Nov. 2, 1971 R. N. LAING 3,616,649

METHOD FOR CASTING LARGE MONOLITHIC CONCRETE STRUCTURES

Original Filed April 2, 1968 3 Sheets-Sheet 1

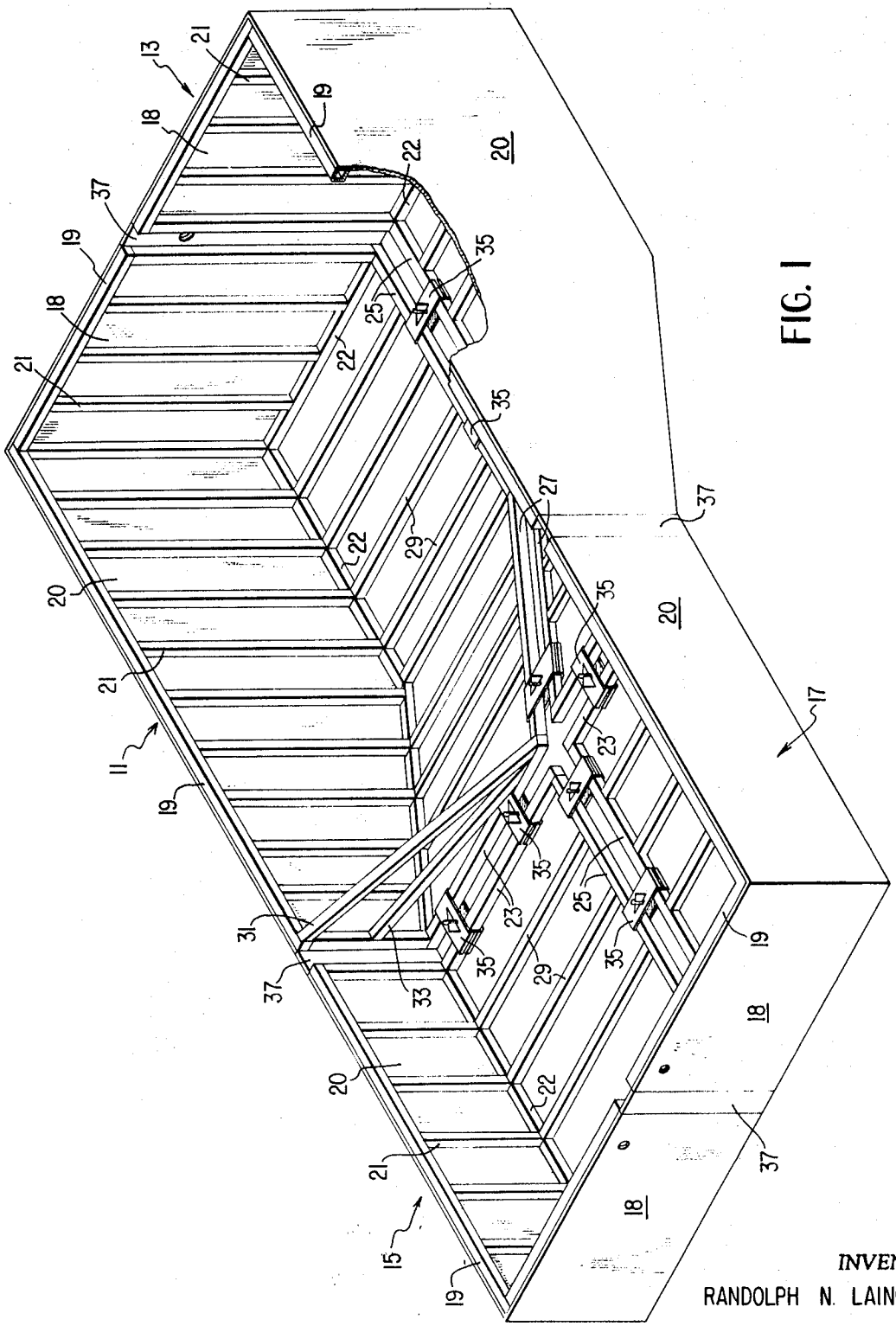


FIG. 1

INVENTOR
RANDOLPH N. LAING

BY Griffin & Branigan

ATTORNEYS.

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METHOD FOR CASTING LARGE MONOLITHIC CONCRETE STRUCTURES

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FIG. 2

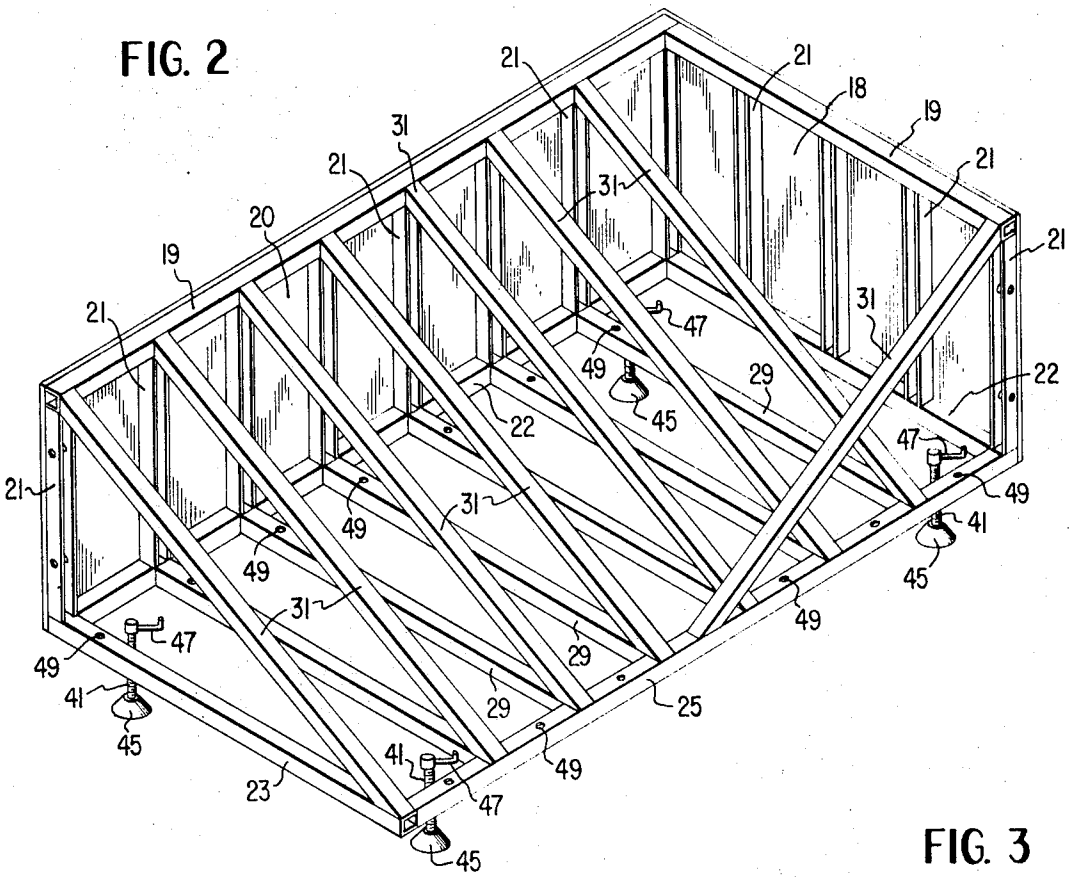


FIG. 3

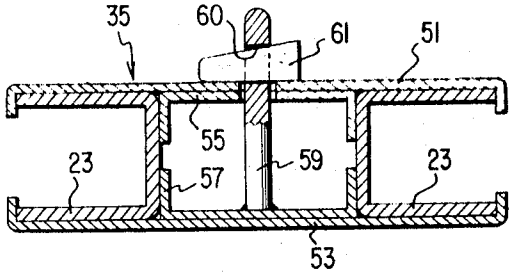
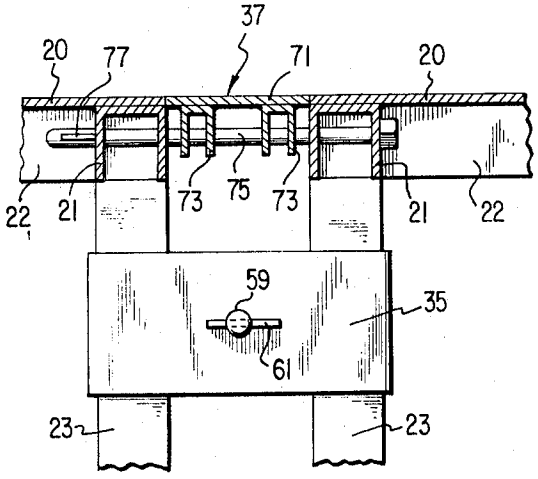


FIG. 4



INVENTOR
RANDOLPH N. LAING

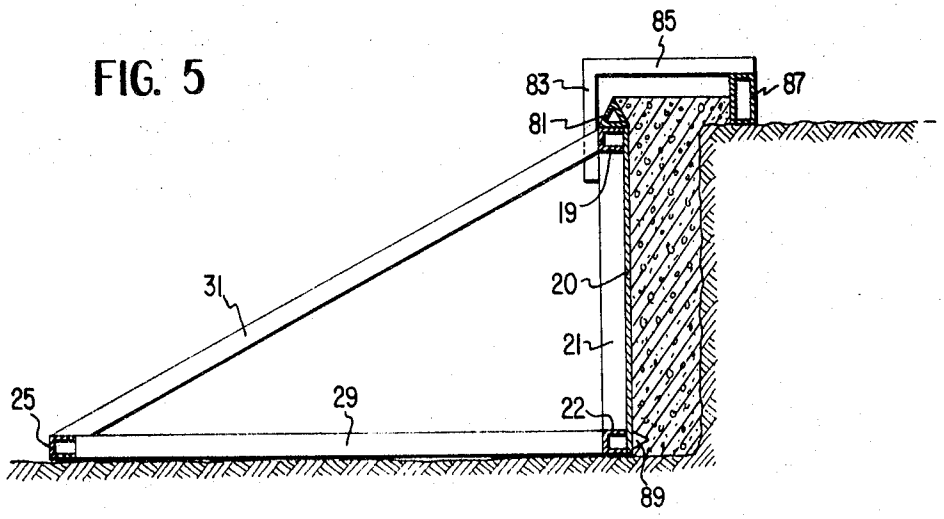
BY Griffin & Branigan

ATTORNEYS.

METHOD FOR CASTING LARGE MONOLITHIC CONCRETE STRUCTURES

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FIG. 5



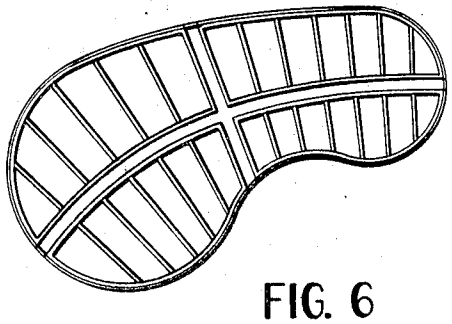


FIG. 6

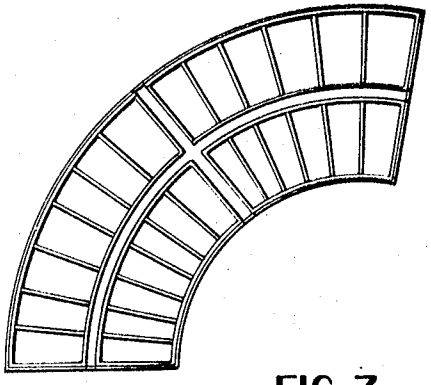


FIG. 7

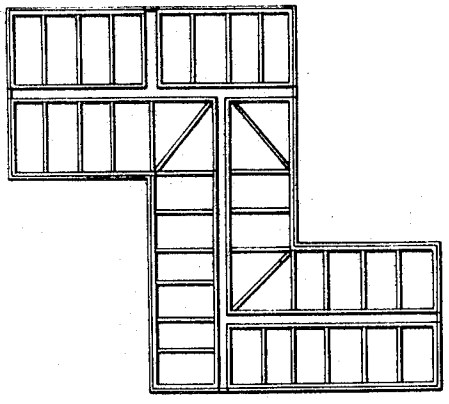


FIG. 8

INVENTOR
RANDOLPH N. LAING

BY Griffin & Branigan

ATTORNEYS.

United States Patent Office 3,616,649 Patented Nov. 2, 1971

3,616,649

METHOD FOR CASTING LARGE MONOLITHIC CONCRETE STRUCTURES

Randolph Neil Laing, 4500 Richmond Henrico Turnpike, Richmond, Va. 23222

Continuation of application Ser. No. 718,065, Apr. 2, 1968. This application Apr. 10, 1970, Ser. No. 27,440
Int. Cl. E04b 1/16
U.S. Cl. 61—35 17 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure describes a method and apparatus for casting concrete swimming pools, tanks or walls, etc. In the below-the-ground applications, the preferred method generally comprises the steps of: excavating a hole in the earth; placing inner permanently prebraced forms in the hole; aligning the forms in spaced relationship with the sides of the hole; locking the forms together in an open position; anchoring the forms in the hole; filling open spaces in the sides of the forms; pouring concrete between the forms and the sides of the hole; disconnecting the forms; closing the forms; removing the forms; and, pouring a bottom. The apparatus is adapted to carry out the method and generally comprises a plurality of inner permanently prebraced form sections. Each form section includes outside wall surfaces that define the inner walls of the pool, or the like. These form sections are braced against inner or center brace members. The inner brace members of each form section are locked to inner brace members of other form sections in a separated, predetermined relationship. Also included are means for filling wall spaces occurring between the wall surfaces of adjacent form sections; and, where applicable, means for attaching the form sections to the bottom of a hole. In addition, in connection with swimming pools means are provided for forming a coping at the upper edges of the wall surfaces of the form sections.

BACKGROUND OF THE INVENTION

This is a continuation of application Ser. No. 718,065, now abandoned entitled, "Method and Apparatus for Casting Swimming Pools or Tanks" which was filed on Apr. 2, 1968.

Most modern concrete swimming pools and the like are presently constructed by either of two methods. One method is to lay a network of reinforcing rods directly over the inside of an excavation and apply a suitable concrete mix under pressure over the network. This method is normally referred to as the "Gunite" method. The second method is to separately, individually create inner and outer forms to define the sides and ends of the pool at each pool site. Then, ordinary premixed concrete is delivered to the pool site and poured between the inner and outer forms.

While both of the foregoing methods produce satisfactory pools, they have certain disadvantages which make them excessively costly and, therefore, place pools out of the reach of the ordinary homeowner. The Gunite method of producing pools is expensive because it requires complex sophisticated equipment. In addition, the Gunite method requires skilled men to operate the sophisticated equipment. Moreover, the Gunite method is expensive because of the time involved in laying the required network of reinforcing rods. Also, the Gunite equipment must be assembled and checked at each pool site. Further, the complex sophisticated Gunite equipment is subject to continuous wear and tear that causes frequent equipment breakdowns. Hence, because the

equipment is expensive and the cost of using the equipment is expensive, the cost of the pool is high. In addition to the cost problems, Gunite pools also have the disadvantage that they must be plastered after the Gunite mixture is applied because the Gunite pool surface is rough. Further, the Gunite concrete mix is a special concrete mixture rather than common or ordinary premixed concrete resulting in increased pool cost.

The second method is excessively expensive because it requires the formation of separate (but often interconnected) individual inner and outer forms for each pool. That is, both inner and outer wall forms must be constructed, and braced at each pool site. In some cases, the cost of the pool has been reduced by constructing relatively small portions of the forms prior to delivering them to the pool site, however, even with this cost reducing step, the forms still must be mounted, interconnected, and braced. And, because forming and bracing or just bracing requires an excessive amount of time, material and labor, the cost of the pool is excessive. In addition, many present methods have the requirement for two forms (inner and outer) that are somehow tied together. This too increases the cost of the pool over that of the instant invention wherein the inner form is both permanently and independently supported. In this respect, it should be noted that certain previous methods (such as "Gunite") have used the dirt wall of an excavation as an outer wall. Frequently, however, two walls are required if for no other reason than that the inner walls are not self-supporting. This invention provides an inner form that is substantially wholly independent of the outer form whether it be a separate outer form above ground, or merely the walls of an excavated hole. Hence, the invention is admirably suited for constructing both the basements and upper story walls of concrete buildings.

One of the major disadvantages of an inner and outer form structure in below-the-ground application is the requirement that dirt for backfilling be inserted between the wall and the sides of the excavation after the outer form has been removed. Specifically, there is the possibility of danger to the wall during the backfilling operation. Further, backfilling does not support the wall as well as does the original earth which hasn't been disturbed. In addition, the softness of the backfill allows more water penetration. Thus, the concrete wall is surrounded by water and in the event the water level outside of a pool, for example, is greater than the water level inside of the pool, the pool may "float."

An attempt has been made at reducing the cost of inner and outer form structures by prefabricating many of the form pieces. While this approach has, to some extend, reduced the cost of such structures, it has not been entirely satisfactory. Specifically, numerous pieces must still be assembled, braced, and checked by component personnel at the construction site. That is, each brace must be individually installed and secured at both ends. If the installation and securing is insufficient, the forms and braces will move or rupture. Further, the pieces cannot be permanently braced because the form wall sections are immediately adjacent to each other and cannot be removed after the concrete is poured if they are permanently braced.

Other methods have also been used in connection with small monolithic castings. One such method is described in U.S. Pat. 2,807,071 relating to burial vaults or septic tanks. Therein, the walls of an inner form are hinged together and expanded into shape by a center-pole linkage mechanism. This is to be sharply distinguished from the instant invention, however, because the linkage mechanism described in the patent is limited to use in connection with relatively small structures and not at all capable of being used with large structures such as swimming

pools, basements, tanks or the like. In fact, attempts have been made to adapt the "linkage" types of structure swimming pools. One such method and apparatus is described in U.S. Pat. 3,355,897 to Mullen. These attempts, however, have resulted in complex systems of overhead bracing—all of which must be individually assembled at the pool site with nuts and bolts. Moreover, the main stresses in pouring a swimming pool occur at the bottom of the forms. Hence, the Mullen structure either requires separate bracing at the bottom of the pool forms or is quite limited to relatively shallow walls. Also, Mullen requires the pouring of a footing for a center pole which increases the time required to form the resultant structure.

In addition to the above noted disadvantages of the foregoing methods, they have other disadvantages. Specifically, pools formed by the Gunite method have been known to "pop" from the earth under certain conditions. That is, the Gunite method forms a thin concrete shell which is "popped" from the ground when the water level outside of the pool provides a force greater than the weight of the pool and the water inside of the pool.

Structures formed by the construction of inner and outer forms and bracing them at the site have the added disadvantage of being dangerous. That is, the inner and outer forms are constructed and braced at the site, and concrete is poured between the forms to create a wall. However, unless adequate bracing is provided, the forms or the braces will burst causing both personal injury and property damage. In other words, if the forms and bracings are not adequate and are not checked by competent personnel, they are likely to burst when concrete is poured between the inner and outer forms. When this happens, the forms and bracings are driven through the air with tremendous amounts of force causing damage to anything in their path. In fact, one of the reasons inner and outer forms are used is so that one can be braced against the other to prevent the rupture of the forms and bracings. However, as stated above, interlocked dual forms increase the cost of a pool or basement and result in faulty construction because of the backfilling requirement.

Therefore, it is an object of this invention to provide a new and improved method and apparatus for casting swimming pools and like concrete structures.

It is also an object of this invention to provide a new and improved method and apparatus for casting large monolithic concrete structures that reduces the amount of labor and the cost of the equipment involved in the casting.

It is another object of this invention to provide a new and improved method and apparatus for producing large monolithic concrete structures that is less expensive, more rapid, and safer than prior art methods and apparatus.

SUMMARY OF THE INVENTION

In accordance with a principle of this invention the steps of the method include: placing a plurality of permanent prebraced form sections with respect to an enclosure having an open top; aligning the form sections with the sides of the enclosure and locking them to form a perimeter between the form sections and the sides; filling open spaces in the walls in the inside form; anchoring the inside form; pouring concrete between the inside form and the sides of the enclosure to form walls; disconnecting the plurality of form sections; and, removing the plurality of form sections.

In accordance with another principle of this invention the method also includes the step of: raising the inside form to bring the top of the inside form to a level position.

In accordance with a further aspect of this invention the method, where applicable, can include the step of placing a coping form around the top of the inside form.

In accordance with yet another principle of this invention the method can include the step of pouring concrete into the walled enclosure, after the inside form has been removed, to form a bottom.

It will be appreciated that the invention is an uncomplicated method of forming large monolithic constructions such as swimming pools, basements or other walled structures. In below-the-ground applications the enclosure with the open top is preferably an excavation in the earth. Hence, the method of the invention simply requires lowering a plurality of permanently prebraced form sections into the excavation, placing them in an open position, locking them together, filling open spaces between them and anchoring them to the excavation. Thereafter, concrete is poured between the sides of the excavation and the inside form to create walls. Finally, the inside form is closed for removal and concrete is poured to form the bottom of the pool or basement.

In accordance with yet another principle of this invention an apparatus suitable for use in carrying out the method of the invention is provided. The apparatus comprises a plurality of permanently prebraced form sections adapted to be locked or clamped together to create an inside form. Each permanently prebraced form section comprises at least one wall having horizontal and vertical, or the like, bracing members on one side. Central braces are connected to the horizontal and vertical wall braces by triangular braces, or the like. The central braces of each section are clampable to the central braces of other sections in spaced, but fixed, relationship so that a composite inside form is created. Filler means are provided for filling open spaces between the walls of the form sections so that a continuous outside face is provided.

In accordance with a further principle of this invention anchor means are provided for anchoring the composite inside form to the bottom of the enclosure. And, leveling means are provided for leveling the inside form.

In accordance with a still further aspect of this invention, when used for swimming pools, a coping form is mounted on the top of the walls so that a coping can be created around the edge of the pool.

It will be appreciated that the apparatus of the invention is equally as uncomplicated as the method. A plurality of form sections are provided which are suitable for placement so as to be surrounded by an excavation or enclosure. Means are provided for locking the sections in fixed, spaced relationship to create a composite inner form that is aligned with the walls of the enclosure. Open spaces between the walls of the composite form are filled by suitable means. And, if desired, means are provided for leveling the form sections. Preferably, the form walls and braces are made of steel structural material that are welded together.

From the foregoing summary description of the invention, it will be appreciated that the method and apparatus of the invention overcome the prior art disadvantages heretofore discussed. Specifically, the cost of the structure is greatly reduced because the permanently prebraced form sections can be moved to the site and placed in the enclosure cheaper and easier than either laying a network of reinforcing rods and covering them with concrete (Gunite method); or constructing and bracing individual forms at the site. In addition, because in the preferred method concrete is poured between the walls of the excavation or enclosure and the walls of the form, they can be made thick. Hence, the structure will not "pop" from the ground as do Gunite pools, for example. Further, because the form sections are permanently prebraced, they can be minutely inspected for faults. Hence, the danger of form braces rupturing to cause personal injury and property damage is greatly reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing objects and many of the attendant advantages of this invention will become more readily appreciated as the same become better understood by reference to the following detailed description when taken in conjunction with the accompanying drawings wherein:

FIG.1 is a pictorial diagram illustrating one embodi-

ment of the composite inside form apparatus of the invention;

FIG. 2 is a pictorial diagram illustrating the structure of one of the form sections making up the composite inside form illustrated in FIG. 1;

FIG. 3 is a cross-sectional diagram of a clamp suitable for holding the form sections fixedly together, but in spaced relationship;

FIG. 4 is a cross-sectional diagram of a filler plate suitable for filling the open spaces between the walls of the form sections;

FIG. 5 is a cross-sectional diagram illustrating the mounting of a back side coping form on top of a wall of a section; and

FIGS. 6–8 are pictorial diagrams illustrating alternative embodiments of the apparatus of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following description of the preferred embodiments of the invention is drawn in a swimming pool environment. That is, the invention is described as a method and apparatus for forming a swimming pool. However, it will be appreciated by those skilled in the art and others that the inventive method and apparatus can be utilized in other environments to form concrete structures such as large concrete basements, tanks, or walls, for example.

So that the invention can be better understood, the apparatus of the invention will be first described. Thereafter, the method using that apparatus will be described, however, as the description provides, it will be understood that other apparatus other than that specifically described herein, can be used to perform the method.

FIG. 1 illustrates the embodiment of a composite inside form, made in accordance with the invention, suitable for use in casting a swimming pool. For clarity, only a portion of the bracing structure is illustrated. A more complete illustration of the bracing structure is shown in FIG. 2 and hereinafter described.

The inside form illustrated in FIG. 1 comprises four form sections **11**, **13**, **15** and **17**. The first and second sections **11** and **13** are mirror images of each other. Similarly, the third and fourth sections **15** and **17** are mirror images of each other. The pool to be cast using the inside form of FIG. 1 has a deep end and a shallow end. The first and second sections **11** and **13** define the deep end of the pool and the third and fourth sections **15** and **17** define the shallow end. In addition, the first and second sections **11** and **13** define an included portion that connects the deep end to the shallow end.

Each section of the inside form illustrated in FIG. 1 defines a right angle corner; however, it will be appreciated that these corners could be of different shapes if desired. That is, the corners could be round or triangular, for example.

Each section of the pool includes an end wall **18** and a side wall **20** joined together to form the right angle corner. Preferably, each wall is formed of a sheet of iron or steel, however, other materials such as wood can be used. Each wall is outlined by upper reinforcing members **19** and lower reinforcing members **22** located on the inside of the wall. In addition, vertical reinforcing members **21** are located at predetermined intervals along the inside length of the wall. One vertical member is located at the outer edge of each side and end wall, and a vertical member is located at the junction between the side and end wall of each section.

Projecting inwardly from the lower corner of the outer edge of each side wall **20**, in a direction parallel to the related end wall, is a center end brace **23**. Similarly, projecting inwardly from the lower corner of the outer edge of each end wall, in a direction parallel to the related side wall, is a center side brace **25**. In the third and fourth form sections **15** and **17** the inwardly projecting center end and center side braces **23** and **25** meet at right angle corners. However, because of the inclined portion, additional center braces are necessary in the first and second sections **11** and **13**. That is, so that the center side brace is parallel to the inclined bottom of the side wall **20**, a center inclined brace **27** connecting the center end brace **23** and the center side brace **25** is provided. The axis of the center inclined brace **27** is coincident with the axis of the center side brace **25** but upwardly inclined so that the center inclined brace **27** and the center end brace **23** meet at a right angle corner.

In addition to the foregoing reinforcing members and center braces, triangular braces are also included in each section of the composite form. Each triangular brace includes: a lower brace **29**; an upper brace **31**; and, if desired, a middle brace **33**. As illustrated in FIG. 1 and more fully described hereinafter with respect to FIG. 2, each triangular brace projects inwardly from one of the vertical reinforcing members **21** to the center side braces **25** or the center inclined brace **27**. In fact, the vertical reinforcing members **21** form one side of the triangle of the triangular braces. Preferably, the triangular braces intersect both the walls and the center braces at right angles.

The four form sections **11**, **13**, **15** and **17** of the composite inside form illustrated in FIG. 1 are separated by a plurality of open spacing clamps **35**. The preferred form of the open spacing clamps **35** are illustrated in FIG. 3 and hereinafter described. The clamps **35** are mounted between: the center end braces **23** of the first and third form sections **11** and **15**, the center end braces **23** of the second and fourth form section **13** and **17**; the center side braces **25** of the first and second sections **11** and **13**; the center side braces **25** of the third and fourth sections **15** and **17**; and, the center inclined braces **27** of the first and second sections **11** and **13**.

The open spacing clamps **35** maintain the sections in fixed, but spaced relationship. And, because the clamps maintain the sections separated, an open space is created in both the composite side walls and the composite end walls. Each of these open spaces is filled with a filler plate **37** mounted as illustrated in FIG. 4 and hereinafter described.

It will be appreciated from the foregoing description of FIG. 1, that the apparatus of the invention provides an uncomplicated means for creating a composite inside form suitable for forming the inside of a swimming pool, for example. The composite form comprises four permanently, prebraced form sections which can be separatedly lowered or placed with respect to a pool excavation or enclosure. The sections are separated but firmly locked together by open spacing clamps. And, filler plates are included to fill open spaces in the walls of the form. Preferably, the walls of the sections are formed of sheet iron or steel. Also, preferably, the reinforcing members and braces of steel have a U-shaped cross-sectional configuration. However, steel members with any regular configuration, such as I, H, L, T, or Box can also be used.

FIG. 2 illustrates in detail one of the form sections of the composite inside form illustrated in FIG. 1; the section illustrated in FIG. 2 comprises: an end wall **18**, a side wall **20**; upper reinforcing members **19**; vertical reinforcing members **21**; lower reinforcing members **22**; a center end brace **23**; a center side brace **25**; and a plurality of triangular braces including lower **29** and upper **31** braces.

As illustrated in FIG. 2, a triangular brace projects inwardly from each of the side and the outsidemost end wall vertical reinforcing members **21**. If desired, a triangular brace could extend inwardly from the corner member and each end wall vertical reinforcing member. In addition, middle triangular braces **33** as illustrated in FIG. 1 could be included. Each triangular brace forms a right triangle. The right triangle is formed by the lower brace **29**; the upper brace **31**; and one of the ver-

tical reinforcing members **21**. The right angle is formed by the intersection of the lower brace and the vertical reinforcing member. For the triangular braces extending inwardly from the side wall, the upper brace and the lower brace intersect at the center side brace. For the triangular brace extending inwardly from the endmost vertical member of the end wall, the lower braces intersect at the center side brace.

It will be appreciated from the previous description and a viewing of FIG. 2 that the invention contemplates inside form sections that are strongly braced. The entire structure illustrated in FIG. 2 is permanently prefabricated and transported to the construction site by a flat bed truck, for example. Preferably, all of the reinforcing members are welded to the walls; and, the braces are welded to the reinforcing members and together to form the resultant structure as illustrated in FIG. 2. However, while welding is preferred, the walls' reinforcing members and braces can be attached in other manners such as by bolting or riveting, for example.

Also illustrated in FIG. 2 are a plurality of leveling jacks adapted to bring each form section to grade prior to attaching the form sections together with the open spacing clamps. Each jack includes a threaded shaft **41** that passes through a vertically tapped element (not shown) welded to one of the lower members or braces. The shaft **41** projects downwardly through the element. A cone shaped end **45**, suitable for pressing against the bottom of an enclosure, is attached to the lower end of the shaft. And, a handle **47** is attached to the upper end of the shaft so that the shaft can be turned through the element thereby raising and lowering the form section when the cone shaped end presses against the bottom of an enclosure or excavation. It will be appreciated that other types of jacks, such as hydraulic, can be used in place of the screw jack illustrated in FIG. 2.

In addition to the foregoing elements, each lower member or brace includes a plurality of apertures **49** formed so as to allow anchor stakes or pins to pass through the apertures into the bottom of the excavation. Hence, after the form sections are positioned and attached together, and after the sections have been raised to grade, the sections can be anchored in place.

FIG. 3 is a cross-sectional diagram of an open space clamp **35** maintaining two center end braces **23** in fixed spaced relationship. The open space clamp comprises: upper and lower wide base flanged plates **51** and **53**; and, upper and lower channels **55** and **57**. As viewed in FIG. 3, the flanges on the upper plate **51** extend downwardly and the flanges on the lower plate **53** extend upwardly. The upper channel **55** has its base attached to the inside of the upper plate **51** so that its flanges also extend downwardly, and are parallel to the flanges of the upper plate. Any suitable means such as welding, riveting, or bolting, can be used to attach the channel to the plate. Similarly, the lower channel **57** has its base attached to the lower plate **53** so that its flanges extend upwardly and are parallel to the flanges of the lower plate. The channels are attached to the plates such that when the upper plate and channel faces the lower plate and channel in the manner illustrated in FIG. 3, three side-by-side box-shaped sections are formed between the various flanges. Each center end brace **23** fits inside of one of the outer two of the three boxes. A pin **59** welded to the lower channel **57** at approximately the center of the channel extends upwardly from the lower channel through corresponding apertures in the upper channel and plate.

The pin **59** has an aperture **60** extending through its longitudinal axis to hold a wedge **61**. The aperture **60** is oval-shaped and, when the pin **59** extends through the aperture in the upper channel and plate and is held by the wedge, the wedge presses the upper channel and plate toward the lower channel and plate. In this manner the center end braces **23** are fixedly retained in spaced relationship. In a similar manner similarly formed open space clamps hold the center side braces **25** and the center inclined braces **27** in fixed, spaced relation.

It will be appreciated from the foregoing description of the open space clamp illustrated in FIG. 3 that the invention contemplates a rather uncomplicated apparatus for locking the form sections together to form a composite inside form. All that is necessary is that the form sections be placed in position and the clamp placed about the center end and side braces in the manner illustrated. The form sections are then locked in place by simply driving a wedge **61** into an aperture in each clamp pin **59**. This method of locking presses the upper and lower plates **51** and **53** against the end and side braces. Lateral movement of the braces is prevented by the flanges of the plates and the flanges of the channels.

FIG. 4 is a cross-sectional diagram that illustrates the mounting of the filler panel **37** in the wall open space created when the form sections are held in place by the clamps. The filler panel **37** comprises: a panel **71**; a pair of U-shaped or other shaped reinforcing members **73**; and connecting pins **75**. Preferably, the panel is a sheet of iron or steel that is the thickness of the side and end walls and is the width of the space. The U-shaped reinforcing members are vertically mounted on the inside of the panel **71**. And, the pins **75** pass through apertures in the U-shaped members **73** at right angles to the longitudinal axis of the U-shaped members. The pins **75** also pass through apertures in the wall's vertical reinforcing members that are adjacent to the open space. Preferably, the panel pins **75** are similar to the clamp pins **59** so that wedges can be passed through apertures in the pins to hold them in place at one end while a head **77** holds the pin in place at the other end.

The foregoing description has described the apparatus of the invention; the following description will describe a preferred method of the invention, the first step of which is to form an open top enclosure. Preferably, the enclosure is an excavation, however, it could be an above-ground enclosure. After the enclosure is formed, permanently, prebraced form sections are lowered into the enclosure and aligned with the sides of the enclosure. Of course, in above-ground applications the enclosure can be erected after the prebraced forms are placed. Thereafter, the form sections are locked together by open space clamps, for example, and open spaces in the walls are filled. At this point a perimeter is formed between the composite form and the sides of the enclosure. Concrete is poured into this perimeter to form walls.

If desired, the method can include the step of lowering or raisnig the forms to grade prior to pouring the concrete. In addition, the method can include the step of anchoring the forms to the bottom of the enclosure.

After the concrete is poured, the filler plates are removed and the open space clamps are removed. The forms are then moved inwardly away from the newly formed concrete walls. Thereafter, the forms are raised from the enclosure. Finally, if desired, concrete is poured into the walled enclosure to form a bottom.

It will be appreciated therefore, that the method of the invention is an uncomplicated procedure for forming large monolithic concrete walled structures. The method merely includes the steps of: preparing an enclosure; placing forms in a predetermined spaced-apart relationship; locking them in place; filling the spaces between the forms; raising forms to appropriate grade level (if desired); anchoring forms (if desired); pouring concrete; removing the fillers; moving the forms together in the center of the enclosure; removing forms; and, if desired, pournig more concrete to form a floor. Because the method of the invention is much less complicated than prior art methods of making concrete structures wherein it was required to build individual forms on the site, it is less expensive. Individual inner and outer walls do not have to be constructed at the site. Nor does the structure have to be braced at the site. Moreover, there is no requirement that

inner and outer walls be tied together. The permanently, prebraced form structures eliminate these steps. The invention is also cheaper because permanently, prebraced forms can be utilized over and over without deterioration. Moreover, the invention is less dangerous because the forms can be initially inspected with care to determine if they have any faults. Periodic inspections may also be performed. However, time consuming inspections of walls and bracing at each construction site is not required.

The method of the invention is also less complicated and therefore less expensive than the Gunite method. Specifically, the method of this invention does not require the transportation and use of expensive, sophisticated equipment. Rather this invention merely requires the transportation and placement of permanently, prebraced forms.

FIG. 5 is a partial cross-sectional design illustrating how the walls of the form sections can be modified to provide a suitable overhanging coping around the top of a pool, if desired. An inner coping form **81** having a triangle cross-section, is placed along the top of the walls of the form sections. A vertical bracing member **83** extends upwardly from the inside of the form wall and is attached to a horizontal bracing member **85** that extends outwardly from the form. An outer coping form **87** is attached beneath the horizontal bracing member **85** to shape the outside of the coping. In this manner, a back side wall coping form is included.

FIG. 5 also illustrates in cross-section the concrete wall enclosure formed between the wall of the form and the earth with the coping forming the top of the concrete wall. It will be appreciated that because the form sections are moved inwardly during removal, the overhanging coping illustrated in FIG. 5 does not prevent form section removal.

Another feature is also illustrated in FIG. 5; specifically, an inwardly extending tooth receptable **89** is illustrated at the lower portion of the concrete wall. The tooth receptable **89** interlocks with a tooth in the floor when a floor is poured to aid in forming a composite structure. It will be appreciated that the tooth receptable **89** illustrated in FIG. 5 is merely exemplary. That is, the tooth and receptacle can take many forms, for example, the tooth can extend from the wall into the bottom rather than extend out from the bottom into the wall.

FIGS. 6, 7, and 8 illustrate alternative embodiments of the apparatus of the invention. More specifically, FIGS. 6, 7 and 8 illustrate different overall configurations and different form section configurations, however, the basic structure of the permanently, prebraced form sections is the same as that illustrated in FIGS. 1 and 2. The configuration illustrated in FIG. 6 is kidney shaped and comprises four sections; the configuration illustrated in FIG. 7 is quarter-circle shaped and comprises four sections; and, the configuration illustrated in FIG. 8 is Z-shaped and comprises five sections. In this respect, it should be noted that the "center-pole-linkage" systems (such as are descibed in U.S. Pats. 2,807,071 and 3,355,897) are not suited for use in connection with pools of this shape.

The embodiments of the invention illustrated in FIGS. 6, 7, and 8 illustrate that the invention can take many forms and that the invention can comprise other than four sections. It will be appreciated that FIGS. 6, 7, and 8 are merely exemplary; that is, other configurations and other numbers of form sections fall within the scope of the invention.

It will be appreciated from the foregoing that the invention provides a rather uncomplicated method and apparatus for forming large monolithic poured concrete structures. The method merely requires: excavating or otherwise forming an enclosure; placing form sections with respect to the enclosure; locking the form sections in a predetermined spaced relationship; filling the spaces between the walls of the form; raising the composite form to a desired level; anchoring the composite form, pouring the concrete; removing the filling; removing the locking structure; and, removing the form sections.

The apparatus is equally uncomplicated. Relatively large form sections, suitable for easy transportation by truck and easy placement by crane or the like, are provided. The form sections are permanently prebraced elements that when fitted together in an enclosure define a wall perimeter. Because they are permanently prebraced, the form sections are not assembled and disassembled at each site. The side walls of the sections may be formed of steel plate and the bracing for the walls may be formed of any regular cross-section steel bracing components. The braces may be riveted, welded or bolted in place. The bracing is mounted so that the lower portion of the form walls have more support than the upper portion of the form walls because when concrete is poured between the wall of the form sections and the sides of the enclosure, the greatest force is against the lower portion of the walls.

Uncomplicated clamps for locking the form sections in fixed but spaced relationship are provided. The means for filling the spaces between the walls of the forms is also uncomplicated. The form sections can be raised to grade by merely adjusting screw jacks. And, the form sections are anchored in place by simply driving anchor pins or stakes into the ground. Hence, the basic apparatus is uncomplicated.

If desired, a coping around the edge of a pool can be provided by mounting a coping form atop the form walls. Because the forms are moved inwardly after the concrete is formed, an overhanging coping can be provided. In addition, the invention provides an interlocking tooth at the lower periphery of the concrete bottom so that the bottom will interlock with the walls to form a composite structure.

It will be appreciated that various changes can be made within the scope of this invention. For example, the coping can have a different configuration. In addition, the location of the tooth at the lower end of the wall can be different than specifically illustrated in FIG. 5. Moreover, the bracing illustrated in FIG. 2 can be varied. And, as illustrated in FIGS. 6, 7, and 8, the configuration of the overall structure and the number of form sections can vary. Hence, the invention can be practiced otherwise than as specifically described herein.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method of forming a concrete structure inside of a walled enclosure comprising the steps of:

placing a plurality of permanently prebraced forms with respect to said enclosure so that the walls of said form sections are substantially parallel to the enclosure walls and so that braces of said form sections extend between the form walls and center brace members located toward the center of said enclosure;

aligning said form sections in a predetermined, spaced relationship;

locking said form sections together in said predetermined relationship by locking selected center brace members together;

inserting filler panels in the open spaces between said form sections; and,

pouring concrete between the walls of said enclosure and the walls of said form sections.

2. The method of claim **1** wherein said prebraced form sections are lowered into said enclosure.

3. The method of claim **1** including the step of excavating to form said walled enclosure and wherein said prebraced form sections are lowered into said enclosure.

4. The method of claim **3** including the step of:

raising said form sections to the grade of said excavation; and,

anchoring said form sections to the bottom of said excavation.

5. The method of claim **3** including the step of mount-

ing a coping around the top of said plurality of permanently prebraced form sections.

6. The method of claim 1 including the step of:

removing said filler panels after said concrete has been poured, and unlocking the selected center brace members holding said form sections in said predetermined, spaced relationship;

moving said form sections away from the walls created after said concrete is poured; and,

lifting said plurality of permanently prebraced form sections from said enclosure.

7. The method of claim 6 wherein the placement of said form sections with respect to said enclosure comprises the step of lowering said form sections into said enclosure.

8. The method of claim 7 including the step of excavating to form said walled enclosure.

9. The method of claim 8 including the steps of:

raising said form sections to the grade of said excavation; and,

anchoring said form sections to the bottom of said excavation.

10. The method of claim 8 including the step of mounting a coping around the top of said plurality of permanently prebraced form sections.

11. The method of claim 6 including the step of pouring concrete between the thusly poured walls after removal of said form sections to form a bottom.

12. The method of claim 11 wherein the placement of said form sections with respect to said enclosure comprises the step of lowering said form sections into said enclosure.

13. The method of claim 12 including the step of excavating to form said walled enclosure.

14. The method of claim 13 including the steps of:

raising said form sections to the grade of said excavation; and,

anchoring said form sections to the bottom of said excavation.

15. The method of claim 13 including the step of mounting a coping around the top of said plurality of permanently prebraced form sections.

16. The method of claim 1 wherein said permanently prebraced form sections are lowered into said enclosure and including the step of mounting a coping around the top of said plurality of permanently prebraced form section.

17. The method of claim 16 including the step of pouring concrete between the thusly poured walls after removal of said form sections to form a bottom.

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HENRY C. SUTHERLAND, Primary Examiner

S. D. BURKE, Assistant Examiner

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