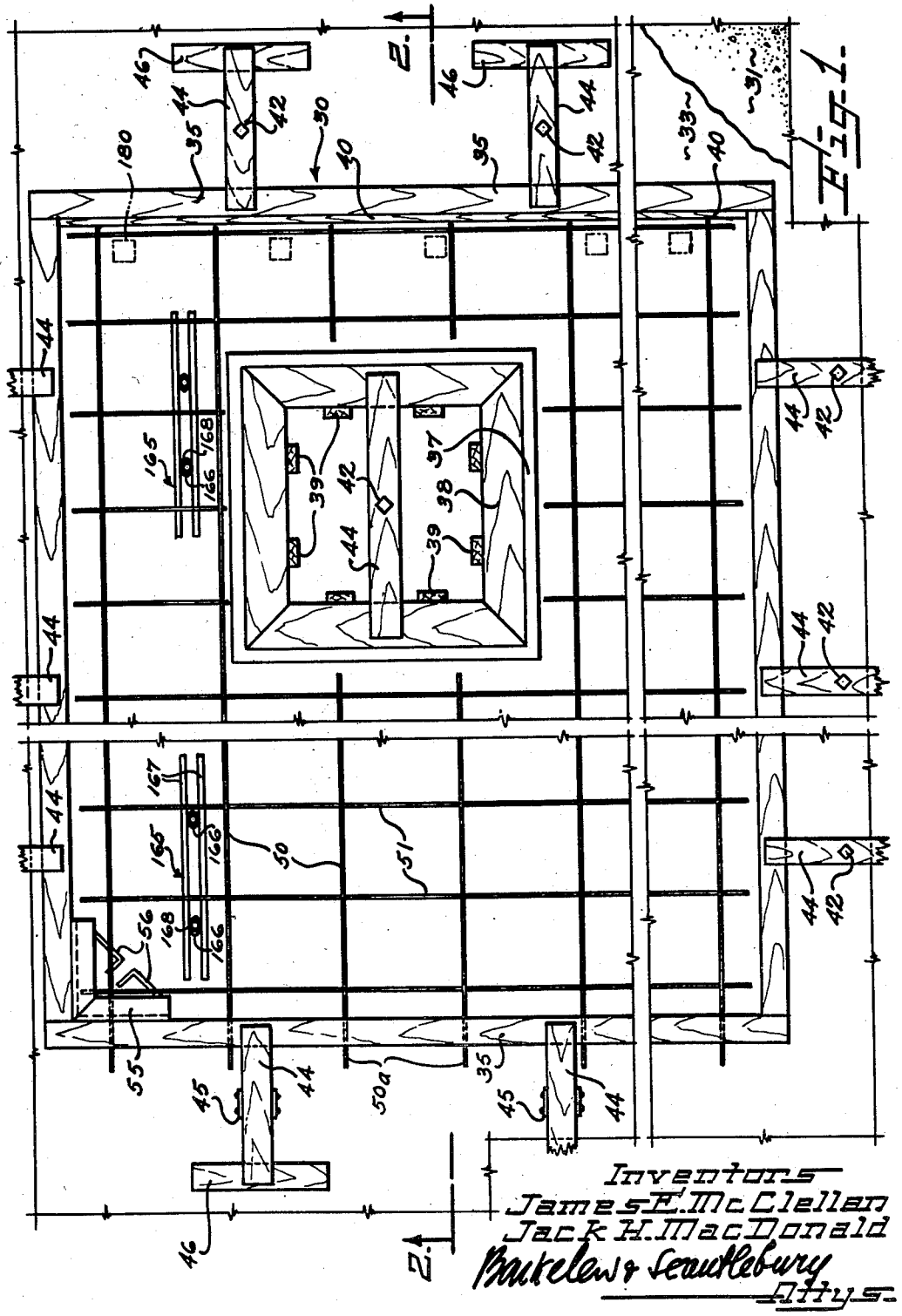
Nov. 28, 1950 J. E. McCLELLAN ET AL 2,531,576

METHOD OF CASTING CONCRETE BUILDING ELEMENTS

Filed March 25, 1948 2 Sheets-Sheet 1



Nov. 28, 1950 J. E. McCLELLAN ET AL 2,531,576

METHOD OF CASTING CONCRETE BUILDING ELEMENTS

Filed March 25, 1948 2 Sheets-Sheet 2

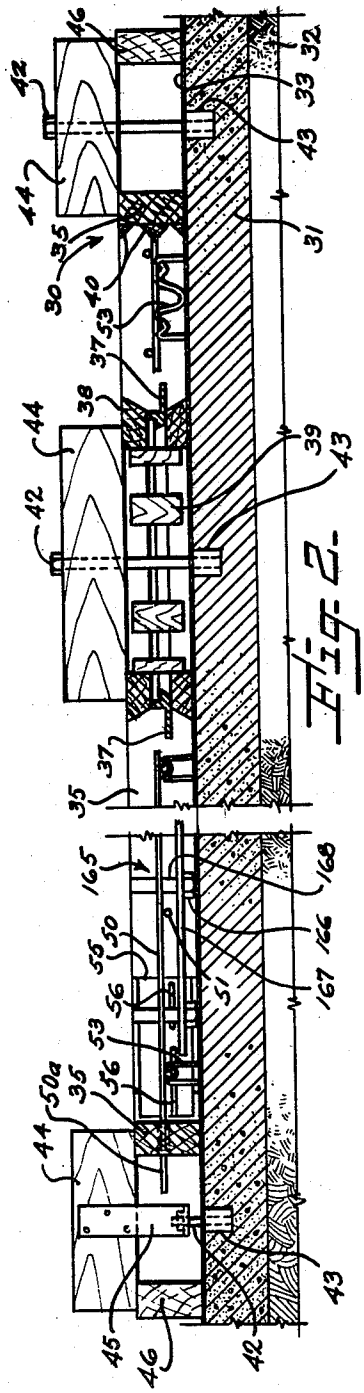


Fig. 2.

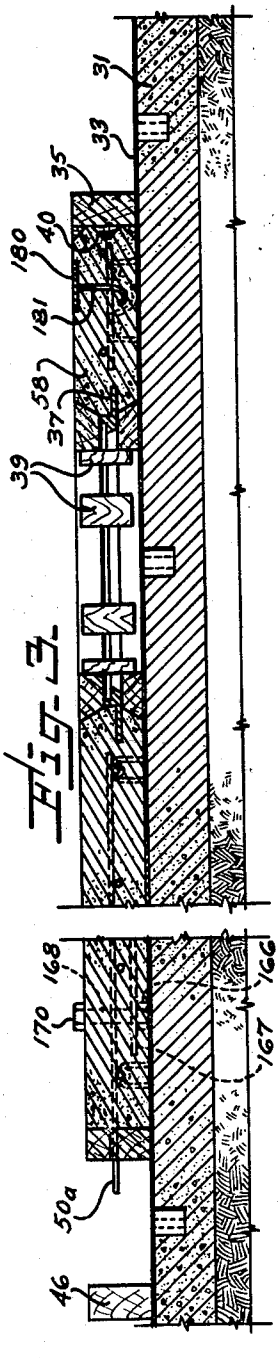


Fig. 3.

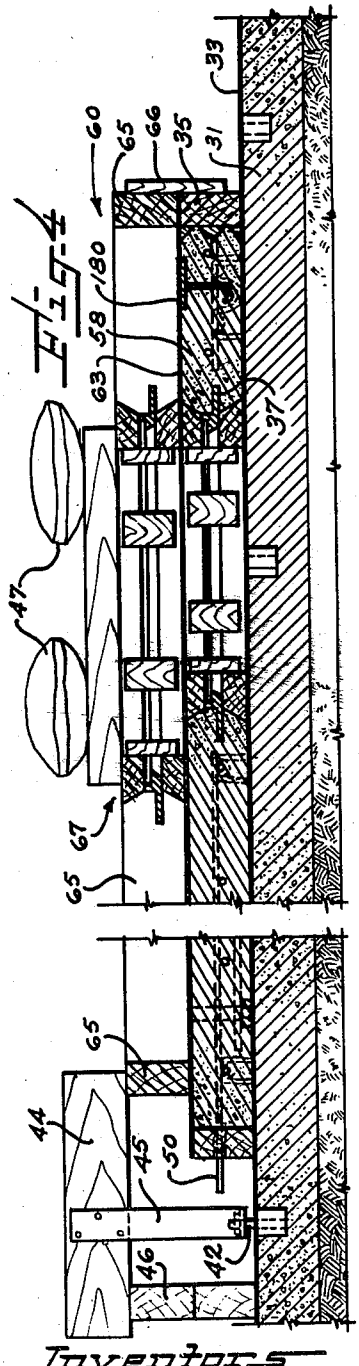


Fig. 4.

Inventors
James E. McClellan
Jack H. MacDonald
Barkelew & Scantlebury
Attys.

Patented Nov. 28, 1950

2,531,576

UNITED STATES PATENT OFFICE

2,531,576

METHOD OF CASTING CONCRETE BUILDING ELEMENTS

James Ed McClellan, Los Angeles, and Jack H. MacDonald, Glendale, Calif., assignors to Buttress & McClellan Inc., Los Angeles, Calif., a corporation of California

Application March 25, 1948, Serial No. 17,078

1 Claim. (Cl. 25—155)

1

This invention is concerned generally with the construction of buildings by the prefabrication of concrete building elements.

More particularly, the invention includes an improved and simplified manner of molding concrete building elements which is particularly adapted for use at the building site.

The invention includes also various fittings and procedures which in suitable combination lead to great economy in construction and to improved operation generally.

The invention, together with its further objects and advantages, will be best understood from the following detailed description of certain preferred embodiments. That description and the accompanying drawings are illustrative, and are not intended to limit the scope of the invention, which is defined by the appended claim. The drawings form a part of the following description, and:

Fig. 1 is a fragmentary plan of typical panel form constructed on a coated concrete base, ready for pouring;

Fig. 2 is a fragmentary vertical section taken on line 2—2 of Fig. 1;

Fig. 3 is a section similar to Fig. 2, but showing the concrete poured and set; and

Fig. 4 is a section similar to Fig. 3, but showing a second panel form in position on the first panel.

An important feature of the invention is the method of prefabricating concrete building elements such as beams and wall panels by pouring them in forms, one wall of which is the face of a previously prepared concrete element. As an illustrative example of the method, Figs. 1 and 2 show a form 30 for a wall panel, constructed directly on the surface of a concrete floor slab 31, which itself has been formed in any usual manner, for example by pouring concrete directly on a suitably graded earth foundation 32. After the concrete floor slab has partially set and before construction of form 30, the entire upper surface of the floor slab is coated with a suitable liquid sealing composition. This composition is of such a nature that it forms on the concrete surface a substantially water impermeable layer 33 which will not form a strong bond with concrete poured upon it and allowed to set. Typical compositions having the required properties are described below. The sealing composition can be spread on the concrete surface in any suitable manner, spraying being preferred. The sealing layer 33 is produced over at least that portion of the floor which will be occupied by the form, but

2

it preferably covers the entire surface of concrete slab 31 on which form 30 is to be constructed. The sealing layer then assists the curing of the floor slab, which continues during construction of the superimposed panels.

After the coated concrete floor has sufficiently set, which may typically require 24 hours, the panel form 30 is constructed directly upon it. That form comprises in general a frame 35 outlining the panel edges and projecting upward from floor 31 a distance equal to the panel thickness. If the panel is to be four inches thick, as is typically the case, 2 x 4 lumber, finished accurately to dimension is preferably used for the form frame.

If a window or door frame is to be set into the panel, the required panel aperture can be blocked out with form lumber, and the actual window frame or door frame set in place after the panel has been completed and erected. However, particularly with window frames, it is generally preferred to set the complete frame directly in place as a part of form 30, as indicated at 37, blocking it in as with form members 38 to complete the definition of the panel aperture. Any desired edge section can be obtained at the panel edge or in the concrete surrounding the window (or door) aperture by introducing appropriately formed molding strips in the form, as shown typically at 40. In practice the window frames 37, preferably of metal, are blocked in advance with form members 38 of suitable section, which are secured temporarily to the frames as by braces 39. In constructing the panel form, the blocked frame is then merely laid on floor 31 and secured in the correct location with respect to form frame 35.

Form frame 35, blocked window frame 37, and any other members which define boundaries of the panel must be firmly anchored in place on floor 31 and tied down to it, so that the concrete will not flow under them and lift them from position. Typical anchoring means are cross braces 44, blocks 46 and the bolts 42 secured in suitable fittings 43, which may be set in advance for this purpose in floor 31, either flush with its surface or slightly below it. After fittings 43 have served their purpose they are preferably plugged with concrete, yielding a smooth final floor surface. Bolts 42 may pull down cross braces 44, either directly or through auxiliary connections such as straps 45. Alternative anchoring means are shown in Fig. 4 in the form of weights such as sacks 47 of sand or the like piled on cross braces 44.

Reinforcing iron 50, 51 is set in form 30, tied

together in the usual manner, and supported above the floor surface 31 by any suitable means, such as reinforcing chairs 53, made of heavy wire. Any fittings which are to be incorporated in the panel structure are either set in the form in advance or are inserted immediately after the concrete has been poured, depending upon their nature. For example, a corner strengthening angle 55, comprising a right angle of channel steel with anchoring lugs 56 butt welded to its inner face, is shown in position in a corner of form 30; and pickup fittings are shown at 165, welded to reinforcing iron in the form. Channel reinforcing similar to corner angle 55 may be used along any panel edges desired, but is not ordinarily required. Welding plates 180 are preferably inserted after pouring, and are brought accurately flush with the surface of the wet concrete.

As the wet concrete mix is poured into the form it is vigorously vibrated by any suitable tamping means, preferably a power driven flexible vibrator, to insure a solid and uniform fill. The upper face is leveled in the usual manner, with reference to the upper edge of form frame 35, and is finished to any desired texture. After the concrete has taken an initial set, anchoring ties 42, 44 may be removed, leaving the complete concrete panel 58 lying directly on the coated concrete floor 31 and still surrounded by form 30, as in Fig. 3.

A second concrete element can now be cast directly on panel 58. For example, a second concrete panel, preferably of equal or smaller size, can be cast on the face of the first panel. Fig. 4 shows a form 60 for such a second panel in place on panel 58. As illustrated, the outer boundary of the second panel coincides with that of the first along the right hand edge (as seen in Fig. 4) and lies inside that of the first along the left hand edge. The second panel has a window aperture, defined by blocked window frame 67, which is of such size and position that it includes all of the window aperture of the first panel, and, in the present instance, extends beyond that aperture to the left in Fig. 4. Similarly, the relative panel dimensions normal to the plane of Fig. 4 are understood to be such that all parts of the second panel lie directly above finished panel 58.

Before a form such as 60 is constructed on panel 58, the upper face of panel 58 is coated with the sealing preparation, as has already been described for preparing floor 31 for the casting of the first panel. Such a coating is shown schematically at 63 in Fig. 4. The construction of the second panel form then proceeds substantially as described for the first panel form, except that the upper face of first panel 58 performs the function previously performed by the surface of floor 31. The second panel frame 65 and blocked window frame 67 may conveniently be anchored either to floor 31, for example by bolts 42, cross braces 44 and straps 45, as described above; or directly to the first panel form 30, which is preferably still in place. The latter type of anchor is indicated at 66.

After the second panel has been poured in form 60 and has partially set, additional panels (provided they are of suitable dimensions) can be constructed successively on top of it. Thus a stack of panels is produced, as shown in Fig. 4, separated only by the sealing layer deposited on each surface before the following panel is poured. The final upper surface is preferably also sealed in the same manner to improve curing. The form frames may be left in place around the panel edges during whatever time is required for adequate curing of the panel stack, and are generally stripped off just before or during the operation of erecting the panels.

The number of panels in a stack depends in practice upon the shapes of the individual panels and also upon the relative area of the concrete floor 31 as compared to the total area of the panels or other concrete elements which are to be formed. Panels for the entire wall surface of a small commercial building, for example, can ordinarily be cast on the floor of the building itself without requiring more than two or three panels in a stack. On the other hand, if roof panels are also to be cast in the same manner, it is sometimes convenient to cast as many as five or six panels in a stack. This sometimes means designing the various panels so that they will stack effectively, the area of each successive panel being contained within the area of the panel upon which it is constructed. That condition need not be precisely fulfilled, since if necessary the area of a panel can be extended by suitable blocking or framing in order to permit a larger panel form to be constructed upon it. But such a procedure is preferably avoided for the sake of economy and speed in construction.

After all the panels of a stack have been poured in the manner described, typically requiring about one day for each panel in the stack, all the panels and the concrete floor on which they are supported are allowed to complete the setting process and to cure, usually for several days. During curing, the water impermeable layer 33 on the floor, the layers 63 between successive panels, and a final similar layer, which is preferably applied to the exposed surface of the top panel of the stack. assist the curing process by retarding evaporation of water from the exposed concrete surfaces and by preventing migration of water from one concrete element to another across their contacting faces.

After the panels have sufficiently cured, they are lifted up successively from the floor or from the top of the stack in which they were cast, and set in position to form the building. A convenient means of handling panels is a conventional portable crane, which can operate from outside the building or can work on the same floor on which the panels have been formed. An advantage of the type of panel form described above is that the panels are directly and firmly supported on the floor so that there is no tendency for them to be cracked if the crane runs over a panel. It is only necessary to block the panel edges to prevent local chipping of the panel. Accordingly, the crane can operate quite freely on a floor that is largely covered by panels, so long as the stacks are not too high.

Not only wall panels, but structural elements of various other kinds can also be cast on a previously prepared concrete surface. For example, structural columns, beams, or unitary frames including both columns and beams can be poured in this manner, and in most cases this method leads to great economy in labor, form lumber and construction time.

In both structural forms and panels, reinforcing iron can be made to protrude from the finished member in nearly any direction to serve as dowels, openings being cut in the form members when necessary, as indicated at 50a, the only exception being that face of the member

which rests on the coated concrete base during pouring.

In forming both panels and other members in accordance with the invention, the face which is cast uppermost can very readily be finished to any desired texture, whereas when the members are poured in position with conventional form construction that is difficult or even impossible. The under face can also be given certain textures by covering the concrete base with a layer of suitable material, the upper face of which carries the desired texture. However, that procedure tends to sacrifice some of the potential simplicity and economy of the method.

The success of the process described above depends largely upon the possibility of producing on the concrete surface which is to become a form wall a sealing layer having satisfactory properties. A primary requirement of such a layer is that it should prevent the formation of a bond between the concrete of the form wall and the concrete which is poured in the form, even after the latter concrete has partially or wholly set. An important additional result of using water-impervious coatings in accordance with the invention is that loss of water is wholly or largely prevented both from the concrete of the form wall and from the concrete poured in the form. This has the well-known advantage of improving the curing of the concrete. Indeed, the function of forming a water seal on a concrete surface is so important for proper curing that a special sealing layer is frequently applied solely for that purpose. When the present method is employed, that function is performed by the coatings **33**, **63**, and no special processing is necessary to insure proper curing.

The most satisfactory compositions for the purposes outlined above have been found to be substances which are water insoluble and which under normal conditions are either solids of very low tensile strength, such, for example, as paraffin wax and resin; highly viscous and non-volatile organic fluids, such, for example, as heavy petroleum residues or vegetable oils. Substances of these types can be used alone or in combination. Certain synthetic resins are useful provided they do not become hard when exposed to air, or provided they are combined with other substances which prevent such hardening. The coating compound is most satisfactorily applied in solution in any suitable volatile cut back material in which it is soluble, for example a volatile petroleum solvent. The solvent serves as a vehicle of relatively low viscosity, and evaporates after application, leaving a uniform layer of the sealing compound on the concrete surface. The substances described above can also be applied to the concrete surface in the form of a stabilized emulsion in water, using some suitable emulsifying agent such as soap.

It has been found that water-impervious coatings of the type described, which characteristically produce a weak bond between the concrete masses which they separate, are even more effective in preventing such a bond when they contain a quantity of some finely divided solid which is inert with respect to the other ingredients present. Examples of such materials are powdered talc, graphite, or any finely ground micaceous material. Presumably the presence of such inert materials further weakens the already small tensile strength of the coating, and thus inhibits any effective bond formation. While the addition of powdered insoluble solids is preferred, it is not necessary to the successful carrying out of the method.

As will be appreciated, the coating compositions useful in this invention are easily separable from the concrete layers upon which they are applied by conventional means.

For lifting the larger panels, which may measure more than 20 feet square and weigh roughly 10 tons, a very considerable force is occasionally needed to break the panel loose from its supporting surface. To distribute that pickup force reasonably uniformly over the panel area, pickup fittings are preferably placed some distance in from the edges of such panels. Furthermore, a flush type of fitting is desirable, both to avoid disfiguring the finished wall, and to maintain the upper face of the poured panel as an unbroken surface on which to construct superposed panels.

Figs. 1, 2 and 3 illustrate a type of pickup fitting presently preferred, which meets the outlined requirements for large panels and yet is simple and economical to produce and convenient in use. Fittings of this type are shown during various steps of the pouring process in Figs. 1–4. Each pickup unit **165** comprises one or more internally threaded sleeves, equal in length to the panel thickness, and widely flanged at one end. Each sleeve is enclosed by transverse bars **167** which are rigidly connected to it in bearing contact with the inner axial face of the flange. In the particular embodiment illustrated, the flanged and threaded portion of the sleeve is provided by a large nut **166**. The remainder of the sleeve **168** is of relatively light stock, preferably tack welded to one face of the nut coaxially with its threaded hole. The two heavy bars **167** of reinforcing iron are welded across the same face of the nut on opposite sides of the sleeve **168**. When two or more nuts are used in a unit, they are spaced along the bars **167** at intervals of roughly one foot, with their sleeves **168** pointing in the same direction. The overall length of sleeve **168** and nut **166** is chosen approximately equal to the thickness of the concrete panel to be formed.

The pickup unit is placed at the required location in the panel form before concrete is poured, with the exposed face of each nut **166** preferably directly on the form floor **31** and the upper end of each sleeve **168** in the plane of the upper panel face. The depth of the nuts **166** is sufficient to raise bars **167** a suitable distance above the form floor, and yet leave the greater part of the panel thickness above the bars. In particular, the regular reinforcing iron (**50**, **51** in Figs. 1–4) of the panel lies above bars **167** in position to distribute most effectively any lifting strain applied to nuts **166**. The sleeves **168** are plugged during pouring, for example by the temporary insertion of bolts **170** (Fig. 3), and serve to keep the threads of nuts **166** clear of cement and thus to provide access to the nuts from the upper panel face. If the combined length of a nut **166** and sleeve **168** is somewhat less than the panel thickness, the entire assembly can be raised above the form floor **31** by merely screwing bolts **170** into the nuts until they protrude the required amount from the lower faces of the nuts and act as supporting legs. The protruding bolt ends do not become bonded to the concrete if they are removed as soon as the concrete has taken an initial set. While it is preferred to fasten sleeves **168** rigidly to nuts **166** to form in effect a unitary flanged sleeve, the sleeve members **168** may be

merely positioned over the nuts and temporarily held in place by bolts 170 while the concrete is poured and set. Any tendency of the wet concrete to leak between sleeves 168 and either nuts 166 or the heads of bolts 170 can then be prevented by applying heavy grease to those joints. When a second panel is to be poured on top of the first, sleeves 168 in the lower panel pickup fittings are temporarily plugged flush with the panel face, as with corks.

Two pickup units 165 are ordinarily used in each panel, approximately symmetrically spaced from a vertical line through the computed center of gravity of the panel (when in final position. In wall panels the pickup units are spaced above a horizontal line through the center of gravity, so that when lifted the panel will naturally hang in a nearly vertical plane; but (at least in large panels) the fittings are perfectly spaced well in from what will be the upper edge of the panel to distribute the pickup forces more uniformly. In wall panels, bars 167 are preferably so oriented in the panel form that they will be horizontal when the panel is in its final position in the wall.

An advantage of pickup fittings of the type just described is that after the panels have been secured in position and bolts 170 removed, the fitting is already flush with the panel face, and can readily be made almost invisible merely by plugging sleeve 168, as with concrete.

In general, suitable fittings are set into the concrete of the panels for anchoring them in final position in the building. Those fittings are of various sorts, depending primarily upon the function the panel is to serve and upon the neighboring structural elements to which it is to be secured. Ordinarily the vertical edges of a wall panel are anchored directly to the columns of the building framework. Preferred means for securing concrete panels to steel members comprise weld plates 180, set flush in the panel face as illustratively shown in Figs. 3 and 4. Weld plates 180 are typically of steel ¼ inch thick and about three inches square, and are anchored in the concrete of the panel by any suitable means, such as the head portion of a bolt or a curved anchoring rod, as indicated at 181, butt-welded to the inner face of the plate. The more elaborate anchoring means 167 used for the pickup fittings 165 described above are not necessary here, since the required strength of weld plates 180 is not abnormally great. Weld plates 180 are preferably set in the freshly poured concrete flush with its upper surface, as indicated in Fig. 3. An advantage of the type of fitting here shown is that it is completely flush with the panel face, presenting a smooth surface for a superposed panel (Fig. 4).

We claim:

The method of making a concrete building member comprising, casting a concrete base layer, sealing the exposed top surface of said layer by coating with a liquid sealing composition containing a substantially water-insoluble film-forming substance in an evaporable liquid vehicle, which substance, upon removal of the liquid vehicle will deposit on the concrete layer as a uniform, substantially water-impermeable and easily separable sealing film which will prevent formation of a bond between the concrete of the base layer and concrete poured wet upon such a deposited sealing film and set and cured thereon, casting a wet concrete layer on the exposed coated surface of the base layer after said base layer has at least partially set, thereby producing a superposed concrete layer on the coated and at least partially set base layer, the layers being separated by said film, permitting the superposed concrete layer to set and cure in its position on the sealing film until the thus produced building member has attained sufficient strength to be lifted free of the base layer, and then removing the produced building member from the base layer.

JAMES ED McCLELLAN.
JACK H. MacDONALD.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
712,841	Parmley	Nov. 4, 1902
1,066,436	Peltzer	July 1, 1913
1,168,492	Freund	Jan. 18, 1916
1,326,400	Halverson et al.	Dec. 30, 1919
1,394,255	Davis	Oct. 18, 1921
1,412,392	Earley	Apr. 11, 1922
1,942,000	Reynolds	July 1, 1931
2,081,499	Nagel	May 25, 1937
2,143,515	Hayden	Jan. 10, 1939
2,199,533	Wuellner	May 7, 1940
2,235,001	Allen	Mar. 18, 1941
2,275,272	Scripture, Jr.	Mar. 3, 1942
2,293,410	Sorem	Aug. 18, 1942
2,306,107	Henderson	Dec. 22, 1942