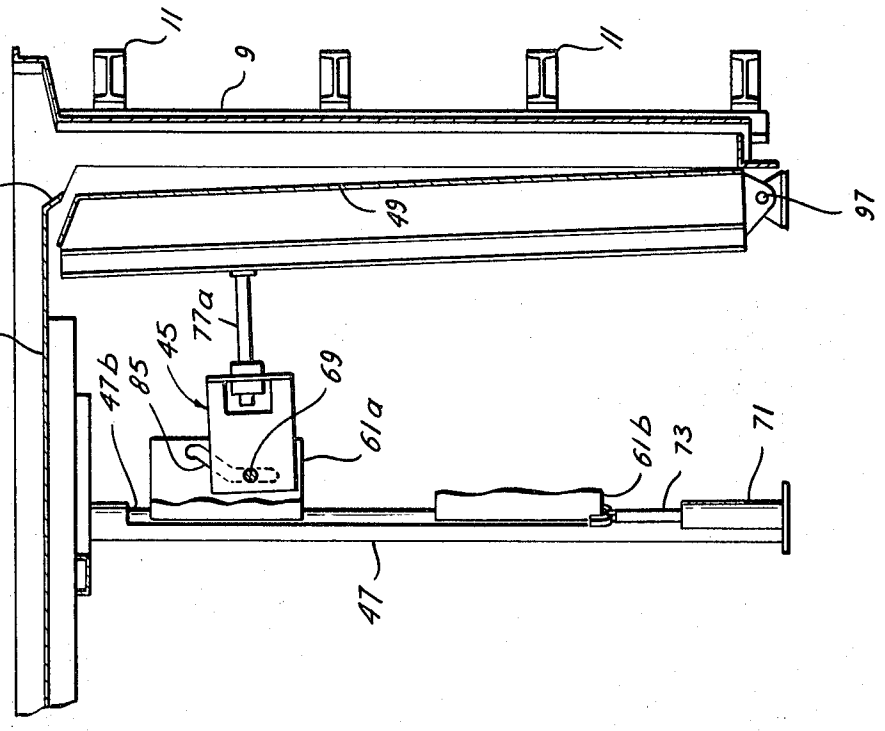
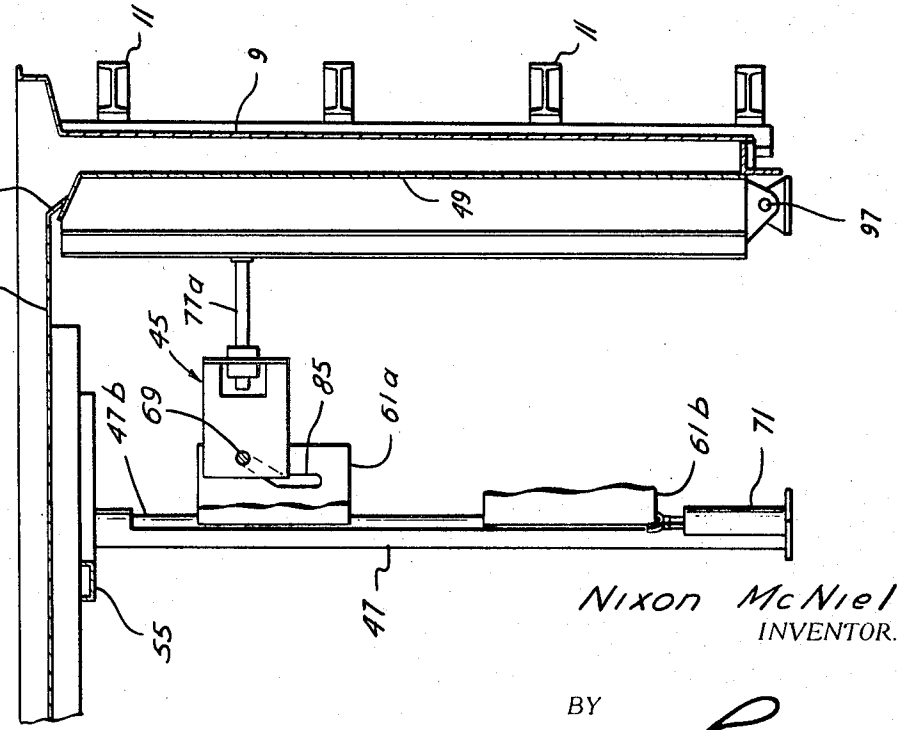


Fig. 5



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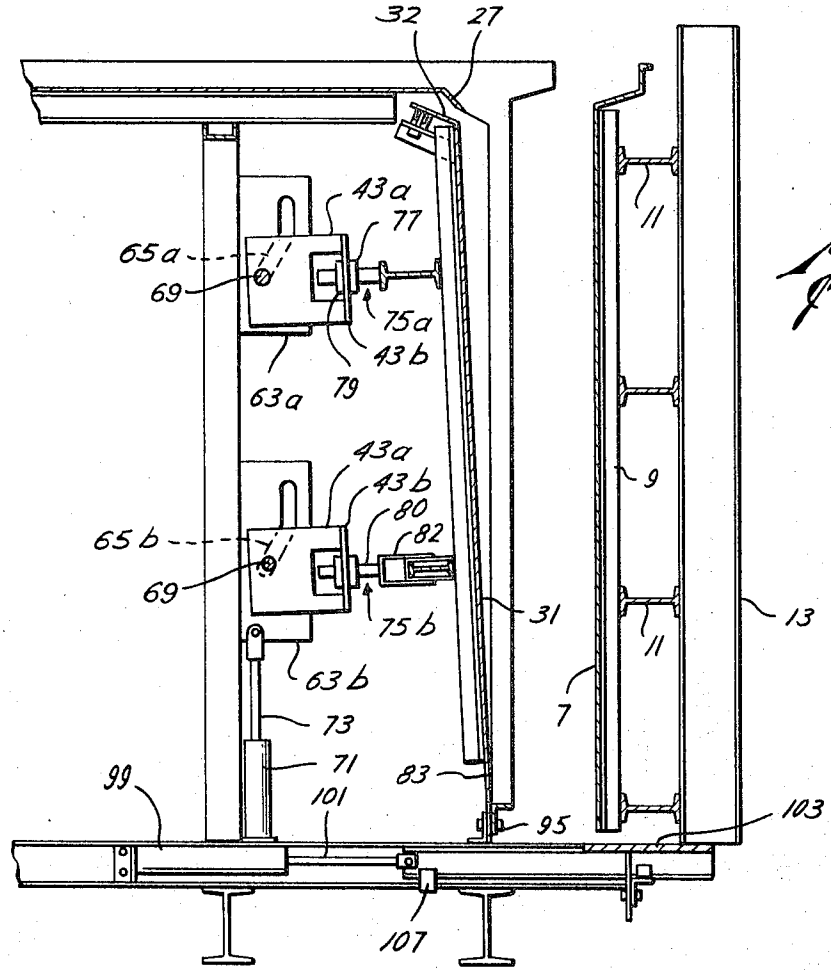


Fig. 7

Fig. 9

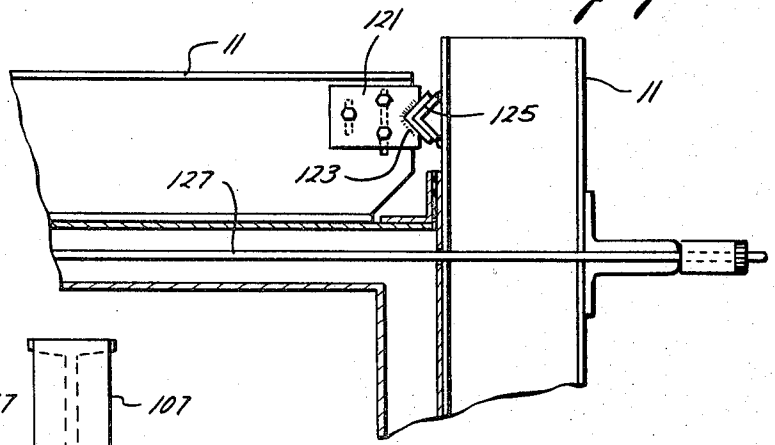
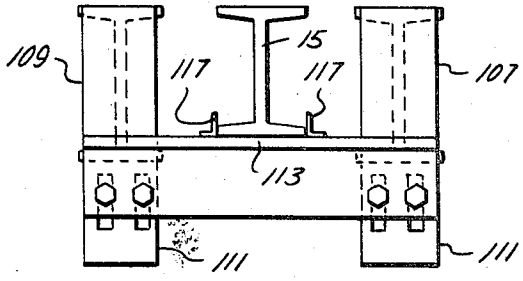


Fig. 10



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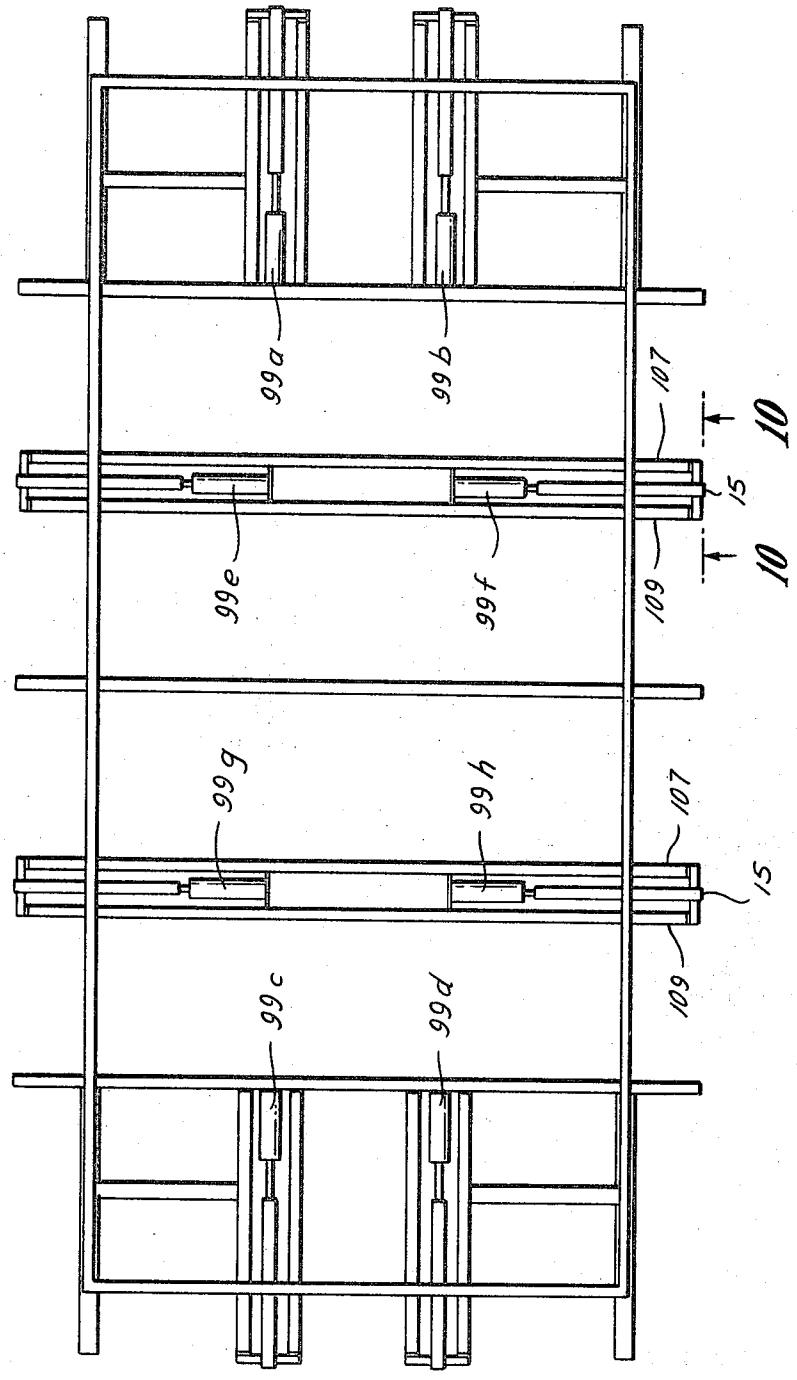


Fig. 8

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BUILDING WALL APPARATUS

BACKGROUND OF THE INVENTION

This invention relates in general to the art of building construction. More particularly, it is directed to a new and improved retractible wall apparatus for making monolithic rooms or building sections for the construction industry.

The construction industry has heretofore utilized numerous tools and methods in order to effect the most efficient and least expensive approach to completion of a given project. Among these is the use of segmental preformed wall molding devices for receiving the concrete or other cementatious material. Frequently, the mold devices are used to create a plurality of wall sections which are then assembled at the job site to form a wall of appropriate area. In connection with such construction methods, it is necessary to provide means to properly align the sections with respect to each other so that corners will be square and wall surfaces plumb. Because of inherent difficulties in doing this and also because of the handling required in multisection wall construction, more advanced unitized construction methods have been developed in which an entire room or building section is fabricated in a mold or wall forming apparatus and then lifted, as by crane, into its predetermined position. It is in this field of monolithic construction that the present invention resides and it is a primary object thereof to furnish the building industry with a new and improved room forming apparatus.

Another object and feature of the invention is the provision therein for an improved inner wall forming means and for an improved inner corner wall forming means, both of which are moved simultaneously away from the concrete wall after it has cured, so as to permit removal of the entire room or building section from the apparatus.

These and numerous other features and advantages of the invention will become more readily apparent upon a reading of the following detailed description, claims, and drawings wherein like numerals denote like parts in the various views and wherein:

FIG. 1 is an exterior perspective view of the building wall apparatus of the invention;

FIG. 2 is a cutaway taken along the plane 2–2 of FIG. 3 of the apparatus showing the position of the actuator units interiorly thereof;

FIG. 3 is a side view of an actuator unit showing the inner and outer wall forms in a normal wall-forming position;

FIG. 4 is a top view of an actuator unit;

FIG. 5 is a sectional view along the plane 5–5 of FIG. 4, showing the inner corner wall form of the actuator unit in a normal position;

FIG. 6 shows the inner corner wall form of FIG. 5 in its retracted position;

FIG. 7 is a side view of an actuator unit showing an inner wall form in its retracted position;

FIG. 8 is a plan view showing the positions of the hydraulic jacks for expanding the outer wall forms;

FIG. 9 is a fragmentary view showing a corner of the outer walls; and

FIG. 10 is a sectional view along the plane 10–10 of FIG. 8.

With reference to the drawings, there is shown in FIG. 1 the building wall apparatus 3 having exterior sidewalls 5 and exterior end walls 7, only one of each being shown. Due to the substantial weight of wet concrete, the walls should be made of plate steel or equivalent material. However, in order to insure against any bulging of the walls, vertical reinforcement beams 9 are affixed to the exterior surface of the side and end walls. Disposed over and affixed to the vertical reinforcement beams on both the side and end walls are a plurality of horizontal beams 11 which are in turn affixed to each of the driving columns 13. The columns are each supported on the hydraulically operated sliding I-beams 15 described hereinafter and are thus adapted to move the exterior walls 5, 7 inwardly or outwardly in the horizontal plane.

It is thus seen that horizontal beams 11 serve not only to reinforce vertical beams 9 but that they also provide for equal distribution of the motive force of columns 13 along the length of the walls. Similarly, the vertical beams 9 equally distribute the motive force of columns 13 along the height of the walls, thereby insuring equal movement of each of the walls over its entire surface area. All of the aforementioned structure is supported on and affixed to a pair of skid means 17 disposed in parallel manner with respect to each other on opposite sides of apparatus 3. The entire apparatus may thus be easily moved from one spot to another at the job site. Also, due to the unitary construction of the apparatus, it may easily be transported from one job site to another. Perpendicularly supported from one end of each of the skids is a canopy support post 19. The canopy forming section 21 extends outwardly in the longitudinal direction from the upper portion of end wall 7 and is braced at its outer or cantilevered ends by each of the posts 19. Extending about the canopy perimeter and three sides of the upper wall portions is the trough means 23, the depth of which defines the thickness of the ceiling of the room which is to be fabricated in the apparatus.

Disposed interiorly of exterior side and end walls 5, 7 respectively, is ceiling plate 25. The perimetal edge of the plate is characterized by downwardly and outwardly directed flange 27, which is adapted to matingly engage the movable side and end interior wall forms 29, 31, respectively, FIG. 2.

As best shown in FIGS. 2—4 and 7 the interior wall forms 29, 31 are disposed in parallel but spaced relation to the exterior walls 5, 7 so as to receive therebetween the flowing concrete or other cementatious construction material. The interior wall forms are braced and reinforced by the vertically disposed, horizontally spaced beams 35. Fixedly connected to the beams 35 and horizontally disposed thereacross in spaced vertical relation are a plurality of beams 41 to each of which is affixed two or more cam-actuated connection units 43, 44 which are in turn operatively connected to the tubular actuator posts 47 described hereinafter. The actuator posts 47 are disposed one at each interior corner of the apparatus and have, as shown in FIG. 2, the two perpendicularly oriented connection units 43, 44, with the latter units (44) each being affixed to the sidewalls and the former (43) each being affixed to the end walls. Also connected to the actuator posts by a cam-actuated connection unit 45 are the inner corner panels 49, see FIG. 4. The inner corner panels will therefore be actuated at the same time as interior walls 29, 31, due to their common connection to actuator post 47 and common means of operation, i.e., by cam actuated upper and lower connection units 43, 44 and 45.

The actuator posts 47 are each characterized by a longitudinal slot 48 which is oriented toward the inner corner panels 49. The lower or bottom end 53 of each post is fixedly connected to a floor plate 51 while the upper end 55 is affixed to the underside of ceiling plate 25. Slidably arranged within the tubular actuator posts 47 is a center bar 47*a*. Fixedly connected to each bar 47*a* and extending out of the longitudinal slot 48 of the actuator post 47 are three vertically spaced pairs of radially extending plates, 59*a*, 59*b*, 61*a*, 61*b*, and 63*a*, 63*b*. For example, connected to sidewall 29 through connection unit 44 are the upper 59*a* plate (FIG. 4). Connected to inner corner panel 49 through connection unit 45 are upper and lower plates 61*a*, 61*b*, respectively, see FIGS. 5 and 6; and connected to end wall 31 through connection unit 43 are the upper and lower plates 63*a*, 63*b*, respectively.

The connection units (43—45) movably engage radial plates 59, 61, 63 by means of a rod-in-slot camming configuration. With particular reference to the end wall 31 retracting mechanism of FIGS. 3, 4, and 7, each of the upper 63*a* and lower 63*b* radial plates are characterized by a slot 65*a*, 65*b*, respectively. The upper and lower connection units 43 which cooperate with plates 63*a*,63*b*, respectively, (FIGS. 3 and 7), each comprise a pair of spaced parallel plates 43*a*, 43*a* (FIG. 4) between which are disposed the respective upper and lower radial plates 63*a*, 63*b* that extend from center bar 47*a*. A bolt

69 or similar connecting means is adapted to tie the connection plates 43*a* to the radial plates 63*a*, 63*b*, respectively. It may be noted that slots 65*a*, *b* include a vertical leg and a downwardly and rearwardly directed oblique leg therebeneath. In order to obtain appropriate dimensional retraction of the end wall 31, it will be readily recognized that variations in the angular relationship of the slot legs may be made to thus effect such change.

The connection units 43, 44 are affixed to the side and end walls 29, 31 by respective upper 75*a* and lower 75*b* couplings. The upper coupling 75*a* (FIGS. 3 and 7) includes a throw bar 80 rigidly affixed at one end to the horizontal internal beam 41 of the end wall 31. The other end of throw bar 80 is threadedly engaged by the adjusting nuts 77, 79 (FIG. 7) appropriately mounted each, on opposite sides of an end plate 43*b* affixed to connection unit 43. It will therefore be readily recognized that the upper coupling provides a means for adjustably varying the effective "throw" or horizontal movement imparted to the upper portion of the side and end walls.

The lower portion of these walls are affixed to the connection plates 43, 44 by a somewhat different coupling 75*b* (FIGS. 3 and 7). This coupling similarly includes a throw bar 80 which threadedly engages at one end a pair of adjusting nuts 77, 79 each disposed on opposite sides of a connection unit end plate 43*b*. The opposite end of the throw bar is affixed to a horizontally disposed U-shaped slide plate 82 which slidably engages a beam of the end wall (or sidewall) so that upon retraction of the wall the slide plate moves from a first beam engaging position (FIG. 3) to a second partial beam engaging position (FIG. 7). Slide plate 82 thus acts primarily as a guide for the retractive movement of the lower portion of the wall, and functions as a brace therefor when the wall is moved to its advanced or normal position.

Both the end walls 31 and sidewalls 29 have lower edge portions 83 which are unsupported by the vertical beams 35 to form flexible webs which are rigidly connected at their lower ends to the floor plate 51 by bolt means 95, see FIGS. 3 and 7, so that upon actuation of the hydraulic jack 71 the wall will tend to pivot about the axis extending longitudinally of portions 83 as best seen in FIG. 7.

Movement of the wall 31 is thus accomplished by the hydraulic jack 71 (FIG. 3) which drives the center bar 47*a* of actuator post 47 up or down. Due to the connection of the wall to radial plates 63*a*, which are in turn affixed to the bar, the wall will swing in or out about the horizontal pivots defined by portions 85. Prior to actuation of the jack 71, the interior end wall 31 is in vertical position (FIG. 3). Upon actuation of the jack, the piston rod 73 pushes plate 63*b* upwardly, similarly moving plate 63*a* upwardly due to their common connection to center bar 47*a*. As this occurs, bolt 69 moves downwardly from the top of the vertical slot leg to the bottom of the oblique slot leg (FIG. 7) and in so doing draws the connections units 43, 44 inwardly. It will be readily recognized in this regard that due to the relative orientation of the slot legs to each other, no movement of the side and end walls will initially occur as the radial plates 63*a*, *b* move upwardly. This is in contrast to the slots of the inner corner panel radial plates, described hereinafter. As the bolt reaches the oblique leg in units 43, 44, a horizontal component of such movement is imparted to the upper portion of the end and sidewalls, pulling the end and sidewalls inwardly about the axes defined by portions 83.

The mechanism and related manner of operation causing retraction of the interior end and sidewalls also causes retraction of the inner corner panels 49. In this regard, reference may be made to FIGS. 4, 5, and 6 wherein there is shown the aforementioned radial plates 61*a*, *b*, connection unit 45 and upper coupling 77*a*, the latter of which is identical to upper coupling 75*a*. As shown in FIGS. 5 and 6, the radial plates 61*a*, *b*, which cooperate with connection units 45 are characterized by slots 85 having a vertical and rearwardly directed leg but in which the position of the legs are reversed by comparison to the plates 59*a*, *b*, 63*a*, *b*, of the inner end and sidewalls. As a consequence, it will be easily visualized that upon actuation of the aforementioned jack 71 the inner corner panels will begin to retract prior to the inner end and sidewalls. Conversely, when moved in the opposite direction, i.e., toward the outer walls, initial movement will be imparted to the end and sidewalls due to the camming configuration in the radial plates. The abutting edges of inner walls 29, 31, and inner corner panels 49 are chamfered at 91, see FIG. 4, in order to enhance the sealing engagement of the walls and panels, so as to preclude leakage of wet concrete. Thus, the inner side and end walls 29, 31, respectively, may be drawn into firm engagement with the inner corner panel 49. In retracting the inner walls, the difference in shapes of the several cam slots in the connection units causes movement of the corner panel portion to precede the walls themselves so as to free the end and sidewalls for inward movement as required. In this regard, it will be noted, as shown in FIGS. 5 and 6, that the inner corner panels 49 are affixed at their lower ends to the apparatus floor panel 51 by hinge construction 97 which may be contrasted with the flexible but fixed bolt means 95 of the side and end walls. This is, of course, necessitated by the configuration of the structure being retracted. With the side and end walls the structure is a planar body which flexes easily when fixed at one end. On the other hand, were the body of multiplanar configuration, as is present in a corrugated structure, or as in the instant case, a corner section, then and in such event flexing cannot occur with one end fixed without causing deformation. Such problems are obviated herein by provision for the hinge 97.

With respect to the exterior walls 5, 7, reference may now be made to FIGS. 3 and 7—9. Expansion or outward movement of the outer walls after the concrete has cured is accomplished by a plurality of hydraulic jacks 99 appropriately placed beneath floor plate 51. The jacks are operatively connected in conventional manner through a stroke arm 101 to sliding support plate 103 on which rests the exterior wall. The sliding support plate may, in turn, overlie floor plate 51. A guide means 107 (FIGS. 3, 7) may also be provided to enhance true movement of the sliding support plate 103.

Placement of the hydraulic jacks 99 beneath floor plate 51 may be accomplished in accordance with the plan shown in FIG. 8. As illustrated therein, the end walls may be reciprocally moved by the end jacks 99*a*, *b* and 99*c*, *d*, while the sidewalls may be moved by jacks 99*e*, *f*, and 99*g*, *h*. Jacks 99*e*, *f* and 99*g*, *h*, may be placed in tandem pairs within the parallel I-beams 107, 109. As shown in FIG. 10, these I-beams may be set on adjustable vertical support plates 111 so as to insure substantially uniform horizontal movement of the walls. The central movable beam 15 which rests on crossbar 113 supports the columns 13 as explained with respect to FIG. 1. Guide plates 117 may be provided to enhance linear movement of the beams. Substantially identical structural support means are provided for each of the other jacks described hereinbefore.

In operation of the subject invention, the inner side and end walls 27, 31 precede the corner panels to the normal vertical positions by actuation of the hydraulic jacks 71 (FIG. 3) which may be connected to any conventional hydraulic pressure supply, not shown. This occurs, as explained above, by reason of the cam configuration in the radial plates. After the end and sidewalls have been rotated about web portions 85 to the normal vertical position and the corner panels have followed due to their rotation about hinge 97, the inwardly directed underhanging flange 32 of inner end wall 31 is moved into engagement with the outwardly directed overhanging flange 27 of the ceiling plate 25. Sealing engagement of these flanges may be insured by a manual threaded pressure clamp 28. By merely rotating the clamp (FIG. 3), the head portion 30 thereof is driven against the somewhat resilient flange 32 so that it positively contacts flange 27. It will be understood that similar flanges are carried by the upper edges of the inner sidewalls. The corner panels are topped by triangular plates 34 to close the corners of ceiling plate 25 and are provided with

sloping flanges 34*a* to connect between the adjacent ends of flanges 27 as best seen in FIG. 1. The exterior walls 5, 7 may then, by actuation of hydraulic jacks 99, be moved into their appropriately spaced position with respect to the inner walls. There is provided in this regard guide plates 121 (FIG. 9) which may be adjustably affixed to the horizontal reinforcing beams 22 on the exterior sidewalls 5. Each guide plate is characterized by a V-shaped groove 123 into which there is adapted to fit a cooperative V-shaped channel 125 vertically carried by the end wall reinforcing beams 11. Conventional pretensioning rods 127 may also be positioned at this point between the spaced walls. Wet concrete, or other cementatious material is then poured into the space defined by the inner and outer walls until the entire volume therein is filled. Additional concrete is poured so as to cover to appropriate depth the ceiling plate 25 and the canopy 21 which resides in a substantially common plane with the ceiling plate. The concrete is subsequently permitted to cure. At the optimal time the hydraulic jacks 71 are operated to effect retraction first of the inner corner panels followed closely by the inner walls as previously explained. Expansion of the outer walls, also in the manner explained hereinabove, is then effected. The monolithic room or building section may then be lifted by crane from the apparatus and prepared for placement in its predetermined position on a prefabricated floor slab or on the building being constructed. The inner and outer walls may then be actuated for return to their normal positions.

It will be thus seen that by use of the apparatus disclosed, there is provided a unitary construction means which is capable of easy movement about the job site due to the skid-type supports on which it rests. In addition, the apparatus may be easily transported from one job site to another and a complete building, including any desired number of rooms and any desired room arrangement may be rapidly constructed by simply placing each monolithic structure on top of or adjacent to another since the ceiling of one may constitute the floor of one above.

It will be understood that various openings may be provided in the finished walls by inserting between the inner and outer walls cement-excluding frames of requisite shape to define the desired openings, as is well known and generally conventional.

While there is shown a preferred form of the invention, it will be understood that various changes may be made in the construction and arrangement thereof by those skilled in the art, without departing from the spirit of the the invention as claimed.

Having thus described the invention, that which is claimed and desired to be secured by U.S. Letters Patent is:

I claim:

1. Apparatus for constructing a room or building section from cementatious material, comprising:

a. a portable base means;

b. an expansible outer form comprising vertically disposed side and end walls supported in said base means for lateral movement;

c. fluid pressure-operated means mounted on the base means operable to effect said lateral movement of said side and end walls;

d. an inner form supported on said base means in concentric spaced relation to said outer form and comprising:

i. vertically disposed side and end walls having means pivotally securing their lower ends to the base means for angular movement to and from vertical positions; and

ii. generally triangular corner sections having means pivotally securing their lower ends to said base means for angular movement to and from vertical positions interfitting between adjacent edges of the inner form side and end walls; and

e. fluid pressure-operated retractor means mounted on the base having connections to the inner form side and end walls and corner sections for effecting said angular movement, said retractor means constructed and arranged to effect said angular movement of said corner sections in advance of said end and sidewalls.

2. The apparatus of claim 1 including a ceiling plate supported on said base means above said inner form to cover the area defined thereby and sealingly engageable by the upper ends of the end and sidewalls and corner sections when in their vertical positions.

3. The apparatus of claim 2, wherein said retractor means comprises:

a. a hollow post member vertically disposed on said base means interiorly of each of said corner sections;

b. an actuator shaft vertically slidable in each said post member;

c. wall actuator linkages extending at right angles to each other from the post member to points on the adjacent side and end walls;

d. an additional actuator linkage extending to said corner section on a plane bisecting the angle between said wall actuator linkages; and

e. cam means interposed in the respective actuator linkages formed to effect angular movement of said corner sections in advance of said side and end walls.

4. The apparatus of claim 1 wherein said outer form includes:

a. vertically disposed, spaced apart beams secured to the respective side and end walls;

b. cross beams secured to the lower ends of said vertical beams and slidably mounted on the base means for movement at right angles to said side and end walls; and

c. means operatively connecting said cross beams to said fluid pressure-operated means.