May 12, 1925.

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O. H. ROBERTS

MOVABLE FORM FOR CONCRETE WORK

Filed Oct. 1, 1924

7 Sheets-Sheet 1

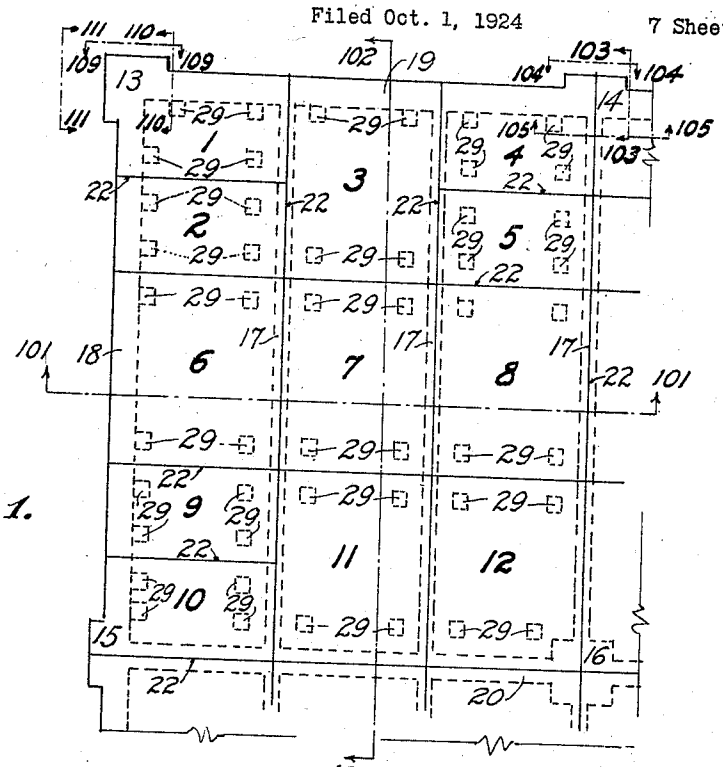


Fig. 1.

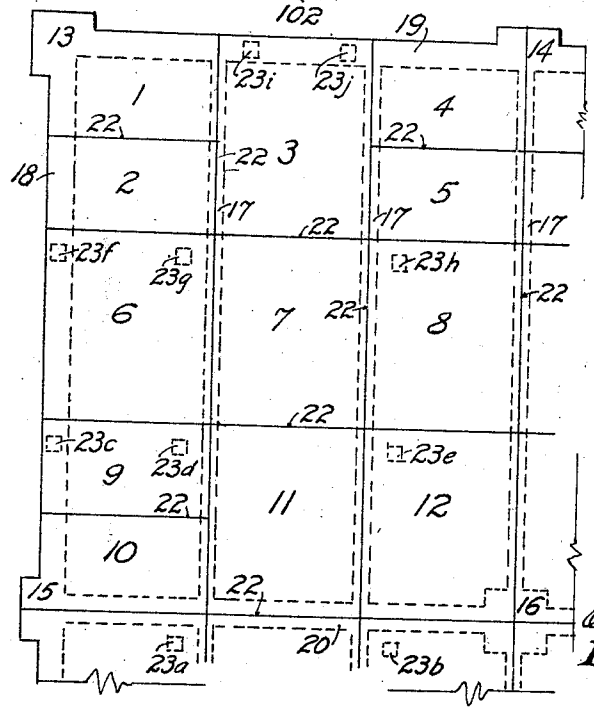


Fig. 2.

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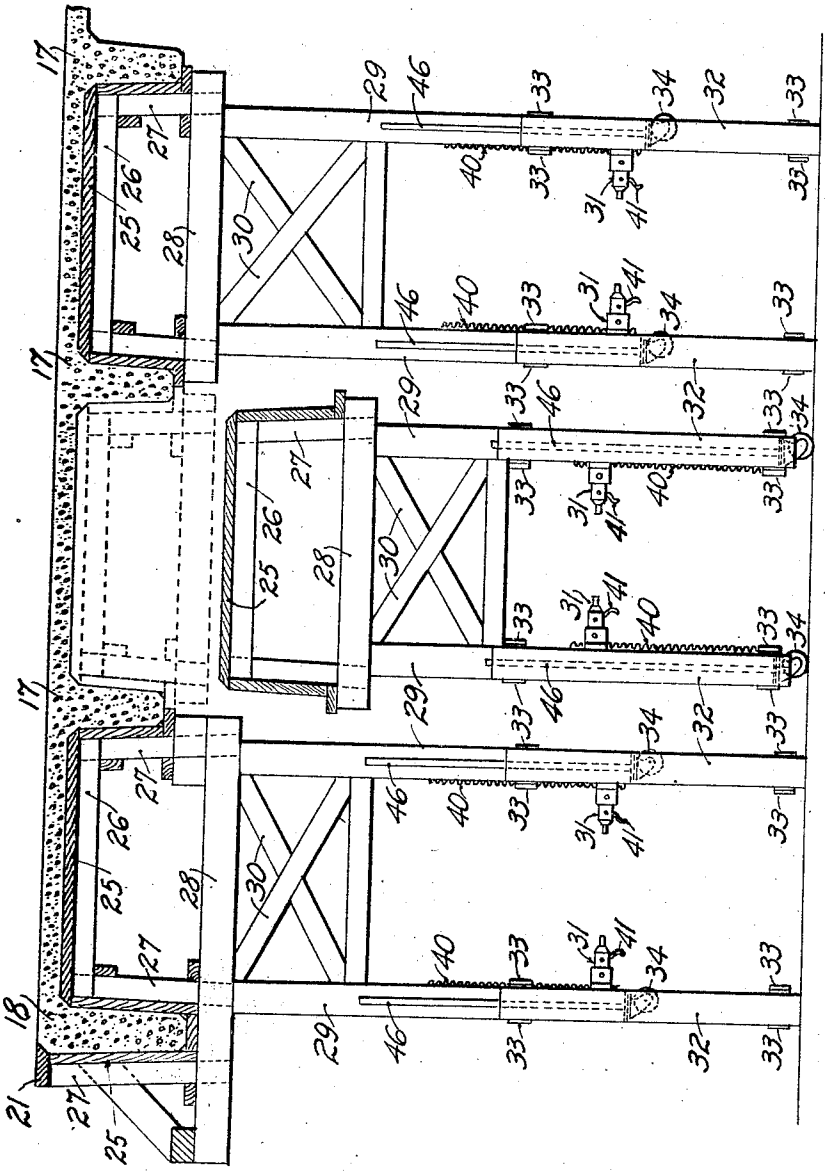


Fig. 3.

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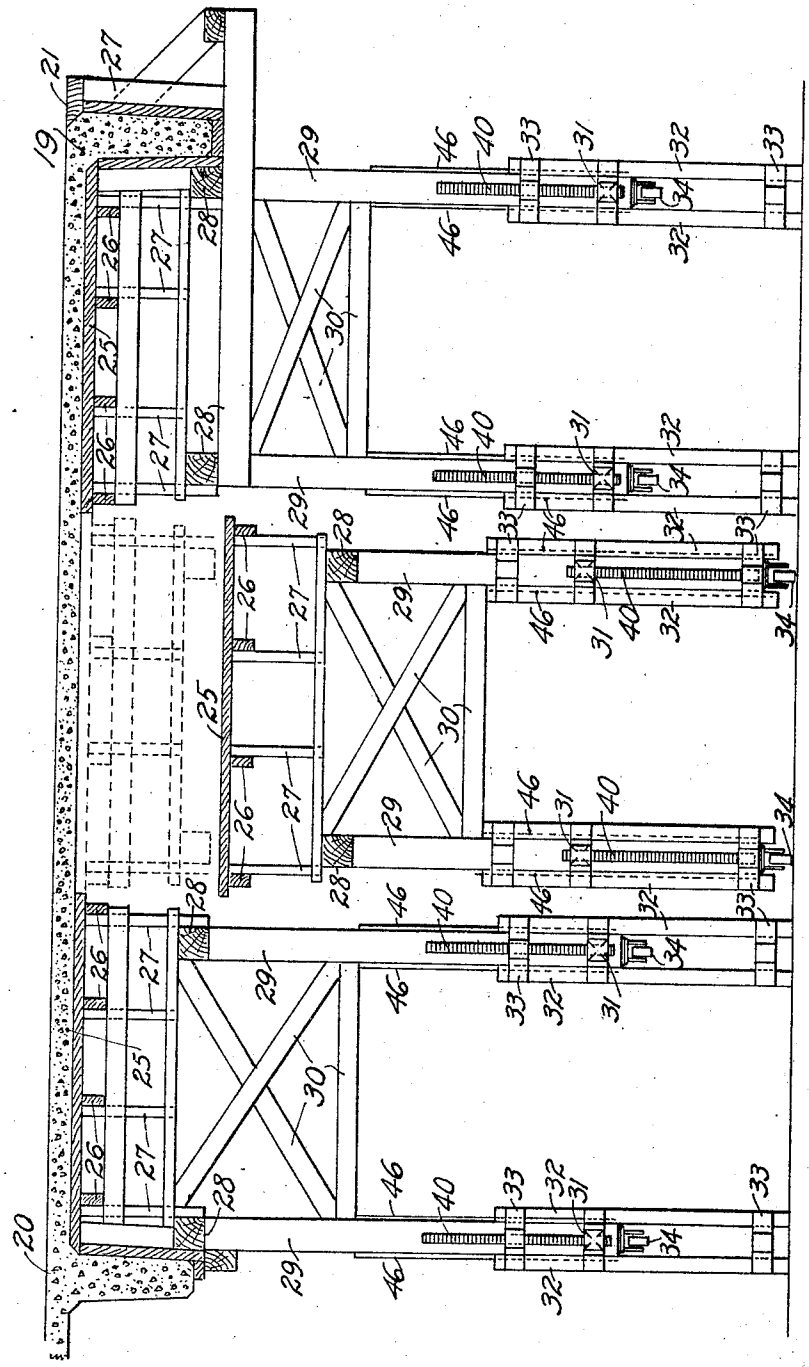


Fig. 4.

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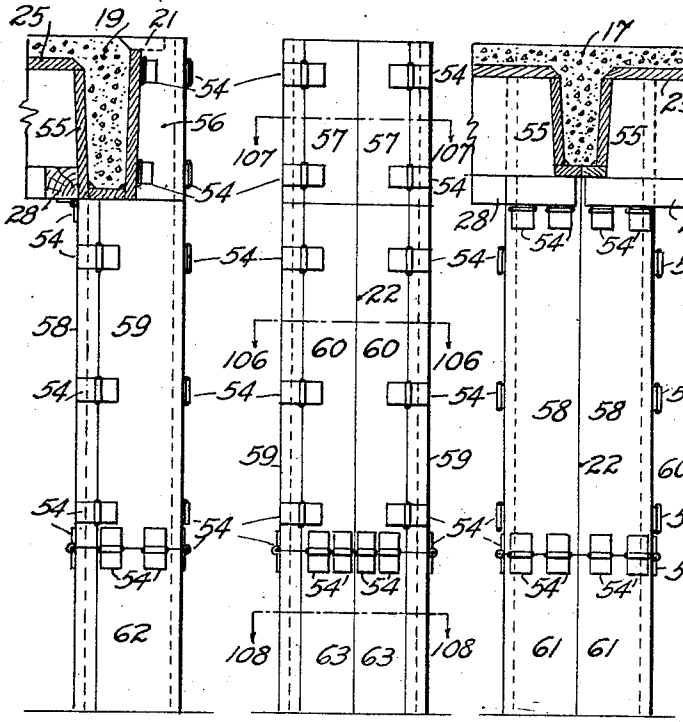


Fig. 5. Fig. 6. Fig. 7.

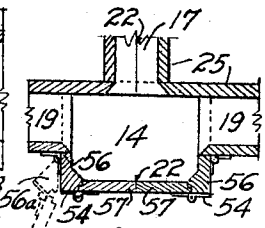


Fig. 9.

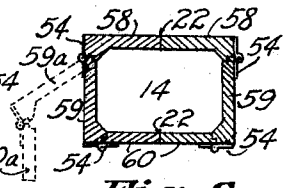


Fig. 8.

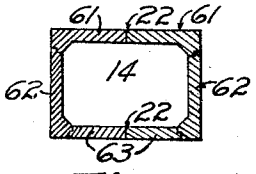


Fig. 10.

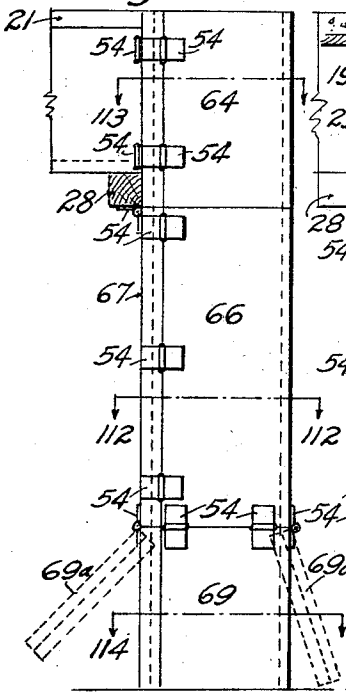


Fig. 11.

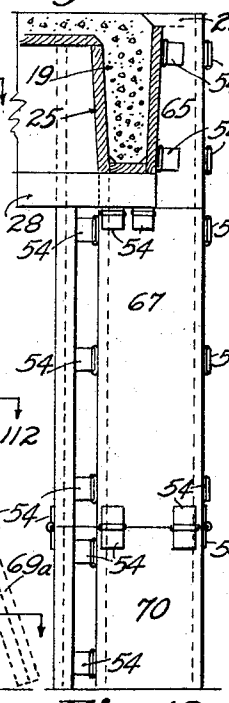


Fig. 12.

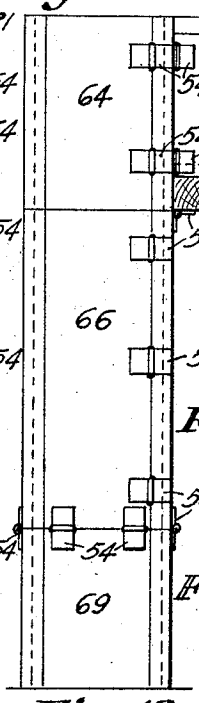


Fig. 13.

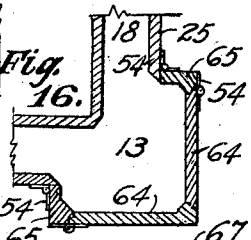


Fig. 16.

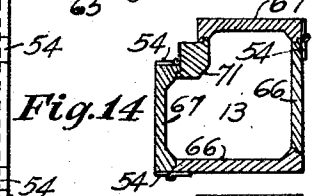


Fig. 14.

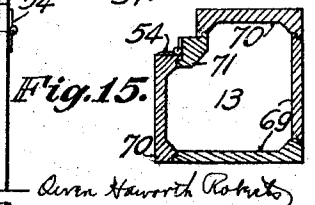


Fig. 15.

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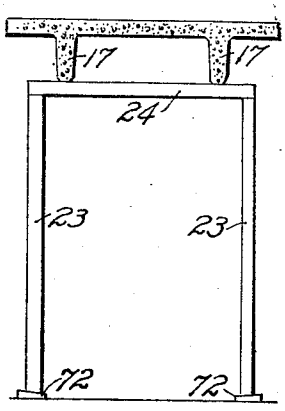


Fig. 22.

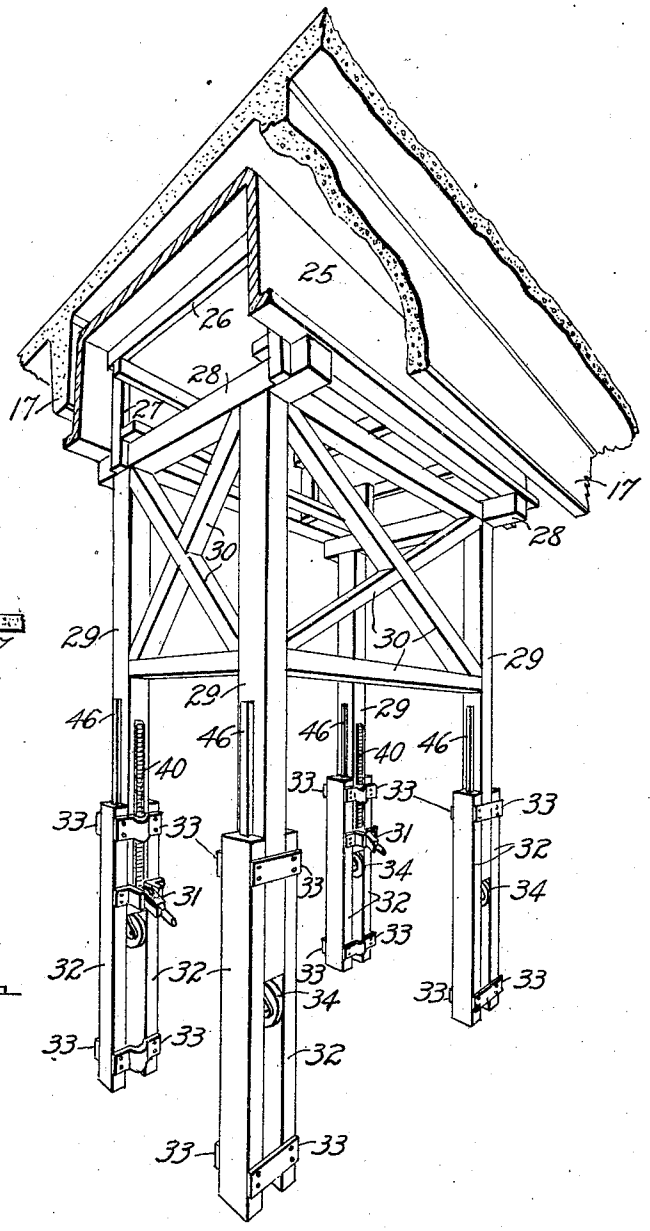


Fig. 17.

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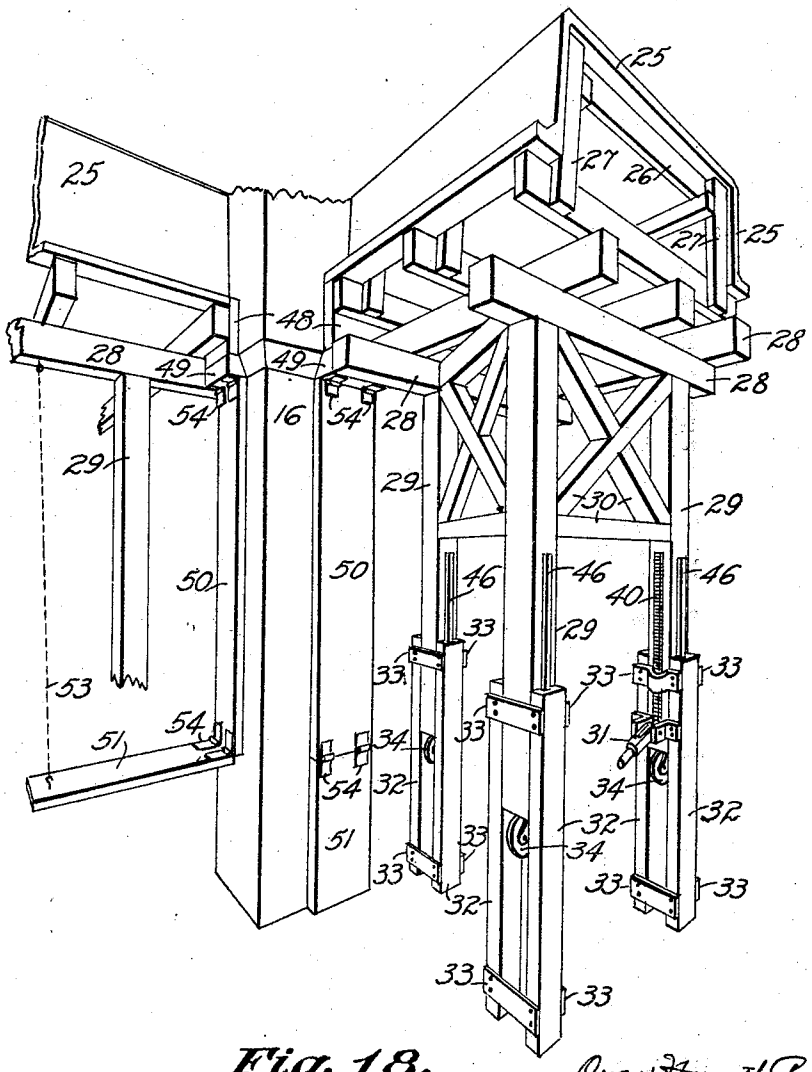


Fig. 18.

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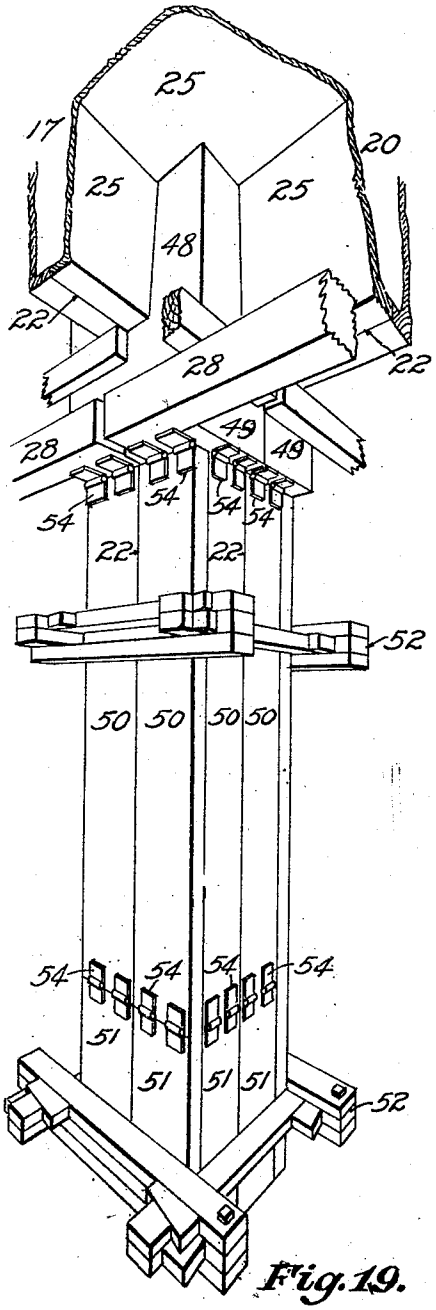


Fig. 19.

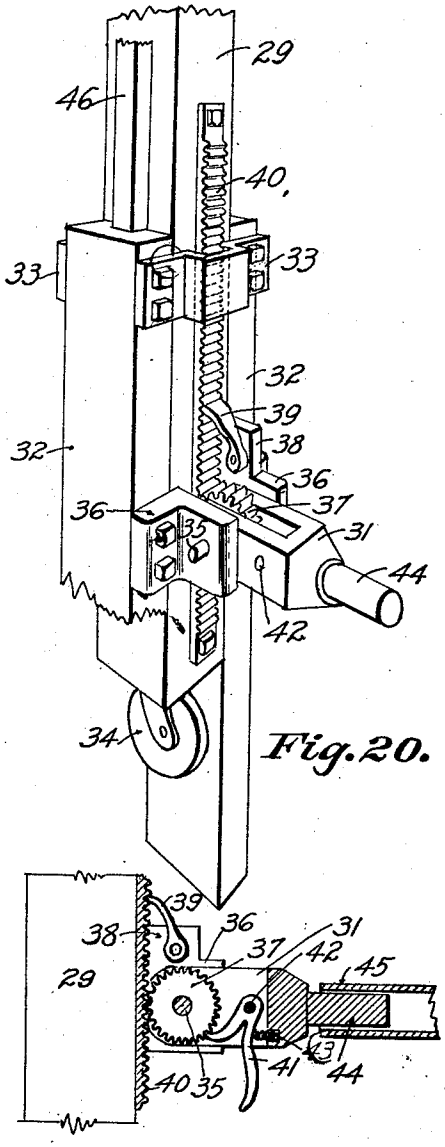


Fig. 20.

Fig. 21.

Inventor:

Patented May 12, 1925. 1,537,882

UNITED STATES PATENT OFFICE.

OWEN HAWORTH ROBERTS, OF SPARTANBURG, SOUTH CAROLINA.

MOVABLE FORM FOR CONCRETE WORK.

Application filed October 1, 1924. Serial No. 740,983.

To all whom it may concern:

Be it known that I, OWEN HAWORTH ROBERTS, a citizen of the United States of America, and a resident of Spartanburg, in the county of Spartanburg and State of South Carolina, have invented certain new and useful Improvements in Movable Forms for Concrete Work; and I do hereby declare that the following is a full, clear, concise, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in forms for use in concrete and cement construction work, having for an object to provide a form for concrete or cement floor systems, beams, girders, arches, slabs, columns, posts, et cetera, which is of such construction and arrangement as will permit the same to be readily set up and then, in order with the following and usual pouring and hardening or curing steps of the process, removed and transported to other parts of a building or structure in course of construction, or to other places of work, and set up for reuse, the apparatus being in itself unitarily mobile, and hence, rendering its relocation and reuse practical without the necessity of rebuilding or reconstructing any portions of the same.

It is likewise an equally important object of the invention to provide a form of the character mentioned including form units so constructed as to effectually and concurrently serve in the forming or molding of concrete or cement flooring and interior or corner of columns, whereupon, with partial curing of such plastic elements, these form units may be completely removed, and the plastic elements so formed then temporarily shored.

Yet another object of the invention is to provide the form units with a novel form of supporting means adapted, with certain adjustments, to be rigidly and immovably arranged in a forming or molding position, and with other adjustment, to be disengaged from the formed elements and at the same time, rendered mobile in order that they may be moved to another place within the structure or "job" or to a different structure or "job", as may be desired.

It is also an object of the invention to provide the supporting means of the form unit with other means, whereby such form units may be adjusted vertically to secure that nicety of arrangement productive of floor units or slabs of uniform disposition, thickness or depth and durability, said vertical adjustment being accomplished without affecting the rigidity of the supporting means in any way whatsoever.

Another important and novel characteristic of the invention resides in the provision of corner and interior column forms so constructed as to permit comparatively quick and accurate assembly or "set up" and with hardening or curing of the plastic masses therein for a sufficient period of time, then readily removed from the columns together with disengagement of the flooring forms preparatory to transportation of the then mobile form units to other places of work.

The invention may be also stated to include a novel relative arrangement of the form units whereby with proper hardening of the plastic elements, such form units may be disengaged from the same to permit their temporary shoring and the units then moved from the formed structures without interference from each other or with any of the formed elements.

Other objects of the invention will be in part obvious, and in part pointed out hereinafter.

In order that the invention and its mode of operation may be readily understood by persons skilled in the art, I have in the accompanying illustrative drawings, and in the detailed following description based thereupon, set out one possible embodiment of the same.

In these drawings:—

Figure 1 is a plan of a typical corner bay of a reenforced concrete building of the beam, girder, and slab type, arranged in accordance with the invention;

Figure 2 is a similar view showing a bay corresponding to that shown in the Figure 1 and wherein temporary shores have been placed as the forms are removed;

Figure 3 is a vertical section taken on the line 101—101 of Figure 1;

Figure 4 is a vertical section taken on the line 102—102 of Figure 1;

Figure 5 is a side elevation of a typical exterior or wall column;

Figure 6 is a front elevation of said exterior or wall column;

Figure 7 is a rear elevation of the exterior or wall column;

Figure 8 is a transverse section taken on the line 106—106 of Figure 6;

Figure 9 is a similar sectional view taken on the line 107—107 of Figure 6;

Figure 10 is a corresponding sectional view taken on the line 108—108 of Figure 6;

Figure 11 is a front elevation of a typical corner column form;

Figure 12 is a side elevation of said corner column form;

Figure 13 is an elevation of the corner column form when in an opposed or reversed position to that shown in the Figure 11;

Figure 14 is a transverse section taken on the line 112—112 of Figure 11;

Figure 15 is a similar view taken on the line 114—114 of Figure 11;

Figure 16 is a like view taken on the line 113—113 of Figure 11;

Figure 17 is a perspective of one of the interior form units;

Figure 18 is a perspective of an interior form unit contiguous to an interior column form;

Figure 19 is a perspective of an interior column form;

Figure 20 is an enlarged fragmentary detail in perspective showing one form of jack or means for effecting vertical adjustment of the form units;

Figure 21 is an enlarged fragmentary detail in section through the means for effecting vertical adjustment of the form units; and,

Figure 22 is a cross section through a reenforced concrete floor showing the method practiced in the placing of temporary shores, the latter being shown in elevation.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Referring more particularly to the drawings, and especially, to the Figures 1 and 2 thereof wherein plans are shown of a corner bay of typical concrete building construction, the numerals 17 and 18 generally indicate the beams of such construction; the numerals 19 and 20 the girders thereof, and, the numerals 13, 14, 15, and 16, the columns employed, such showing of the beams, girders, and columns being in dotted lines. In constructing this corner bay, sections or units of suitable size and design, hereinafter termed "form units" are employed for purposes of convenience and practicability in erection, lowering, disengagement and moving in their respective order as included in the plastic building process. These form units, obviously, may be of different sizes, such as conditions or preference may dictate, regard being had in this respect to subsequently presented or encountered obstructions to their disengagement and removal from a place of work, such as columns, temporary shores, et cetera. In the said Figures 1 and 2, the various form units utilized in construction of the corner bay are indicated for purpose of convenience, by the reference numerals 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12, each of said units being complete in itself and capable of individual erection, removal or disengagement and transportation. The method by which this particular step of a building operation utilizing the invention may be accomplished is more fully hereinafter described.

The form units employed may be stated to be designed for interior and exterior use as regards the general plan of arrangement shown in connection with the Figures 1 and 2, such units each including or comprising a suitable form 25 upon which the plastic concrete or cement is deposited, such forms being received upon joists 26 and studs 27, whereby they will be rigidly supported with respect to the completed form unit construction. These form supporting joists and studs are, in turn, rigidly supported upon a frame work 28 provided with relatively spaced legs or standards 29, which, in turn, are engaged by suitable sway-bracing 30. Extension leg sections 32 are provided upon the lower portions of each of the legs 29, comprising relatively spaced bars or timbers rigidly inter-connected by transversely disposed and spaced tie-members 33, such extension leg sections 32 by reason of their construction, serving to telescopically receive the lower portions of their respective legs 29 and to permit of vertical adjustment of the forms 25 carried upon the frame work 28 thereon.

With a view towards providing means for manually effecting vertical adjustment of the various frame works 28 of the form units, jacks 31 are provided upon each of the extension leg sections 32, details of which are shown in the Figures 20 and 21. Each of these jacks 31 comprise transversely disposed shafts 35 journalled in suitable bearings at their opposite ends in hanger brackets 36 secured by bolts or other suitable fastening devices to adjacent parts of the upper portions of the leg sections 32. A pinion 37 is mounted on each of the shafts 35 and as will be noted, is embraced by the forked end of the jack 31, as is clearly shown in said Figures 20 and 21; a pawl 41 being pivotally mounted upon a portion of the forked end of the jack 31, as indicated at 42, and being adapted to be normally engaged between the adjacent teeth of said pinion 37 through the medium of a coiled spring 43 seated in an adjacent portion of the jack 31. A boss or lug 38 is extended from the jack 31 and carries thereon a pivotally mounted upwardly disposed

pawl 39, which as will be noted, is so positioned as to be arranged adjacent to the corresponding marginal portion of the leg or standard 29 received in this particular leg section 32. Secured to and disposed longitudinally of said corresponding marginal portion of the lower end of the leg 29 is a rack bar 40, the teeth of which are adapted to be engaged with the teeth of the pinion 37, while the free end of the pivotal pawl 39, due to its disposition, is adapted to be normally engaged in between certain of the teeth of said rack bar 40, as is shown herein. Thus, it will be seen that with rocking of the jack 31 in one direction, rotation of the pinion 37 will be effected by reason of the connection of the spring pressed pivotal pawl 41 therewith, hence, moving the rack bar carrying leg 29 upwardly with respect to the leg section 32, thus effecting vertical adjustment or raising of the entire form and its supporting frame work. Undesirable downward movement of the leg 29 with respect to the leg section 32 will, of course, be prevented by reason of the constant engagement of the pawl 39 between the adjacent teeth of the rack bar 40.

To facilitate rocking of the jack 31, I may and preferably do form an extension 44 on the outer end of the same whereby a suitable handle 45 may be engaged thereover in order that as much leverage as is desired may be obtained.

To render the form units mobile, that is, to facilitate their movement from one place to another, casters or rollers 34 are suitably secured and mounted upon the lower ends of each of the leg sections 29. Consequent upon this arrangement, it is to be appreciated that with lowering of the form 25 and their respective frame works 28, the casters 34 will be brought into engagement with a floor or other supporting surface and will, at that time, serve as an effectual means for supporting the form units rather than the extension leg sections 32.

Guide strips 46 may be and preferably are fixedly attached to certain of the sides of portions of the legs 29 and are slidable in longitudinally disposed grooves formed in the adjacent sides of the extension legs 32 and serve as means for preventing said legs 29 from chafing the tie members 33 of said extension leg sections 32 as well as from having undue lateral movement with respect to said extension legs 32.

In the Figures 5, 6 and 7, I have shown an embodiment of an exterior or wall column form, such as is used in forming the columns 14 and 15 referred to in connection with the Figures 1 and 2. In this connection, it should be noted hereat that one-half of the column form is firmly attached to a portion of the frame work 28 of one form unit, while the other half thereof is firmly attached to an adjacent portion of the frame work 28 of the adjoining form unit, the jointure between the same being clearly indicated at 22 in the Figures 1 and 2. The upper part of the back 55 of the column form is secured, as aforesaid, to a portion of the frame work 28 carrying the beam and girder forms 25, while the upper portion 56 of said form is connected to the front of the form 25 through the medium of hinges 54; the front pieces 57 of the upper portion of the column form being vertically hinged to the portions or sides 56 in a corresponding manner. The intermediate or middle portion of the column form comprises panels 58 which in turn, are vertically hinged, as at 54, to adjacent portions of the frame 28, while side pieces 59 are provided the same at this point and are hingedly connected in a corresponding manner to adjacent portions of the panels 58. An intermediately disposed front wall consisting of oppositely disposed panels 60 hinged to adjacent portions of the sides 59 is provided, and thus completes a column form substantially rectangular in cross section, as is shown in the Figure 8. Other oppositely disposed panels 61, 62, and 63, are horizontally hinged adjacent their upper ends to adjacent parts of the panels 58, 59, and 60, and as will be understood, are swingable in vertical planes away from each other, the purpose of which will be subsequently apparent.

To secure the column forms in assembled relation and to prevent their spreading or bulging with the pouring of concrete therein, a sufficient number of clamps, generally indicated herein by the numeral 52, are employed, the clamps embracing all sides of the column form and exerting pressure thereupon sufficient to avoid any undue relative movement or bulging thereof. These clamps, however, do not form any part of my invention, and of course, may be varied in design or arrangement, as may be required.

In the Figures 11, 12, and 13, I have shown for purposes of illustration, a corner column form for producing the columns indicated at 13 in the Figures 1 and 2. These columns each comprise sections which are adapted to be connected to the form units such as indicated by 1 (Figure 1), and are completely movable with such form unit. They may be stated to comprise front walls 64, which in turn are vertically hinged, as indicated at 54, to the sides 65, the latter being attached in a suitable fashion, to the front of the form 25 through the medium of hinges 54. The construction thus produced completes the upper portion of the corner column form whose cross sectional shape or configuration is clearly shown in the Figure 16. The main or intermediate

portion of the corner column form consists of oppositely arranged sides 67 hingedly connected adjacent their upper ends to adjacent portions of the frame work 28, as clearly shown in the Figure 11, while front pieces 66 are hingedly connected along certain of their vertical marginal portions, as at 54, to adjacent portions of said sides 67. The corner column form also includes bottom parts or members 69 and 70, whose arrangement is such as to provide a substantially cross-sectionally square form, as shown in the Figure 15; these parts 69 and 70 being hingedly connected adjacent their upper ends to adjacent portions of the front and side pieces 66 and 67. Interior angle pieces 71 are also arranged adjacent certain portions of the parts 69 and 70 of the form and are hinged thereto by hinges, generally indicated by the numeral 54.

In order that the corner column forms may be secured in their assembled relation, clamps, similar to those hereinbefore described, may be used, such clamps embracing the forms and preventing spreading or bulging of the same with the depositing of concrete therein.

In the Figures 18 and 19, I have shown the manner in which the forms for producing an interior column are constructed and attached to the adjacent portions of the frame 28 of the form unit carrying the same. In the Figure 18, the column 16 appears as it would if the form unit nearest the observer had been removed. In this connection, it will be noted that the column form is attached to the contiguous form unit through the parts indicated for purpose of convenience by the numerals 48 and 49, such parts forming a head or upper part for the column form and which are firmly attached to the beam, girder, and slab forms 25 and to the frame work 28. The main or intermediate part of the form, indicated herein for convenience, by the numeral 50, is attached at its top to the part 49 by means of hinges 54, while the lower part 51 of the form is attached in a corresponding manner to the adjacent end of the part 50, that is, through the medium of hinges 54. Clamps are shown in the Figure 19 as embracing the assembled form whereby to prevent its spreading or bulging with the pouring of concrete therein.

It will be noted at this point that one form unit is contiguous to an interior column, such as indicated by the numeral 12, in the Figure 1, and includes the form for one-fourth of such column.

If desired, the lower portions or parts of those forms shown as being horizontally hinged in the Figures 5, 6, 7, 11, 12, 13, 17 and 18, may be retained at approximately right angles with respect to the column during lowering of the same and movement thereof by means of a cord or chain, as indicated at 53 (Figure 18), or by other suitable means.

To form a chamfer on the upper edge of an exterior beam or girder (Figures 3, 4, 5 and 12), a bar 21 is preferably employed, such bar being adapted to be removed before a form unit is lowered.

The modus operandi of my invention may be stated to be as follows:

The various form units indicated in the Figures 1 and 2 are arranged as shown therein, carrying with the same properly arranged and assembled forms for forming the columns 13, 14, 15, and 16. With the forms 25 properly positioned upon the frame works 28 of the different form units and positioned as aforesaid, said forms 25 are raised by means of the jacks 31 to the correct level or height, whereupon the plastic concrete is poured into the same, such relative arrangement of the forms 25 and the column forms being clearly shown in the Figures 3, 4, 18, and 19. After the concrete has sufficiently cured or hardened, the form units are ready for disengagement, and to effect this, the vertically swinging portions or panels 62, 63, 61, 69 and 70 of the various column forms are swung upwardly upon their horizontally positioned hinges 54, as is indicated in dotted lines by the numeral 69^a in the Figure 11; it being, of course, understood that the clamps 52 for such column forms have been previously removed. At this time, the forms 25 supported upon the frame works 28 carried on the legs 29 are lowered by means of reverse operation of the jacks 31 until the casters 34 upon the various legs 29 engage or bear upon the floor or other support for the form units. The lower or extension legs 32 are now raised until they clear the floor or other support whereupon the entire form unit may be then moved on its casters to another part of the structure or to another place of work and suitably placed and raised for a reforming operation.

To completely remove the column forms from the plastic columns formed thereby, it is only necessary that the vertically hinged panels thereof be swung outwardly away from their respective columns to positions as indicated in the Figures 8 and 9 by the numerals 59^a—60^a and 56^a—57^a. With such disengagement of the horizontally swinging and vertically hinged panels of the different forms, they may be readily removed from the partially cured columns without interference.

When the form shown in the Figures 18 and 19 is removed, the panels or parts 51 are swung in vertical planes to positions at substantially right angles to the columns, as is indicated in the Figure 18. The panels or parts 50 may be then swung horizontally

away from the partially cured columns to the required extent and the entire form unit with the column form attached may be lowered and removed for further usage, as hereinbefore stated.

In order that the different form units shown in the Figures 1 and 2 may be conveniently removed from a formed structure without interference and further, to permit of the temporary shoring of the partially cured or hardened concrete elements, the following method may be used to advantage.

Form unit 11 is first lowered and removed, whereupon temporary shores 23^a and 23^b (Figure 2) are placed under the plastic elements formed in the manner shown in the Figure 22. In this Figure 22, a temporary shore 23 is illustrated, such shore being provided with cross timbers 24 which are adapted to have engagement with and effectually support the beams 17 of the concrete elements formed. In this connection, it is to be noted that the oppositely disposed supporting legs of the shores are of widths greater than the widths or lengths of the slabs to be supported thereupon, the purpose of which will be presently apparent.

With removal of the form unit 11, the form units 10, 9, and 12 are then lowered and removed in the order given, the same being successively moved into the space formerly occupied by the form unit 11 and then moved outwardly between the opposite sides of the shores 23^a and 23^b, which, as stated hereinbefore, are of widths greater than the widths or lengths of the slabs and in consequence, greater than the widths or horizontal dimensions of the form units. Shores 23^c, 23^d, and 23^e are then suitably placed under the formed elements to temporarily support the same. At this time, the form units 7, 8, and 6 are lowered and removed in the order given; the form unit 7 being removed first, whereupon the form units 8 and 6 are removed to the space formerly occupied by the form unit 7, thence between the shores 23^d, 23^e, 23^a and 23^b. With removal of these form units 7, 8 and 6, other temporary shores 23^f, 23^g and 23^h are properly placed so as to support the plastic elements during their period of final curing or hardening. Following this, the form unit 3 is lowered and removed, and shores 23^i and 23^j are properly placed to support the plastic elements so formed. At this time, the form units 2, 1, 5 and 4 are lowered and removed in the order given, whereupon they are properly shored and the bay will then be clear of forms.

While I have described with some degree of particularity, hereinbefore, the construction of the jacks employed for effecting raising of the frame works 28 carrying the various forms 25, it is of course to be understood that different forms of jacks may be substituted. For example, a screw jack may be substituted in lieu of the rack and pinion type of jack herein shown with practical and successful results; the form selected in this particular embodiment being for purposes of illustration.

Manifestly, the construction shown is capable of considerable modification, and such modification as is within the scope of my claims, I consider within the spirit of my invention.

I claim:

1. A plastic form comprising a supporting frame, a form on said frame, means for bracing the frame against swaying motion, spaced legs carrying said frame, casters secured to the lower ends of said legs, extension legs slidably receiving portions of the legs of said frame therein, interengageable means on the adjacent portions of said first legs and said extension legs whereby to prevent relative lateral movement between the same, and adjusting means carried on said extension legs engageable with portions of said first legs whereby to effect raising and lowering of the frame.

2. A plastic form comprising a legged supporting frame, a form removably supported thereon, casters secured to the lower ends of the frame legs, extension legs telescopically receiving portions of said frame legs, rack bars secured to certain sides of each of said frame legs and disposed longitudinally of the same, pinions rotatably mounted upon the adjacent side portions of the extension legs having the teeth thereof engaged with the teeth of said rack bars, a jack frame positioned adjacent each of said pinions, pawls movably carried by said jack frames engageable with the teeth on said pinions, and other pawls carried upon said jack frames normally engageable between the teeth of said rack bars.

3. A plastic form comprising a legged supporting frame, a form on said frame, extension legs slidably receiving said frame legs, casters secured to the lower ends of the frame legs, means on the extension legs for raising and lowering the frame, and column forms secured to and carried by portions of said frame in proximity to portions of said first forms.

4. A plastic form comprising a legged supporting frame, a form removably received upon said frame, extension legs telescopically receiving the legs of said frame therein, casters secured to the lower ends of the frame legs, means carried on said extension legs engageable with portions of the frame legs for effecting raising and lowering of said frame, and column forms secured to and carried upon portions of said frame adjacent said first forms.

5. A plastic column form comprising top, intermediate, and bottom side wall panels, a

carrying frame engaged by certain of said top and intermediate side wall panels, means for hingedly connecting the adjacent portions of said top and intermediate side wall panels, and other means for hingedly connecting the upper ends of said bottom side wall panels to the adjacent portions of the intermediate side wall panels.

6. A plastic form comprising a supporting frame, a plurality of juxtaposed top, intermediate, and bottom side wall panels, certain of said top and intermediate side wall panels being hingedly connected to portions of said supporting frame, said top and intermediate side wall panels being hingely inter-connected for horizontal swinging movement, and hinges connecting the upper ends of said bottom side wall panels to the lower ends of the intermediate side wall panels whereby to permit of vertical swinging movement of said bottom side wall panels.

7. A plastic form comprising a legged supporting frame, a form removably supported upon the upper end of said frame, extension legs telescopically receiving portions of the legs of said frame, casters secured to the lower ends of the frame legs, means mounted on said extension legs engageable with portions of said frame legs for effecting raising and lowering of the frame, and column forms comprising top, intermediate, and bottom side wall panels, certain of said top and intermediate side wall panels being hingedly connected to portions of the supporting frame, each of the top and intermediate side wall panels being hingedly inter-connected for horizontal swinging movement, and hinges connecting the upper ends of the bottom side wall panels to the adjacent lower ends of the intermediate side wall panels.

In witness whereof I have hereunto set my hand.

OWEN HAWORTH ROBERTS.