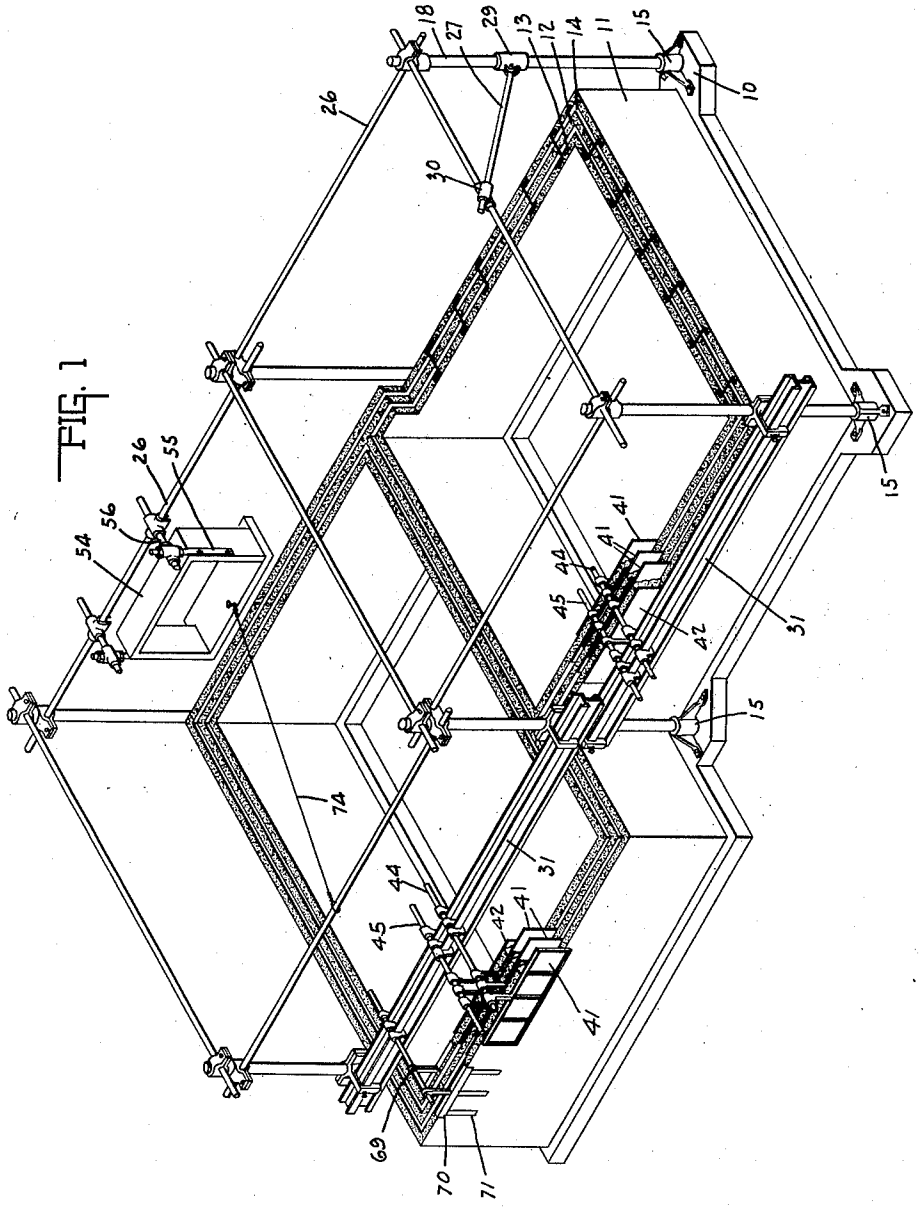
Dec. 9, 1924. 1,518,149

B. KAY

APPARATUS FOR BUILDING STRUCTURES

Filed June 21, 1921 4 Sheets-Sheet 1

FIG. 1



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Dec. 9, 1924. 1,518,149

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APPARATUS FOR BUILDING STRUCTURES

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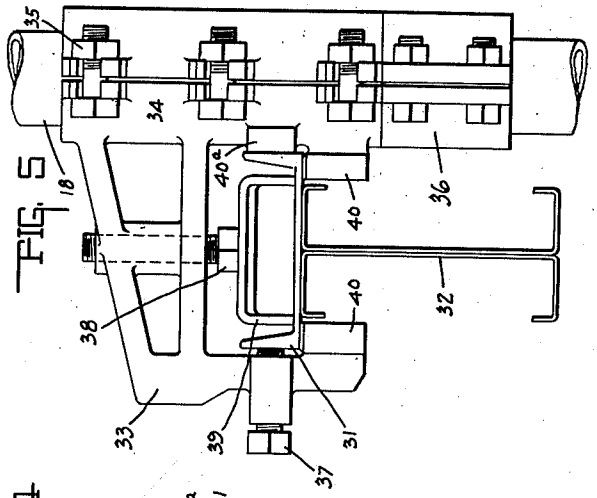

FIG. 5

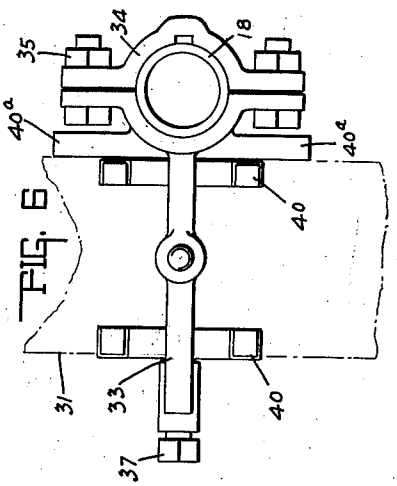

FIG. 6

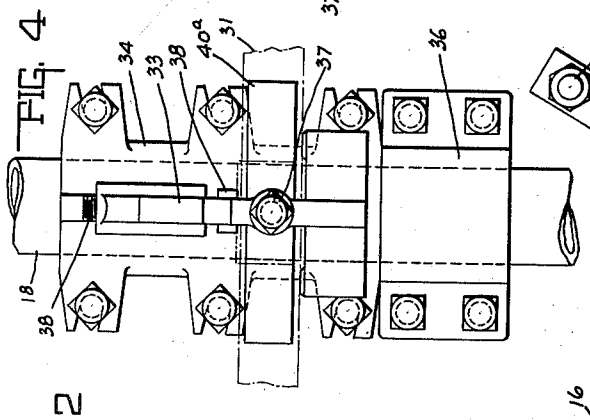

FIG. 4

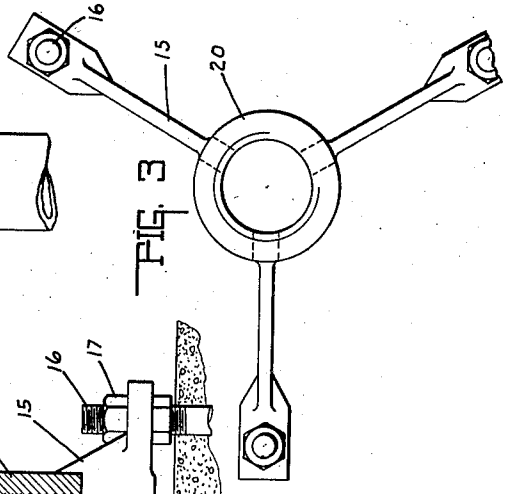

FIG. 3

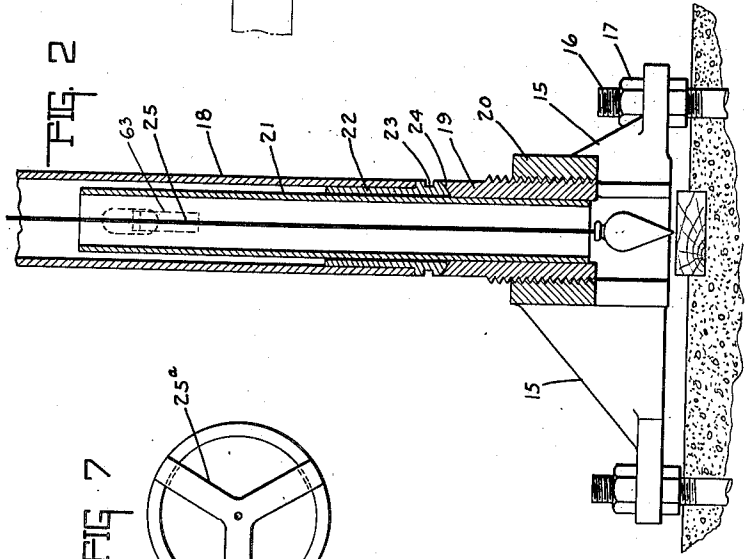

FIG. 2

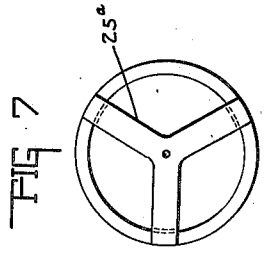

FIG. 7

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APPARATUS FOR BUILDING STRUCTURES

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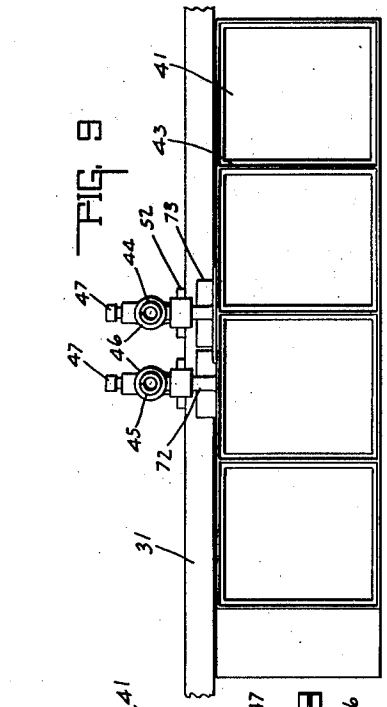

FIG. 9

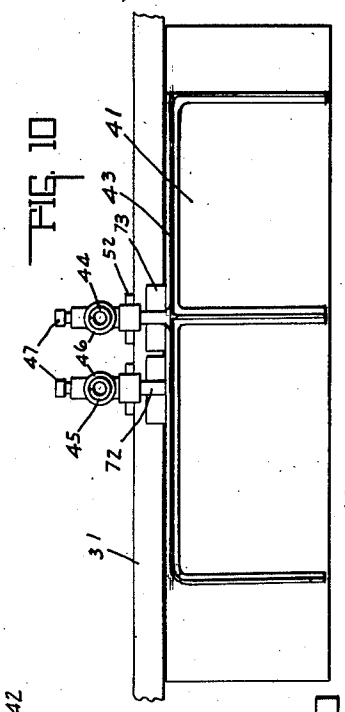

FIG. 10

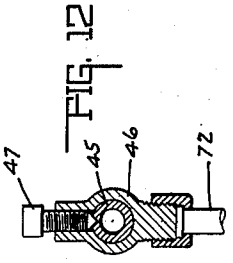

FIG. 12

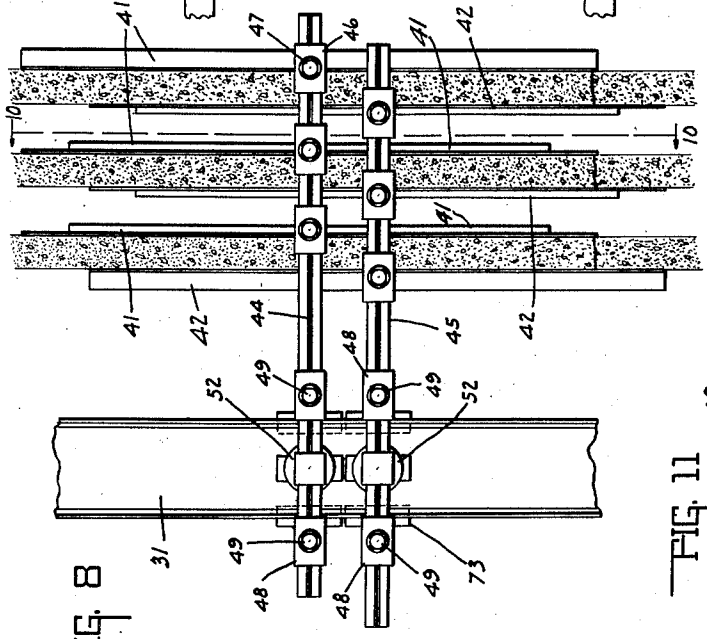

FIG. 8

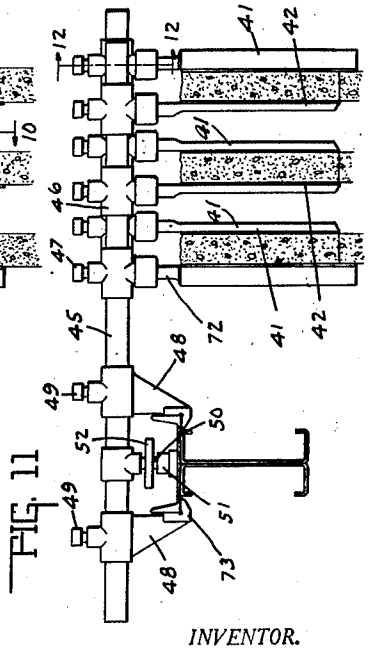

FIG. 11

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FIG. 16

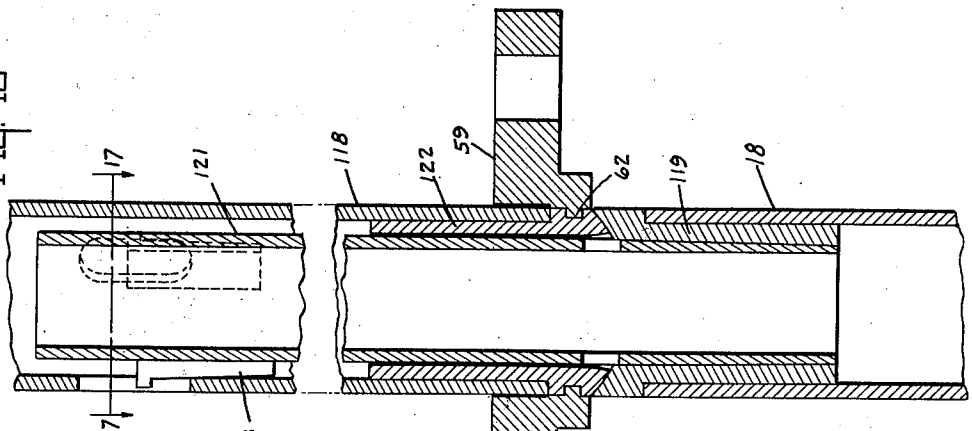


FIG. 17

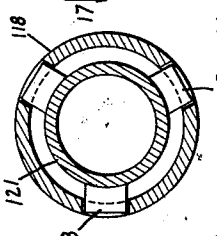


FIG. 14

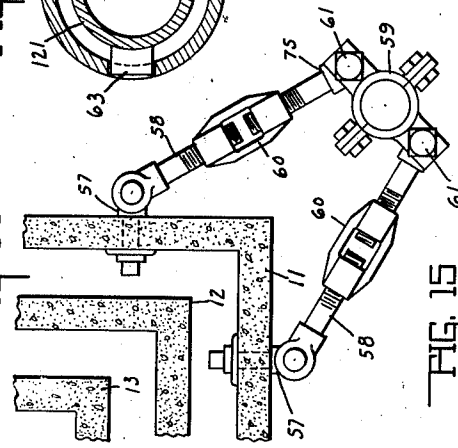


FIG. 15

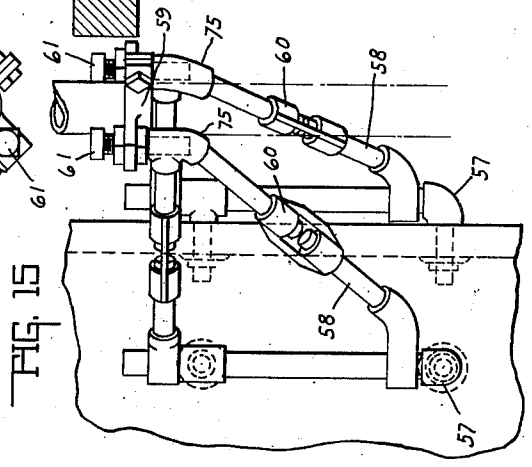
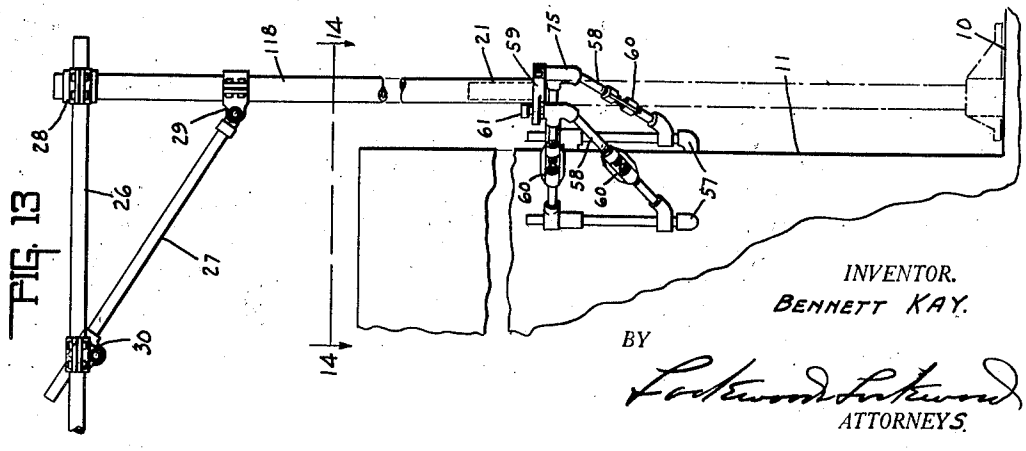


FIG. 13



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UNITED STATES PATENT OFFICE.

BENNETT KAY, OF INDIANAPOLIS, INDIANA.

APPARATUS FOR BUILDING STRUCTURES.

Application filed June 21, 1921. Serial No. 479,268.

To all whom it may concern:

Be it known that I, BENNETT KAY, a citizen of the United States, and a resident of Indianapolis, county of Marion, and State of Indiana, have invented a certain new and useful Apparatus for Building Structures; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which like numerals refer to like parts.

This invention relates to a method of building concrete buildings, as well as structures built with other types of masonry walls and the apparatus and parts used in the building thereof. This method of building is particularly adaptable to multiple wall structures wherein a dead air space is left between two or more concrete walls.

The principal object of the invention is to effect a saving of material, reduce the amount of skilled labor required, and accelerate the speed of construction, all of which is accomplished by means of the specially devised construction apparatus, and the method of using the same.

Heretofore multiple wall concrete buildings having a continuous air space have been built by various types of apparatus, consisting essentially of molding plates joined together to form a mold for building a short stretch of wall at a time, after which the plates are released from the concrete and the form moved along the wall for building another section, leaving exposed the freshly constructed piece of wall still damp. The difficulties encountered with the present types of apparatus and the method of using the same are principally that when the form is released, the damp mold of concrete is left exposed, which is bound to distort somewhat, as there is no means of bracing the fresh concrete wall; and while a slight distortion is not serious, it is quite apparent that if the lower section is out of plumb, some difficulty will be encountered in properly plumbing the form for molding the section immediately above. This will result in an uneven wall surface. Another disadvantage in the methods now employed is that the form is aligned with a builder's line, which is a tedious, and time-consuming process. Furthermore, if there is a slight distortion in the section below, the form must be plumbed, in addition to being aligned. The methods now in use require considerable skill on the part of the men handling the forms; otherwise, an unextremely unworkman-like job will result.

It is the purpose of this invention to overcome and avoid the difficulties above noted and render the method of construction and the apparatus used therein substantially fool-proof, so that it may be readily operated by unskilled workmen, and time saved which ordinarily was consumed in moving and aligning the form. This apparatus consists essentially of a demountable light steel framework, all the similar parts being interchangeable, and to which the molds are attached for forming the walls. One of the vital differences between this invention and the existing methods is that instead of the molds being supported on the concrete below, they are supported on a steel framework. Therefore, any inaccuracy in the concrete poured will not affect the alignment and plumbing of the forms. Furthermore, means are provided for bracing the damp mold immediately after the form is removed.

Another feature of the invention is the provision for means, whereby the window and door frames may be suspended from the frame structure and set in the usual manner in the concrete. This eliminates bracing such frames with boards and the like, which is a cumbersome, tedious and costly operation.

Another feature of the invention consists in the method of building up the frame structure for supporting the molds, whereby it may readily attain a height of several stories for building chimneys, silos and high buildings, without danger of the general vertical line of the walls being out of plumb, due to the distortion of the frame on account of temperature changes, loosening of connection, etc., or the sagging of fresh concrete.

By means of this method or system of construction, the same apparatus may be used in any type of building, such as a garage, residence, warehouse, tall chimney, or the like; the only special parts being required

being the mold plates which are of light construction and inexpensive. The method and apparatus is, therefore, adaptable to building any kind of structure and is not limited to "standardized" building.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims.

In the drawings, Fig. 1 is an isometric view of a building in the process of construction. Fig. 2 is an enlarged sectional view through the base portion of a supporting column. Fig. 3 is a plan view of the base of the supporting column. Fig. 4 is a front view of the support for mounting the stringers in position. Fig. 5 is the same as Fig. 4 showing a side elevation thereof with a stringer clamped in place. Fig. 6 is the same as Figs. 4 and 5, showing a plan view with a stringer clamped in place. Fig. 7 is a plan view of the top of a column showing the plumb line support. Fig. 8 is a plan view of the molding forms mounted in position on the stringer. Fig. 9 is a front elevation of the molding form showing the outside plate. Fig. 10 is a section taken on the line 10—10 of Fig. 8. Fig. 11 is the same as Fig. 8 showing an end elevation of the molding forms. Fig. 12 is a section taken on the line 12—12 of Fig. 11. Fig. 13 is a side elevation of an auxiliary mounting for the supporting column above the base with the column supported thereby. Fig. 14 is a section taken on the line 14—14 of Fig. 13. Fig. 15 is an enlarged view of the auxiliary supporting brace. Fig. 16 is a section through the adjacent end supporting columns showing the method of joining them together. Fig. 17 is a section taken on the line 17—17 of Fig. 16.

In the drawings there is shown a structure having a base or foundation 10, side walls formed with an outer wall 11, a middle wall 12 and an inner wall 13 formed from concrete or a like masonry, with air spaces 14 between said walls. Mounted at suitable positions, which will be most advantageous for the purpose of supporting the molds, there are supporting column bases 15 which are secured on the foundation 10 by means of the bolts 16 embodied therein and the nuts 17. The supporting columns 18 are secured in said supports by means of the threaded sleeve 19, which is screwed into the central supporting member 20 into which there is inserted an inner sleeve 21 having a tapered fit at the bottom about which is mounted the column 18. Secured on the lower end of the column 18, there is a bearing fitting 22 shrunk thereon for securing said column in position and connecting it with the sleeve 19 in connection with the sleeve 21. The fitting 22 is provided with an annular groove 23 and a spherical end 24 adapted to fit snugly against a similar spherical end of the sleeve 19. This construction is such that the column 18 may be readily removed from the supporting sleeve 19, at the same time being fixedly mounted thereon and adaptable to vertical adjustment. For this purpose the plumb line 25 is suspended from the top of the column by the supporting member 25ª so as to hang in the center thereof.

Each of the columns are braced at the top by the tie members 26 and knee braces 27, thereby completing a rigid frame. The tie members are adjustably secured to the columns by means of the socket clamps 28 through which the tie members may be longitudinally and vertically adjustable on the columns. The knee braces are pivoted to a clamp 29 at one end and are slidably mounted in a pivoted clamp 30 at the other end, whereby they may be adaptable to any angle between the column and the tie member which is important in order that they may be attached at any point and at any angle. The clamps 29 and 30 are adjustable on the column and tie member respectively. In addition, to adding rigidity to the frame, the knee braces serve the purpose of greatly reducing the free span of the tie members, which is an important consideration, since the window and door frames are hung from said members.

Mounted between the columns and supported thereby, there are stringers or beams 31, stretching between the columns for supporting the concrete forms. This stringer is formed of a heavy rolled standard structural channel section to resist a crimping action, since the molds are attached to it in such a manner as to cause torsional stress. It is stiff enough to resist lateral deflection, and symmetric, since the mold can be hung from either side, as shown in Fig. 1. The loads on this stringer will not be large, but because of the relatively large span the vertical deflection will be appreciable. For this reason, to reduce the vertical deflection, the channel is reinforced by a light "steel-lumber" section 32 built of light gage steel, which is now on the market. This steel lumber section may be bolted, riveted, or spot-welded to the channel sufficiently to provide for horizontal shear between the two sections.

The stringers 31 are attached to the columns by means of the brackets 33, shown in Figs. 4, 5 and 6. Said brackets are slidably mounted on the columns 18 by means of the tubular clamps 34, which are clamped in position by the bolts 35 and adapted to be vertically adjustable thereon. To raise the stringer by the vertical adjustment of the brackets, as one course of wall after another is built, the clamps 34 are loosened and raised, being supported at the new elevation

on an annular clamping seat 36, which is brought to the proper height and tightened on the column while the bracket clamp is left slightly loose temporarily. The bracket 33 is particularly designed to provide ample clearance relative to the stringers 31, so that one end of the stringer may be raised in advance of the other without binding them, as it will be almost impossible to keep the stringer level while raising it. This is accomplished by loosening the clamping bolt 37, which engages the side of the stringer and clamps it firmly in the bracket against lateral movement, and a clamping bolt 38, which clamps the stringer from the top through the clamping shoe 39 against the supporting seats 40. During the process of adjustment the end of the stringers are loosely supported by the bracket. With this arrangement, the stringer may be elevated, and when it is tightly clamped in position and bears tightly against the horizontal arms 40ª at both ends, the stringer is aligned parallel to a line through the column centers. Upon the vertical adjustment of the stringers, the collar 36 is tightened on the column, after which the clamp 34 and bolts 37 and 38 are tightened so as to hold the stringer firmly in place. The bracket clamp 34 is made in two sections so that the bracket may be removed from the column at any time without slipping it over the end.

The concrete molds are comprised of a plurality of plates 41 and 42, one for each surface of each wall. As there are three adjacent walls shown herein, there are six plates. The plates 41 are adapted to engage and support the surface of the walls remote from the stringer, as shown in Figs. 8 to 11, and the plates 42 are adapted to form and support the nearer surface of the walls. The plates are provided with a plurality of angle iron braces 43 which also comprise the supporting frame of the plate so as to hold it rigidly in alignment. The plates 41 are suspended from the arm 44, and the plates 42 from the arm 45 by means of a sliding collar 46 adapted to be clamped in place by the set screws 47, whereby the plates may be slid longitudinally of the arms and rigidly clamped in position thereon. The arms 44 and 45 are supported by the stringers so as to extend out over the walls to be built, by means of the clamps 48, which are slidably mounted on the arms 44 and 45 and secured in adjusted position thereon by the clamping screws 49. The clamps 48 are adapted to engage, and clamp the underside of the stringers and secure the arms rigidly in position with respect thereto against the adjustable supporting screw 50 adapted to screw into the boss 51 resting on top of the stringer by means of the thumb nut 52, so that after the arms are in position and the clamps 48 set, said arms may be tightened up and secured rigidly in position by turning the thumb nuts 52. To release the mold, the screw 49 and the thumb nut 52 are loosened, and the arm 45 is moved back through the fitting 48 until the plates 42 disengage the nearer surface of the walls, and the arm 44 is moved forward until the plates 41 disengage the remote surface of the walls. In this manner, the entire mold is released and is ready to slide along the stringer to mold another section of the wall. It will, therefore, be readily seen that the fixing in place and the releasing of the mold is simply a matter of tightening and loosening a few screws, which ought to consume only a fractional part of a minute. The screws 49 always remain set for the adjustment of the form to its new position.

The arms 44 and 45 are provided with longitudinal grooves, as shown in Figs. 8 and 12, into which the point of the screws 47 are adapted to engage for maintaining parallelism between the various parts, and permit the sliding movement thereof. The location of the stringer with respect to the wall to be built being known, and the sizes of the various fixtures being also known, the plates are brought to the proper position on the arms by any ordinary measuring means. The particular type of molds or molding plates depend upon the kind of material used in the wall, whether the wall is to be stuccoed or not, the number and size of the wall elements and air spaces respectively; and also whether the air space is to be continuous, as in "thermos bottle" house, or whether masonry ribs are to be provided between the wall elements. Special mold plates will also be required for corners, chimney flues, circular walls, and special forms of construction in general. However, whatever type of mold is used, the method of attaching it to this apparatus will always be substantially the same in principle.

For inserting the door, window frame 54, ornaments or the like in position, the frame is secured to hangers 55 which are slidably secured to the arms 56 which are likewise slidably supported on the tie rods 26, as shown in Fig. 1, so that the frame may be rotated out of a vertical position previous to being set, to be out of the way of the workmen who are molding the wall. The hangers are extensible and adjustable, so that in the process of setting, the frame is first brought to a vertical position and then gradually lowered to the newly placed concrete. The wall is then built up to partially surround the frame, after which the hangers 55 are removed therefrom. This eliminates the necessity of bracing such frames in the ordinary manner, which is both expensive and tedious. The frames are positioned and secured by means of a

cable 74, secured at one end thereto and at the other end to one of the members of the frame.

In order to build a plurality of stories, such as in tall buildings, chimneys, silos or the like, the supporting columns 18 may be mounted one upon the other and built up with the wall, the lower sections of columns being removed after the upper columns added thereon are set in place. As shown in Figs. 13 to 17, there are column brackets secured to the wall by casting pipe nipples 57 in the green concrete immediately after the form is removed, and attaching the adjustable brackets 58 thereto. The brackets 58 comprise a tension and compression member, and support a collar 59 in which the lower section of the superimposed column is mounted. Lateral adjustment of said brackets in order to grip the column is obtained by means of the turn buckles 60; and vertical adjustment is effected by means of the screws 61 through the wings of the collar 59 and fitting 75, which is attached to the bearing fitting 122 of the superimposed column 118. This collar fits the fitting 122 without play, and is provided with an annular ring 62 adapted to fit in a corresponding annular groove in said fitting.

When the masonry is built up to about the top of the first tier of columns 18, another tier of columns 118 is added, and the tie rods and braces, therefore, are raised to the tops of the second tier of columns. When the masonry is brought up to the top of the second tier of columns, then an important step in the building process takes place. The brackets 58 are attached to the bottom of the second tier of columns 118, which is already in place, as shown in Fig. 13. The first tier of columns is then slightly lowered, on account of the nature of the joint, and removed and then placed on top of the second tier of columns, thus forming a third tier. At this stage the tie members 26 and knee braces 27 may be removed and mounted on the tops of the newly superimposed tier of columns and the entire apparatus is supported by the brackets 58, at the level of the bottom of the second tier of columns. It is assumed that the concrete will have attained sufficient strength at this level to support these concentrated loads. By repeating these steps, a very tall structure, such as a tower or chimney, can be constructed with this apparatus. Therefore, in the construction of a multiple story building, each column in the apparatus usually consists of two sections, the lower section 18 and the upper section 118. Each section should be equivalent to approximately a story height, although occasionally special length of column sections will be found advantageous. It is absolutely essential that each column be articulated, so that if a lower section or column works out of plumb, the departure from vertical shall not be continued upward, but can be corrected by bringing the top point of the top section in line.

A universal joint having a spherical bearing surface is common to all of the column sections, as shown in Figs. 2 and 16, which permits the upper section of the column to be adjusted, so that a plumb line dropped from the center of the top of the column will align with the established point in the foundation below, whereby the structure will conform to a general vertical line, even through individual sections may be slightly out of plumb, due to the slight distortion of the apparatus from the temperature changes and loosening of connections. The adjustment of the upper column section 118 is accomplished by means of the tapered bearing fitting 119 secured on the column 18 between said column and the inner sleeve 121. For securing proper adjustment and alignment of the superimposed column, the wedging members 63 are provided, which are insertable through suitable openings in the column 118, to wedge between said column and the sleeve 121, by the adjustment of which the alignment is accomplished.

Clamped in a like manner on the stringer 31, there are laterally extending arms 69 similar to the arms 44 and 45, and clamped in the same manner so as to be releasable and slidable on the stringer as the said arms 44 and 45. Suspended from the arms 69, there are angle iron braces 70 which lightly engage the surface of the walls. Extending downwardly from the angle irons, there are a plurality of fingers 71 which engage the lateral surfaces of the walls for supporting them in vertical position while they are still "green." These supports are mounted in position after the wall has been formed by the forms 41 until that portion of the wall becomes sufficiently strong to maintain its upright position in proper alignment. The support can then be removed and placed in another position for supporting the new section of the green wall after the mold has been removed therefrom.

It will be understood that the molding plates 41 and 42 may be adjusted at any angle with respect to the arms 44 and 45 by means of the lateral turning movement of the stem 72 with respect to the sliding collar 46, whereby walls may be formed at an angle to the stringer. However, the arms 45 are always maintained at exactly right angles to the stringer by means of the angle plates 73 which are integral with the clamps 48, as shown in Figs. 8 and 11.

It will be understood that wherein the apparatus is herein shown as adapted to building concrete structures, the same may

be similarly used for building masonry structures of any kind, such as from cement, brick, stone and the like, and the details of the apparatus may be varied according to the type of structure to be built.

The invention claimed is:

1. An apparatus for building masonry structures and the like, comprising a frame for supporting a window frame or other permanent fixture in said structure, and adjustable means for suspending said fixture from said first-mentioned frame in position to be embedded therein.

2. An apparatus for building masonry walls and the like, comprising a frame for supporting a window frame or other permanent fixture in said wall and a supporting bracket mounted on said first-mentioned frame in position to suspend said fixture in position to be embedded in said wall and permit it to be swung away therefrom while said wall is being formed.

3. An apparatus for building masonry walls and the like, including a frame positioned independent of the freshly formed walls, for supporting a window frame or other permanent fixture in said walls, a laterally extending arm slidably mounted on said first-mentioned frame so arranged as to extend over said walls, and a bracket removably secured to said fixture frame and slidably mounted on said arm for permitting the lateral and vertical adjustment thereof with respect to said walls.

4. An apparatus for building masonry walls and the like, comprising a form-supporting frame having a vertical supporting column therefor, a base member adapted to be rigidly secured to a foundation, a supporting sleeve secured in said base member and having a spherically curved upper end, an inner sleeve mounted in said base member and extending upwardly therefrom, a tubular supporting column, and a wedging member wedged between said column and said inner sleeve for locking said column thereto, the lower member of said columns having a spherically curved edge adapted to abut the upper edge of said supporting sleeve for forming substantially a ball and socket joint for permitting the vertical adjustment and alignment of said column with respect to said base.

5. An apparatus for building a structure, comprising a plurality of vertical supporting members, said members being formed of a plurality of sections adapted to be superimposed one upon the other, joints between said sections having spherical abutting bearing surfaces between said sections, and means whereby the superimposed sections may be adjustably aligned and locked in position.

6. An apparatus for building a structure, comprising a plurality of vertical supporting members, said members being formed of a plurality of sections adapted to be superimposed one upon the other, joints between said sections having spherical bearing surfaces between said sections, and means including a member attached to one of said sections at each joint and projecting within the adjoining section, whereby the superimposed sections may be adjustably aligned and locked in position.

7. An apparatus for building masonry walls and the like, comprising a plurality of vertical supporting columns, said columns being formed of a plurality of sections adapted to be superimposed one upon the other, means for adjustably connecting said sections together at their joints, whereby they may be vertically adjusted, and brackets secured in the completed portion of the wall for supporting the superimposed sections of said columns.

8. An apparatus for building masonry walls and the like, comprising a plurality of vertical supporting columns, said columns being formed of a plurality of sections adapted to be superimposed one upon the other, means for adjustably connecting said sections together at their joints, whereby they may be vertically adjusted, and tension and compression members rigidly secured in the completed portion of said wall for supporting the superimposed column sections.

9. An apparatus for building masonry walls and the like, comprising a plurality of vertical supporting columns, said columns being formed of a plurality of sections adapted to be superimposed one upon the other, means for adjustably connecting said sections together at their joints, whereby they may be vertically adjusted, a bracket secured in the completed wall adjacent the lower end of the superimposed column section, a collar mounted on said bracket adapted to embrace and secure said section thereon, a bearing fitting mounted within said section and locked in said collar, and removable means for connecting the abutting ends of said sections.

10. An apparatus for building a masonry structure, comprising vertical members, a transverse form-supporting member movably supported on said vertical members, said transverse member having a section adapted to resist lateral deflection and shaped so that a molding form may be supported from it from either side, and means for reinforcing said section of said transverse member for resisting vertical deflection.

11. An apparatus for building a masonry structure, comprising vertical members, a transverse form-supporting member having a section adapted to resist lateral deflection and shaped so that a molding form may be supported from it from either side, means for reinforcing said section of said trans-

verse member to resist vertical deflection, and means movably supported on said vertical members for supporting said transverse member, said means permitting the longitudinal adjustment of said transverse member with respect to said vertical members.

12. An apparatus for building masonry walls and the like, comprising a form in which the masonry material is formed, means for supporting said form in position independently of the freshly formed walls, whereby it may be removably positioned for forming additional sections of wall, and a supporting form similarly supported independently of said freshly formed walls for maintaining the shape thereof until the material becomes hardened.

13. An apparatus for building masonry walls and the like, comprising a vertical supporting column, and means suspended within said supporting column for plumbing said column to a vertical line.

14. An apparatus for the construction of buildings including vertical supporting members, said members being formed of a plurality of sections adapted to be superimposed one upon the other, means for connecting said sections together at their joints whereby they may be adjustably aligned, and a transverse guide member movably supported on said vertical supporting members for regulating the placing of masonry material to a predetermined contour.

In witness whereof, I have hereunto affixed my signature.

BENNETT KAY.