

March 7, 1950

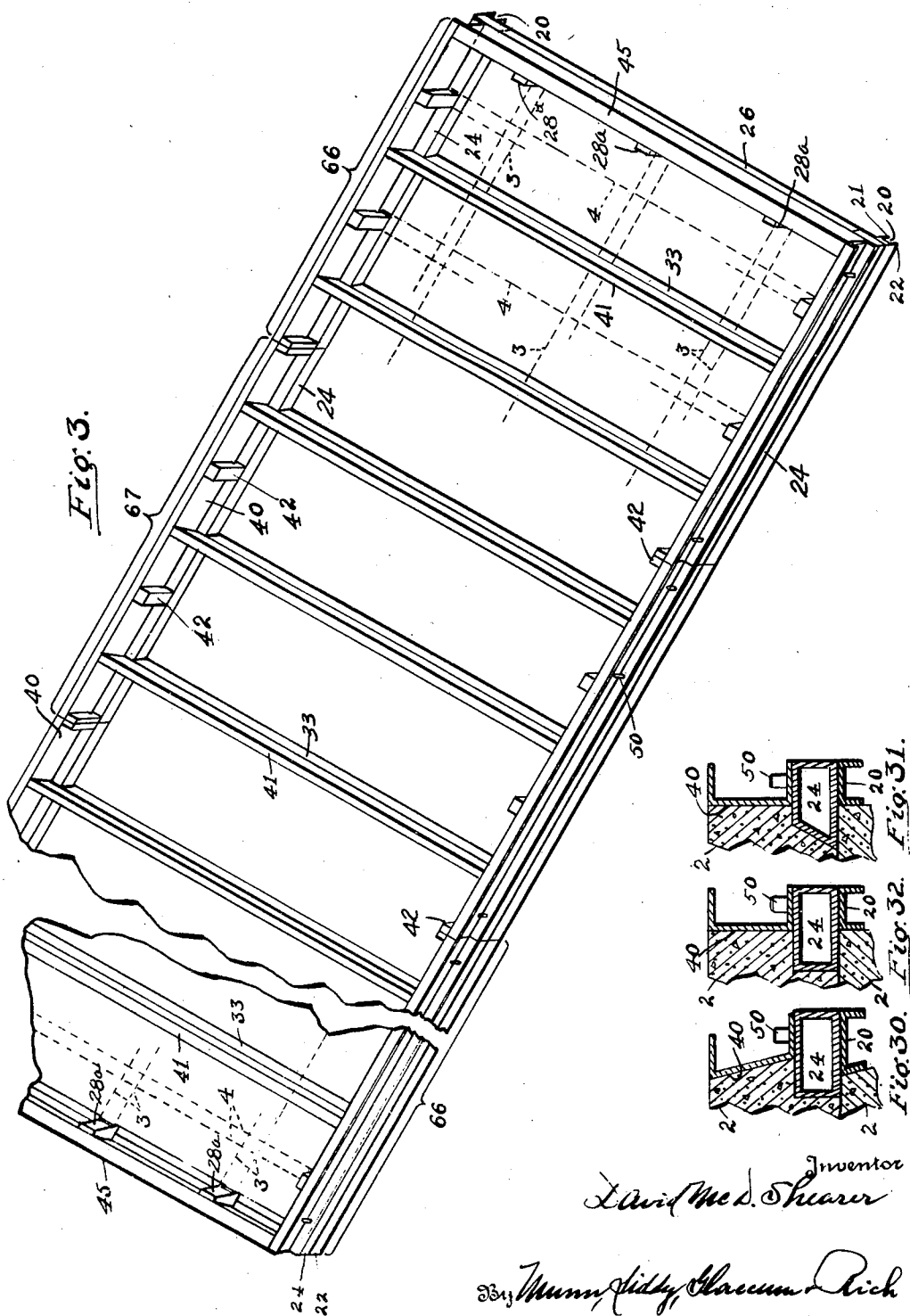
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2,499,532

MOLD FOR CASTING REVETMENT MAT SECTIONS

Filed Feb. 7, 1947

7 Sheets-Sheet 2



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MOLD FOR CASTING REVETMENT MAT SECTIONS

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7 Sheets-Sheet 3

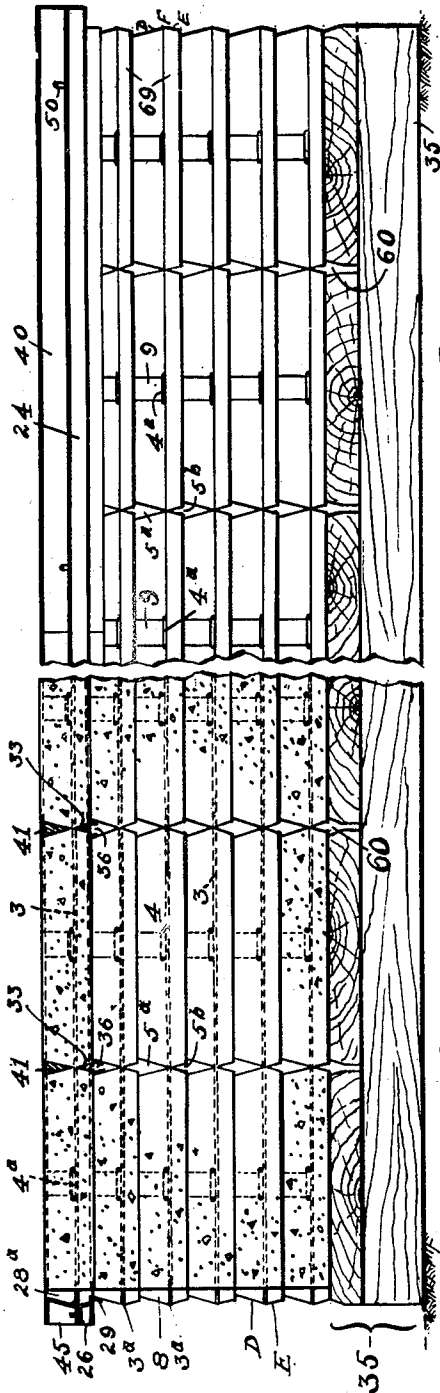


Fig. 4.

Fig. 5.

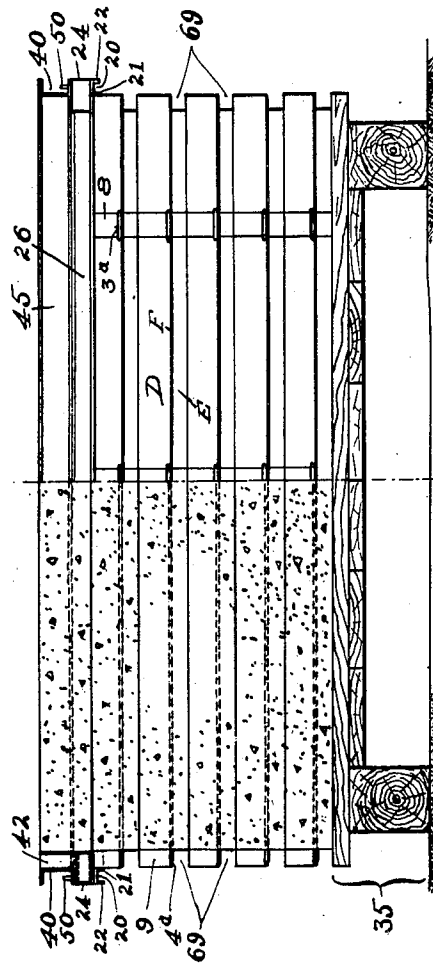


Fig. 6.

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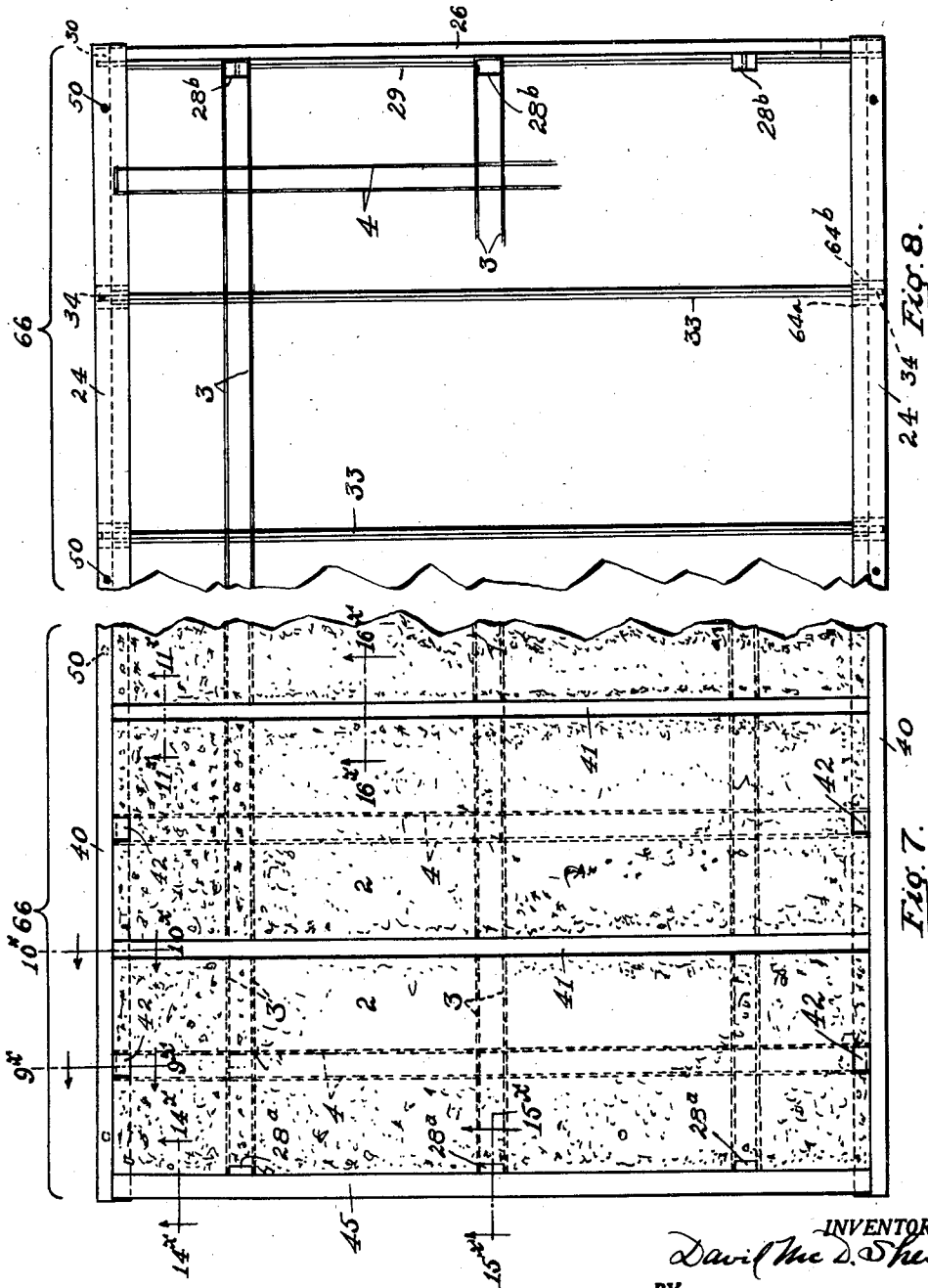
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MOLD FOR CASTING REVETMENT MAT SECTIONS

Filed Feb. 7, 1947

7 Sheets-Sheet 4



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MOLD FOR CASTING REVETMENT MAT SECTIONS

Filed Feb. 7, 1947

7 Sheets-Sheet 5

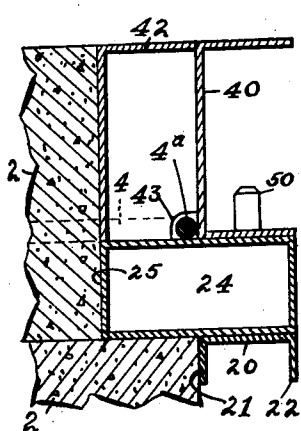


Fig. 9.

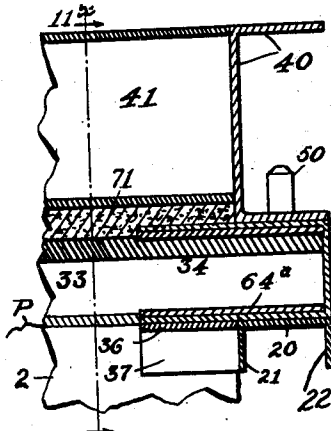


Fig. 10.

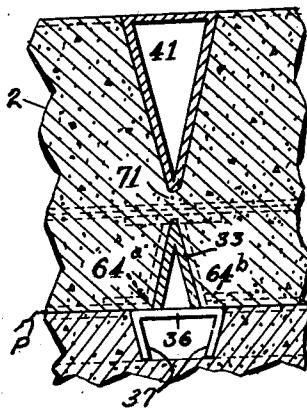


Fig. 11.

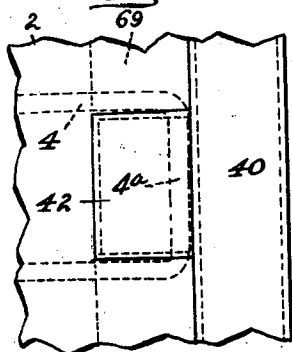


Fig. 12.

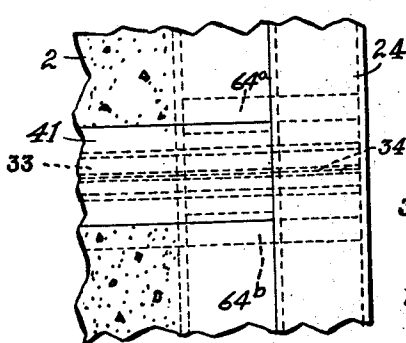


Fig. 13.

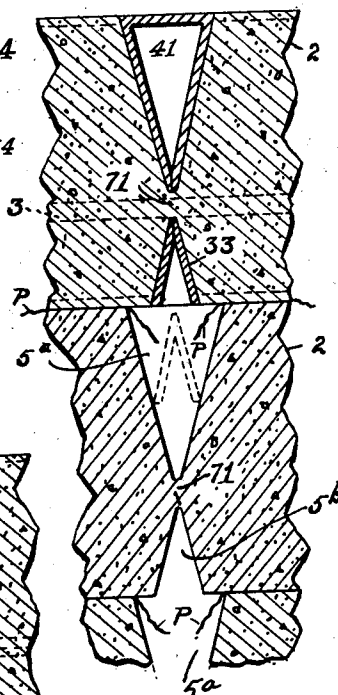


Fig. 16.

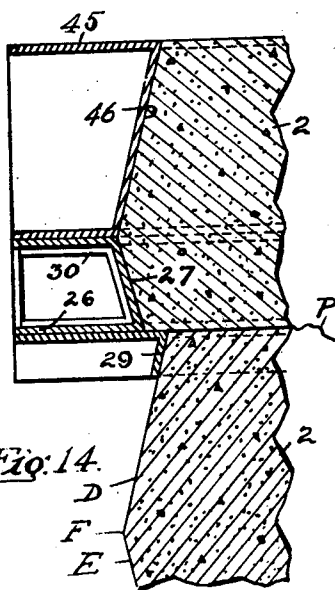


Fig. 14.

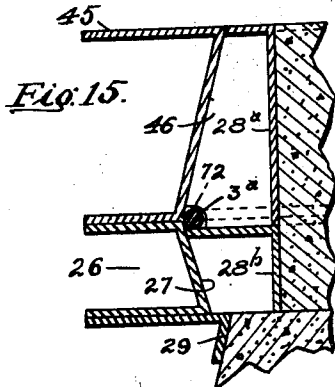


Fig. 15.

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MOLD FOR CASTING REVETMENT MAT SECTIONS

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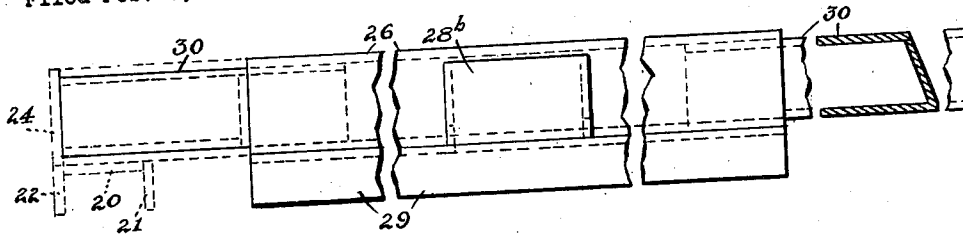


Fig. 17.

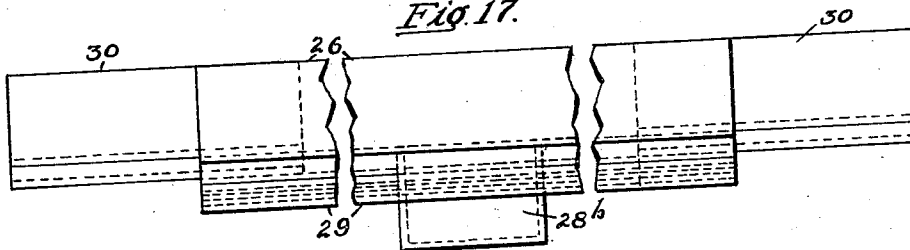


Fig. 18.

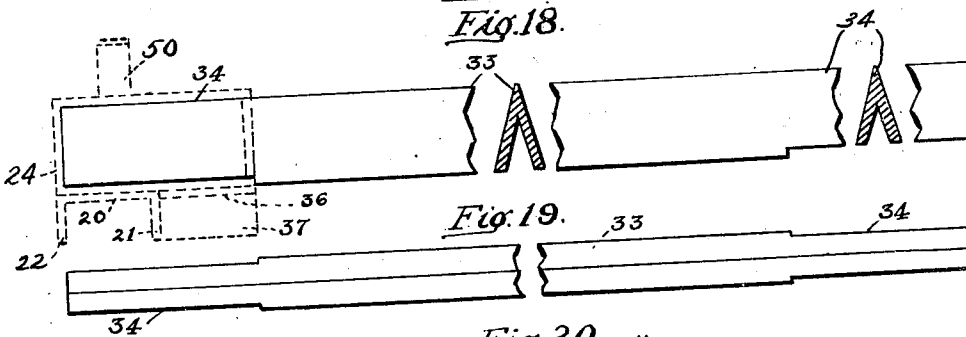


Fig. 19.

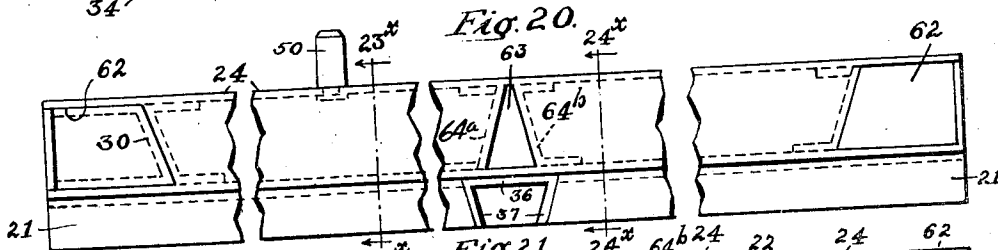


Fig. 20.

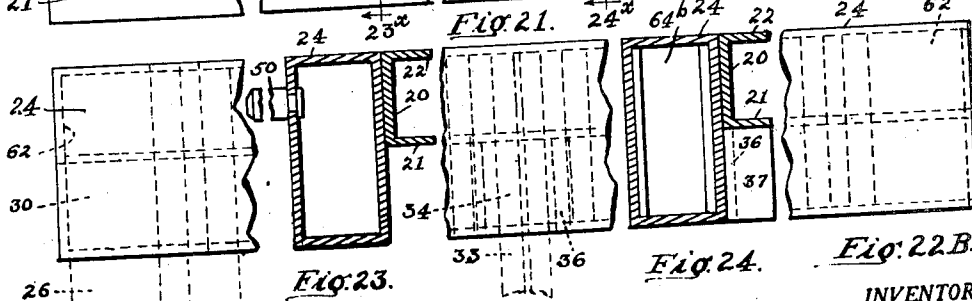


Fig. 21.

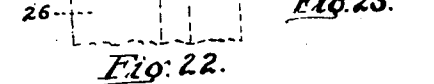


Fig. 22.

Fig. 23.

Fig. 22A.

Fig. 24.

Fig. 22B.

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MOLD FOR CASTING REVETMENT MAT SECTIONS

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7 Sheets-Sheet 7

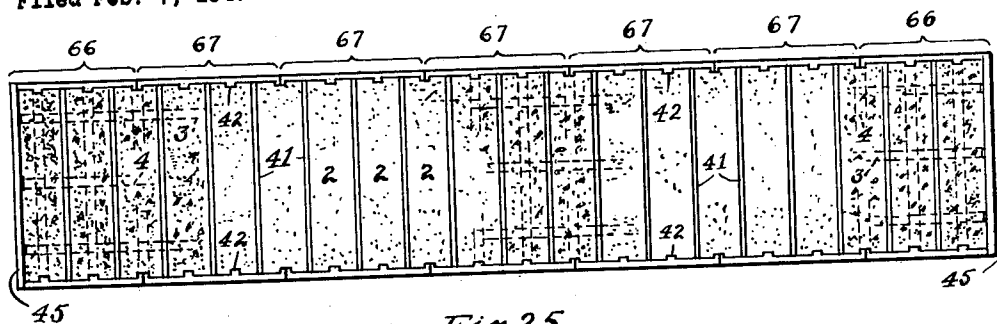


Fig. 25.

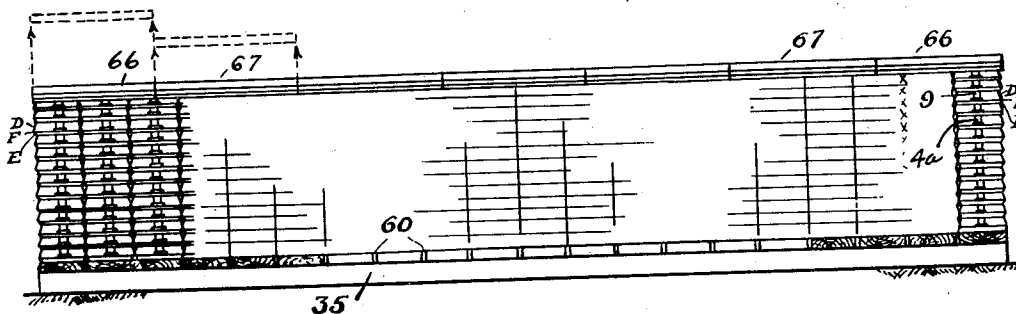


Fig. 26.

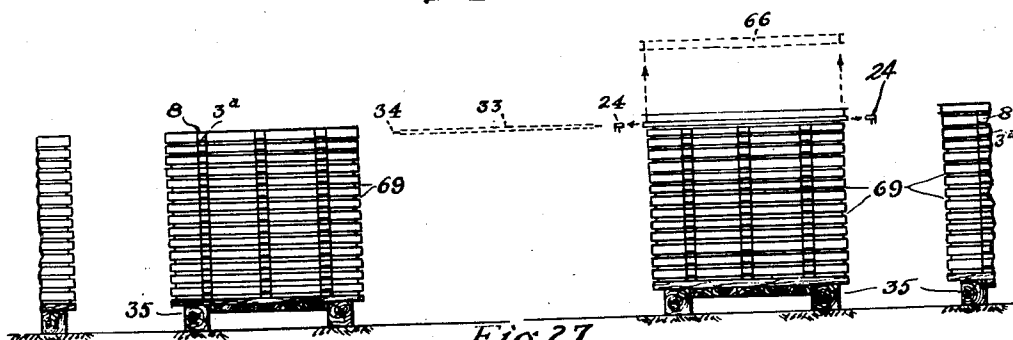


Fig. 27.

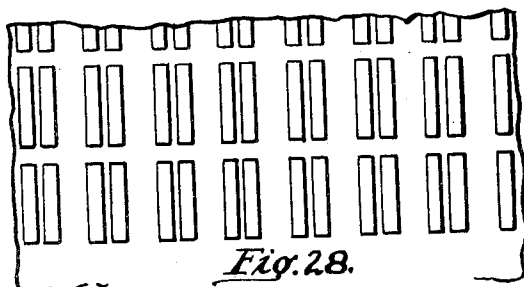


Fig. 28.



Fig. 29.

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UNITED STATES PATENT OFFICE

2,499,532

MOLD FOR CASTING REVETMENT MAT SECTIONS

David McD. Shearer, San Antonio, Tex.

Application February 7, 1947, Serial No. 727,042

6 Claims. (Cl. 25-121)

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Articulated slab revetment mats as heretofore constructed and employed in the protection from erosion of the submerged banks of alluvial streams in deep water and strong currents necessarily require certain openings between the unit slabs and between prefabricated unit groups thereof in the mat structure, which permit "leaching" or erosion to occur which gradually undermines the structure when in place. To remedy this condition is the purpose of my copending application of even date, "Revetment," Serial No. 727,043.

My present invention relates to the production of prefabricated unit "sections" or units of construction of the characteristic revetment mat described in said copending application. It has for its object to provide practicable means whereby the characteristic unit mat sections may be prefabricated in quantity in limited areas, rapidly, cheaply and efficiently, and of such uniformity in design and dimension that a plurality of them may be assembled over launching cables, side to side and end to end to produce a unit mat structure of desired width and length devoid of openings between slabs through which water may circulate to undermine the mat structure in place.

Another object of my invention is to provide a sectional, demountable mold form for molding articulated slab revetment mat sections devoid of spaces between unit slabs thereof, other characteristic features of which are its adaptation to the top of a previously cast mat section with positive and fixed registration of parts thereto, whereby duplicate sections may be formed in tiers, one section superimposed exactly above another from which it is separated by a layer of thin paper only, and the feasibility of the recovery of the parts of the form from the casting for repeated use thereafter.

Another object of the invention is to provide a segmented, demountable mold-form, the lower cross parts of which may be disengaged from the lower face of the included casting by tripping into the larger corresponding spaces in the upper face of the preceding casting or casting base, and freely withdrawn therefrom, as well as the method employed in the use of the mold form.

Another object of the invention is to provide a segmental, demountable mold-form for the production of prefabricated sections of an articulated slab revetment mat, equipped with cooperating pairs of similar, parallel, unequal triangular strips, oppositely disposed in the vertical planes normal to their horizontal axes with inverse relation of parts, and which are spaced

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apart to accommodate the continuous wire grid of the mat section and provide for continuity of the adjacent slabs in the zone of the grid, and adapted to delimit the slabs above and below the zone of the grid, the lower strip being the smaller.

Another object of the invention is to provide a demountable mold form for the production of prefabricated sections of an articulated slab revetment mat in tiers of sections, one above another, having sides adapted to bear on the sides of the preceding casting to support the mold form in position thereon and at the same time form continuous recesses in the sides of the lower face of the casting for accommodation of the launching cables of a mat structure consisting of an assembly of such sections.

Another object of the invention is to provide a segmental, demountable mold form for casting one section of an articulated slab revetment mat above another, in which the reinforcing bonding wire grid of the casting is included wholly within the borders of the mold form and positioned in an open horizontal zone left between the interior members thereof, whereby continuity of the materials of the slabs through the zone is secured.

To these and other ends my invention embodies further improvements described in the accompanying specification, the novel features thereof being set forth in the appended claims.

In the drawings:

Figure 1 is an isometric view of an end portion of a prefabricated unit revetment mat section constructed in accordance with the method and apparatus comprising the subject matter of my present invention.

Figure 1A is an enlarged detail cross section of one of the transverse joints taken on the line A-A of Fig. 1 showing the relative position and size of the two associated V-shaped grooves.

Figure 1B is a similar view taken on the line B-B of Fig. 1 at the center of the end of one of the unit slabs.

Figure 1C is a similar cross sectional view taken on the line C-C of Fig. 1 showing one of the recesses formed in the end slabs of a unit section.

Figure 2 is an enlarged isometric view of one corner of the end slab of the unit mat section partly shown in Fig. 1.

Figure 3 is an isometric view of the mold form comprising the apparatus of the present invention.

Figures 4 and 5 are views of the two end portions of a tier of precast revetment mat sections, the former being shown in vertical section, the latter in side elevation, and both illustrating the

position of the mold forms with reference to the uppermost mat section.

Figure 6 is an end view of a tier of precast sections as shown in Figs. 4 and 5, one half being shown in vertical section and the remainder in elevation.

Figure 7 is a top plan view of the tier shown in Fig. 4 with the mold form filled and in place. It features the top plan of the cope in the assembled mold form.

Figure 8 is a similar view looking down upon the tier shown in Fig. 5 showing in top plan the assembled nowel with the reinforcing grid members in place over it before placing the cope thereon and filling the assembled mold form.

Figure 9 is an enlarged detail sectional view of the side of the mold form assembly taken on the line 9^x—9^x of Fig. 7.

Figure 10 is an enlarged cross sectional view similar to Fig. 9 taken on the line 10^x—10^x of Fig. 7.

Figure 11 is an enlarged detail cross sectional view taken on the line 11^x—11^x of Fig. 10, and which for general reference is also indicated on Fig. 7, showing in broken lines the detail of the side bars in elevation.

Figure 12 is a top plan view of the details shown in Fig. 9.

Figure 13 is a top plan view of the details shown in Fig. 10.

Figure 14 is a detailed cross sectional view in the vertical plane indicated by the lines 14^x—14^x of Fig. 7.

Figure 15 is a vertical cross sectional view thru one of the form boxes taken on the line 15^x—15^x of Fig. 7.

Figure 16 is a cross sectional view in the vertical plane defined by the line 16^x—16^x of Fig. 7 showing the method of freeing the nowel cross bar from the casing by dropping it into the underlying larger opening in the top of the preceding casting of the tier from which it may be withdrawn endwise.

Figure 17 is an enlarged inside elevation of the demounted end bar of the nowel including an insert showing a cross section of the reduced end extension.

Figure 18 is a top plan view of the parts shown in Fig. 17.

Figure 19 is a side elevation of one of the nowel cross bars including inserts showing cross sections of the middle part and of the reduced end extensions.

Figure 20 is a top plan view of the cross bar shown in Fig. 19.

Figure 21 is an elevation as seen from the inside of parts of the nowel side bar showing the two ends and essential intermediate details.

Figures 22, 22A, 22B are top plan views of the ends and intermediate sections of the side bar shown in Fig. 21.

Figure 23 is a cross sectional view taken on the line 23^x—23^x of Fig. 21.

Figure 24 is a cross sectional view taken on the line 24^x—24^x of Fig. 21.

Figure 25 is a top plan view of a typical prefabricated unit mat section as molded in the mold forms embodying my invention, shown atop a tier of mat sections.

Fig. 26 is a side elevation of the tier of mat sections shown in Fig. 25.

Figure 27 shows the preferred arrangement of unit tiers of mat sections in a typical casting yard layout, featuring the spacing between tiers and the method of stripping or demounting the

parts of the mold form from the top casting of one tier.

Figure 28 is a small scale plan view of a portion of a typical bank side casting yard showing the arrangement of the tiers of mat sections in pairs with suitable intervening spaces for passage of workmen or vehicles.

Figure 29 is a horizontal elevation of Fig. 28 for clarification.

Figure 30 is a cross sectional view similar to Fig. 9 taken through the side of the mold form assembly showing a modification of the side bars for producing beveled ends in the slabs of the unit mat sections when V-shaped longitudinal joints are desired in the mat structure.

Figure 31 is another sectional view similar to Fig. 9 taken through the side of a mold form assembly showing an appropriate modification of the nowel side bars for forming regular trapezoidal launching cable channels in the under side of the ends of the slabs of the sections when employment of channels of this shape are desired in the mat structure.

Fig. 32 shows the preferred design of the side bar for easy comparison and is the same as Fig. 9.

Figures 33, 34 and 35 are cross sectional views showing modified forms of the cross bar shown in Figs. 19 and 20, the first illustrating a solid triangular bar, the second showing a bar made of two pieces united, and the third showing a hollow triangular bar.

Similar reference characters in the several figures indicate similar parts.

Referring first to Figs. 1 and 2, I have illustrated isometrically portions of a revetment mat unit section, such as shown in its entirety in Fig. 25 within the mold forms constituting the subject of this invention. The preferred dimensions for these sections are: Length 25 feet, width 4 feet, thickness 3 inches. The unit sections are divided into a plurality of unit slabs 2 which are articulately interconnected by longitudinal bonding members 3 of a reinforcing grid, the grid also comprising transverse members 4 which extend above and at right angles to the members 3 and are located below the mid portion of each of said slabs. In the edges of those slabs which form the ends of the unit section are recesses 8 across which extend rectangular stirrup like ends 3^a of the grid wires 3. In each end of each of the slabs 2 are recesses 9 across which extend similar stirrup like ends of the grid wires 4, said stirrups 3^a and 4^a serving as the means for connecting the ends and sides respectively of contiguous mat sections together. Extending longitudinally beneath the ends of the slabs 2 are the continuous undercut recesses 69 which in a revetment mat structure complement similar recesses in adjacent sections of the mat to form covered channels for accommodation of the launching cables to which the sections are clamped side to side by means of clamps which include the meeting stirrups 4^a of adjacent sections as well as the cable in each fastening.

The unit slabs 2 of the mat section are formed by means of complementary pairs of similar but unequal open, triangular or V-shaped grooves oppositely disposed in the vertical plane normal to the face of the unit mat section and separated by the longitudinal grid wires 3, the larger V-shaped opening indicated by 5^a being above the grid and the smaller one indicated by 5^b being below it, as shown particularly in Fig. 1A. When casting these bodies the adjacent slabs are initially joined rigidly together by the flow of the

molding material through the zone indicated by 71 which constitutes a plane of weakness which fractures to form a close joint contact between adjacent slabs when the unit section is moved or worked into the mat structure.

Details of the recesses or access walls 8 and 9 and the relation thereto of the stirrups of the reinforcing grid wires are shown in Figs. 1B and 1C particularly, and in the former illustration it will be noted that the recess 9 terminates in the launching cable recess 69 and that the rectangular end 4^a of the transverse reinforcing grid passes outside of the side walls of said recess but inside and across the open side thereof and just above its lower end, thus exposing the stirrup for ready accessibility, yet allowing it to be held rigidly in place.

As shown in Figs. 1C and 2 it will be observed that the outmost edges of the slabs at the ends of the unit section are beveled to provide faces D and E which incline backwardly from their point of intersection F which is in horizontal alinement with the grid member 3, the angles of inclination of these facial planes being in conformity with the corresponding faces of the V-shaped recesses 5^a and 5^b between the slabs 2. The sides of the stirrup members 3^a are embedded in the walls of the recess and the outer ends of these loops are flush with the point F.

The molding apparatus which constitutes the subject of the present invention and in which the unit mat sections heretofore described are formed, is shown generally in the isometric view of Fig. 3. It comprises a flask consisting of cope, or upper, and nowel, or lower, cooperating parts, somewhat similar to the flasks employed in foundries for casting metal shapes in sand. The flask is preferably subdivided into end segments 66 and any desired number of intermediate segments 67. One purpose of this segmentation of the flask is to break it up into parts which may be easily handled and assembled. Another purpose is to make it possible to fit the flask closely to irregular surfaces such as the curved decks of barges or uneven ground. Still another purpose is to enable the length of the casting to be varied in accordance with needs by simply adding or removing intermediate segments as necessary. The apparatus is especially adapted to casting unit mat sections successively, one section superimposed on another in exact registration of parts, starting from a suitable casting base or template over which a layer of thin, tough paper has been spread.

The lower face of the flask is equipped with flanges and lug keys which engage the sides and openings of the template base or preceding casting, as the case may be, in such a manner as to cause accurate or positive registration of corresponding parts and, therefore, accurate duplication of the sections. This is an essential feature of the mold forms and the method comprising this invention.

The preferred design of the cope or top frame is a rigid unit which facilitates its placement in making up the parts of the flask and subsequently lifting off the cope frame. It also provides the necessary rigidity to the flask assembly. The cope is composed of the side pieces 40, the end bars 45 and the V-shaped cross bars 41, said parts being joined by welding or other suitable means of connection between them. The end bars 45 carry on their inner faces the form boxes 28^a which form the end recesses 8 in the molded unit sections and these serve at the same time to en-

gage and position the ends of the longitudinal grid members 3. Likewise the side bars 40 of the cope carry the V-shaped cross bars 41 and the form boxes 42 which form the recesses 9 in the sides of the unit mat section. These boxes serve to engage and position the ends of the transverse grid wires 4.

The nowel or lower frame of the flask is composed of detachable side bars 24, end bars 26 and cross bars 33 which are the inverted V-shaped members used for molding the recesses 5^b in the lower face of the slab and are in alinement with the bars 41 of the cope. The upper and lower parts of the flask are centered and held in perfect registration by means of studs 50 rigidly carried on the side and end bars of the nowel. These studs 50 of the nowel register with and pass through corresponding apertures in the lower face of the side and end pieces 40 and 45 respectively of the cope. The side bars of the nowel project within the corresponding parts of the cope to form the launching cable channels 69 and each of them carries on its underside projections or keys 36 (Figs. 11, 21) which fit into the V-shaped recesses 5^a of a precast unit section and also marginal flanges 21 (Fig. 9) which engage the longitudinal face of said section. The end bars 26 likewise have a depending flange 29 (Fig. 14) for engagement with the ends of such unit, and on said end bars are inwardly extending boxes 28^b (Figs. 15-18) which cooperate with the end boxes 28^a of the cope to form the recesses 8 in the ends of the unit mat section.

In building up a tier of unit mat sections the forms are withdrawn from each casting as soon as it has set up or hardened sufficiently to stand without aid of the forms. The parts of the forms are then cleaned and oiled for use in the next casting, which follows as soon as the materials of the preceding casting have further hardened sufficiently to support it without damage. When ready for the next casting a sheet of thin, tough paper is first spread over the last casting. The several segments of the nowel are then assembled separately in any convenient manner and place, but preferably by use of prepared rack sticks adapted to support and accurately space the several cross bars 33, and end bars 26 in case of end segments, and enable the side bars 24 to be easily and quickly slipped over their reduced end extensions 34 and 30, respectively, through the corresponding sockets 63 and 62, in the side bars, in a single operation. The assembled nowel segments in order are then lifted and superimposed vertically on the paper P covering the preceding casting by pressing downwardly until the dependent lug-keys 36 on the underside of the nowel side bars 24 cut through the edges of the underlying paper and come to rest snugly fitting in the upper ends of the V-shaped openings 5^a of the preceding casting (Figs. 11, 21). In the cases of the end bars 26 of the end segments 66 (Figs. 17, 25, 26), the dependent flange 29 automatically bears against the end of the preceding casting. Finally, the opposite side bars 24 of each segment of the nowel are simultaneously pressed inwardly to insure contact of the dependent flanges 21 against the upper portions of the ends of slabs 2 forming the sides of the preceding casting. The functions of the dependent lug-keys 36 and of the dependent flanges 21 and 29 thus assure exact registration of parts and therefore duplication in the successive sections of the tier (Fig. 4).

After the assembly and placement of the

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nowel and layers of paper the longitudinal grid wires are laid over the paper across the bars 33 and extend between the end bars 26, their stirrup ends resting on the tops of the boxes 28^b (see Figs. 8 and 15). The transverse grid wires are then laid across the mold form over the wires 3 in the approximate position that they will occupy in the several slabs of the casting. The unit cope is then lowered over the nowel and brought into correct registration therewith by the studs 50 which lock all parts of the flask together, whereupon the ends of the grid members 4, which extend over the top face of the nowel and their stirrup ends, are engaged in the notches 43 in the boxes 42 of the cope. Similarly the stirrup ends of the grid members 3 rest on the box 28^b and are locked in position by recesses 72 in the lower end edges of the boxes 28^a of the cope. The placement of the cope causes its transverse cross bars 41 to be pressed into engagement with the longitudinal grid wires 4 as shown in Figs. 4, 11 and 16.

To dismount the mold form assembly its several unit cope segments are simply lifted vertically clear of the casting (Fig. 26). The nowel side bars 24 of the several nowel segments are then loosened and removed laterally, disconnecting them from the ends of the cross bars 33 and the end bars 26 (Fig. 27). Finally the cross bars 33 are loosened by tapping one of their exposed ends and then forcing each bar downwardly through the separating layers of paper P into the V-shaped opening 5^a (Fig. 16) of the underlying preceding casting from which it is withdrawn lengthwise.

In building up a tier of successive unit castings a casting base or template 35 (Figs. 26 and 27) is conveniently employed, the deck of which is provided with openings 50 corresponding to the V-shaped openings 5^a of a mat section, thus providing space necessary for withdrawal of the cross bars 33 of the nowel when dismounting the mold form assembly from the first casting above the template base. However, in lieu of the template a casting case may be quickly improvised by making a preliminary base casting formed by means of the cope only. In this case such cope castings would remain in place and be used repeatedly for building up the several tiers of mat sections as desired.

Referring to Fig. 8 the heretofore described assembly of the parts of the nowel will be seen in top plan with the reinforcing grid members in position thereon. In Fig. 7 the superimposed cope is depicted in top plan. The relative arrangement of these parts is also shown in section in Fig. 4 and in elevation in Fig. 5 which represent a tier of five precast unit sections with the top sections still within the parts of the molding flask. The sectional view (Fig. 4) shows particularly the registration of the key lugs 36 with the notches in the upper face of the preceding section and the registration of the end member of the nowel therewith. Figure 6 shows a half cross section and a half end view of the same tier of precast unit sections featuring particularly the registration of the side bars 24 of the nowel with the longitudinal edges of the preceding section and the formation therein of the launching cable casting channel recesses 69.

Larger details of the aforementioned parts are shown beginning with Fig. 9 which is a sectional view through the side of the molding flask illustrating a nowel side bar 24 projecting inwardly beyond the inner face of the side member 40 of

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the cope on which is located the mold boxes 42, the inner faces of which are vertical and flush with the inner face 25 of the nowel side bar and is provided with the notch 43 in which the stirrup 4^a of the transverse grid 4 is received and held in position during the molding operation. On the lower side of the nowel side bar 24 is a small channel bar 20 the inner flange 21 of which is in line with the inner face of the cope side bar and abuts the edge of the precast unit section. The outer flange 22 thereof serves as a hand grip for removing the nowel side bar 24 and is also useful for engaging a goose neck pinch bar on occasion for loosening the nowel side bar preliminary to its withdrawal from the assembly.

At intervals on the underside of the nowel side bar 24 there are placed key lugs 36 which extend inwardly from the flanges 21 as shown in Fig. 10 and are located for registration with the V-shaped notches 5^a of the preceding casting, the edges of the lugs being provided with wings 37 (Fig. 11) which are formed at suitable angles and are yieldable for ready accommodation to slight variations that may occur in the openings 5^a of a precast section, the edges of these wings are sufficiently sharp to insure their cutting through the edges of the underlying separating paper P when the assembled nowel is set in place over the base casting.

As shown in Fig. 10 and Fig. 21 the nowel side bar is provided with socket openings 63 which receive the reduced ends 34 of the lower inverted V-shaped cross bars 33. These apertures extend upwardly from the bottom of the side bars 24. They open into sockets formed by bent diaphragm plates 64^a and 64^b (Fig. 21) permanently united at their lower ends only to the inside flooring of the side bar 24 whereby their converging edges may yield as necessary to accommodate the ends of the cross bars 33 with minimum play.

Certain details of the end sections of the upper and lower members of the molding flask are illustrated in detail in Figs. 14 and 15. In Fig. 14 it will be seen that the end bar 45 of the cope is a bent plate shaped into a channel bar of unequal horizontal legs the connecting web 46 forming the upper facial plane D in the side of the end slab 2 of the unit mat sections. The nowel end bar 26 is a similar irregular section, the inner face 27 of which is inclined to form the face E of such end slab. The base of the end bar 45 coincides with the top of the end bar 26 on which it rests so that the inner faces 46 and 27 of these two bars shape the end of the unit mat section to conform to the shape of the intermediate V-shaped grooves 5^a—5^b of the sections. In this way uniformity in transverse articular joints is preserved throughout the mat structure composed of an assembly of such prefabricated unit mat sections. Because of the unequal thickness of the cope and nowel and, therefore, of the widths of the facial planes D and E formed in the end slabs, the end bars of the assembled flask necessarily overhang the base casting leaving appreciable openings through which leakage of the casting materials might occur in the plastic state. Such leakage is however prevented by the inwardly extending flange on the bottom of the nowel end 26 which carries the aforementioned depending flange 29 (Fig. 14) which serves as an alining member for the end members.

It will be observed in Fig. 15 that the cope and nowel when assembled in position are interlocked

by means of the studs 50 and also that in line with the longitudinal grid members 3 there is located the form boxes 28^a and 28^b. The latter extends beneath the stirrup ends of the longitudinal reinforcing wires and hence is below the parting line of the cope and nowel so that the box 28^a carried on the cope has its lower end extended to fit within the stirrup and is notched as indicated at 72 to engage therewith. In this manner the longitudinal grid wires are locked in their desired positions with the median line of the stirrups in the meeting plane of the flask sections.

Figure 16 features the relation of a nowel cross bar 33 to the underlying V-shaped groove 5^a in the preceding casting of the tier of mat sections. From this illustration it will be readily seen that in dismounting the flask that after the side bars of the nowel have been withdrawn laterally that the cross bars 33 are unsupported and may be loosened by tapping their ends and then forced downwardly through the separating layer of paper P thus enabling them to be easily withdrawn lengthwise from the larger underlying aperture. This method of reproducing the characteristic mat sections one above another renders possible the successive recovery of the nowel cross bars from the successive castings. In this connection it will also be noted that the cross bars 41 and 33 are separated by the thickness of the grid wires 3 plus a reasonable amount of tolerance above the grid, the spacing of the cross bars permitting initial continuity of the bodies of adjacent slabs 2 through the several zones 71 which later fracture to produce articular joints between the successive slabs of the unit mat section.

A nowel end bar is illustrated in Figs. 17 and 18 which feature the reduced end extensions 30 thereon which engage in corresponding sockets of the side bars 24, the latter being shown in dotted lines. Similarly in Figs. 19 and 20 I have shown the nowel cross bars 33 having reduced ends which pass through apertures in the side bars 24 shown in dotted lines, the extremities of said ends contacting the inner face of the outside wall of said bars. These cross bars which are V-shaped in cross section may be formed by die stamping a suitable plate or by welding together two separate plates with bevel contact edges, or they may be otherwise constructed as illustrated in Figs. 33, 34 and 35, their reduced end extensions 34 being formed by cutting away the lower edges of the bars and in forming them their apices may be either pointed or rounded slightly without affecting their functional operation.

In Fig. 21 I have shown in elevation a face view of the inner side of one of the nowel side bars 24 provided at its ends with the apertures or sockets 62 which receive the reduced extremities 30 of the end bars 26 and also an intermediate section of the bar showing the aperture and socket 63 provided for the reception of the reduced end 34 of one of the cross bars 33. In connection with the latter there is also illustrated the key lug 36 with its yieldable wings 37 which as before explained fit within and engage the inclined side walls of the V-shaped openings 5^a of a unit mat section. It will be noted that this key lug is centered immediately below the cross bar socket 63 at which point it is welded or otherwise permanently attached to the lower inner face of the side bar 24. The arrangement of the several parts shown in Fig. 21 are also further illustrated in the plan views

Figs. 22, 22A and 22B and in the associated cross sections of Figs. 23 and 24.

The method and the mold forms above described will be best understood from the illustrations shown in Figs. 25 to 29, which are small scale drawings, illustrating the manner in which the mold forms are employed in the reproduction of unit sections of an articulated slab revetment mat forming the subject of my copending application Serial No. 727,043 from which will be seen the desirability of dividing the mold flask into end segments and intermediate segments which will practically adapt themselves in conformity with the curve of a barge deck or unavoidable irregularities in the ground surface of the casting yard. The end segments of the cope carry the end cross bars of the molding flask in addition to two or more cross bars, while the intermediate cope segments consist of the side bars and two or more cross bars. The segments are vertically butt jointed, preferably, at certain of the form boxes 42 with small horizontal clearance between the ends of the abutting side bars. In Fig. 25 the mold form unit is shown conveniently sub-divided into two end segments 66 and five intermediate segments 67.

Figure 26 shows a plurality of precast sections successively molded upon a casting base template 35 which may be constructed of wood, metal or concrete, the essential features being accurate lineal dimensions corresponding to the mat sections to be reproduced with crosswise openings 60 in the top of the template corresponding to the shape and spacing of the V-shaped opening 5^a (Figs. 1, 1A and 16).

In a casting yard these unit tiers of mat sections will be laid out in pairs as shown in Fig. 27 with a convenient space between the tiers sufficient for the passage of workmen, while between said pairs sufficient space is provided for the lateral withdrawal of the nowel cross bars 33 in dismounting the mold upon the completion of the casting. The width of this last mentioned space may vary from the minimum used when the castings are made on the decks of barges with a floating casting plant to that required to provide a roadway for the passage of trucks, industrial railways, power cranes or the like where the unit mat structures are prefabricated in casting yards. Part of an extensive lay-out for a riverside casting yard is illustrated in Figs. 28 and 29.

In Figs. 26 and 27 the method and direction of removal of parts of the mold form assembly from its position on a completed casting on one of the tiers of sections is illustrated by representing the parts in broken lines as these are removed. First the end cope segments 66 are lifted vertically followed successively by the intermediate cope segments 67. Next the nowel side bars 24 are loosened and withdrawn laterally as indicated in Fig. 27. This frees the end bars 26 of the nowel and its cross bars 33. In this operation it usually happens that in loosening or freeing the cross bars they automatically break through the underlying paper sheet, but if this does not occur the bars may be easily forced downwardly to rupture the paper whereupon they may be removed longitudinally.

In a casting yard the material composing the bodies of the castings is distributed from the central mixing plant by means of trucks, railway cars passing alongside the rows of tiers or by other suitable means such as gravity or compressed air systems, overhead carriers, cranes

and the like as will be understood. The tiers of sections are moved as units from the yard by means of trucks, trailers, suitable cars or other suitable mechanical devices from which the unit tiers are loaded by suitable power machinery onto barges which are towed to the site of the revetment where the unit sections are removable singly, for assembly into the mat structure, by means of a power crane mounted on a launching float of a "sinking plant" as more fully illustrated and described in my copending application previously mentioned Serial Number 727,043.

The unit mat sections to be cast by the use of the flask described herein are preferably a good quality of concrete made of Portland cement, sand, gravel or broken stone. The preferred material for constructing the mold form is sheet metal of either steel or aluminum rolled or stamped into the required shape with the parts suitably united by welding, riveting or bolting, or they may be constructed of wood or a combination of wood and metal.

In handling the parts of the mold form before assembly they are coated with oil or an equivalent by either dipping the parts in a vat or brushing or spraying them to prevent adherence of the concrete to the forms and at the same time facilitate the cleaning of the parts before their assembly to make a subsequent casting.

It will be seen from the foregoing that I have provided means whereby each mat section is a duplicate of its predecessors in a tier, as it will be comprehended that uniformity in the dimensions of such units is essential within acceptable tolerances. In practical operations it is to be understood that many tiers of mat sections will be built up at the same time in order to support operations of normal magnitude. Normally each tier may receive one to three castings per day depending upon weather conditions and the setting quality of the cement employed. In a large mat assembly plant requiring commensurate casting yard capacity the pouring of the castings is a continuous operation. The concrete or other material carriers move over or alongside the rows of tiers pouring one casting after another on successive tiers without interruption in furtherance of which as many duplicate mold forms or flasks as may be required are employed. I claim:

1. A mold flask for casting unit sections of articulated slab revetment mats in stacks of sections comprising a cope having end pieces, connecting side pieces for molding the longitudinal side faces of a section, and cross pieces carried in spaced relation between said side pieces for forming V-shaped grooves in the upper face of a mat section, an underlying nowel having demountable sides and ends and inverted V-shaped cross pieces alined with the cope cross pieces and of a size to drop into the grooves formed by the cope cross pieces in the preceding mat section when the nowel cross pieces are liberated by the disconnection of the nowel sides.

2. A mold flask for casting in superimposed relation unit sections of articulated slab revetment mats with one section registering above another, comprising a cope having ends inclined inwardly, connecting side pieces, and V-shaped cross pieces carried in spaced relation on said side pieces, an underlying nowel composed of demountable side pieces extending inwardly of the molding faces of the cope sides, nowel ends having faces inclined outwardly, and inverted V-shaped cross pieces in alinement with the cor-

responding cope cross pieces and of lesser cross sectional area than the latter, flanges on the bottom of the nowel side pieces having faces lying in the planes of the inner faces of the cope side pieces and registering key-lugs attached to the under faces of the nowel side pieces and extending inwardly from said flanges and alined with and having the shape in cross section of the upper part of the cope cross pieces.

3. A mold flask for casting unit sections of articulated slab revetment mats comprising a cope having side pieces arranged to mold the longitudinal upper side faces of a unit mat section, end pieces and spaced connecting cross pieces rigidly joined to the cope side pieces respectively shaping the ends and forming grooves across the top of the mat section, a nowel comprising sides underlying the sides of the cope and extending inwardly from the molding faces thereof of having socket openings therein, end pieces fitted at their extremities in some of the openings and cross pieces also fitted at their ends in other openings in alinement with the cope cross pieces and serving to mold grooves in the bottom of the unit mat section underlying those in its top surface, the nowel cross pieces being smaller in cross section than the corresponding cross pieces of the cope and removably attached above the bottom of the nowel side pieces, flanges below the bottom of the nowel having inner bearing faces in alinement with the mold faces of the cope side pieces, and downwardly extending lug-keys on the nowel alined with and similar in cross section to the top portion of the cope cross pieces.

4. A mold for casting uniform unit sections of an articulated slab revetment mat in superimposed relation, said mold consisting of an assembly of complementary rectangular upper and lower frames, said frames having cooperating members for securing a continuous bonding-reinforcing grid between them, transverse V-shaped cross pieces in the upper frame, alined transverse inverted V-shaped cross pieces in the lower frame of lesser cross sectional area, said cross pieces serving to define slabs to be connected by the interposed grid above and below the zone of the grid, means on the lower frame for engaging the borders of the preceding casting to support, hold and aline the mold thereon, other means on said frame for engaging within the recesses formed in the top face of said casting for effecting positive registration of the mold with the base casting, the cross pieces of said lower frame being disconnectable therefrom and removable endwise from the grooves in the top of a preceding casting.

5. A rectangular mold for prefabricating successively in superimposed relation uniform unit sections of an articulated slab revetment mat including continuous wire bonding-reinforcing grids extending through all slabs of each section, said mold consisting of two complementary, rectangular, detachably interlocking, open faced frames with corresponding, associated, complementary members, adapted to include within its borders and positioned in an open zone, formed by the interior members being spaced apart, the continuous wire bonding-reinforcing grid for incorporation within a unit mat section casting, the interior parts of the mold lying under the wire grid being separately demountable and removable from the completed casting through corresponding openings in the base casting, means attached to the detachable side pieces of

the lower frame to secure positive alignment and centering of the mold with respect to the preceding casting serving as a base, the transverse members of the mold consisting of a series of complementary parallel pairs of triangular bars oppositely and inversely disposed vertically with oppositely beveled molding faces, the lower frame side members extending inside the molding faces of the upper frame side members to form a continuous recess in the edge of the lower face of the casting; vertical form boxes attached to the inside faces of border members of the mold to expose the borders of the wire grid and provide recesses for seating fastenings between the sections of a mat structure.

6. A mold for casting uniform unit sections of an articulated revetment mat in stacks of sections, one successively above another, each unit section comprising a series of slab elements, said mold consisting of an assembly of two complementary rectangular frames, one above the other, adapted to contain within their borders and support between their interior members a continuous bonding reinforcing wire fabric for inclusion within the casting and at the same time allow the plastic material of the casting to flow freely between the adjacent slabs of the casting in the zone of the wire fabric thus interconnecting them, said interior members of the upper frame being triangular in cross section, each cooperating with a similar, but smaller, interior member in the lower frame to form V-shaped grooves between slabs above the wire fabric, and

similar but smaller vertical inverted V-shaped grooves in opposed position between slabs below the wire fabric, the interior members of the lower frame being demountable and separately removable from the finished casting through the corresponding upper, larger V-shaped grooves of the preceding casting; connected with the lower frame side member, means for engaging the grooves and borders of the preceding casting to support the mold thereon and secure positive registration of the mold with its parts, and means for securing positive longitudinal alignment of the mold with the base casting, form boxes around the interior borders of the mold to form clip fastening recesses around the borders of the mat sections.

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