

Jan. 10, 1961

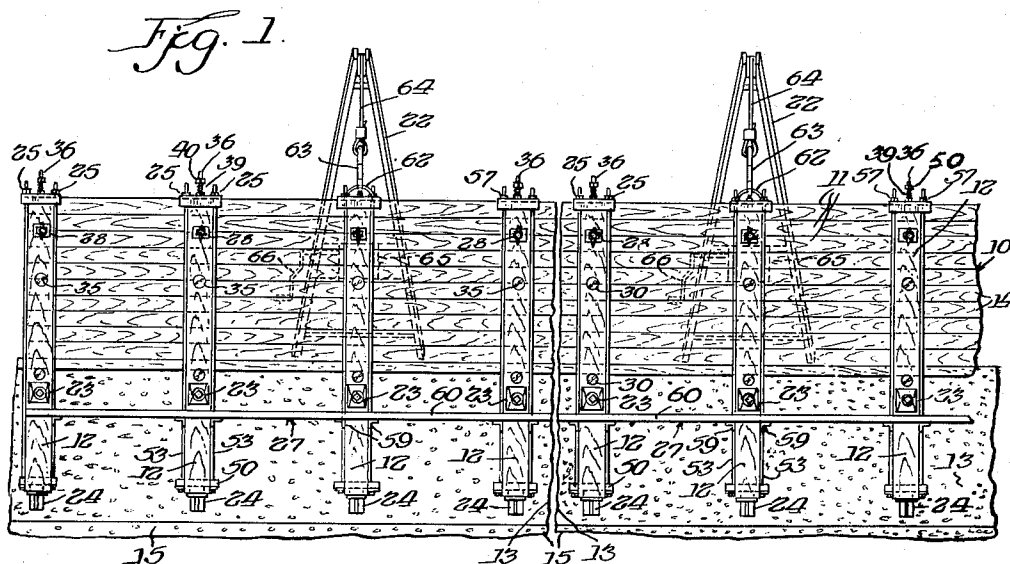
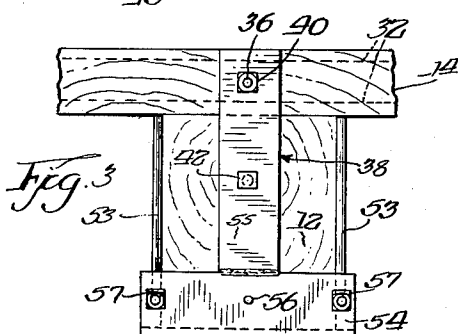
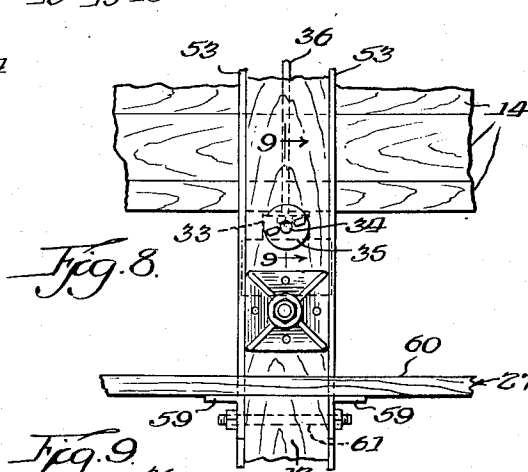
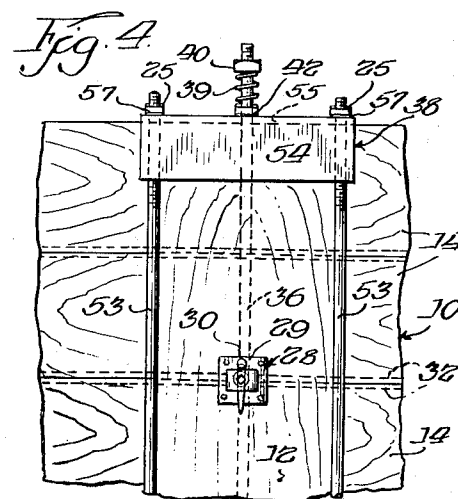
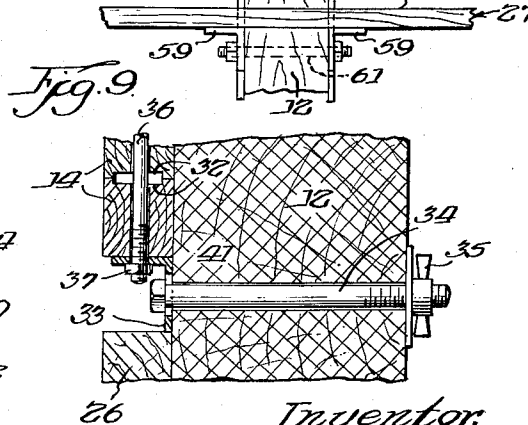
C. I. WILLIAMS

2,967,343

CANTILEVER FORM

Filed Dec. 2, 1952

2 Sheets-Sheet 1



Inventor:
Chester I. Williams.
By: *Stee & Stee* Attys

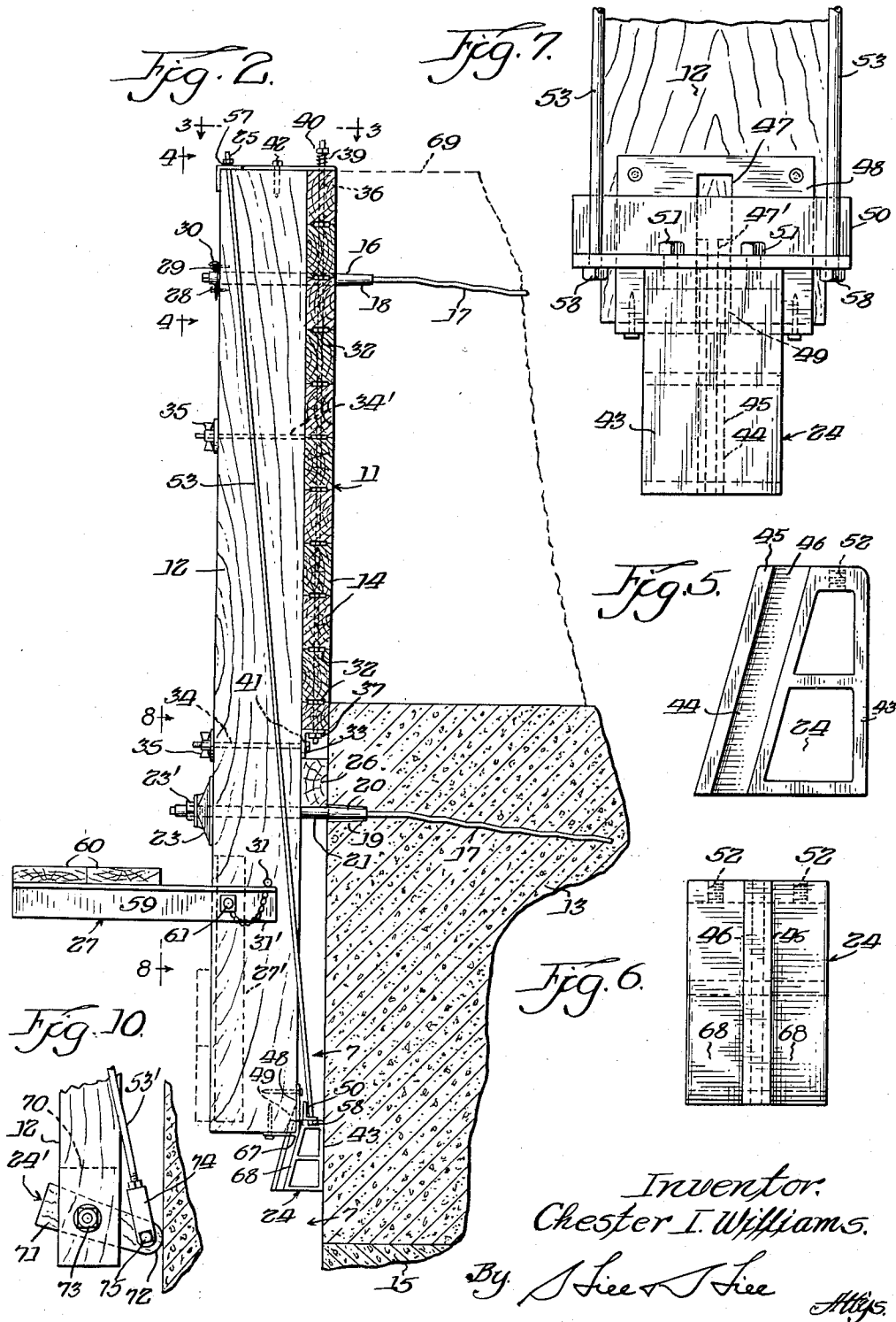
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1

2,967,343

CANTILEVER FORM

Chester I. Williams, 1501 Madison Ave. SE.,
Grand Rapids, Mich.

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13 Claims. (Cl. 25—131)

This invention relates to concrete forms, and more particularly to an apparatus for tying and alignment of cantilever forms in a minimum time.

This invention is an improvement of my co-pending applications Serial No. 233,853, filed June 27, 1951 to Apparatus for Handling Forms, now Patent No. 2,825,115, granted March 4, 1958; and Serial No. 233,851, filed June 27, 1951 for Dummy She-Bolts, now Patent No. 2,823,441, granted February 18, 1958.

Prior to my invention, concrete forms, after each pour, were raised with a derrick crane, such as disclosed in the above-mentioned applications, and then held in place until the forms were point located and affixed in position for pouring the next lift of concrete. With the method of my earlier U.S. Patent 2,825,115, the forms were aligned using a leveling jack positioned at the bottom of each strong-back. With this method of leveling, it was necessary to have workers adjusting the leveling jacks at the bottom of the form, and also to have men to determine whether the form was being aligned properly.

It is therefore a principal object of my invention to provide an improved and simplified form construction wherein the form may be aligned from the top, where it is most convenient to have the adjustment, especially when the form is set to a chalk line. In accordance with this improvement, one man may complete the alignment himself, whereas in other prior methods, there is usually required one man to do the measuring at the top of the form, and one man at the bottom to adjust a form leveling jack of one form or another.

Another object of the invention is to provide an improved board construction for the sheathing of a concrete form in which the opposite edges of the boards are grooved so that the normal expansion and contraction of the boards forming the sheathing from being wet and dry will not buckle the boards.

Still another object of the invention is to provide means for placing the boards forming the sheathing of a form under a predetermined compression.

It is also an object of the invention to provide a form constructed in accordance with the above objects with the improved form of dummy she-bolt construction as disclosed and claimed in my U.S. Patent 2,823,441, which will permit the ready removal of the she-bolt from the anchoring means, and the raising of the forms, after which an ordinary she-bolt may be attached to the anchoring means, and the forms leveled in accordance with the procedure of this invention for the next pouring, in combination with a simple portable lifting or hoisting mechanism, which may be positioned adjacent the face of the concrete being poured for lifting the form while the dummy she-bolts are being removed and replaced by ordinary she-bolts.

Another object of this invention is to adapt the improved form of this construction for use with portable lifting means in combination with anchoring means which may be precast in the concrete to provide an anchor for the lifting means.

2

Another object of the invention is to provide adjusting means operatively connected to the strong-backs of the form wherein the form may be leveled at the top of the form.

5 Still a further object of this invention is to provide a simple means for erecting concrete forms, and the alignment thereof for pouring successive vertical lifts of large blocks of concrete, such as used for massive dam construction.

10 In order to accomplish the above objects of my invention, I have provided a simple form construction which is adapted for use with dummy she-bolts and ordinary she-bolts, together with an improved form of leveling jack for affixing and adjusting the same to the face of the block being poured. I have also provided an improved form of sheathing construction for a concrete form in which the boards forming the sheathing are edge grooved so that the normal expansion and contraction of the boards from being wet and dry will not buckle the sheathing, and will keep the edges of the boards from opening up. In this improved form construction, the sheathing boards are bolted together rather than nailed. The improved form construction of this invention is adapted to be relocated for pouring successive lifts, together with simple form handling carrying or lifting means which are portable, and may readily be carried from one position to another by the erectors on the job for raising the forms and holding them in position while the forms are secured in erected position and affixed to the face of the block being supported. This improved form is likewise equally adapted for use with a simple form of anchoring means for anchoring the portable lifting means in position for raising or lowering the forms, after which the anchoring means may be left within the concrete as the next successive layer or lift is poured.

In order to erect this improved form of cantilever type of form to the face of a block being poured, I prefer to use the dummy she-bolt construction, together with the ordinary she-bolt which replaces the dummy she-bolt for affixing the form to the face of the block being poured, and which is particularly adaptable for the erection of the cantilever type of form. This particular form of construction is disclosed and claimed in the above-mentioned, co-pending applications.

Many other objects and advantages of the construction herein shown and described will be obvious to those skilled in the art from the disclosure herein given.

To this end, my invention consists in the novel construction, arrangement, and combination of parts herein shown and described, and more particularly pointed out in the claims.

In the drawings, wherein like reference characters represent like or corresponding parts:

Fig. 1 is a view in front elevation illustrating the use of the improved cantilever form of my invention with form handling devices, and with the form supported in raised position for aligning and affixing the form in its next successive position prior to the removal of the form handling devices;

Fig. 2 is a vertical, sectional view in side elevation illustrating the erection of the cantilever form of Fig. 1, illustrating the improved leveling means for aligning the form in conjunction with the improved dummy she-bolt and anchoring means for securing the form in position;

Fig. 3 is a plan view taken along line 3—3 of Fig. 2, illustrating the means for adjusting the leveling means mounted at the upper end of a strong-back of the form;

Fig. 4 is an enlarged view in side elevation taken along line 4—4 of Fig. 2, illustrating the adjusting means for the leveling means of the form, and the means for affixing the boards forming the sheathing together;

Fig. 5 is a view in side elevation of the wedge-shaped leveling means to be operatively connected between the bottom of a strong-back of the form and the face of the poured lift;

Fig. 6 is a view in front elevation of the leveling means of Fig. 5;

Fig. 7 is a view in elevation, taken along line 7—7 of Fig. 2, illustrating the leveling means adjustably mounted at the bottom of the strong-back of the form;

Fig. 8 is an enlarged view illustrating the mounting of the scaffolding on a strong-back of the form, taken along line 8—8 of Fig. 2, together with the clamp bracket for the dummy she-bolt construction and the clamping means for the support of the form boards;

Fig. 9 is a view, partly in section, taken along line 9—9 of Fig. 8 looking in the direction of the arrows illustrating the mounting for the boards of the form; and

Fig. 10 is a view, in side elevation, of a modified form of leveling means from that of Fig. 1.

Referring now to the drawings, particularly Figs. 1 and 2, there will be described the method of erecting the improved cantilever type form of this invention, and the apparatus used in conjunction therewith, together with the means for anchoring the form in its adjusted position. A cantilever type concrete form construction 10, including sheathing 11 and strong-backs 12, shown as being erected on the peripheral faces of a concrete block construction 13 such as is used in dam construction. For an ordinary concrete form construction where large lifts of concrete are being cast, the strong-backs may be eight inches by eight inches or twelve inches by twelve inches, and the sheathing is made up of three inch by six inch board members 14, and the sheathing or form facing may even be made up of a member four inches in thickness. The relative lengths of these cantilever type forms as they are erected may range from twenty five feet to fifty feet in length, and may even extend to seventy five feet. The spacing between strong-backs varies from five feet six inches, and usually is six feet. The lengths of the lifts poured, and with which these forms are adapted for use, may extend as long as three hundred feet. The particular method of erecting the forms as illustrated in Figs. 1 and 2 has been illustrated to show the form handling device used in conjunction therewith, and the particular form with which this invention is being described is substantially seventy five feet in length, and this may be raised with three of the form handling devices, although for the purpose of illustration, only two have been shown. In this particular form, there are fifteen strong-backs, and these are shown in Fig. 1 with two of the lifts placed from each end, and one in the middle of the form. These form handling devices, which are particularly disclosed and claimed in the aforementioned U. S. Patent 2,825,115, are adapted for raising the forms when pouring successive lifts or layers one upon the other. The forms may be usually erected in the ordinary manner, starting from bedrock, and pigtailed or tie rods may be anchored in place in the bedrock to which the forms are mounted and the necessary bracing applied for erecting the form for the first pouring.

Fig. 1, for example, illustrates the invention in which the concrete form 10 is illustrated after the first pour 15 has been poured and set, followed by the second pour, also permitted to set, and the form lifted to the position shown. Prior to this, the dummy she-bolt 16, as illustrated in Fig. 2, was set in the form so that its tapered end extends through the form to the position shown, and to which a pigtail anchoring means 17 is complementally threaded into the corresponding threaded portion of the dummy she-bolt. The tapered end 18 of the dummy she-bolt 16, after it was removed from the concrete, left a tapered opening 19 in the concrete slab which was later cemented. This tapered opening 19 permits the insertion of the tapered end 20 of an ordinary tapered she-bolt

construction 21 as the relative taper of the dummy she-bolt is greater than that of the ordinary she-bolt. This provides for the easy insertion of the regular she-bolt so that it may be attached to the threaded end of the pigtail anchor 17, which has been cast in place with the threaded end extending into the large, tapered opening 19 left by the removal of the ordinary she-bolt. The particular form of the dummy she-bolt construction is disclosed and claimed in the aforementioned U. S. Patent 2,823,441, and need not be further described in the connection with the method of the erection of this application.

The concrete form 10 is then raised by hoisting means 22 from its lowered position in which the lift 13 was poured, to its present position as shown in Fig. 1, and while suspended in this position, the regular she-bolts 21 are placed through the concrete form in the same holes provided through the strong-backs 12 for insertion of the dummy she-bolts 16. The regular she-bolt 21 is affixed to the threaded end of the pigtail anchor 17 by attaching a wrench to the squared end of the she-bolt and firmly threading the she-bolt in position on the threaded end of the anchoring means 17. The bracket 23 and adjusting nut 23' are then threaded upon the she-bolt, clamping the form against the face of the cast block 13, after which the double-headed nails may be driven through holes (not shown) provided in the bracket 23 to affix the bracket in position upon the strong-back of the form.

In the preferred form of my invention, I have provided adjusting means 24 (Fig. 2) which are placed between the rear of each strong-back and the contiguous poured lift for aligning the form to a predetermined set line, and which is an improvement over the conventional form of adjusting or lifting jack disclosed in the aforementioned U. S. Patent 2,825,115. This same construction of the regular she-bolt and adjusting means 24 is provided at frequent intervals across the width of the form, as shown in Fig. 1, and provides the support for the form when erected in place and the concrete is poured against the form. The forms are leveled by adjusting the adjusting means 24 vertically with respect to the bottom corner edge of the strong-back and its contiguous lift from the top of the form by adjusting means 25 mounted at the upper end of each strong-back to which the aligning means 24 is mounted. A block 26 is placed above the she-bolt 21 between the rear face of the strong back and the form, and serves as a fulcrum about which the form is pivoted by the movement of the aligning or adjusting means 24 as it is vertically adjusted up or down until the top edge of the form is aligned to the set line, which has been adjusted and leveled for aligning the form. After making the necessary adjustments so that the form is correctly aligned, the adjusting nut 23' is firmly secured to take the thrust of the concrete when poured against the form.

With the usual she-bolt construction and anchoring means, the pigtail thereof will develop approximately a thirty five thousand pound pull in each anchor under test, whereas the actual load is usually approximately one-half, so that there is always a sufficient factor of safety. In a form construction erected in the manner described, it is possible to work along the sides of the form, preparing the surface of the concrete for the next pour with a great deal of freedom, since by using this type of form construction, it is not necessary to place the anchoring means 17 for the next pour until just ahead of the pouring operation. With the anchoring means 17 out of the way, it is also much easier to adjust the form from the top thereof in accordance with the improved aligning means of this invention. This has been made possible by the dummy she-bolt construction of the aforementioned invention of my U.S. Patent 2,823,441, and utilized in connection with the disclosure of the method of erecting forms of this invention. Since vertical spacing for the location of the

5

she-bolt has been predetermined during fabrication of the forms, all that is necessary is for the dummy she-bolts 16 to be set in the form, as illustrated in Figs. 1 and 2. The she-bolt 16 may have the pigtail anchor 17 attached thereto for erecting, and the she-bolt and pigtail anchor inserted through holes previously drilled in the form, or the dummy she-bolt may be erected from the outside of the form from the scaffolding 27, and the pigtail anchor 17 mounted thereon from the inside face of the form.

A support bracket 28 for mounting the dummy she-bolt 16 is shown mounted contiguous to the opening through the form, and is also nailed in position by double-headed nails (not shown). The bracket 28 has an arcuate, struck-out portion which provides an opening for the dummy she-bolt 16 as the bracket 28 abuts the face of the strong back 12. The arcuate, struck-out portion 29 is also provided with an opening for the passage therethrough of the dummy she-bolt 16. The dummy she-bolt is held in position with respect to the bracket 28 by a pin 30 inserted through a complementally formed hole in the dummy she-bolt. The pin 30 is preferably pointed at one end for use in removal of the pin from the she-bolt. The she-bolt 16 is provided at its outer end with a squared end for rotating the she-bolt for detachably connecting it to the pigtail anchoring means 17 by the complementally formed threaded portions thereof. The particular construction of the dummy she-bolt is disclosed and claimed in the aforesaid co-pending application, and has been disclosed herein in connection with the improved form construction of this invention, together with the method of erecting and aligning concrete forms using a simple A-frame type of form handling device 22, and the alignment means 24. There is also illustrated in connection with the form, a simple scaffolding construction 27 for erecting and removing the she-bolts. The scaffolding shown may be pivoted downwardly along the face of the string-backs to its dotted position 27' by the removal of a pin 31. The details of the scaffolding will be described along with the improved form construction. Any other simple form of scaffolding may be used if it is found necessary to provide a support for the workers in erecting the forms, especially for positioning the she-bolts. The scaffolding is not necessarily used for aligning the form as it is customary with the improved form of aligning means to align the form by standing on the previously poured lift, with or without a suitable ladder, depending upon the height of the erector, to actuate the adjusting means 25 of the aligning means. However, it is possible to adjust the forms by standing on the scaffolding.

Referring to Figs. 1 and 2, the novel features of the improved concrete form construction incorporating the aligning means 24 will be described. Prior to my invention, the sheathing or boards 14, which may be three inches by six inches or even larger, were usually nailed to the strong backs. It has been found that this method of erecting forms although satisfactory, permits the edges of the boards forming the facing to warp, causing ridges to be formed in the poured lift because of the tendency of the boards to warp as they go through cycles of from wet to dry as the concrete is poured thereagainst, and the form stripped after the concrete has been set becoming dry as they are erected in position prior to the pouring of the next lift. To overcome this objection, the edges of each of the boards are grooved longitudinally, as at 32, to prevent this warping. Instead of nailing this improved form of facing to the strong-backs 12, an angle bracket 33 is mounted on the strong-back by a through-bolt 34 extending through the bracket, and the strong-back being secured in place by a wing-nut form of bracket 35 affixed to the complementally threaded end of the through-bolt 34. It is preferred to place the wooden block 26 below the lower edge of the bracket 33, as shown in Fig. 2. The block 26 serves to act as a fulcrum, as previously described. The facing 14 is then assembled across the

6

strong-backs, as shown in Fig. 1, and a tie rod 36 located at each strong-back 12 extends through the facing and is affixed at one end to the bracket 33 by suitable securing means, as the nut 37. The upper end of the tie-rod extends through a T-shaped member 38, Fig. 3, and is secured by a compression spring 39 and a nut 40. It is within the scope of the invention that the assembled facing may be assembled without the compression spring 39, but this construction permits the expansion of the facing when wet due to any swelling of the boards, and this expansion is taken up by a slotted hole 41 in the bracket 33 through which the through-bolt 34 extends. To prevent any bowing of the facing, the facing may be secured intermediate its ends by one or more through-bolts 34', Fig. 2, extending through the facing and through the strong-back 12, being similarly secured by a wing-nut bracket 35 as the through-bolt 34 for affixing the bracket 33. Although it is preferred to use a tie-rod extending through the facing and located at each strong-back, it is to be understood that it is within the scope of the invention that additional tie-rods may be positioned intermediate the strong-backs, as desired. The T-shaped bracket 38 is affixed to the top of the strong-back by a lag screw 42.

As an indication of the sizes to which these forms may be constructed, the present form is made to a length of approximately seventy five feet, and the strong-backs 12 are spaced on five foot four inch centers, with the end strong-backs spaced on five foot six inch centers. The overall height of the strong back is approximately nine feet, and the height of the facing is approximately five feet three inches to the top from the bracket 33. Forms of this type are utilized for pouring lifts approximately three hundred feet long, and it has been found that a seventy five foot concrete form of this invention may be lifted readily with three of the A-frame type hoists 22, as shown in Fig. 1.

Holes for the she-bolts 16 and 21 are drilled in the strong-backs so that they are placed approximately one foot below the top of the pour lifts, as shown in Fig. 2. The diameter of the she-bolts is substantially one and three-eighth inches, and the pigtails to which they are attached are approximately three-fourth inch diameter rods, thirty inches in length. However, the length of the pigtails may be longer, especially for winter pouring of the low compression concrete with which this cantilever type of form is adapted.

The improved aligning means with which I prefer to align this type of cantilever form comprises an alignment shoe or aligning means 24, as illustrated in Figs. 1, 2, 5, 6 and 7. The shoe 24 is wedge-shaped in construction, having a face 43 adapted to abut the front face of the previously poured lift contiguous to the bottom edge of the strong-back 12. It is preferred to reinforce the shoe by suitable ribs, as shown in Figs. 5 and 6, and to have the front edge of the shoe formed with a T-shaped portion 44 having a head portion 45 and a flange portion 46. The T-shaped portion 44 is complementally formed to a slot 47 formed in an angle-shaped member 48 affixed to the front, bottom edge of the strong-back, as shown in Figs. 2 and 7, by securely nailing the member in place. The corner of the strong back is complementally grooved at 49 to the L-shaped slot 47 so that the head of the flange 45 will slide through the slot 47, and the flange 46 will slide through the smaller slot portion 47' of the bracket 48. With the slot constructed in this manner, the shoe 24 may slide therein for vertical movement of the shoe to align the form.

The shoe or aligning means 24 is provided with an angle-shaped member 50 which is affixed to the upper edge of the shoe by securing means 51 complementally threaded within the threaded holes 52 of the shoe. In order to adjust the alignment shoe 24 with respect to the face of the lift and the lower edge of the strong-back

to which it is operatively mounted, the adjusting means 25 is formed by tie rods 53 mounted on opposite sides of the strong-back, Figs. 1, 2, 3, 4 and 7, which extend upwardly and are affixed at their upper ends to the T-portion 54 of the T-shaped member 38. The T-portion 54 preferably comprises a three-eighth inch by three inch by three inch angle affixed to the stem portion 55 by welding, or other suitable means. If it is desired, the member 54 may also be secured with a suitable lag screw extending through a hole 56. The upper threaded ends of the tie-rods 53 extend through the T-portion 54, as shown in Figs. 2 and 3, and are secured in their adjusted position by the nuts 57. The bottom ends of the tie rods 53 may be formed with a suitable head 58, as shown in Fig. 7, for engaging the angle-shaped member 50. It is to be understood that, if desired, the heads 58 may be replaced by suitably threading the ends of the tie rods, and affixing the nuts thereto, as is well understood in the art.

The scaffolding 27 is mounted by angle-arm brackets 59 pivoted to opposite sides of the strong-back to which they are pivoted, and are adapted to support the plank 60 forming the scaffolding. The scaffolding is pivotally mounted on the through-bolt 61, and is held in its horizontal position by the dowel pin 31, which is attached by a chain 31' to the through-bolt 61 to prevent its loss. Upon removal of the dowel pins from the strong backs, the scaffolding may be lowered to its storage position 27', with the planking 60 abutting the front face of the strong back. The scaffolding may be erected so as to extend as one scaffolding across the entire face of the form, or it may be fabricated in sections to simplify the erection and dismantling thereof. It is preferred to locate the scaffolding as shown so that the she-bolts may be erected from the front face of the form structure and it is also possible to adjust the scaffolding for aligning the form from the front of the form structure. Usually, it is preferred to align the form with the erector working from the inside face of the form on the previously cast lift.

In order to attach the forms to the A-frame hoist 22 for raising the forms from the previously poured lift to the next raised position for the pouring of a successive lift. U-shaped hanger brackets 62 may be affixed to certain of the strong-backs, as shown in Fig. 1, or, for convenience, the hanger brackets may be mounted on each of the strong-backs so that wherever it is necessary to use a hoist for assisting in the raising or leveling of the form, the hoist may be readily attached. The hoist 22 is provided with a lifting hook 63 to receive the hanger bracket, and the hook is attached to a lifting cable 64, and the cable is raised and lowered through the hoisting mechanism 65 which is actuated by a crank handle 66, and the hoisting mechanism is adapted to be held in its adjusted position by a suitable mechanism (not shown). It is preferred to use a hoisting mechanism such as disclosed and claimed in my U.S. Patent 2,825,115.

In the adjustment of the cantilever type of concrete form construction of this invention, in order to adjust the form to a predetermined set-line, the line is usually strung and leveled, and the form is adjusted to this set-line, depending upon the contour of the completed pour. For the purpose of illustration, a form has been illustrated for erecting lifts in which the face is substantially vertical, although it is to be understood that the form construction of this invention may be used for fabricating forms of many contours. After the form has been raised to the position shown in Fig. 1, and the regular she-bolts 21 have been erected in place of the dummy she-bolts 16, as shown in Fig. 2, and the form secured in its raised position, it is preferred to keep the hoist in position until the final adjustments are made, as it may be necessary to adjust the form slightly vertically in one direction or the other for practical purposes. As the form is prefabricated for a predetermined height of

pour, it is only necessary to raise the forms to the desired height, and secure the she-bolts to the precast pigtail anchoring means 17, as shown. It is then only necessary to adjust the edge of the form to the set-line to obtain the necessary adjustment. This is accomplished by applying a suitable wrench to the adjusting nut 57 at the top of each tie rod 53 for the respective strong-back, Figs. 1, 2 and 4. As the nut is adjusted one way or another, the tie rods 53, which are attached to the alignment shoe 24, raise and lower the alignment shoe, and as the lower corner edge 67 abuts the wedge-shaped faces 68 of the alignment shoe, a tilting action about the fulcrum 26 is permitted in either direction, depending upon whether the alignment shoe is raised or lowered along the face of the previously poured lift. It is quite obvious that with this alignment means, it is possible for a single worker to adjust and align the form, whereas with the usual form constructions using the leveling jack, it is necessary to have a worker on the outside of the form, as well as one on the inside to properly adjust and align the form.

With the form in the raised position shown in Figs. 1 and 2, and after the form has been aligned as described by the adjustment thereof with the alignment means, the hoists may be detached from the hanger brackets 62 by rotating them rearwardly to permit detachment of a hook from its anchoring means, which is not shown, but which is clearly disclosed and claimed in the aforesaid co-pending application. The form handling device may then be stored to one side, or carried to the next location where a similar form is to be raised in order to use a minimum number of form handling devices to raise the forms, for example, in casting a large concrete block as used in dam or other massive concrete work. Also a sufficient number for all of the forms may be used without the need of transporting them from one position to another, but positioned or stored adjacent the forms which are to be raised by this simple type of form handling device in conjunction with this improved cantilever type form of construction.

Although the form handling devices 22 have been described as being hand operated by using the crank handle 66 for actuating the lifting winch 65, it is possible to have each of the hoists power driven, such as by a portable air motor, if such a source of power is available, or to suitable electric motors connected to the shaft for actuating the hoist so that, if desired, each of the hoists connected to a particular form may be simultaneously actuated to evenly lift the form from its lowermost position simultaneously actuated to evenly lift the form from its lowermost position to its next successive position after the poured concrete of this lift has become set. It is also within the scope of this invention that the adjusting means 25 may be operated through power driven wrenches for adjusting the alignment shoe.

After the forms have been raised for pouring the next lift, adjusted and aligned in position by relatively aligning the form with respect to the face of the previously poured lift, for example, in pouring a huge block for concrete dam work, or other massive concrete construction, the surface of the lift is suitably cleaned, and the form handling device moved to one side, after which the dummy she-bolts 16 and pigtail anchor 17, or other suitable anchoring means, may be mounted at the upper end of the form, as shown in Figs. 1 and 2. The concrete is then poured to a predetermined level, as indicated by the pouring line 69. With this particular improved cantilever form construction, the dummy she-bolt construction permits the erection of the pigtail type of anchoring means just ahead of the pouring with the form of she-bolt construction of the co-pending application. It is thus possible to pour a greater amount of concrete than has heretofore been possible, at reduced labor cost because of the improvement in lifting and using a simple, portable form handling device, and the improved align-

ing means allows the forms to be easily erected and leveled.

After the poured layer of concrete has set for the required period, the dummy she-bolts are then removed by unscrewing from the threaded end of the anchoring means 17, which is indicated as being cast in the lift 13. The brackets 28, which were previously located in the position of the brackets 23 of Fig. 2 are then detached, and the she-bolt 16, bracket 28, and pin 30 are reassembled together to prevent misplacement of parts so that they may be readily assembled when the next layer is poured after the forms have been raised and re-leveled as illustrated in Fig. 2. This has been previously described with respect to the raising of the form for the casting of the lift 13 to the position in Fig. 2 for the casting of the next successive lift to the pour line 69. Removal of the dummy she-bolt with its enlarged, tapered end provides an enlarged, tapered opening 19, as described above, so that an ordinary she-bolt 21 may then be assembled in the opening left by the dummy she-bolt, and threaded on to the threaded end of the anchoring means 18 left by the removal of the dummy she-bolt, as illustrated in Fig. 2. The ordinary she-bolt is then assembled and affixed as described above, and the forms aligned by the alignment means 24 and 25. However, prior to the setting of the concrete, the anchoring means used in conjunction with the hoisting means 22 have been set in place in the concrete and arranged for the later erection of these form handling devices 22.

In the embodiment shown in Fig. 10, another aligning means 24' is illustrated for leveling a concrete form from the top of the cast concrete lift. This aligning means 24' may be readily fabricated, as the form is being built from materials at hand, when necessary, if castings of the embodiment of Figs. 5 and 6 are not readily available. This embodiment is provided by slotting the lower end of the strong-back 12' at 70 to receive a pivoted block 71 of hardwood which is provided with a curved surface 72 to engage the front face of the block 13 similarly as the face 43 of the embodiment of Figs. 5 and 6. Tie rods 53' for pivoting the block 71 about its axis which is formed by a securing means such as a through bolt 73 extend through the strong-back 12' and the block 71. Each of the rods may be affixed to a suitable clevis member 74 assembled to a bolt or pin 75. In adjusting the leveling means 24', the procedure is similar to that previously described and is adjusted by the adjusting nut 57 of the adjusting means 25. This adjustment rotates the member 71 causing the upper edge of the form to be moved about the fulcrum block 26 whereas in the previous embodiment, the vertical movement of the shoe 24 provides for this adjustment. The positioning and adjustment of the forms with the hoists and detachment of the hoists is also similar to that described with reference to Figs. 1 and 2.

Although there has been described a particular size of concrete form, and a particular form handling device for lifting the forms together with embodiments of an improved alignment means for the forms, the forms may be of any desired length and height, and likewise, the form handling device may be so constructed as to manipulate the particular form to which it is used, and may take any other conventional form of lifting means which is capable of being used with massive concrete construction. The forms constructed in this manner are adapted to be dismantled and used repeatedly for the pouring of concrete, and the pivoted scaffolding permits the planking thereof to be nested against the face of the strong-backs to minimize the space required by the form until it is used again, and permits the forms to be easily stacked one against another. The forms are likewise adapted to be used repeatedly for pouring the concrete, or for the construction of vertical or battered walls, and likewise, the form handling devices are equally adapted for any type of wall. Similarly, the dummy she-bolts, as well as

the ordinary she-bolts and anchoring means may be adapted for use with this improved construction.

It is also obvious that the alignment means and adjustment means thereof may remain assembled to the respective strong-back of the form construction in its dismantled condition, and when again used, may be readily adjusted for the adjustment of the form in the alignment thereof with a previously poured lift.

Likewise, the improved form construction in which the boards forming the facing are grooved permits the normal expansion and contraction of the boards from their wet and dry condition, so that the sheathing will not buckle, and the edges of the boards forming the sheathing will be prevented from opening up. The improved construction also permits the clamping of the boards together if any shrinkage occurs, and likewise, if any swelling takes place by the absorption of moisture from the poured concrete, suitable expansion is provided to prevent any buckling of the sheathing, and any misalignment because of this buckling.

It is further obvious that there has been disclosed a simple and inexpensive concrete form construction which is readily adapted for use with conventional concrete form hardware, and equally adapted for use with simple form handling devices and anchoring devices, as disclosed in my U.S. Patent 2,825,115 for the rapid erection of concrete forms as the concrete is being poured.

The improved concrete form construction and adjusting and alignment means therefore work equally well on vertical or battered walls, or for erection of the forms directly to a rock foundation.

It is also obvious that there has been disclosed an improved method of construction and alignment of cantilever type forms for forming huge blocks of concrete such as are poured on massive concrete constructions today where a slow setting, low compression concrete has been heretofore very difficult to use.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence, I do not wish to be understood as limiting myself to the exact form, construction, arrangement, and combination of parts herein shown and described, or uses mentioned.

What I claim as new and desire to secure by Letters Patent is:

1. The combination with studding for a concrete form, of sheathing adapted to be affixed to the studding; said sheathing comprising a series of vertically tiered and horizontally extending abutting boards, the horizontal opposite edges of each of the contiguously abutting boards being longitudinally grooved, whereby the normal expansion and contraction of the boards, from being wet to dry, will prevent the sheathing from buckling and the edges of the boards from opening up, and securing means extending transversely through the boards forming the sheathing and intermediate the opposite faces of the sheathing and transverse to the grooved edges for affixing the boards together preventing the opening of the joint between contiguous boards formed by the contiguous edges.

2. The combination with studding for a concrete form, of sheathing adapted to be affixed to the studding, said sheathing comprising a series of vertically tiered and horizontally extending abutting boards, the edges of contiguously abutting and horizontally extending boards being longitudinally grooved, whereby the normal expansion and contraction of the boards from being wet to dry, will prevent the sheathing from buckling and the edges of the boards from opening up, and resilient means extending through the boards and intermediate the opposite faces of the boards forming the sheathing and transverse to the grooved edges for affixing the boards together preventing the opening of the joint between contiguous boards formed by the abutting edges.

3. The combination with studding for a concrete form, of sheathing adapted to be affixed to the studding, said sheathing comprising a series of vertically tiered and horizontally extending abutting boards, the horizontally extending edges of contiguously abutting boards being longitudinally grooved, whereby the normal expansion and contraction of the boards, from being wet to dry, will prevent the sheathing from buckling and the edges of the boards from opening up, and a plurality of securing means extending transversely through the boards and intermediate the opposite faces of the boards forming the sheathing and transverse to the grooved edges for affixing the boards together preventing the opening of the joint between contiguous boards formed by the contiguous edges.

4. The combination with studding for a concrete form, of sheathing formed from a series of vertically tiered and horizontally extending abutting boards and adapted to be affixed to the studding, means for supporting and affixing the sheathing to the studding comprising lower support means affixed to the studding and adapted to be affixed to the lowermost board of the sheathing and upper support means affixed contiguous to the upper end of the studding and adapted to be affixed to the uppermost board of the sheathing, and securing means affixed to the means for supporting and affixing the sheathing to the studding and extending transversely through the boards and intermediate the opposite faces of the boards forming the sheathing for affixing the boards together and to the studding, whereby the joints between contiguous boards of the sheathing are prevented from opening.

5. The combination with studding for a concrete form, of sheathing formed from a series of vertically abutting boards and adapted to be affixed to the studding, leveling means operatively mounted contiguous to the bottom of the studding and adapted to be adjusted relative to the studding from the upper end of the studding, means for supporting and affixing the sheathing to the studding, adjusting means extending from the top of the studding and operatively connected to the leveling means at the bottom of the studding for moving the leveling means with respect to the studding, and said adjusting means operatively connected to the means for supporting and affixing the sheathing, whereby said leveling means and said means for supporting and affixing the sheathing are adapted to be adjusted contiguous to the upper ends of the studding.

6. The combination with studding for a concrete form, of sheathing formed from a series of vertically abutting boards and adapted to be affixed to the studding, leveling means operatively mounted contiguous to the bottom of the studding and adapted to be adjusted relative to the studding from the upper end of the studding, means for supporting and affixing the sheathing to the studding comprising upper support means affixed contiguous to the upper end of the studding, adjusting means extending from the top of the studding and operatively connected to the leveling means at the bottom of the studding for moving the leveling means with respect to the studding, and said adjusting means operatively connected to the upper support means, whereby said leveling means and said means for supporting and affixing the sheathing are adapted to be adjusted contiguous to the upper ends of the studding.

7. The combination with studding for a concrete form, of sheathing formed from a series of vertically abutting boards and adapted to be affixed to the studding, means for supporting and affixing the sheathing to the studding comprising lower support means affixed to the studding and adapted to be affixed to the lowermost board of the sheathing and upper support means affixed contiguous to the upper end of the studding and adapted to be affixed to the stop of the studding and to the uppermost board of the sheathing, leveling means operatively mounted contiguous to the bottom of the studding and adapted to be adjusted relative to the studding from

the upper end of the studding, securing means operatively connected to the upper support means for supporting and affixing the sheathing to the studding, adjusting means extending from the top of the studding and operatively connected to the leveling means at the bottom of the studding and to the upper support means for moving the leveling means with respect to the studding, whereby said leveling means and said support means for supporting and affixing the sheathing are adapted to be adjusted contiguous to the upper ends of the studding.

8. The combination with a concrete form comprising studding and sheathing affixed to a lift of concrete, and anchoring means extending through the form for affixing the form to the aforesaid lift, of means for adjusting the form with respect to the face of the lift to which the form is applied, said means for adjusting comprising leveling means operatively mounted between the bottom of the studding and the face of the lift, adjusting means operatively connected to the leveling means and extending to the top of the studding, support means for the leveling means operatively mounted contiguous to the top of the studding, and said adjusting means operatively connected to the support means, whereby the leveling means is adjusted from the upper end of the studding.

9. The combination with a concrete form comprising studding and sheathing affixed to a lift of concrete, and anchoring means extending through the form for affixing the form to the aforesaid lift, of means for adjusting the form with respect to the face of the lift to which the form is applied, said means for adjusting comprising wedge-shaped leveling means operatively mounted between the bottom of the studding and the face of the lift, adjusting means operatively connected to the wedge-shaped leveling means and extending to the top of the studding, support means for the leveling means operatively mounted contiguous to the top of the studding, and said adjusting means operatively connected to the support means, whereby the wedge-shaped leveling means is adjusted from the upper end of the studding.

10. The combination with a concrete form comprising studding and sheathing affixed to a lift of concrete, and anchoring means extending through the form for affixing the form to the aforesaid lift, of means for adjusting the form with respect to the face of the lift to which the form is applied, said means for adjusting comprising pivotally mounted leveling means operatively mounted between the bottom of the studding and the face of the lift, adjusting means operatively connected to the pivotally mounted leveling means and extending to the top of the studding, support means for the leveling means operatively mounted contiguous to the top of the studding, and said adjusting means operatively connected to the support means, whereby the pivotally mounted leveling means is adjusted from the upper end of the studding.

11. A concrete form construction including studding and sheathing therefor for forming successive lifts of concrete, detachable means for affixing the concrete form construction to supporting means for mounting and positioning the concrete form construction, complementally formed means on the concrete form construction for detachably connecting the concrete form construction to a lifting means of a means for raising and lowering the concrete form construction, said means for raising and lowering the concrete form construction being adapted to be supported on a previously poured lift and contiguous to the concrete form construction, said lifting means thereof adapted for moving the concrete form construction to its next successive position so that the concrete form construction is affixed in its elevated position by the aforesaid detachable means, said concrete form construction also including aligning means operatively mounted contiguous to the bottom edge of the studding for adjusting the concrete form construction to a pre-

13

determined line with respect to the previously poured lift, said aligning means comprising a wedge-shaped shoe, an inclined face thereof operatively engaging the bottom edge of the studding and another face thereof operatively engaging the face of the previously poured lift, said aligning means comprising substantially vertically extending adjusting means operatively mounted contiguous to the top edge of the concrete form construction, said substantially vertically extending adjusting means operatively connected at the lower end thereof to the wedge-shaped shoe and adapted to be adjusted from the top of the form, after which the means for raising and lowering may be removed upon the concrete form being affixed in its adjusted position, and the concrete poured embedding certain of the aforesaid supporting means.

12. A concrete form construction including strong-backs and sheathing therefor for pouring successive lifts of concrete, detachable means for affixing the concrete form construction to supporting means for mounting and positioning the concrete form construction, a plurality of complementally formed means on the concrete form construction for detachably connecting the concrete form construction to lifting means of a plurality of means for raising and lowering the concrete form construction, said plurality of means for raising and lowering the concrete form construction adapted to be supported on a previously poured lift and contiguous to the concrete form construction as it is being raised and lowered and including means for anchoring the means for raising and lowering in said position contiguous to the concrete form construction to its next successive position so that the concrete form construction is affixed in its elevated position by the aforesaid detachable means, said concrete form construction also including aligning means operatively mounted contiguous to the bottom edge of each of the strong-backs and operatively connected to said strong-backs for aligning the concrete form construction to a predetermined level line with respect to the previously poured lift, and said aligning means comprising substantially vertically extending adjusting means extending from the bottom to the top of the concrete form construction and adapted to be adjusted from the top of the form.

14

13. A concrete form construction including studding and sheathing therefor for forming successive lifts of concrete, detachable means for affixing the concrete form construction to supporting means for mounting and positioning the concrete form construction, complementally formed means on the concrete form construction for detachably connecting the concrete form construction to a lifting means of a means for raising and lowering the concrete form construction, said means for raising and lowering the concrete form construction being adapted to be supported on a previously poured lift and contiguous to the concrete form construction as it is being raised and/or lowered, so that the concrete form construction is affixed in its elevated position by the aforesaid detachable means, said concrete form construction also including aligning means for adjusting the concrete form construction to a predetermined line with respect to the previous poured lift, said aligning means comprising an alignment shoe operatively positioned between the previously poured lift and one of the studding at the bottom edge of the studding, and adjusting means contiguous to the top of the aforementioned studding and extending to the alignment shoe for adjusting the alignment shoe from the top of the form.

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