C. BRYNOLDT.

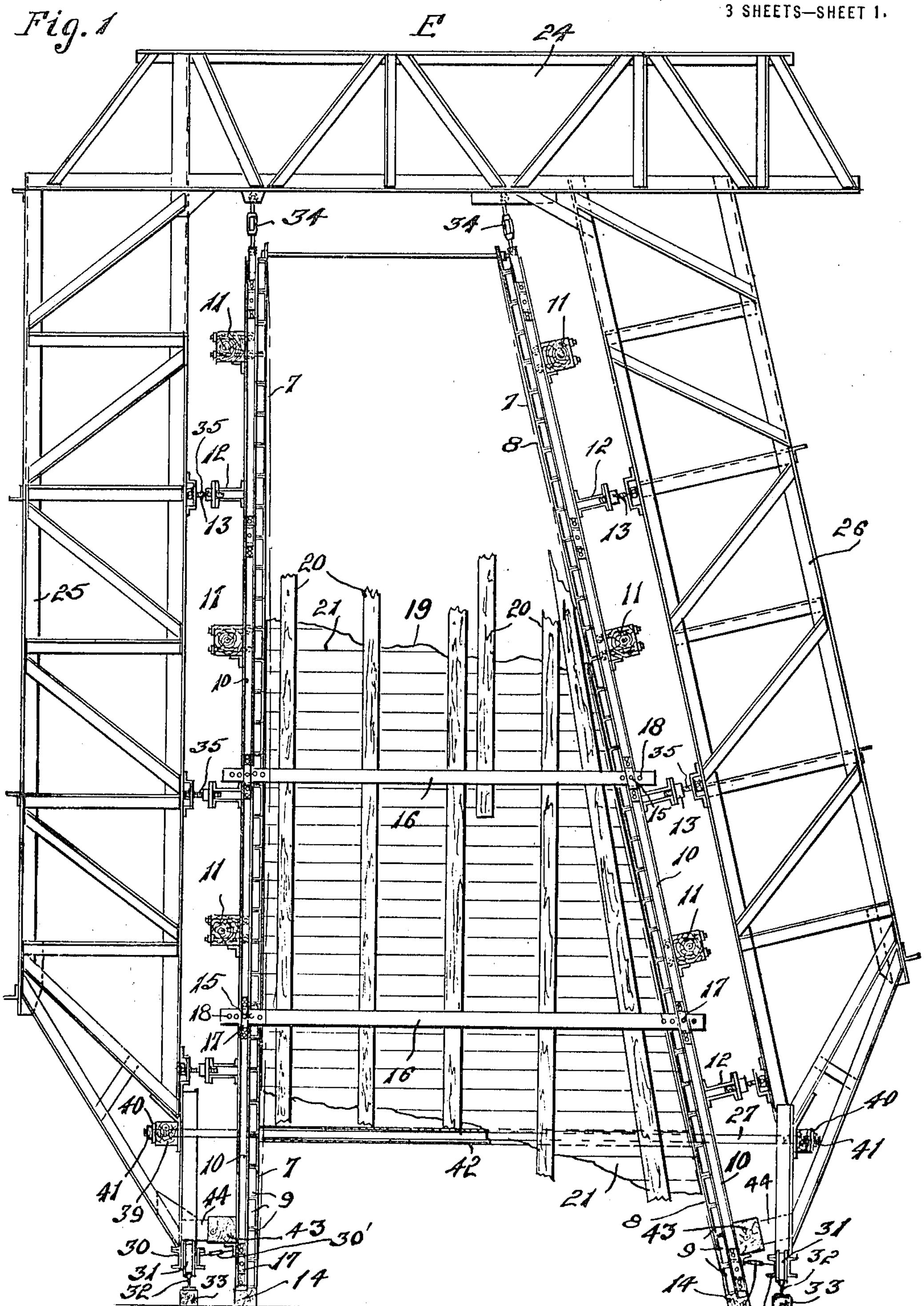
APPARATUS FOR CONSTRUCTING CONCRETE WALLS.

APPLICATION FILED MAY 14, 1918.

1,298,450. Patented Mar. 25, 1919.

3 SHEETS—SHEET 1.

Fig. 1




WITNESS

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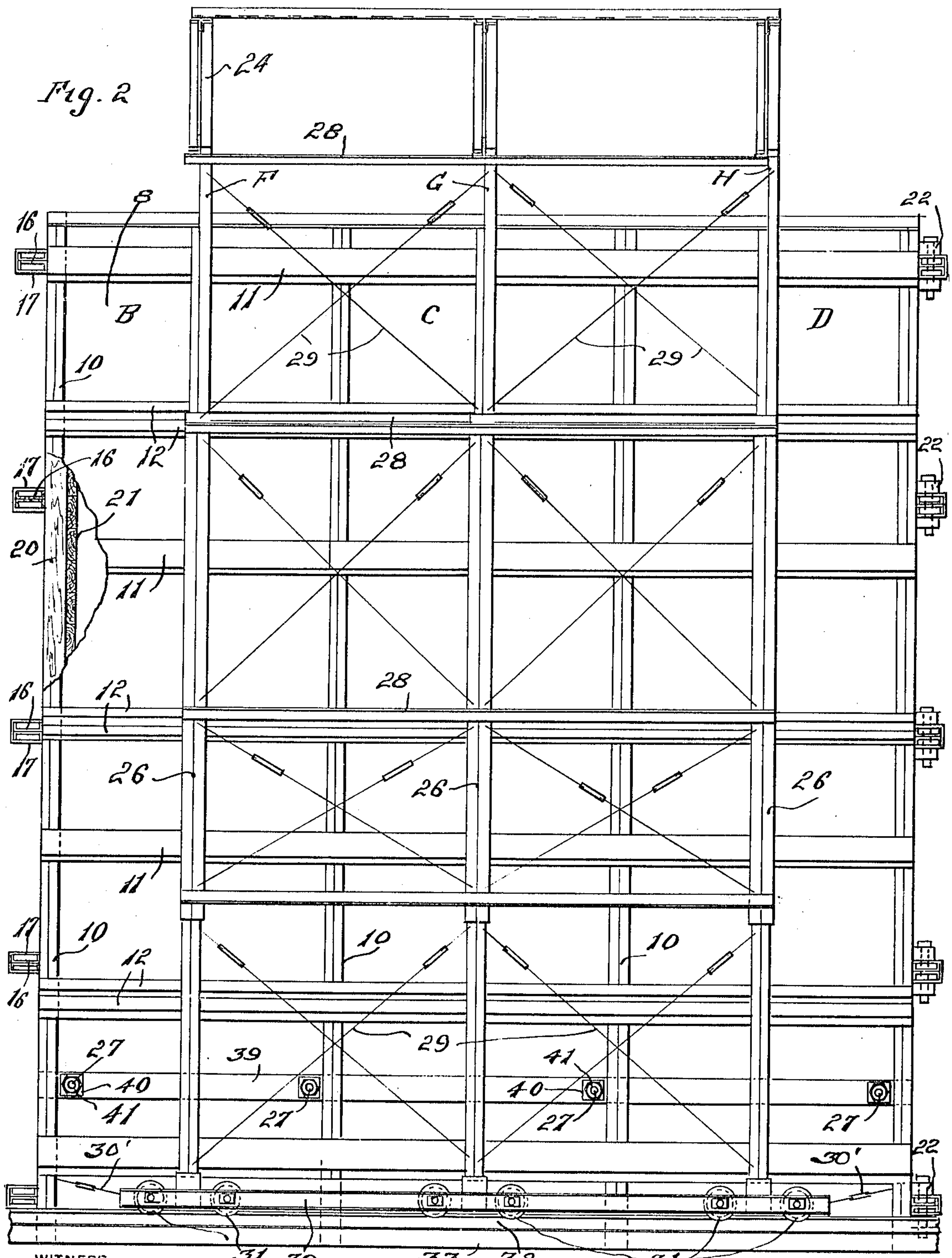
Fig. 2

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3 SHEETS—SHEET 3.

Fig. 6

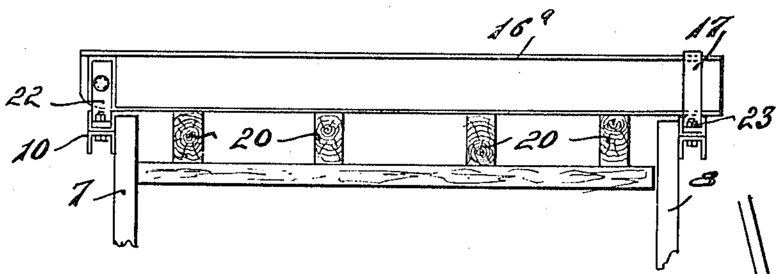



Fig. 9

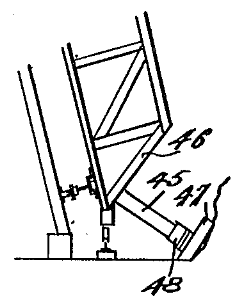



Fig. 3

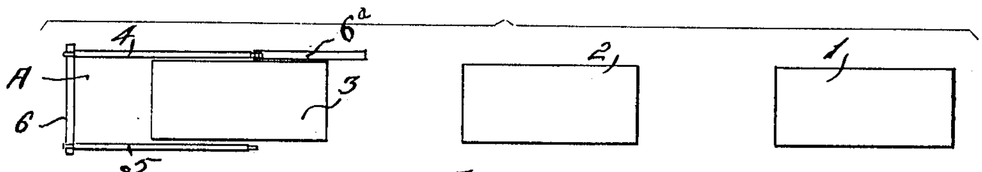



Fig. 4

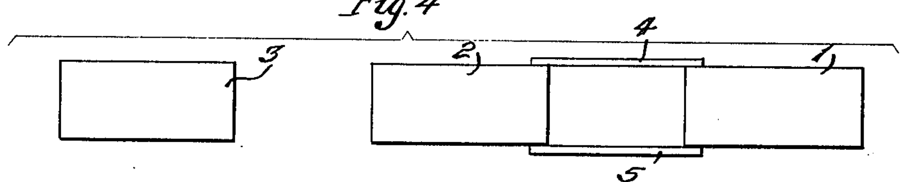



Fig. 5

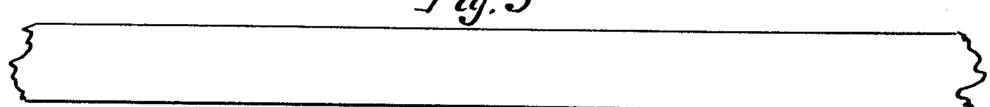


Fig. 7

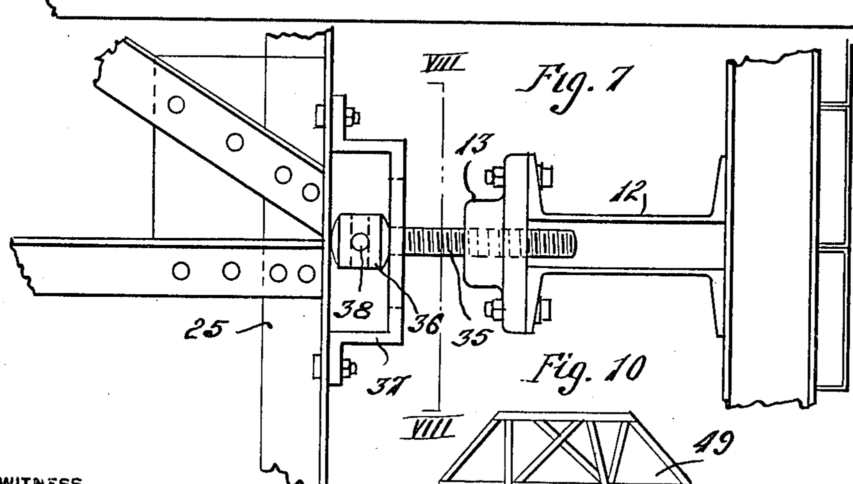



Fig. 8

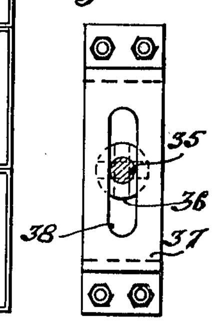
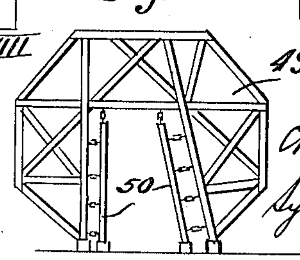



Fig. 10

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# UNITED STATES PATENT OFFICE.

CHRISTIAN BRYNOLDT, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO BLAW-KNOX COMPANY, A CORPORATION OF NEW JERSEY.

## APPARATUS FOR CONSTRUCTING CONCRETE WALLS.

1,298,450. Specification of Letters Patent. Patented Mar. 25, 1919.

Application filed May 14, 1918. Serial No. 234,370.

*To all whom it may concern:*

Be it known that I, CHRISTIAN BRYNOLDT, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in the Apparatus for Constructing Concrete Walls, of which the following is a specification.

This invention relates to the process and apparatus for constructing concrete walls and more particularly that class of walls required for canal locks, retaining walls, and the like, and has for its principal objects; the provision of means whereby a single wall form may be used to construct a wall of greater length than the form with a minimum of apparatus and manipulation; the provision of an apparatus wherein a wall form may be supported without the customary use of tie rods, or in the case of a very high wall with a minimum number of tie rods; the provision of a mold form wherein the strain upon the supports and tie rods is equalized throughout the length of the mold form; the provision of improved methods of supporting the bulkheads closing the ends of the forms whereby the form may be detached from the finished wall section and moved to a new position with a minimum of labor and time consumed in its operation; the provision of efficient means for adjusting the mold forms with respect to the supports, and such other objects as may hereinafter appear. Certain embodiments of the invention are illustrated in the accompanying drawings, wherein—

Figure 1 is an end view of the preferred form of the apparatus used in forming a comparatively high wall; Fig. 2 is a side elevation of the form; Fig. 3 is a diagrammatic showing of the first steps in the process of forming a wall with the mold forms shown in Figs. 1 and 2; Fig. 4 is a diagrammatic view showing intermediate steps in the process of forming a wall; Fig. 5 is a diagrammatic showing of the finished wall; Fig. 6 is a plan view of the top of the hinged bulkhead closing one end of the form; Fig. 7 is a side elevation in enlarged scale of the adjustable connecting apparatus for securing the form to its support; Fig. 8 is a section on the line VIII—VIII of Fig. 7; Fig. 9 is an end elevation of a portion of a modified form of mold apparatus wherein the supports are retained against spreading by braces engaging an embankment, thus eliminating the necessity of tie rods, and Fig. 10 is a diagrammatic showing of a modified form of mold apparatus wherein the supporting frame or trusses are of sufficient rigidity to support the forms without the use of braces or tie rods.

Referring to the drawings, and more particularly to Figs. 3, 4 and 5, the various steps of the process of forming a continuous wall is illustrated so as to clearly show how the mold form is used. The process of making the continuous wall with the forms to be hereinafter described consists in, first, molding sections 1, 2 and 3 of the wall at separate points in the line of the wall, by means of a suitable mold A which consists of a pair of wall molds 4 and 5 joined at their ends by end molds 6 and $6^a$ forming a complete rectangular mold capable of forming complete wall sections.

After the completed sections 1, 2 and 3 have firmly set, the adjacent sections are connected by suitable wall forms which may be the wall forms 4 and 5 previously used to form the sections, and the wall forms are then held in the position shown in Fig. 4 by supporting trusses (not shown) or any suitable supporting means. It will be seen that the sections 1 and 2 serve as bulkheads and when concrete is filled in between the wall molds 4 and 5 the wall will be continuous with the sections 1 and 2, being joined. After the concrete has set between sections 1 and 2, the wall forms are removed and placed so as to connect the sections 2 and 3 so that concrete may be filled between these sections. It will be seen that this process may be carried out indefinitely, making walls of any length and shape.

Referring to Figs. 1 and 2, the preferred form of mold apparatus for forming a continuous wall is illustrated. The mold apparatus consists of a pair of oppositely disposed wall mold forms 7 and 8, which are built up of a series of metal panels 9 secured to vertical beams or channels 10. The wall forms are preferably made up in sections as illustrated in Fig. 2, and in the form there disclosed, three sections B, C and D are alined to form a complete mold form of desirable length for manipulation.

The sections B, C and D are held in alinement and reinforced by longitudinal wales 11 and 12, the wales 11 being preferably wood timbers and the wales 12 consisting of a pair of steel channels spaced apart and joined at their outer webs by screw-blocks 13 to be hereinafter described. The wall forms 7 and 8 are preferably supported upon wooden beams 14 and are provided at their ends with loop straps 17 (Figs. 1, 2 and 6) adapted to slidably receive bulkhead retaining beams 16 which extend horizontally from the wall form 7 to the wall form 8. The loop straps 17 are provided with holes 15 and the bulkhead retaining beams are provided with similar holes 18 so that the bulkhead retaining means 16 may be retained in fixed relation with the wall forms by means of suitable pins which are adapted to be inserted through the holes 15 and 18.

In Fig. 1 the near end of the form is shown with a portion of a bulkhead 19 mounted therein, and this bulkhead comprises vertical wooden beams 20 which are adapted to bear against the retaining beams 16, and horizontal wooden lagging 21 is secured to the vertical beams 20. The whole bulkhead is adapted to be supported by the wall forms 7 and 8 so that when the wall forms are moved longitudinally, the bulkhead will be moved with the forms. The vertical beams 20 are secured by any preferred means to the beam 16, and therefore the entire bulkhead will be supported upon the wall forms 7 and 8.

The opposite end of the form is provided with a hinged bulkhead illustrated in Fig. 6. The bulkhead proper is of the same general construction as the bulkhead just described except that the bulkhead retaining beams $16^a$ are hinged to the vertical wall form 7 by means of a hinged casting 22 secured to the end channels 10 of the wall form by means of bolts, and the hinge pins $22^a$ passing through the hinge block 22 and the beam 16. The free ends of the bulkhead retaining beams $16^a$ are adapted to be secured to the wall form 8 by the strap loops 17 secured to the end of the wall form 8 by means of bolts 23. When it is desired to open the bulkhead the bolts 23 are removed so that the beams $16^a$ are free to be swung outwardly, as illustrated in Fig. 6, so that the form may be moved after a section of the wall has been molded.

The wall forms 7 and 8 are supported in any desired position by means of a supporting frame or truss E which consists of a series of connected truss sections each comprising a horizontal truss 24 and a pair of substantially vertical trusses 25 and 26 rigidly connected to the horizontal truss 24. All of the truss members are of sufficient rigidity to support the wall forms in operative position without perceptible deflection when under full load, but in the case of extremely high walls it is desirable to support the lower ends of the truss members 25 and 26 against lateral displacement by means of suitable tie rods 27 which connect the lower ends of the trusses 25 and 26.

When tie rods are used to support the lower ends of the trusses 25 and 26, the said trusses are constructed so that they will resist the load imposed upon them between the tie rods and the upper truss 24 without perceptible deflection, but in the case of extremely high walls and where the concrete is formed rapidly, it is sometimes not possible to prevent a certain degree of deflection under full load. Such deflection is compensated for by springing in the more or less flexible wall forms 7 and 8, as indicated in dotted lines in Fig. 1, so that when the load is imposed the wall forms 7 and 8 will assume a true plane by reason of the outward deflection of the trusses 25 and 26. It sometimes takes several days to fill up a form, in which event the concrete formed in one day becomes set over night. Where such is the case the forms are pressed in slightly by the jack-screws a short distance above the set concrete so that the next portion will cause the forms to be again straightened. This process is repeated after each successive filling, and the result is a straight wall when the filling has been completed.

Referring to Fig. 2 it will be seen that the form support comprises three sections F, G and H of the trusses just described. These truss sections are joined by a series of horizontal angles 28 placed at suitable points, and the frame support is rigidly braced against distortion by means of the diagonal tie rods 29 (Fig. 2).

The lower ends of the truss sections are joined by longitudinal channels 30 having wheels or rollers 31 pivoted therebetween which are adapted to roll on rails 32 supported on the ground upon wooden beams 33. The supporting frame or trusses are therefore adapted to be moved longitudinally so as to carry the mold forms 7 and 8 into any desired position.

The mold forms 7 and 8 are preferably suspended from the truss sections 24 by means of adjustable turn buckles 34 which, when manipulated, will cause the forms to be either raised or lowered as desired. The forms 7 and 8 are positioned with respect to the supporting trusses by means of jack-screw apparatus, illustrated in enlarged scale in Fig. 7. Referring to this figure it will be seen that the channels constituting the wales 12 are connected by means of a screw block 13 adapted to receive a jack-screw 35 having an enlarged head 36 which is adapted to bear against the vertical truss members 25 or 26 as the case may be. The enlarged head 36 is retained in a socket strap 37 having a vertical slot 38 therein to permit of vertical movement of the jack-screw 35 so that when the forms 7 and 8 are operated vertically in either direction the jack-screws may move with the forms while the supporting trusses remain stationary. The head of the jack-screw 35 is provided with holes 38ª in which a suitable bar may be inserted so that the screws may be rotated. When the screws are rotated the wall forms will be moved toward or away from the supporting trusses according to the direction of rotation of the jack-screw 35. By spacing the channels of the wales 12 space is provided for the entrance of the end of the jack-screw 35 between them.

The forms 7 and 8 are retained against relative longitudinal movement by means of tie rods 30′, secured at one end to the channels 30 of the supporting truss and at the other end to the wall forms, as shown in Figs. 1 and 2.

Heretofore it has been customary to support the wall forms by means of closely spaced tie rods disposed at spaced intervals at various elevations passing through the space between the forms and tying the wall forms together so that they would not be displaced by the concrete. The rods thus placed could not be removed from the concrete after it had become set without the use of numerous expensive pipes or tubes and therefore were left in the wall. In a very long wall this would be a very expensive procedure and therefore it is the object of this invention to do away with a great number of these tie rods and in some cases eliminate them altogether. As previously set forth, in the case of a very high wall it is found desirable to support the lower end of the trusses with suitable tie rods but in this case the tie rods 27 are not attached to the wall forms 7 and 8, but are extended therethrough and attached to the lower end of the truss supports, as indicated in Figs. 1 and 2. The ends of the tie rods are threaded and extend beyond wooden washers or stringers 39 sufficient distance that metal washers 40 and nuts 41 may be secured thereon. The interposition of the wooden washers or stringers 39 between the metal washers 40 and the vertical truss members provides a yielding connection between the opposed truss supports which is very advantageous in distributing the strain equally upon all of the tie rods 27, because the washers 40 will press into the wood until the strain on the rods has become equalized throughout the length of the mold forms. This would not be the case were the rods not so yieldingly secured and the strain on one rod might become so localized that its rupture would be practically certain.

In order that the tie rods 27 may be removed from the wall so that they can be used again and so that the forms may be moved longitudinally of the finished wall, steel tubes 42 are mounted upon the rods between the wall forms 7 and 8. When the concrete hardens the tubes will be retained in the concrete and the rods 27 may then be removed by unscrewing the nuts 41 from the rods.

The operation of this complete mold form is as follows. The truss supports carrying the mold forms 7 and 8 are first moved into the desired position after which the forms are adjusted into the desired position by means of the turn-buckles 34 and the jack-screws 35. The wooden beams 14 are then placed beneath the forms, as indicated in Fig. 1, and the lower end of the forms are then supported with respect to the truss supports by wooden wales 43 and suitable blocks 44. After this adjustment the bulkheads are secured in operative position. As previously stated in the case of a very high wall, the wall forms 7 and 8 are bowed inward until they occupy the position indicated in dotted lines 1 and 2, so that when the mold is full they will be displaced into the plane indicated by full lines.

After the form has been filled with concrete and the concrete has been permitted to set permanently, the pins connecting the bulkhead retaining beam 16 with the wall forms are removed permitting lateral displacement of the forms with respect to the bulkhead and the finished wall. The forms are drawn away from the wall by manipulation of the jack-screws 35 and are then elevated by manipulation of the turn-buckles 34 raising the forms off of the timbers 14. After this has been done the hinged bulkhead may be released and opened until it has been swung into alinement with the mold form 7, as indicated in Fig. 6. After the tie rods 27 have been removed the form is free to be moved longitudinally of the finished wall because the hinged bulkhead has been turned so as to clear it. The form is then moved a distance from the finished wall and again set up for refilling.

After a number of spaced wall sections have been thus formed, the bulkheads are removed from the wall forms and the forms are again moved back over the finished sections where they are again set up so as to bridge the space between the adjacent sections, the finished portions of the wall serving as bulkheads. After the forms are properly adjusted and supported by the truss supports the space between the sections may then be filled with concrete and the entire continuous wall completed in the same manner.

Referring to Fig. 9, a modified form of supporting the lower end of the truss support against lateral displacement is illustrated. In this case a wooden beam 45 is diagonally disposed between the lower end of the truss 46 and a wooden beam 47, with wedge blocks 48 between the ends of the beam 45 and the beam 47. The beam 47 is supported by the adjacent earth embankment and the wedges 48 are used to attain the desired adjustment of the frame. It is obvious that the wooden beam 45 may be supported in a ditch or projection in a concrete base depending upon the nature of the surrounding construction.

Referring to Fig. 10, a modified form of truss support is diagrammatically illustrated adapted for use where the height of the wall is not excessive. In this construction the truss member 49 is made of sufficient strength to resist deflection without the use of any additional means for supporting the lower ends against separation. It will be seen that this structure eliminates both the use of tie bolts or any external supporting means. The wall forms 50 are supported upon this form of truss in the same manner that the forms are supported in the construction previously described, the only difference in the construction being in the rigid design of the supporting truss.

It is obvious that many changes may be made in the details of the construction without departing from the spirit of the invention, and the invention is therefore not limited to the specific construction herein illustrated and described.

What I claim is:

1. A wall mold apparatus comprising a supporting member mounted for longitudinal movement, a pair of oppositely disposed mold sections supported within said member, and means connected to the supporting member and to said sections for effecting a lateral movement between the sections and the supporting member.

2. A wall mold apparatus comprising a supporting member mounted for longitudinal movement, a pair of oppositely disposed wall mold sections supported within said member and a plurality of connecting members extending between the opposed faces of said sections.

3. In a wall mold apparatus, the combination of a pair of side trusses connected adjacent the top so as to constitute a member adapted to straddle the work, a pair of oppositely disposed wall mold sections supported within said member, and means for supporting the lower ends of the side trusses against displacement.

4. In a wall mold apparatus, the combination of a pair of side trusses connected adjacent the top so as to constitute a member adapted to straddle the work, a pair of oppositely disposed wall mold sections suspended within said member and movable therewith, and means for supporting the lower ends of the side trusses against displacement.

5. In a wall mold apparatus, the combination of a pair of substantially vertical truss members adapted to lie on opposite sides of the work, means connecting the upper portions of said members to prevent displacement thereof, means adapted to prevent displacement of the lower portions of said members, two oppositely disposed wall mold sections between said truss members, and means for supporting the sections from the said members.

6. In a wall mold apparatus, the combination of a pair of substantially vertical truss members adapted to lie on opposite sides of the work, means connecting the upper portions of said members to prevent displacement thereof, means adapted to prevent displacement of the lower portions of said members, two oppositely disposed wall mold sections between said supporting members, and means between the sections and the truss members for shifting the position of the former.

7. In a wall mold apparatus, the combination of a pair of upwardly extending truss members adapted to lie on opposite sides of the work, means connecting the upper portions of said members to prevent displacement thereof, means adapted to prevent displacement of the lower portions of said members, and two oppositely disposed wall mold sections between the truss members.

8. In a wall mold apparatus, the combination of a substantially U-shaped inverted truss member adapted to straddle the work, and two oppositely disposed wall mold sections supported within the member.

9. In a wall mold structure, the combination of a pair of upright trusses disposed on opposite sides of the work, and provided with means to position the same, and two oppositely disposed wall mold sections collapsibly supported between the upright supports.

10. In a wall mold form, the combination with suitable tracks, of a pair of oppositely disposed side wall mold sections, a support exteriorly straddling said sections, and constructed to travel along said tracks as a rigid unitary carrier for the sections when the latter are in their inoperative position.

11. In a wall mold form, the combination with a pair of oppositely disposed wall mold sections, of a support therefor comprising a pair of upright rigid truss members connected at their upper ends by a truss so as to surround the top and sides of the sections, means passing through the sections adjacent their base and secured to the opposing upright truss members to prevent lateral separation of the lower ends of the upright trusses, and means between the sections and the upright trusses for preventing lateral displacement of the sections with respect to the trusses.

12. In a wall mold form, the combination with a pair of oppositely disposed wall sec-

tions, of a support therefor comprising a pair of upright rigid truss members connected at their upper ends by a truss so as to surround the top and sides of the sections, means connecting the opposing lower portions of the upright truss members to prevent lateral separation of the lower ends of said members, and means between the sections and the upright trusses for preventing lateral displacement of the sections with respect to the trusses.

13. In a wall mold form, the combination with a pair of oppositely disposed wall mold sections of a support therefor comprising a pair of upright rigid truss members connected at their upper ends by a truss so as to surround the top and sides of the sections, yielding means connecting the opposing lower portions of the upright truss members to prevent lateral separation of the lower ends of said members, and means between the sections and the upright trusses for preventing lateral displacement of the sections with respect to the trusses.

14. In a wall mold form, the combination with a pair of oppositely disposed wall mold sections, of a support therefor comprising a pair of upright rigid truss members connected at their upper ends by a truss so as to surround the top and sides of the sections, tie bolts connecting the opposing lower portions of the upright trusses to limit lateral separation of the lower ends thereof, yielding washers between the ends of the tie bolts and the upright trusses, and means between the sections and the trusses for preventing lateral displacement of the sections with respect to the trusses.

15. A mold form comprising in combination, a pair of opposing wall mold sections, means whereby the sections may be independently supported in operative and inoperative positions, and a hinged bulkhead adapted to connect the sections when closed, and be supported by one of the sections when in open position.

16. A mold form comprising in combination, a pair of upright form supporting members joined at their upper ends, roller means secured to the bottom of the upright members whereby the members may be moved longitudinally, a pair of wall mold sections oppositely disposed between the upright supporting members, and means for supporting the sections upon the supporting members whereby the sections will be moved with the supporting members when such members are moved to another position.

17. A mold form comprising in combination, upright trusses, means for preventing lateral displacement of the trusses, a pair of mold sections oppositely disposed between the upright trusses, and means for adjustably securing the sections to the trusses comprising supporting wales extending longitudinally of the sections and secured thereto to retain the sections in alinement, a screw-block mounted upon the wales, a headed jack-screw mounted in the block having the head thereof in contact with the trusses and a socket secured to the trusses for retaining the head against displacement from the sections, whereby the sections may be adjustably positioned with respect to the trusses.

18. In a wall mold apparatus, the combination of upright supporting members adapted to lie on opposite sides of the work, a pair of oppositely disposed wall mold sections supported therein including a plurality of vertically arranged beams and a plurality of longitudinally arranged reinforcing wales, and means connecting said sections to the upright supporting members.

19. In a wall mold apparatus, the combination of upright truss members, a pair of oppositely disposed wall mold sections supported therein; and means adapted to connect the sections at a plurality of points in the area thereof to prevent relative displacement.

CHRISTIAN BRYNOLDT.