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Price

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[54] JOBSITE APPARATUS FOR HORIZONTALLY POURING AND VERTICAL STACKING OF THIN SLABS

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[51] Int. Cl. **B28b 7/08,** B28b 7/22

[58] Field of Search ..... 25/1 B, 1 D, 1 R, 41 F; 249/137, 165, 166; 214/7; 264/336

[56] **References Cited**

FOREIGN PATENTS OR APPLICATIONS

50,043	10/1919	Sweden	25/1 B
571,140	5/1924	France	25/1 B
404,753	1/1934	Great Britain	249/165
1,052,612	1/1954	France	25/1 B

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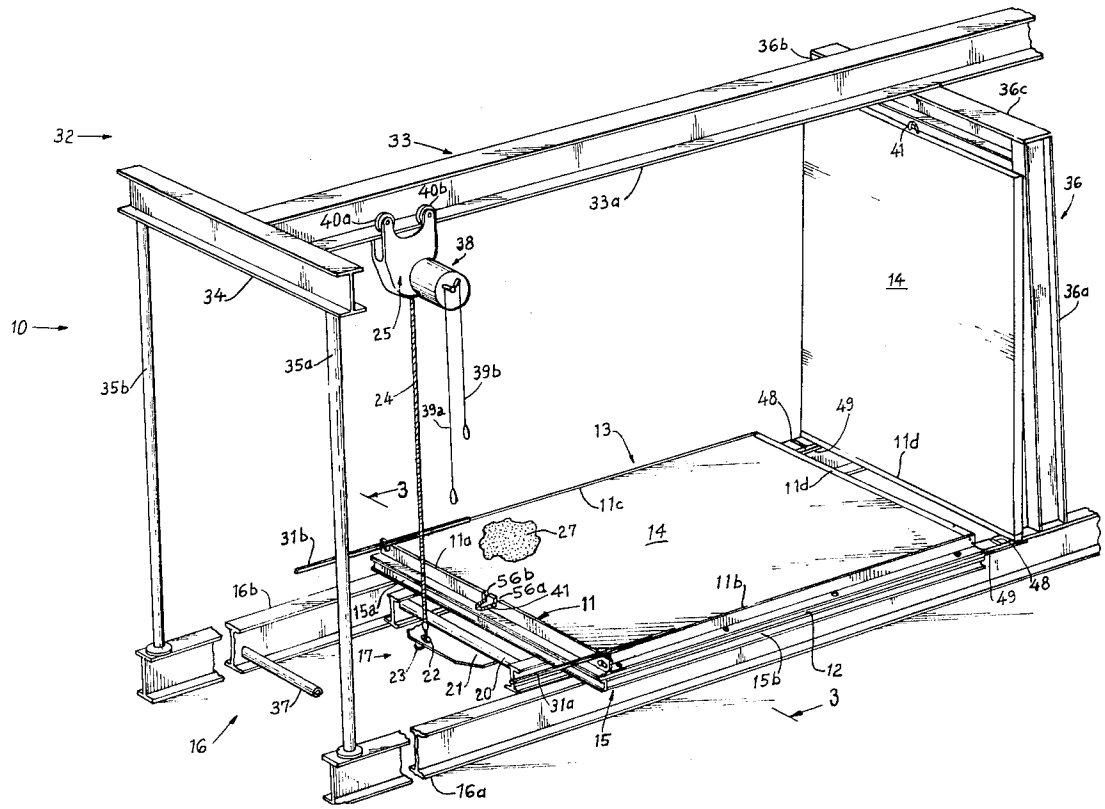
[57] **ABSTRACT**

Apparatus for pouring preferably thin slabs or reenforced concrete of substantial area with a form therearound and light bottom therebelow completing a pan with the pan bottom being supported by a lift frame initially resting upon stationary support runners. The concrete is poured upon reenforcing means in the pan, including an extending bail, and the lift frame is engaged centrally from the outer end together with pan-encased poured slab to dispose such slab leaning against an upright. The upper end and side forms and the pan bottom may then be recovered, the slab curing in raised position above a lowest form member left thereunder to rest upon the support runners. The bail extending from the slab upper portion may then be engaged to handle the slab into permanent, predetermined position in a structure, the lowest form member at this time being removed.

7 Claims, 12 Drawing Figures



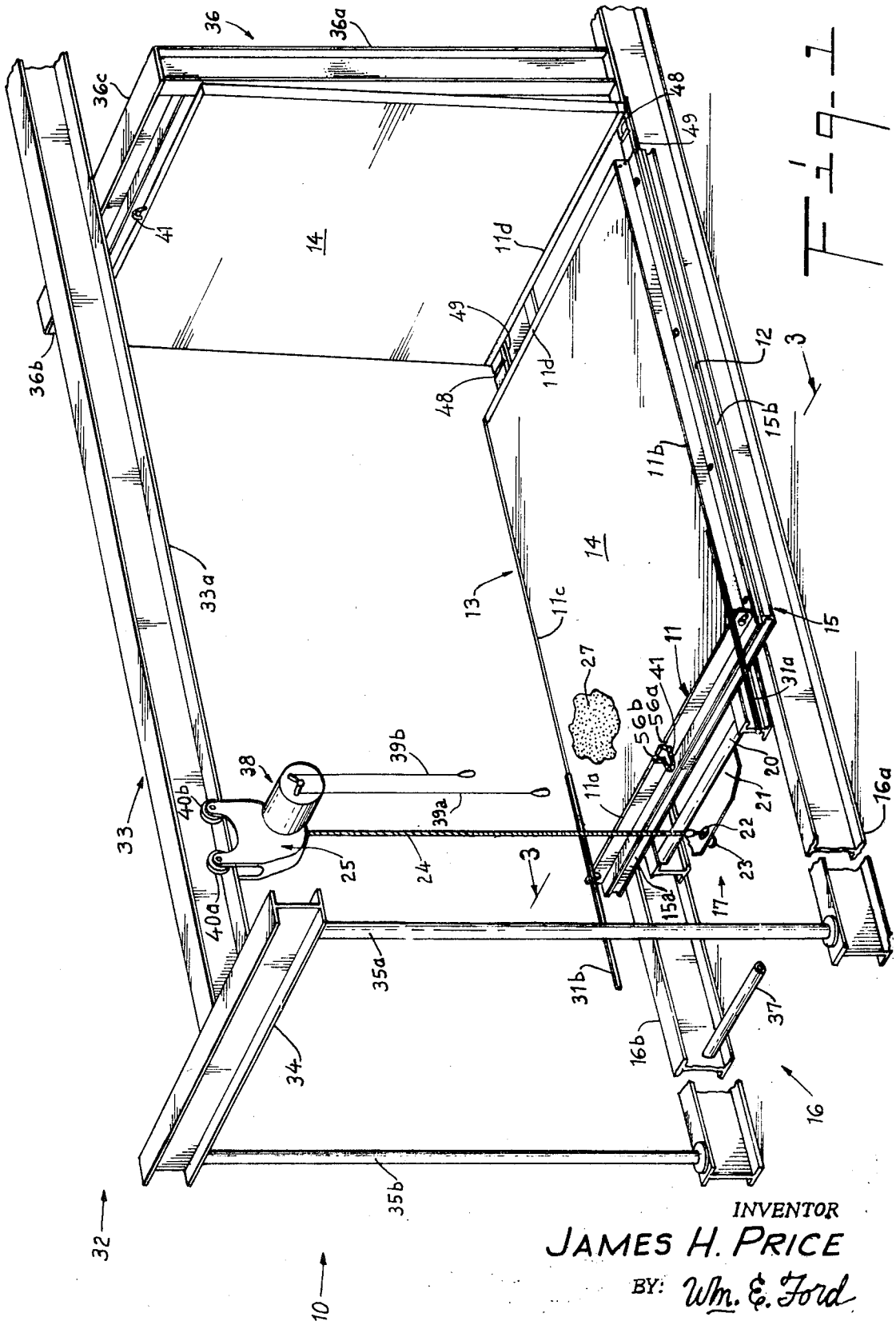


FIG. 1

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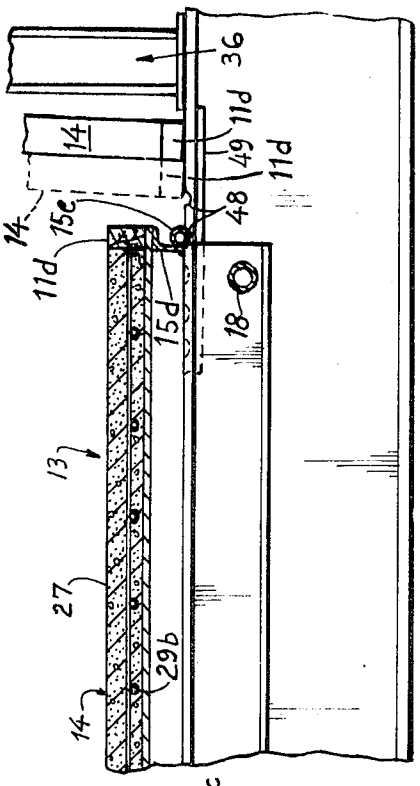

FIG. 2

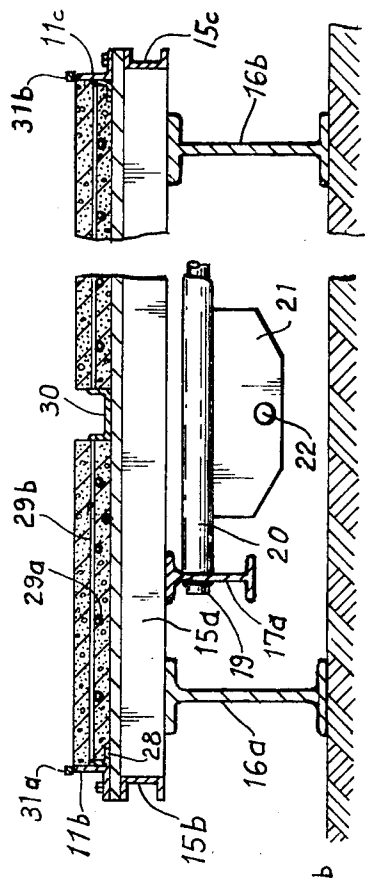

FIG. 3

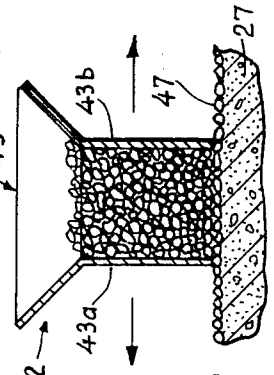

FIG. 8

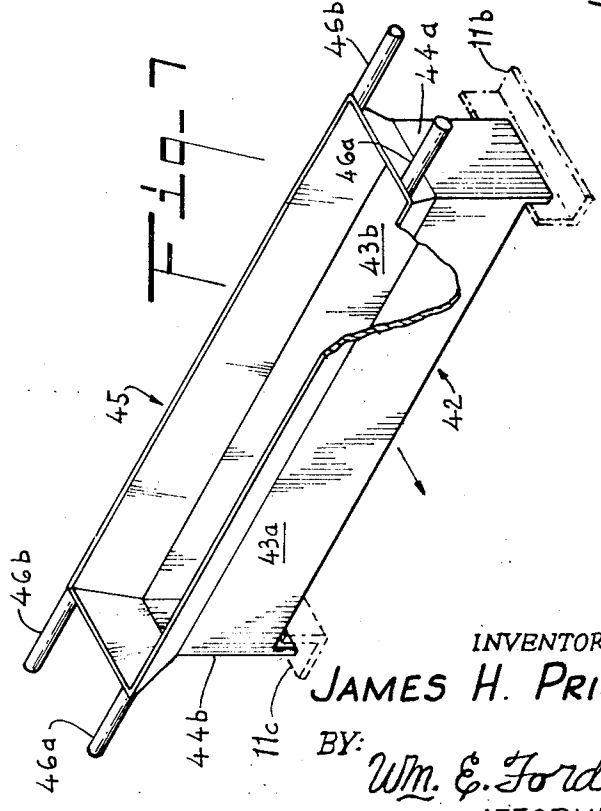

FIG. 7

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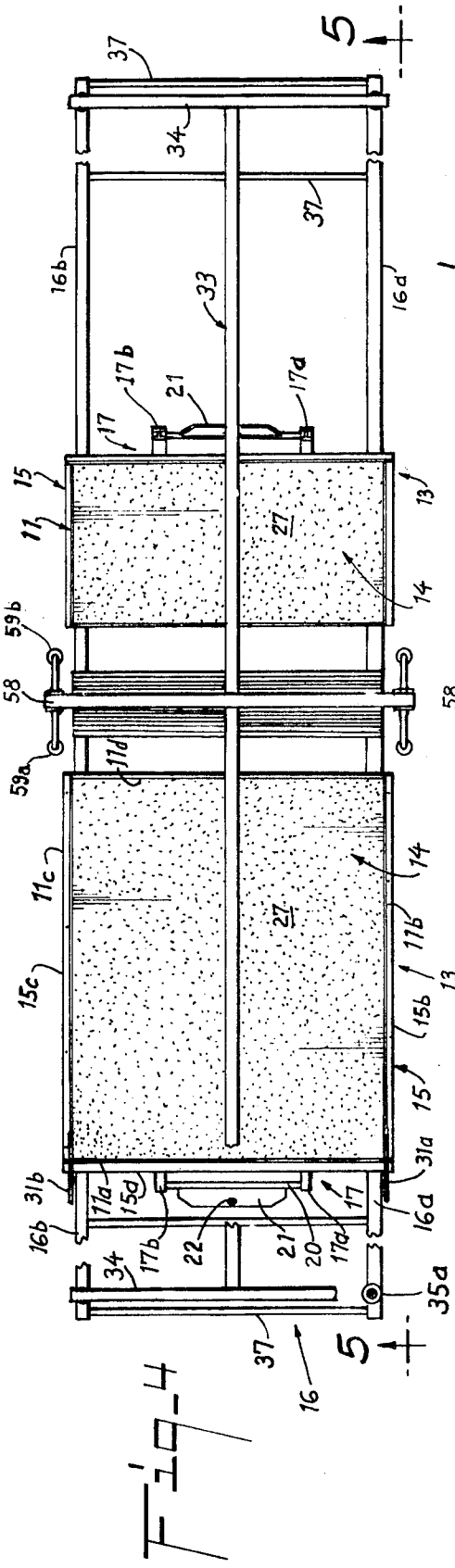

FIG. 4

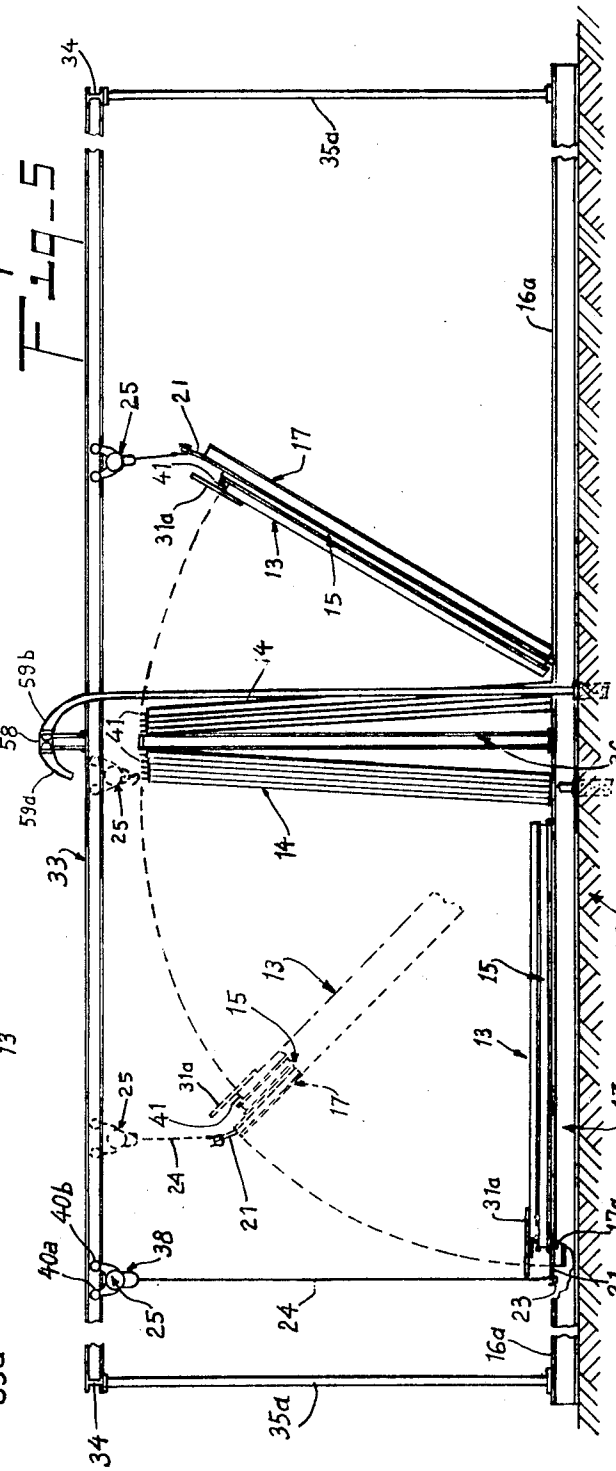

FIG. 5

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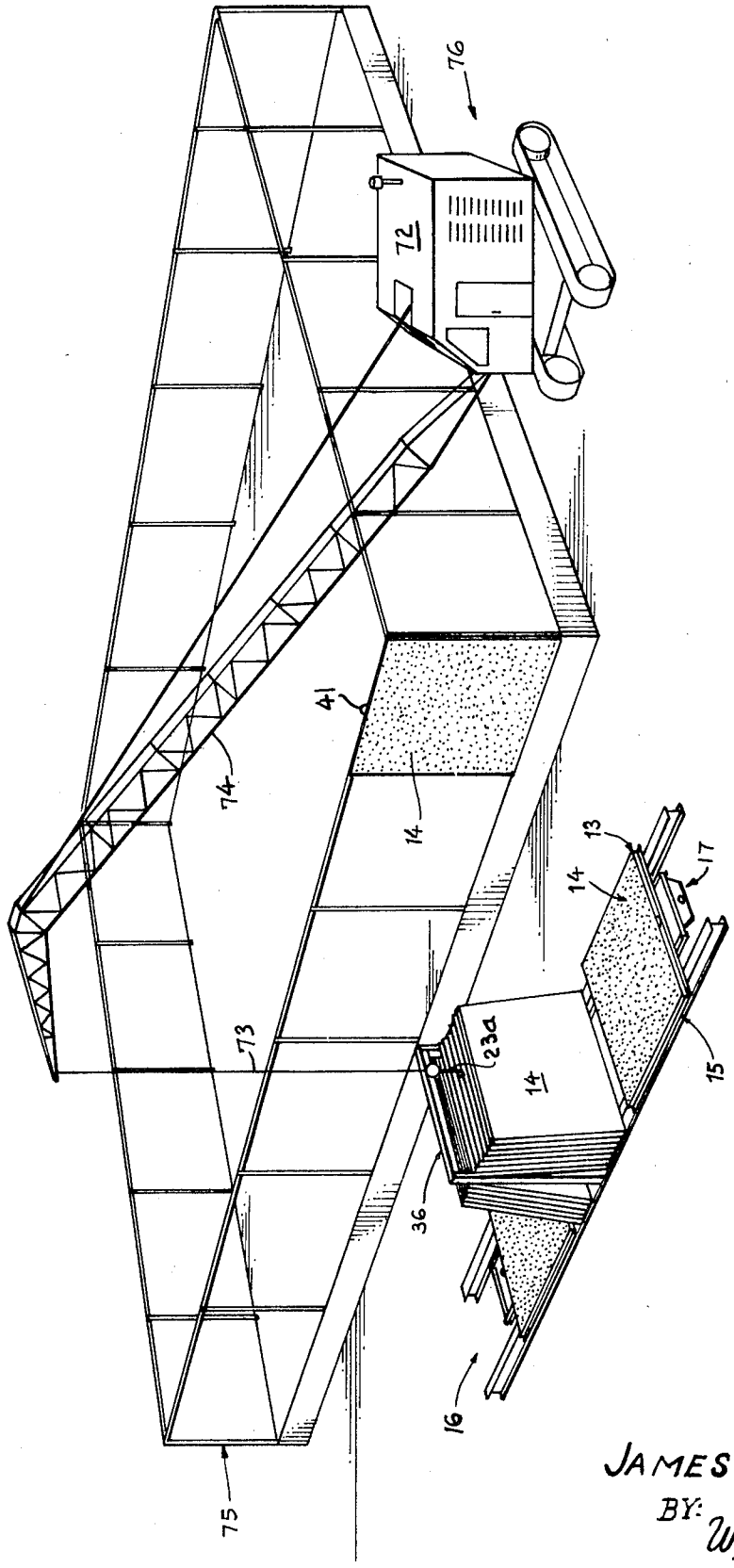

FIG. 8

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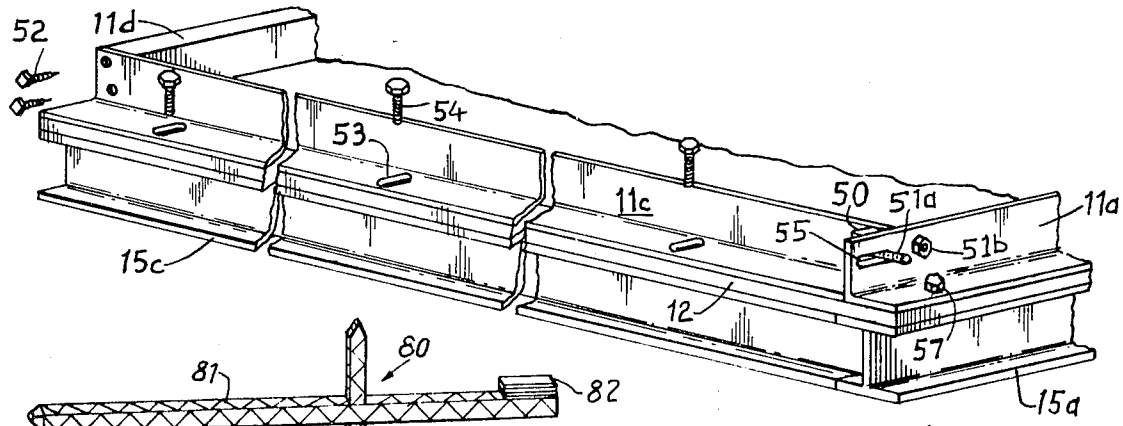
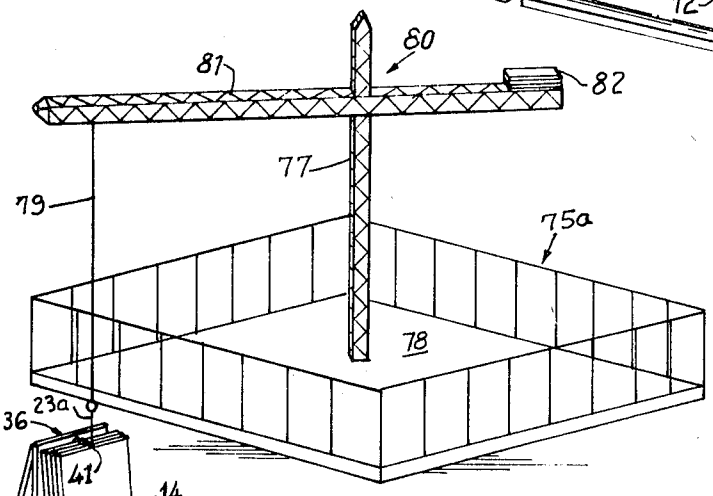


Fig. 9



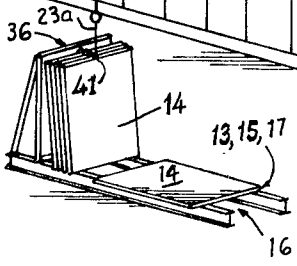


Fig. 12

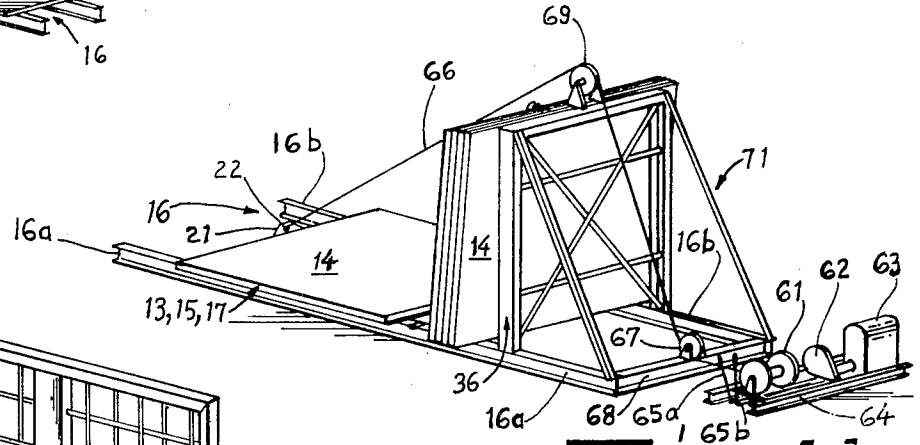


Fig. 11

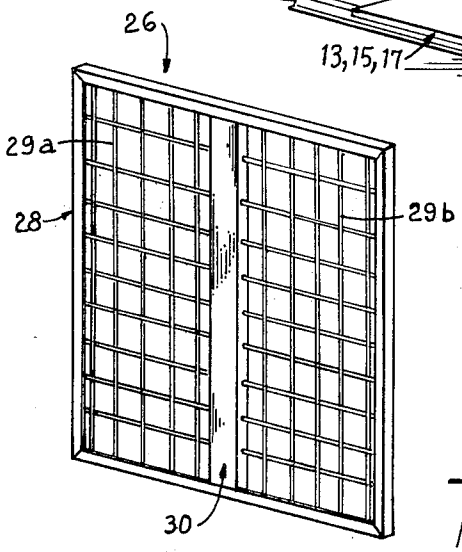


Fig. 10

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JOBSITE APPARATUS FOR HORIZONTALLY POURING AND VERTICAL STACKING OF THIN SLABS

The invention relates to substantially large area, thin, reenforced concrete slabs poured upon a pan including a form around the slab with slab bottom supported on a lift frame supported by stationary support means. The lift frame is then engaged by lift means to lift pan with poured slab to be supported substantially vertically while curing, the form top end and side members and the pan bottom being removable for successive use.

It is a primary object of this invention to provide apparatus for pouring thin or normally thin reenforced concrete slabs at jobsite, the slabs taking up minimum room while curing vertically, with the same form, slab bottom, lift frame, base runners and lifting apparatus being used in providing a succession of substantially vertically stacked and cured slabs ready for handling in a most appreciably short time after being poured.

It is also another and most important object of this invention to provide apparatus of the class described for providing a quick succession of substantially vertically stacked sand cured slabs ready for handling at jobsite, with the poured slabs only requiring a bail cast thereinto to extend substantially centrally from the top for handling.

It is still a further and important object of the invention to provide apparatus enabling thin reenforced concrete slab pouring at jobsite by virtue of the slabs being stacked substantially vertically to cure, substantially the same small yard space serving for the pouring of a vast succession of slabs, which during and after curing, until placed, occupy each only the jobsite area equal to the area of only the upper (or lower) edge or end of the slab.

It is also a further and important object of the invention to provide apparatus of the class described, enabling slabs to be poured and cured at jobsite without taking up but a minimum space per slab (thickness times transverse or horizontal dimension), as compared with yard space required per horizontally poured and cured slab, where a slab occupies yard area (transverse dimension by longitudinal or elevational dimension) and for approximately a week before cured to take a positive set.

It is yet another and further object of the invention to provide apparatus of the class described, enabling relatively thin slabs to be poured and cured at jobsite in relatively shortest time, whereas slabs as thin as say 2 inches in thickness may be provided most inexpensively, enabling slabs of this and comparable thickness to be acceptably provided at minimum costs as bid against slabs of conventional approximately 5 inches thickness required to enable handling in case of slabs poured conventionally horizontally and brought to jobsite after lengthy curing.

It is another and important object of the invention to provide apparatus of the class described which may be employed to pour slabs for substantially vertical stacking upon opposed sides of an upright structure; to provide slabs, as described, which may be lifted for substantially upright stacking by a variety of hoisting or lifting means, and which may be handled into predetermined final position on a structure by a variety of handling equipment, and in a minimum time.

Other and further objects will be apparent when the specification is considered in connection with the drawings, in which:

FIG. 1 is an isometric view of a poured slab in pan on lift frame on support beams, with lift frame ready to be lifted by beam crane hoist, slab to be leaned against previously raised slab with top leaned against upright support means; bottom of slab on lower form in turn resting upon support beams;

FIG. 2 is a longitudinal sectional elevation through slab, pan and lift frame, part in section, with a support beam or base member also being shown;

FIG. 3 is a transversal elevational view, part in section, taken along line 3—3 of FIG. 1;

FIG. 4 is a plan view of back-to-back slab pouring, lifting, and stacking for curing operations, prior to erecting the cured slabs;

FIG. 5 is a side elevational view taken along line 5—5 of FIG. 4;

FIG. 6 is an isometric view showing back-to-back slab-handling operation apparatus at a jobsite, with a dragline handling slabs from upright supported position into position on a building structure;

FIG. 7 is an isometric view of a trough employed in pea gravel facing of the slabs shown in FIGS. 1–6, inclusive;

FIG. 8 is a transverse sectional elevational view taken through the trough shown in FIG. 7;

FIG. 9 is an isometric, fragmentary view of a pan and supporting lift frame, showing details of assembly of pan members, and in explanation of pan recovery from a stacked slab;

FIG. 10 is an upright view, partially diagrammatic, showing a reenforcing steel mat to be placed within a pan before pouring concrete therein;

FIG. 11 is an isometric view of alternative apparatus, (winch), handling lift frame lifting of slabs in pans, with the alternative apparatus being on opposite side of the vertical slab support from the slab pouring and lifting operation; and

FIG. 12 is an isometric view of handling apparatus in the form of a rotating crane in process of picking up a stacked and cured slab to dispose at location as a wall, roof or floor slab.

Referring now in detail to the drawings in which like reference numerals are applied to like elements in the various views, apparatus **10** comprised by the invention is shown as comprising a form **11** disposed upon a light bottom or baseplate **12**, the form comprising a top end member **11***a*, side members **11***b*, **11***c*, and a lower end member **11***d*, the form **11** and the bottom **12** together comprising the pan **13** into which the mixed concrete to form a slab **14** is poured from a conventional cement mixer, not shown.

The baseplate or bottom **12** may be of a light but substantially thick material, as plywood, adequately to support the slab **14**, as its thickness, say 2 inches, is determined by the depth or height of the form members; the top end member **11***a* and the side members **11***b*, **11***c* being indicated as comprised of structural angles, while the lower end form member **11***d* may be comprised of wood, as a 2 inch wooden support piece or bar timber.

The pan **13** is supported by a support frame **15**, indicated in FIG. 1 as being a rectangle of conventional structural steel shape construction, with the upper transverse member **15***a* (FIGS. 1 and 2) and the longitudinal side members **15***b*, **15***c*, shown respectively in FIGS. 1 and 2, being comprised of channels, while the lower transverse member is indicated (FIG. 2) as being comprised of a structural angle **15***d* with a steel pipe **15***e* substituted in place of the lower flange of a conventional channel, otherwise suggested. As best seen in FIG. 1 the support frame **15** overextends on each side two spaced-apart, parallel-extending support or base beams **16***a*, **16***b*, (I-beams being shown) which may be installed at a selected location at jobsite to remain during the whole slab-providing and handling operation.

Beneath the pan support frame **15** two parallel extending lift beams **17***a*, **17***b* are provided within the respective base beams **16***a*, **16***b* and parallel thereto, the upper ends of the lift beams **17***a*, **17***b* being shown underextending the upper support frame member **15***a* for a short predetermined distance in FIG. 1. The lift beams **17***a*, **17***b* and the support frame transverse member **15***a* are rigidly connected, as by welding, and also the lift beams **17***a*, **17***b* are connected rearwardly to the support frame transverse members **15***d*, **15***e*, FIG. 2. Additionally the lift beams **17***a*, **17***b* may be crosstied together, lower rear, by a spacer pipe **18**, and forwardly by a connection plate axle or rod **19**, which extends across between, and through the webs of the lift beams **17***a*, **17***b* so that the outer ends of the rod or axle **19** may be welded to the webs of the respective lift beams **17***a*, **17***b*.

The rod or axle **19** extends through a pipe **20**, which extends with slight tolerance from inner face of web of beam **17***a* to inner face of the web of beam **17***b*, and has a lift plate or bail plate **21** connected thereto centrally thereof as shown in

FIGS. 1, 2 and 3. A hole 22 is provided through the forward portion or tongue of the bail plate 21 so that the hook 23 on the lower end of the lift chain 24 of a lift hoist 25, FIG. 1, may be engaged therethrough for connection to lift the lift frame 15, with pan 13 thereon after a concrete slab 14 has been poured therein.

Now considering FIGS. 2, 3 and 10, the reenforcing structure 26 that is fitted within each form 11 before the concrete 27 is poured therein, is shown as viewed from the bottom thereof that seats on the support plate or plywood bottom 12. Thus the reenforcement 26 comprises an angle frame 28, angle backs outwardly, with the crossed reenforcing rods 29*a*, 29*b* extending between the toes of the angles, a central member or wall channel 30 being shown dividing the reenforcement longitudinally centrally in FIG. 10.

The reenforcement 26 is dimensioned so that the angle frame forming its rim or border fits with slight or frictional clearance within the form members 11*a*, 11*b*, 11*c* and 11*d*, the reenforcement being in the equivalent of thickness measurement substantially half the thickness of the slab 14, thus to dispose the reenforcing rods 29*a*, 29*b* in a space substantially centrally of the slab 14 to provide substantial uniformity of reenforcement. A pair of spreader support rods 31*a*, 31*b* are cantilevered forwardly from their parts connected to the forward top edge surfaces of the respective side form members 11*b*, 11*c*, for a purpose to be hereinbelow described.

As shown in FIG. 1, a beam crane 32 is installed with the beam 33 providing the hoist runway extending longitudinally parallel to, and centrally between the base beams 16*a*, 16*b*. A crossbeam 34 has the forward end of the runway beam 33 connected centrally thereto, and support posts 35*a*, 35*b* are shown upstanding from the upper flanges of the base beams 16*a*, 16*b*, near the forward ends thereof, with the under surface of the crossbeam 34 being seated upon the top surfaces of the support posts 35*a*, 35*b*, the posts being preferably removably connected at top and bottom to facilitate easy removal of the beam crane 32 for subsequent usages at new locations.

The runway beam 33 extends with proper clearance above an upright wall 36, above the base beams 16*a*, 16*b*, and rearwardly of the upright wall 36, substantially equidistant rearwardly of the upright wall 36 as the support posts 35*a*, 35*b* are forwardly thereof, corresponding posts extend above the base beam to support a corresponding crossbeam to which the rear end of the runway beam 33 is connected centrally thereof. As indicated in FIG. 1, the base beams 16*a*, 16*b* may be crosstied together by cross-pipe 37 at longitudinally spaced-apart intervals, and thus held parallel.

The hoist 25 is indicated as having the conventional motor-driven lift winch 38 carried thereby, and in FIG. 1 the pull cord 39*a* is indicated as having been pulled downwardly to actuate the lift winch motor to lower the lift chain 24 so that the lift hook 23 can be engaged in the lift hook 22. Then, the pull cord 39*b* may be pulled downwardly to start the lift winch motor in direction to lift the poured slab 14 by lifting the support frame 15, as raised with the lift beams 17*a* and 17*b* by structure associated therewith, such structure with the lift beams 17*a*, 17*b* and with the support frame 15, together being termed the lift frame 17.

The hoist 25 is indicated as being suspended from the shafts of conventional spaced-apart rollers 40*a*, 40*b* which may run along the upper surface of the runway beam lower flange 33*a* on both sides thereof. The hoist 25 may be of the type to be pulled manually longitudinally along the runway beam 33, by the lift chain 24, or by a pull chain, not shown, or a separate motor-driven transmission may be provided to make driving connection with at least one of the rollers 40*a*, 40*b*, so that the aforesaid separate motor, not shown, may be actuated, and at speed, to drive the hoist 25 in predetermined direction and at predetermined speed, along the runway beam flange 33*a*.

The upright wall 36 is shown in FIG. 1 as comprising upright posts 36*a*, 36*b* of channel construction, and an I-beam 36*c* across the top. Also, although not shown, suitable bracing structures may be provided so that the upright 36 does not tend to lean forwardly or rearwardly, or tend to sway sidewardly. Noticeably in the construction of beam crane 32, upright 36, and base beam assembly 16, care should be taken that the constituent parts of these assemblies are not welded, or otherwise rigidly connected, but that the parts thereof are connected for disassembly and removal from jobsite to jobsite.

As best shown in section in FIG. 2, a bail of wire rope 41 is best provided embedded centrally in the upper portion of the slab 14, as wrapped in contact with the reenforcing cross wires 29*b*, or with the longitudinal wires 29*a*. The wire rope 41 extends outwardly through a suitable slot in the form member 11*a*, and thus not shown, and outwardly thereof to form an outstretched bail or handle to be engaged as will be hereinafter described. Such a bail 41 may be seen in FIG. 1, substantially centrally of the top form member 11*a*, and extending outwardly therefrom.

Also, the respective form members 11*b*, 11*c*, may have a spreader support rod 31*a*, 31*b* cantilevered outwardly or forwardly from seated connection upon the top surfaces or edges thereof, see FIGS. 1–5. After the concrete for a slab 74 has been poured to fill a pan 13, the area uppermost may be surfaced for special appearance in the following manner. A spreader or open-bottomed box 42, including sides 43*a*, 43*b* can be disposed across slab width, with box ends 44*a*, 44*b* to extend below its sides, and to be moved along the respective form members 11*b*, 11*c*, is placed across the portion of the slab 14 adjacent the upright 36, and a surfacing material, as pea gravel, selected for variety of color, is poured through the hopper construction 45 atop the box 42 to fill the box so that the lowermost gravel pebbles, pellets or particles 47 rest upon, and are impressed into the soft concrete 27 of the slab upper surface, as the box or spreader 42 is moved manually along the slab 14 from initial point outwardly to the outer end, two operators holding the spreader 42 by its leading and trailing handles 46*a*, 46*b* to urge it along at elevation with the under edges of the sides 43*a*, 43*b* just above the poured level of the concrete 27 to impress the gravel particles into the slab 14 while the concrete upper surface is still a quickly hardening slurry.

As the spreader 42 nears the outer end of travel, its open bottom begins to overextend the form member 112 comprising the end of the pan 13 opposite the form member 11*d* adjacent the upright 36. The box or spreader lead side 43*a* first is disposed across the cantilevered spreader support rods or bars 31*a*, 31*b*, with part of the pea gravel or surfacing material 47 falling out the front end of the spreader 42, preferably to be recovered in a suitable receptacle for the purpose, while the pea gravel particles or pebbles 47 in the rear portion of the box or spreader 42 are worked into the concrete 27 until finally the whole spreader 42 overextends the outer or top form member 11*a* to rest for support on the cantilevered rods or bars 31*a*, 31*b*. Obviously other surfacing material than pea gravel may be applied to the surfaces of the slabs 14, the spreader 42 and its method of use to surface a concrete slab with pea gravel being set forth as an example of surfacing, and as an example of the stage of operations where it may be best applied.

Heretofore it has not been found practicable to pour concrete wall slabs, foundation slabs, or floor or roof slabs, of thickness much less than 5 inches, because any thinner structures than those of the customary 5 inches thickness, cured and set horizontally, will be too breakable to handle, as into vertical position, or otherwise in accordance with the handling practice. Since the types of concrete slabs available have been thus limited in thickness, the trade has become used to calling for this thickness, as on architect's plans and specifications, whereas, as a matter, of practicality, concrete slabs of no greater than 2 inches thickness could serve in many cases.

Because it has not heretofore been found practicable to provide thin slabs, or thick slabs, for that matter, at jobsite, the slabs employed have been poured in pouring "yards," as where ample space may be found or kept available. Also, as

poured conventionally, and in conventional thicknesses, it takes slab width by height in area, plus clearance, for each slab that is being poured at one time, say 300 square feet or yard space for a 20-foot by 10-foot slab. Furthermore, the curing and setting time for a slab poured horizontally, is usually several days, sometimes a week. Assuming a building construction that will require 40 slabs, 20 feet by 10 feet, if of conventional thickness, poured in a pouring yard, approximately 12,000 square feet of space can be kept tied up for a week. Additionally, the costs of transporting the 40 slabs from pouring yard to jobsite can be appreciable.

By comparison, the space required to pour, cure, and have set all of the slabs needed for any conventional or special construction job, at jobsite, can be accomplished in less than 1,000 square feet for apparatus for stacking slabs from opposed sides of an upright, FIGS. 4, 5 and 6; or less than say 600 square feet for apparatus for stacking slabs from only one side of an upright, FIG. 1 or FIG. 11. Such a slight need for pouring space, where the slabs can be stacked vertically, makes the difference between whether or not slabs can be poured, cured and set at jobsite, or otherwise must be processed elsewhere and brought to the jobsite by special hauling, timed for immediate installation upon arrival.

In view of the foregoing description of apparatus and methods, the manner of handling the slabs **14**, after the concrete **27** has been poured into a pan **13** with reenforcement **26** therein, is obvious. Only a small time interval need elapse after a slab **14** has been poured, or after a slab **14** has been poured and the upper side surfaced, (with apparatus shown in FIGS. 7 and 8), the hoist **25** is brought to position over the bail plate **21**. The lift chain **24** is then lowered, so that the hook **23** may be engaged in the lift hole **22** in the bail plate **21**, and the slab **14** in its pan **13**, as supported by the support frame **15** thereunder, with the lift frame **17**, including the bail plate **21**, below the support frame **15**, are all ready to be lifted.

Noticeably, at this stage it is pointed out that the cross-pipe **15***e*, FIG. **2**, comprising part of the lower support frame member **15***d*, **15***e*, is disposed in aligned notches **48** across the base beams or runners **16***a*, **16***b*, as formed in the upper surfaces of the top flanges thereof, and in alignment across the end portions thereof adjacent the upright or slab-stacking frame **36**. Such notches **48** are spaced apart across the runners **16***a*, **16***b* at intervals just slightly greater than the thickness of a slab **14** after the form elements and plywood base **12** have been removed therefrom. Reenforcement plates, as the plate **49** shown in FIG. **2**, may be provided under each side of each runner beam top flange, thus to reenforce the flange portion that is weakened by removing the material providing the notches **48**.

As the lift chain **24** is raised by the hoist winch **38**, the hoist **25** is also allowed or imparted movement down the flange **33***a* toward the upright **36**, as the support frame pivot (in form of the cross-pipe **15***e*), turns in its respective notches **49**. Thus slab **14** in the pan **13** is pivoted through substantially 90° plus a slight degree of lean, so that the upper face of the slab **14** comes to lean flush against the outer (once the under) face of the preceding slab **14** that has been poured and stacked vertically. (See the slab **14** in dotted lines in FIG. **2** as stacked against the preceding slab **14** in solid lines). The first poured slab **14** having been stacked against the upright **36**, at some predetermined slight degree of lean, each successively stacked slab **14** is stacked with the face that was upwardly when the slab was poured to rest upon the face that was the under face (against the plywood base **12**) of the slab **14** that immediately preceded it. Theoretically the slabs, say 2 inches thick, should be of total thickness in multiples of 2 inches, but as a matter of practicality some slight clearance must be allowed for surface irregularities. Consequently the pivot notches may be spaced apart say 2 1/16 inches or 2⅛ inches when the slabs calculated for pouring are to be no more than 2 inches thick.

The success of this type of operation is obviously dependent upon using the same apparatus comprised of pan **13**, support frame **15** and lift frame **17** over and over again, the form members **11***a*, **11***b* and **11***c* of the form **11** being loosened from assembly so as to leave the slab **14** resting upon the form member **15***d*, usually a 2-inch×2-inch wooden slat, as indicated in FIG. **2**.

The pan **13** and support frame **15** are constructed in manner that the pan elements can be released quickly so that a slab **14** can be left in stacked, or upright position, the pan parts then being quickly reassembled upon the support frame **15** for the next slab to be poured therein. As shown in FIG. **9**, the upper form member **11***a* is connected by bolts or machine screws **57** passed through the plywood pan bottom **12** into the support frame top I-beam member **15***a*. Also, in FIG. **9**, the upper form member **11***a* is connected by a stud **51***a* extending from a connection lug **50** across the upper end of the side form **11***b* through a slot **55** near the adjacent end of the upper form member **11***a*, a nut **51***b* being threaded full up on the upper end of the stud **51***a*. The opposite form side member **11***c* is similarly constructed and is similarly connected to the opposite end of the upper form member **11***a*.

Further, as shown in FIG. **9**, the crossbar or foot bar lid **11***d*, on which the poured slab is to rest, has lag screws **52** passed through the lower ends of the side form members **11***b*, **11***c*, and into the end face surfaces thereof, thus to complete assembly of the form **11**.

Longitudinally spaced-apart slots **53** are provided in the side forms **11***b* and **11***c*, and bolts **54** pass through these slots and through holes in the pan base or bottom (plywood plate or sheet) **12** and through holes in the upper flange of the respective support frame side channels **15***b*, **15***c*, with nuts, not shown, being threaded upon the lower ends of the bolts **54** to assemble the support frame side members **15***b*, **15***c* flush under the form members **11***b*, **11***c*. The aforesaid top crossmember **15***a* of the support frame **15**, shown as an I-beam in FIG. **2**, may be welded to the tops of the support frame side members **15***b*, **15***c*, or optionally these elements may be bolt-assembled. Similarly, the support frame lower crossmember **15***d*, shown as an angle in FIG. **2**, may be welded to the lower ends of the support frame side members **15***b*, **15***c*, or otherwise these members may be bolt-connected.

When a slab **14** has been stacked substantially vertically, as indicated in FIG. **2**, in FIGS. **4–6** and in FIGS. **11–12**, the pan **13**, support frame **15**, and lift frame **17** may be freed to be swung back downwardly, as the hoist direction of travel is reversed. This is accomplished simply by removing the lag screws **52**; loosening the nuts, not shown, which normally bear against the under side of the upper flanges of the side channels **15***b*, **15***c*; and then loosening the nuts **51***b* on the studs **51***a* which extend upwardly from lugs **50** at the tops of the respective form side members **11***b*, **11***c*, through slots **55** in the ends of the top form member **11***a*. Then, the form members **11***b*, **11***c* may be moved sidewardly, as the slots **53** move outwardly about the bolts **54**, and the studs **51***a* move outwardly in the slots **55**, whereby any adhesive contact between the side forms **11***b*, **11***c* and the slab **14** being stacked is broken. Then the hoist **25** may be reversed in direction of travel to move toward the outer end of the runway beam **33**, whereby the hoist hook **23** in the plate hole **22** draws the lift frame **17** therewith, also the connected support frame **15**, together with the plywood pan base **12** and the form members **11***b*, **11***c* and **11***a*, since the form side members remain connected to the support frame members **15***b*, **15***c* by the loosened bolts **54**, and since the top member **11***a* connected by means of the bolts or machine screws **57** to the support frame top member **15***a*. As the top member **11***a* is thus moved, slots **56***a*, **56***b* in the top member **11***a*, pass by the sides of the loop of the bail **41**, precast in the slab **14**. The slab **14**, just stacked, has its wooden slat form member **11***d* thereunder, extending across the runner beams **16***a*, **16***b*.

As the form members **11***a*, **11***b*, **11***c*, pan base **12**, support frame **15**, and lift frame **17** are withdrawn from the last stacked slab **14**, the hoist **25** is manipulated to drag these members outwardly so that the cross-pipe **15***e* of the lower support frame element **15***d*, **15***e*, is slid out of the pivot

grooves 48 (occupied as the slab 14, hereinabove described, was stacked), and comes to rest in the next grooves 48 immediately outwardly thereof, upon the top flanges of the runner beams 16*a*, 16*b*. Then the form is reassembled by urging the side members 11*b*, 11*c*, inwardly (as the slots 53 slide about the bolts 54, and the studs 51*a* slide in the respective end member slots 55), and then tightening the nuts, not shown, upon the lower ends of the bolts 54, and the nuts 51*b* upon the upper end of the studs 51*a*. Also the lag screws 52 are passed through holes in the lower ends of the form members 11*b*, 11*c*, and into a newly provided lower support member or wooden form member or slot 11*d*. Then a reenforcement 26 may be placed within the reassembled pan 13, and a succeeding slab is ready to be poured.

The employment of a single assembly of slab-producing and handling apparatus to provide slabs in succession compares most economically favorably with present methods where a large number of heavier forms have to be in use at the same time, each occupying horizontal space of slab area plus clearance, and where additional heavy handling apparatus is necessary to transport the heavier (5-inch thick) slabs to jobsite and into position on a structure. In addition to economic advantages in the nature of thinner slabs costing less, advantages of design and space considerations are gained in the architecture of buildings at every place where a thinner slab may serve as well or better than a thick slab for various purposes and requirements.

As shown in FIG. 5, slabs 14 are being poured and stacked on opposite sides of a single upright or lean support structure 36. It may be noticed that, whereas a hoist 25 is shown on both ends of the runway beam 33, a single hoist 25 may serve both sets of pouring and stacking apparatus 13, 15, 17. In this case a single hoist 25 can be called into play from one side to the other of the upright 36, as the respective slabs are poured and ready to be lifted. Noticeably the runway beam 33 is at sufficient elevation above the upright 36 that the hoist 25 can pass over the top of the upright 36 in moving from a lift operation on one side to a lift operation on the other side.

In this case a beam 58 is provided above the runway beam 33 and a connection member 59 extends downwardly from the beam 58, centrally thereof, to the runway beam 33, centrally thereof, and above the upright 36. Then at each end of the transverse support beam 58, support posts 59*a*, 59*b* are provided for connection to the respective end portions of the transverse beam 58, and transversely outwardly of the upright 36, the support posts 59*a*, 59*b* being disposed forwardly and rearwardly of the beam 58 with firm foundations in the soil 60, which supports the runner beams 16*a*, 16*b*.

As shown in FIG. 1, slabs 14 are poured and stacked on only one side of an upright structure 36, also no runway beam structure is required. As disclosed, the slabs 14 are stacked by a winch 61 driven through a transmission 62 by a prime mover, as a gasoline engine 63, all being mounted on a skid beam assembly 64 clutched and braked by manually operated clutch lever 65*a* and brake lever 65*b*. From the hoist drum a lift cable 66 extends under a pulley 67 mounted upon a cross-beam 68 between the adjacent ends of the beam runners 16*a*, 16*c* comprising the base support assembly 16. From thence the lift cable 66 extends over a pulley 69 mounted centrally upon top of the upright support 36, and then to be dead-ended in the lift hole 22 in the bail plate 21 of the lift assembly 17. An adequate bracing frame 71 is shown on the side of the upright 36 opposite the slabs 14 aNd adjacent to the lift winch 61 for cross-bracing and diagonally bracing the upright structure 36 both against side sway and against leaning backwardly under slab load from the pouring and stacking side of the upright 36. This form of the invention apparatus may be employed to require less room at jobsite than the apparatus shown in FIGS. 1, 4, 5 and 6.

The apparatus as shown in FIG. 11 may best be used when the slabs 14 needed for a job are not so many that they cannot all be leaned on one side of an upright 36. Also apparatus of this type can be much more quickly installed than the apparatus comprising runway beam and overhead hoist, as indicated for the invention shown in FIGS. 1, 4 and 5. Also, for greater mobility and selectivity of location of prime mover for stacking, the assembly 70 of elements, including the winch 61, may be mounted upon a motor vehicle, as upon a tractor or upon the back of a truck.

The slabs 14 as poured and stacked vertically, are cured and set within a short few hours, less than a day, and as a building structure progresses, there should never be any delay at the job resulting from waiting for a slab to be cured, set and handled into position. Rather, with the apparatus and methods of this invention, there should be available on the job from the earliest days, a supply of poured, stacked, cured and set slabs to be handled from a substantially vertically disposed, adjacent stack, by respective bails 41, into position, as in the case of the wall slab 14, shown in position just north of the southwest corner of the building 75, FIG. 6. Such slab 14, has been picked up from its then outermost position on the stack, by engagement of the hoist chain hook 23*a* into its bail 41, winch means within the dragline cab 72 being actuated to draw in the dragline cable 73 over pulleys, not shown, but disposed in the dragline boom 74, to position the slab 14 for installation on the wall of the building structure 75 adjacent the aforesaid southwest corner.

With the form of apparatus for stacking shown in FIG. 6, it can be assumed that the slab-lifting and stacking means, as runway and hoist, have been removed after the number of slabs 14 needed for the building 75, have been poured and stacked. Assuming the building 75 to be planned as a single story building requiring say 18 slabs, 10 feet by 10 feet, then in great accuracy 17 slabs should be shown on the apparatus of the invention, lower left in FIG. 6. For purposes of clarity only 13 such slabs are shown, but obviously 18 slabs, in greatest accuracy, could well have been shown.

The dragline 76 shown in FIG. 6 is only typical of handling apparatus that may be employed to take the slab 14, as stacked, to position for installation. As shown in FIG. 12, a building 75*a*, to be taller than the building 75 shown in FIG. 6, is indicated as having a rotating beam crane 80 with post 77 installed centrally in the ground floor slab 78. The rotating beam crane 80 is shown diagrammatically without details of operative equipment, it being well known that a lift cable 79 is provided to pick up objects to be lifted, the lift hook 23*b* at the end of the lift cable 79, being engaged in a slab bail 41.

The beam 81 is rotatable about the post 77 to dispose a lifted slab 14 in radial alignment with the wall section to receive the slab, then a means within the beam or boom 81 can move longitudinally (radially) with relation to the beam or boom 81, thereby to carry the means from which the cable 79 depends to a radial location to make the lifted panel or slab 14 accessible to be affixed to the building 75*a* at the desire position. Noticeably, the beam or boom 81 has a conventional counterweight 82 on the end thereof opposite the suspended cable 79.

In a construction of several stories, the rotating beam or boom crane 80 may have its base or post 77 raised a floor at a time, as the walls from ground up are successively completed, and the floor laid above the walls just finished. Obviously other apparatus for handling the slabs 14, in addition to the exemplary devices hereinabove mentioned, may be employed to handle the slabs 14.

The invention may be practiced with variations as to apparatus for lifting and stacking, with variation as to means, other than bails 41, by which connection may be made between slab 14 and apparatus for handling a slab 14 into final position upon a structure under erection. Also variations can be made as to the assembly of form and supporting pan, except that the side elements in all cases must be capable of releasing or breaking contact with the sides of the slab. Also, it should be noted that an important variation in hoisting means or lifting means may be hydraulic cylinder and piston means to lift support frame with lift connection, pan and slab therein, by applying the lifting force from under the slab. Optionally, the

hydraulic cylinder means may have its base mounted on some form of beam supported above the slab to be stacked.

The variations of apparatus and method of use are multitudinous except that there must exist, in common, the object of minimizing slab space occupied at jobsite, minimizing slab-curing and setting time, eliminating handling of thick and heavy slabs from "pouring" yard to jobsite, providing a lighter, thinner slab to serve where previously a slab much thinner than 5 inches thickness could not well be handled without cracking, breaking, or chipping; also, providing a thinner slab to serve architecturally, structurally, or functionally in place of a conventional slab of greater thickness.

I claim:

1. Reenforced concrete slab-forming apparatus, for fixed location exteriorally adjacent a building during its construction, for disposing a plurality of successively formed and vertically stacked slabs to finish curing and setting and in position for being handled successively into place in said building, said apparatus including support runners, a stacking upright means of substantially slab width extending across said runners and over slab height thereabove, a support frame to extend across said support runners at a spaced distance from said upright, means extending from the support frame end portion opposite the end portion adjacent said upright and adapted to have a lifting connection made thereto, a pan including a bottom support upon said support frame and a form assembly of height substantially equal to slab thickness and upstanding from said bottom support to define the side and end borders of the slab, and lifting means adapted to make said lifting connection to lift said support frame, pan and slab to complete slab-curing and setting as leaned for support by said upright, said lifting means being adapted to be reversed to draw said connection, said support frame and said pan away from a leaned slab, and said form assembly including a lowermost member removably secured to side elements thereof having means adapted to be loosened to permit limited movement with relation to said bottom support and away from the sides of respectively, successively stacked slabs whereby said respectively, successively stacked slabs are left self-sustained and supported above said support runners by respective lowermost form members which remain with respective slabs at least until respective slabs are taken from stack for installation in said building.

2. Apparatus as claimed in claim 1 in which said support frame includes a pivot axle and in which said runners provide longitudinally spaced-apart pivot grooves therein in which said pivot axle may turn as successively poured slabs are lifted to be leaned.

3. Apparatus as claimed in claim 1 in which said form assembly includes an upper member with notches opening opposite the support frame side thereof and adapted to receive therethrough a bail to be cast in said slab, whereby said form assembly may be withdrawn from said slab upon reversal of said lifting means, as aforesaid, thus to leave said bail with said slab.

4. Apparatus as claimed in claim 1 in which said form assembly stands substantially 2 inches in height above said bottom support.

5. Apparatus as claimed in claim 1 in which said form assembly stands from substantially 2 inches to substantially 5 inches in height above said bottom support.

6. Apparatus as claimed in claim 1 in which said lifting means comprises a beam crane with hoist runway beam supported centrally between and substantially above said support runners and above said stacking upright.

7. Apparatus as claimed in claim 1 in which said lifting means includes a winch means disposed on the opposite side of said stacking upright means from said support frame, the winch cable passing over pulley means provided centrally atop said stacking upright means.

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