Oct. 28, 1958 B. WILLIAMS 2,857,647

CONCRETE FORMS

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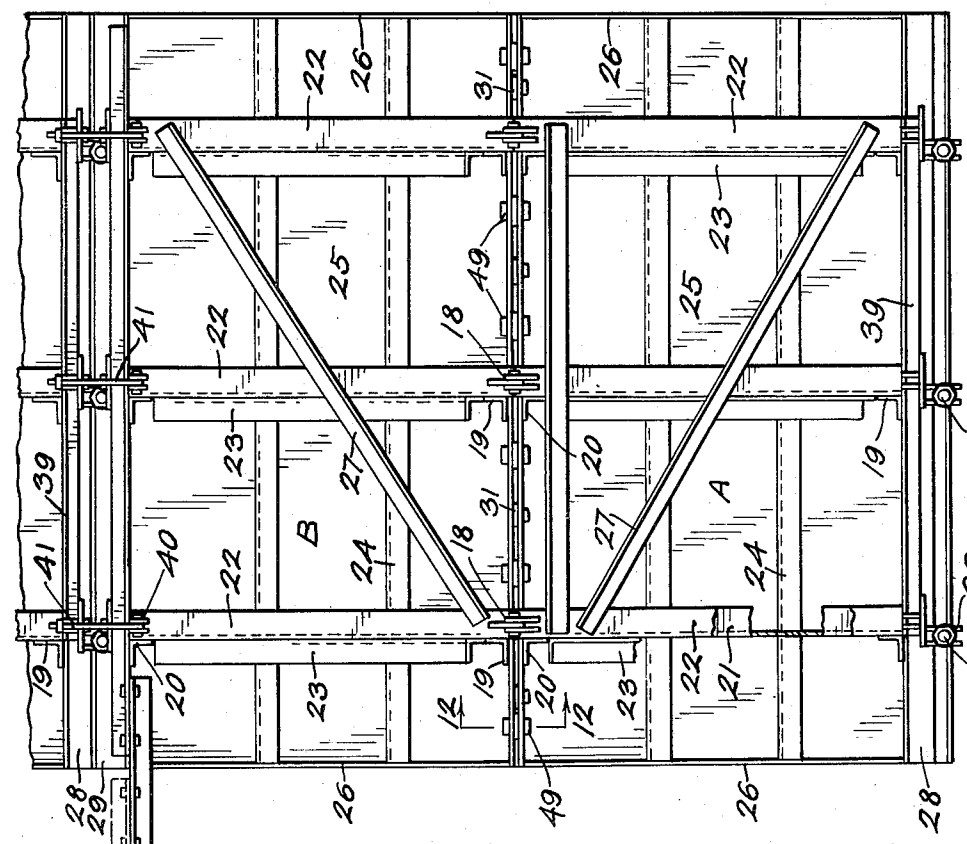

Fig. 2.

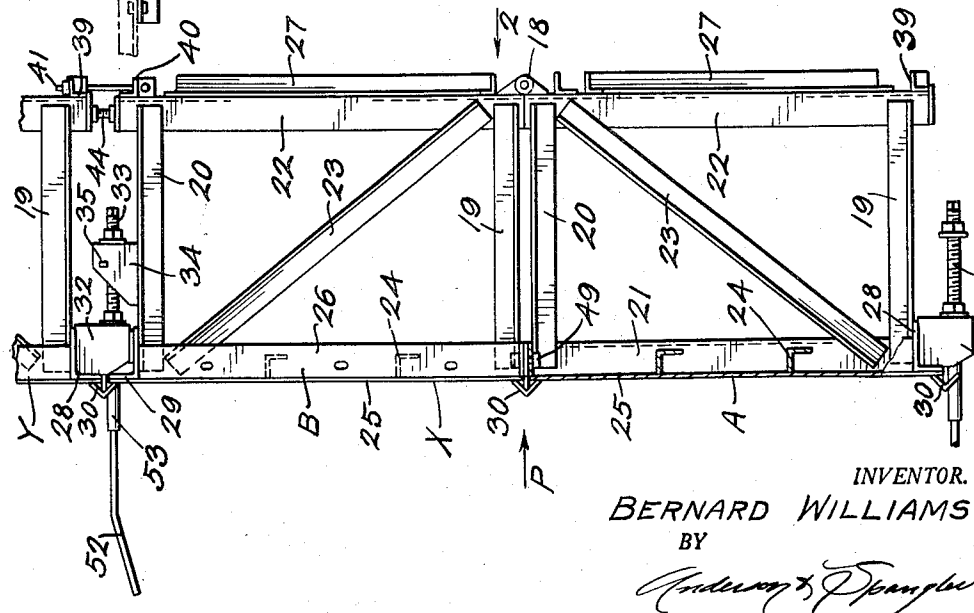

Fig. 1.

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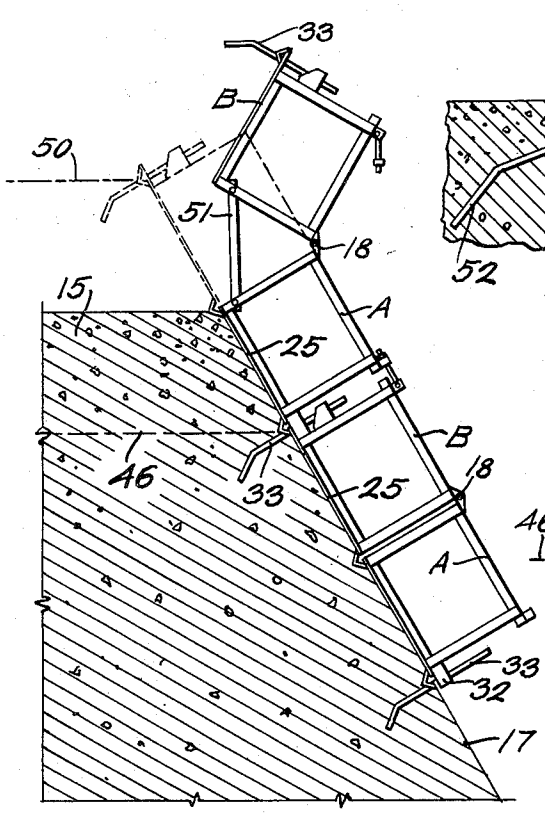

Fig. 4.

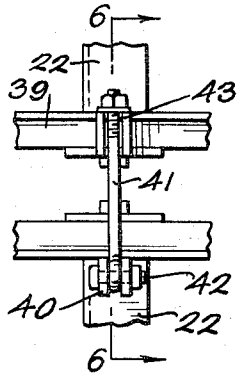

Fig. 5.

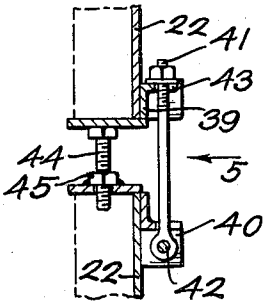

Fig. 6.

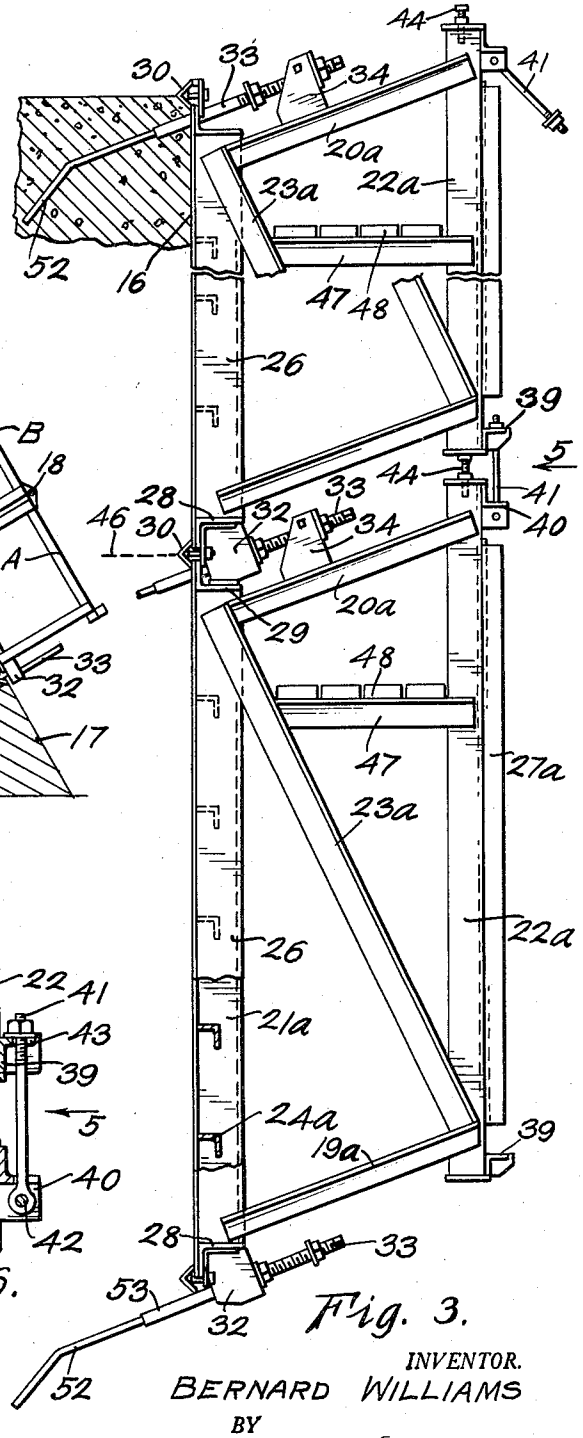

Fig. 3.

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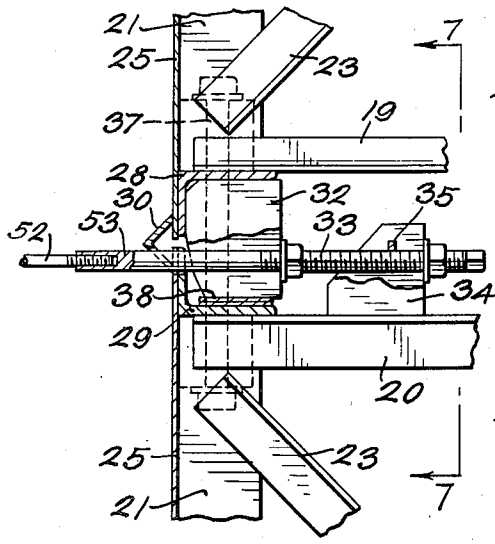

Fig. 8.

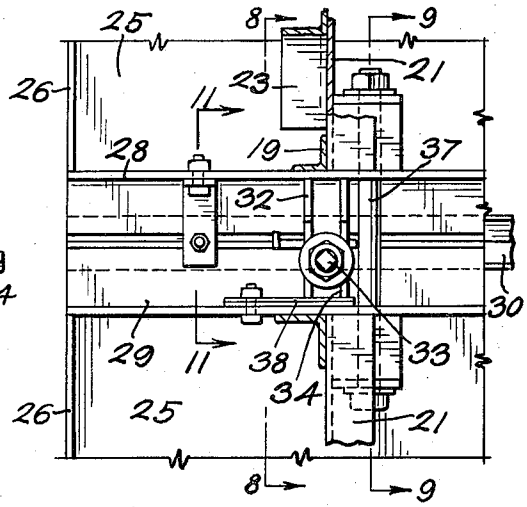

Fig. 7.

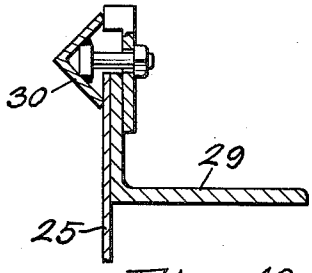

Fig. 10.

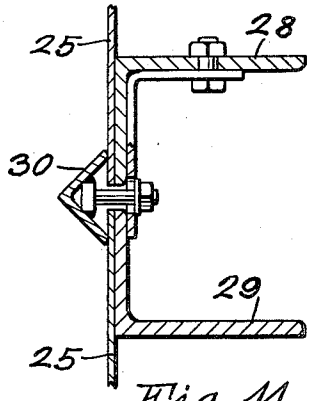

Fig. 11.

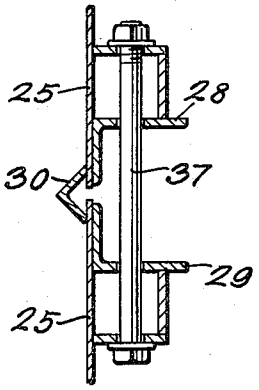

Fig. 9.

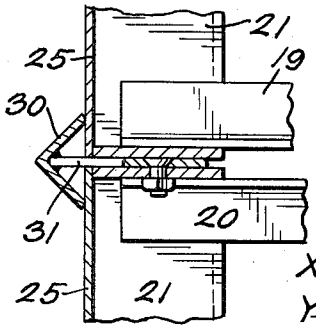

Fig. 12.

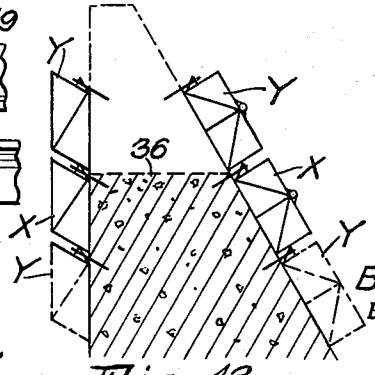

Fig. 13.

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CONCRETE FORMS

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Application December 1, 1955, Serial No. 550,260

4 Claims. (Cl. 25—131)

This invention relates to forms for the construction of large concrete masses, such as dams and the like, which are built in superposed layers.

Concrete dams for retaining large bodies of water for irrigation and for the generation of electricity are often of such great height and length that they must be built in separate layers superposed on each other and frequently each layer is built in sections. Forms for such large masses are constructed from panels or sections that are anchored to the solidified concrete and extend upwardly to the height of the next layer. Such forms are sometimes referred to as "cantilever forms" and one example thereof has been shown in U. S. Patent 2,649,643. Concrete in the flowable state in which it is poured into the forms exerts a powerful hydrostatic pressure which tends to move the forms outwardly and this pressure is measured when the concrete is subjected to mechanical vibration for increasing its compactness and density. It is, therefore, evident that forms of the type referred to must be so designed that they can withstand great pressures without undue flexure or distortion.

Accordingly, the principal object of the present invention is to provide a concrete form consisting of two superposed panels each including two superposed hinged sections, the lower panel being fixedly attached to the concrete in position to support the upper panel thereon and the upper panel providing the support for the lower panel when removed and arranged on top thereof.

Another object is to so design the form panels that they can be set in position with a minimum amount of labor and expense.

A further object is to produce a form that can be correctly aligned and which will retain its alignment during the concrete placement.

An additional object is to produce a form that can be set with less risk of injury to the workman and property than is usual in similar operations.

Having thus, in a general way, described the construction and some of the principal objects of the invention it will now be described in detail, for which purpose reference will be had to the accompanying drawings wherein the invention has been illustrated, and in which:

Figure 1 is an end elevational view of the panel shown in Figure 2;

Figure 2 is a front elevational view looking in the direction of arrow 2, Figure 1;

Figure 3 is an end elevational view, similar to the one shown in Figure 1, but showing a modification that better adapts the invention for use on the vertical side of a concrete mass;

Figure 4 is a side elevational view showing the manner in which the upper half of the top section employed on an inclined wall can be turned back to facilitate pouring the concrete;

Figure 5 is a fragmentary elevational view looking in the direction of arrow 5 in Figures 3 and 6;

Figure 6 is an elevational view, partly in section, taken on line 6—6 Figure 5;

Figure 7 is a fragmentary elevational view, looking through plane 7—7, Figure 8;

Figure 8 is a section taken on line 8—8 Figure 7;

Figure 9 is a section taken on line 9—9 Figure 7;

Figure 10 is a section through the uppermost chamfer strip shown at the extreme top of Figure 3;

Figure 11 shows a section taken at the point indicated by 11—11 in Figure 7;

Figure 12 is a section taken at the point indicated by 12*a* in Figure 1; and,

Figure 13 is a transverse diagrammatic section intended to facilitate the description.

Referring now to the drawing, reference numeral 15 designates a portion of a poured concrete dam which has a vertical up-stream side 16 and an inclined down-stream side 17. The forms shown on the drawing may be considered as positioned at some distance above the bottom of the dam in order to simplify the description. For reasons that will hereinafter be explained, the form units or panels used on the up-stream or vertical side (see Figure 3) are slightly different from those used on the inclined down-stream side (see Figures 1, 2 and 4) and the description will be directed principally to the latter. Each panel comprises two sections A and B (Figures 1 and 2) that are interconnected by hinges 18. Each section A and B consists of three frames including a bottom angle bar 19, a similar top bar 20, an inside frame member 21, and an outside frame member 22 secured against deformation by diagonal braces 23 which are inclined in opposite directions in the two sections to form with members 21 and the hinges 18 a truss for resisting forces acting in the direction of arrow P in Figure 1. A plurality of stiffener angles 24 (which are welded to frame members 21) extend horizontally and serve as supports for plate 25 which is usually 3/16" in thickness. The vertical edges of plates 25 are stiffened by flat steel bars 26. Each section is additionally strengthened by diagonal braces 27 the whole forming a strong and rigid panel assembly.

The three rectangular frames of Sections A and B above described are joined at their corresponding lower and upper ends by heavy angle bars 28 and 29. Sections A and B are joined by hinges 18, as above noted, and as shown in Figure 1. The corners, on the inside corresponding to the position of the hinges, are spaced by a chamfer strip assembly 30, like that shown in Figure 12. This assembly is formed from a 2 x 2 x 1/4 L having welded thereto a plate 31 that forms a bisector of the angle and extends outwardly into the space between the two sections where it is removably attached by a bolt.

The lower inside corners of the three frames of the lower section of each panel are provided with inverted U-shaped members 32 through which the anchor bolts 33 extend, as shown most clearly in Figures 3 and 8. Welded or otherwise secured to the top of the uppermost frame members 20 of each panel are upwardly opening U-shaped anchors 34 that receive the anchor bolts and extend above them as shown most clearly in Figure 8. The sides of anchors 34 are provided with holes 35 for the reception of a heavy spike or pin.

The anchor bolts have long threaded sections and two nuts that independently engage members 32 and 34, as shown most clearly in Figure 8. It will be seen from Figure 1 that each panel is anchored to the concrete mass by the lower anchor bolt and is releasably anchored at its upper end to the top anchor bolts by

means of the U-shaped member 34. After the concrete mass has reached line 36 (Figure 13), the lower panel, which has been shown dotted in that figure and designated as "panel Y," is released by removing the nuts shown at the lower end of section A in Figure 1, removing the spike or pin from opening 35, and removing the clamping bolt 37 (shown in Figures 7, 8 and 9). Panel Y can now be pried loose from the concrete mass and positioned on top of panel X which remains firmly anchored to the concrete mass by the lower and upper anchor bolts, the former of which cooperates with member 32 and the second mentioned with member 34. After panel Y has been transferred to the top of panel X, and positioned as shown in Figure 8, bolts 37 are positioned as shown in Figure 9 and if it is found to be necessary, shims 38 are positioned as shown in Figures 7 and 8, after which bolts 37 can be tightened.

It is now necessary to adjust the two panels for vertical alignment and for this purpose the following means have been provided which are shown in detail in Figures 5 and 6. A Z-bar 39 is attached to the lower outside corner of the panel frames and a cooperating bracket 40 is attached to the upper outer corners of the panel frames. An eye bolt 41 is attached to the bracket by means of pivot 42. The outwardly directed flange of the Z-bar is provided with a notch 43 for each bolt, as shown in Figures 5 and 6. An adjustment bolt cooperates with nut 45 that is welded to the top of the vertical frame members 22. The heads of the bolts form stops or supports for the lower outer corners of the section frame members. By turning bolt 44 the panels can be tilted about the inner corners and the plates 26 can, therefore, be angularly adjusted after which bolts 37 and 41 are tightened. Panel Y, which now projects above the top of the hardened concrete, is now in position to act as the outer form wall. Due to the thickness of the panel frames and their diagonal braces they resist powerful forces without appreciable flexing which assures that the surfaces of the concrete mass will have the desired inclination which is an important consideration where tall dams and other structures are built.

The chamfer strip 30 must be attached to the panels in several different manners depending on their location. The chamfer strip at the top of the upper panel is attached by means of a screw clamp arrangement as shown in Figure 10. It is important that the upper ends of the supporting or lower panel be anchored securely to the solidified concrete. Referring now to Figure 4, line 46 designates the top of the layer before the top panel has been put into position. It will be observed that the top anchor bolts are downwardly inclined relative to the top surface 46 and are, therefore, firmly anchored, especially since their inner ends are angled downwardly. The sections on the inclined sides can, therefore, have rectangular parallelogram shaped frames. From Figure 13 it will be seen that the up-stream surface of the dam is vertical and, if rectangular frames like those shown on the inclined side were used the upper anchor bolts would not be properly embedded in the concrete. It has been found that the panel frames for the vertical side must be rhomboidal, as shown in Figure 3. For reasons that will shortly appear, the frame panels need not be constructed of two hinged sections such as A and B of Figure 1.

Referring now to Figure 3, it will be seen that each panel is slightly shorter than the combined lengths of Sections A and B of Figure 1, since the latter correspond to the hypothenuse of a triangle while the panels on the vertical side correspond to the vertical side of a right angle triangle. For ease in comparison the corresponding frame members have been given the same reference numbers as those in Figure 1, but have the letter *a* added. In Figure 3 several transverse members 47 are provided to support a plank platform 48. It is evident from Figure 3 that the top of the upper panel will remain firmly anchored to the solidified concrete and that the lower panel can be shifted from the bottom to the top in the manner above described in connection with the panels on the inclined surface.

The reason for making the panels for the inclined or down-stream surface in two hingedly connected sections will now be explained, for which purpose reference will be had to Figure 4. Due to the fact that the inside surface of the panels are upwardly ranging in the direction of the up-stream side, the concrete must be vibrated or "spaded" to flow into the angle between the panel surface and the top of the lower layer. By hinging the top section B there is, first of all, more room for dumping the concrete and less thickness of concrete to vibrate than if the upper panel was straight and occupied the broken line position. This is a feature of considerable importance as it assures a more uniform density of the concrete due to the more thorough vibration or spading and speeds the operation. When the concrete reaches the top level shown in Figure 4, Section B is turned back to the broken line position and the opposed flanges of frame members 19 and 20 are firmly interconnected by bolts 49 as shown in Figure 12; whereupon the pouring of concrete continues up to the level indicated by broken line 50. Section B is held in tilted position by one or more bars 51. The anchor bolts are of well known construction and comprise two parts 52 and 53 that have a threaded connection so that part 53 can be removed for reuse.

The basic idea or gist of this invention resides in the fact that the form on each side of the concrete mass consists of two substantially identical forms composed of one or more panels, depending on the length of the mass to be cast at one time. After the concrete has set or hardened the lower form is removed and positioned on the top of the remaining form which serves as a base as above described.

Another feature of great importance is that the panels employed on the down-stream or sloping side are each formed in two sections of equal width hinged so that the upper half may be tilted outwardly to provide a wider space into which to pour the concrete and in which to work. Since the forms are made in two hinged sections they can be fitted for heights that are multiples of one half the width of the form panels. Attention is directed to the fact that the anchor bolts are operatively attached to each panel at its very top so as to offer the greatest possible resistance to the powerful cantilever forces developed during use.

What is claimed as new is:

1. In combination: at least two substantially identical concrete forms, each of said forms having at least one substantially flat and substantially rectangular panel, each of said panels having at least two frames projecting outwardly from one face thereof in horizontally spaced substantially parallel relation, the frames of any two forms arranged in superposed contacting relation cooperating to resist forces acting to tilt the panel of the upper form outwardly relative to the lower form panel, lower bracket means attached to at least two of the frames of each form along the lower inside edge thereof, upper bracket means attached to each form along the upper edge thereof spaced outwardly from the panel and positioned for alignment with one of the lower bracket means of a superposed form, and anchor means releasably attached within the lower and upper bracket means of at least one form in position to be cast into a concrete structure to support said form thereon, said anchor means attached within the upper bracket means of said form providing means for attaching the lower bracket means of a second form in superposed position on top of said first mentioned form, said second form providing a retaining wall

to contain a fresh pour of concrete and, after said fresh concrete has set, a support for said first-mentioned form when detached from said anchor means and placed in superposed relation on said second form.

2. A device in accordance with claim 1 in which the two superposed forms are releasably interconnected adjacent their adjoining outer edges by an adjustable connector operative to adjust the alignment of the panels.

3. A device in accordance with claim 1 in which each panel is divided into upper and lower panel sections, each frame is divided into upper and lower frame sections, the upper frame sections being attached to the upper panel sections and the lower frame sections to the lower panel sections, and hinge means interconnecting the upper and lower sections of the frames at the adjoining outside edges thereof.

4. A device in accordance with claim 1 wherein the

superposed forms are releasably interconnected adjacent their adjoining outer edges by an adjustable latch means which operatively interconnects the superposed forms and maintains said forms in adjusted relation.

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