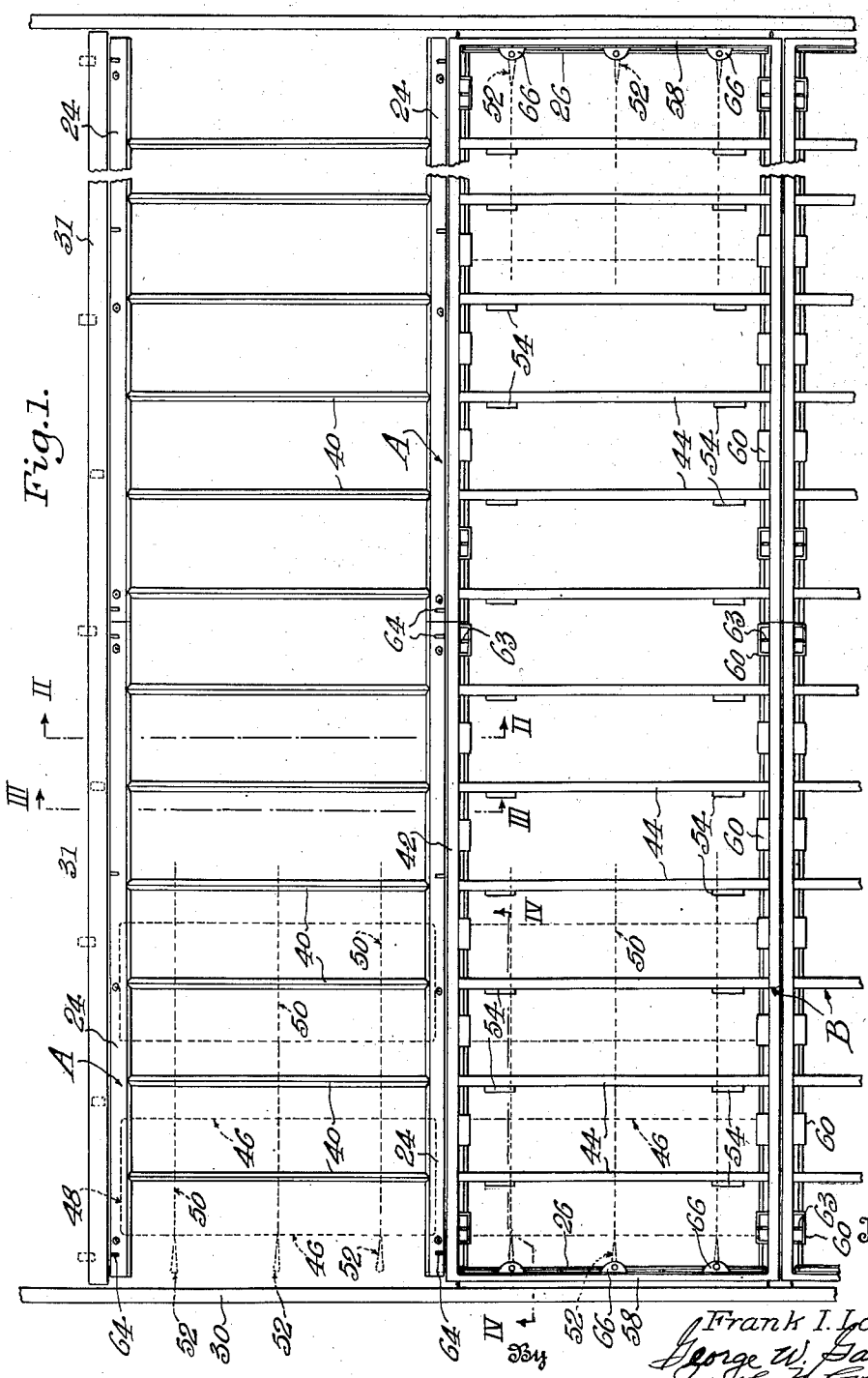
April 29, 1952 F. I. LOUCKES 2,594,324

MOLD FOR CASTING FLEXIBLE REVETMENT MATS

Filed May 2, 1950 6 Sheets-Sheet 1

Fig. 1.



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MOLD FOR CASTING FLEXIBLE REVETMENT MATS

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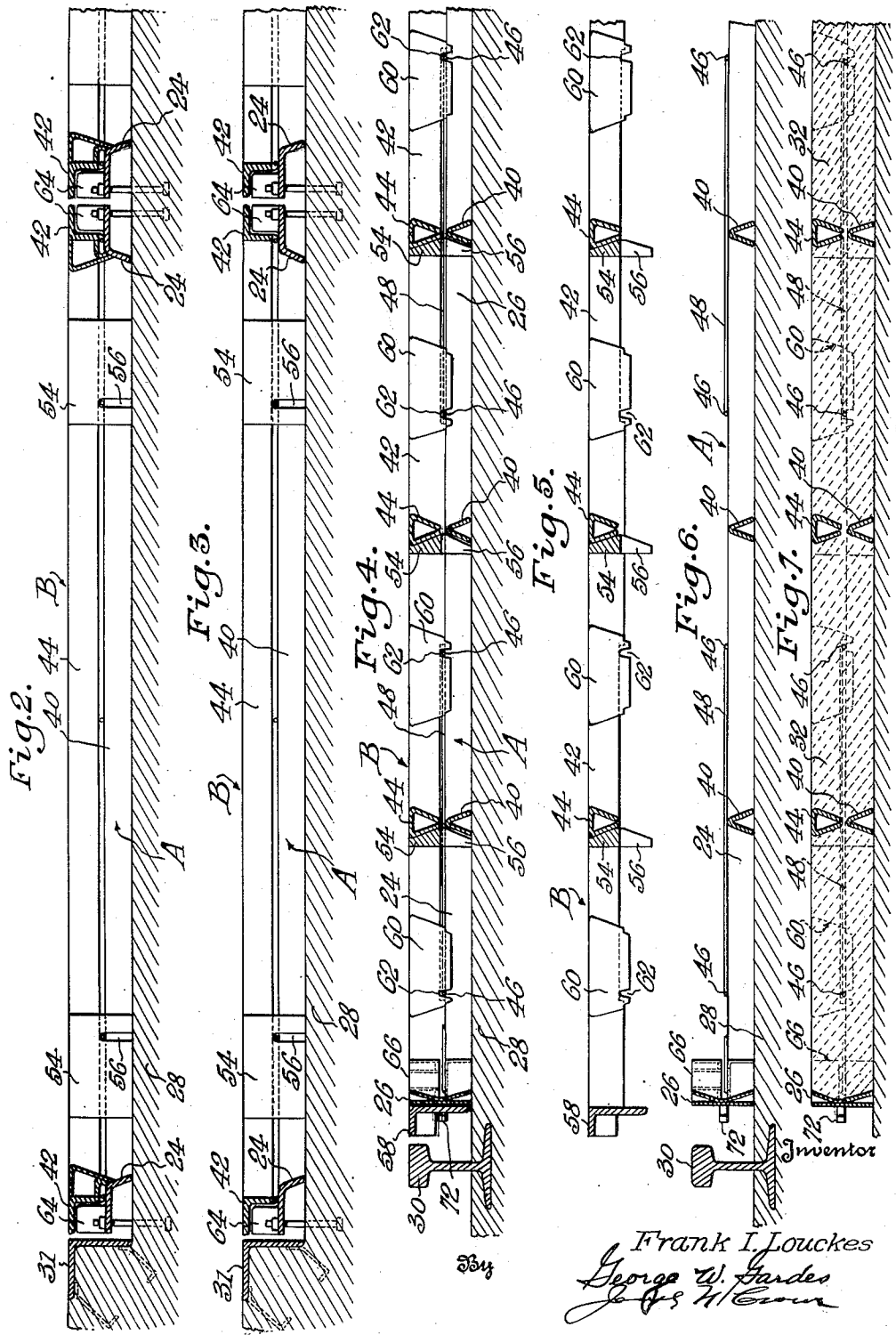


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

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MOLD FOR CASTING FLEXIBLE REVETMENT MATS

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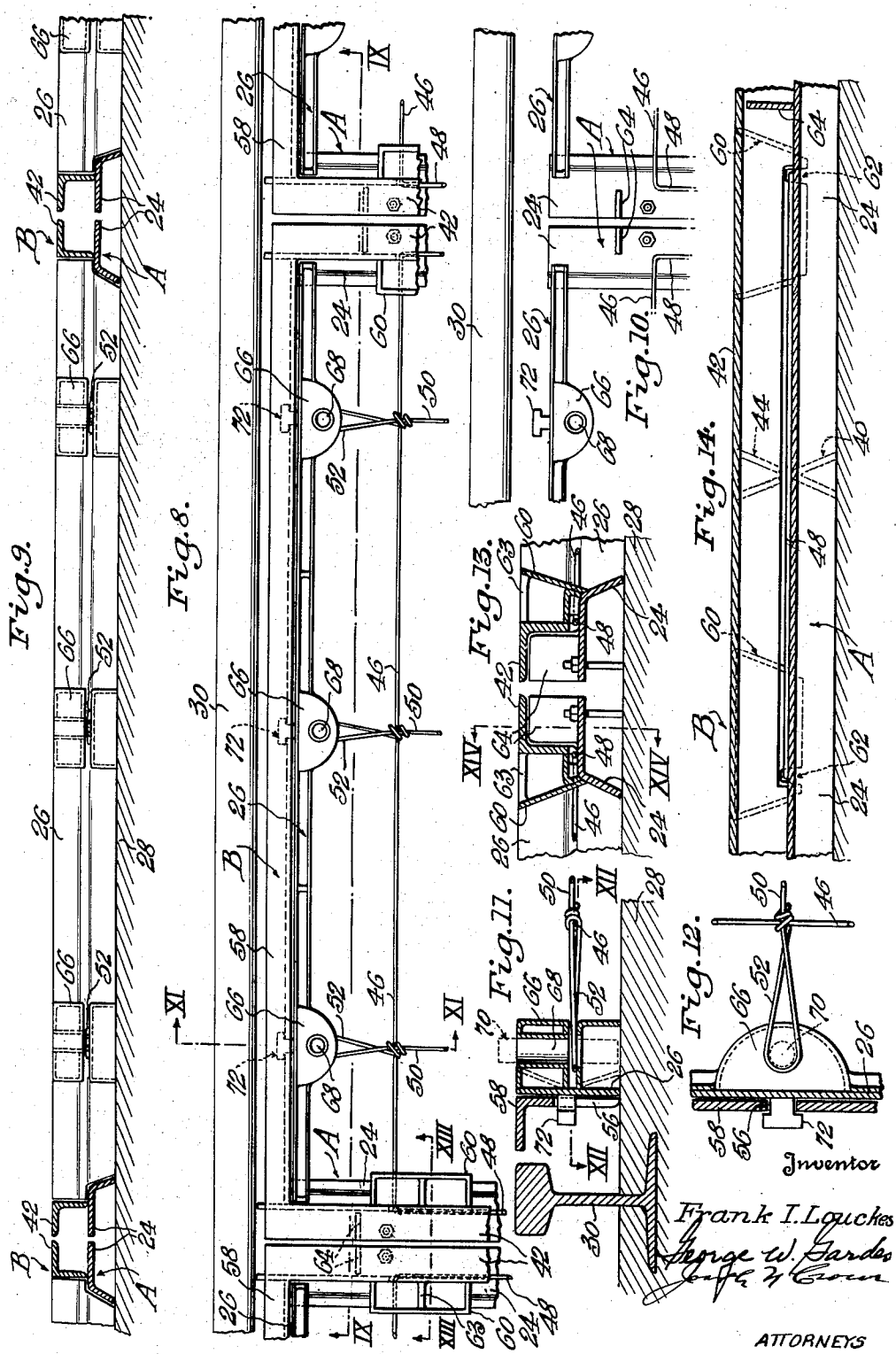


Fig. 9.

Fig. 8.

Fig. 10.

Fig. 13.

Fig. 14.

Fig. 11.

Fig. 12.

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MOLD FOR CASTING FLEXIBLE REVETMENT MATS

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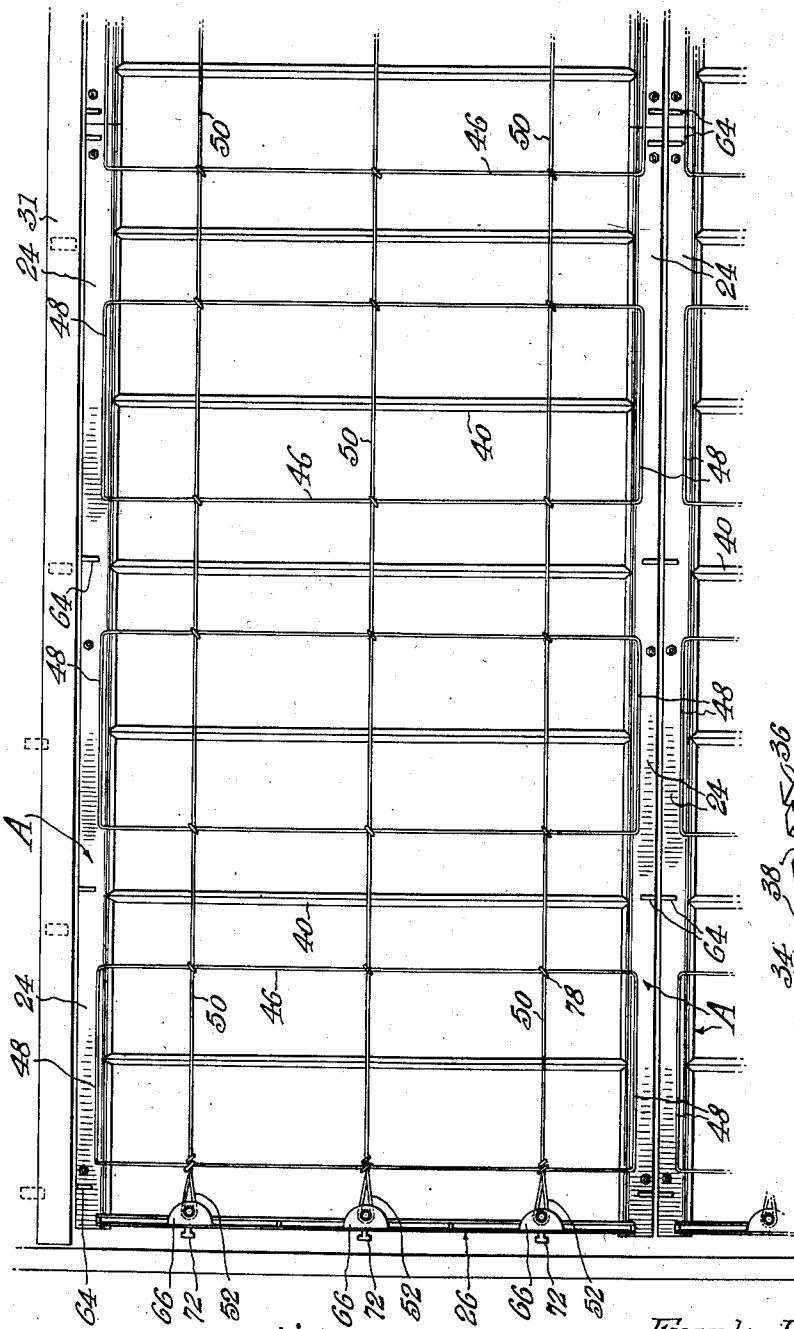


Fig. 15.

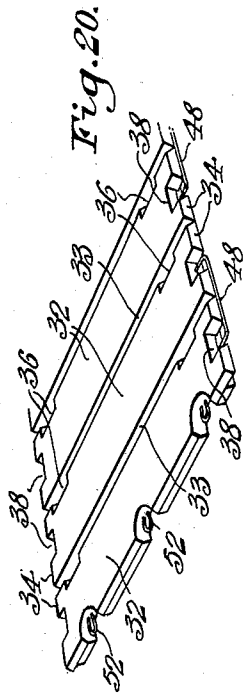


Fig. 20.

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MOLD FOR CASTING FLEXIBLE REVETMENT MATS

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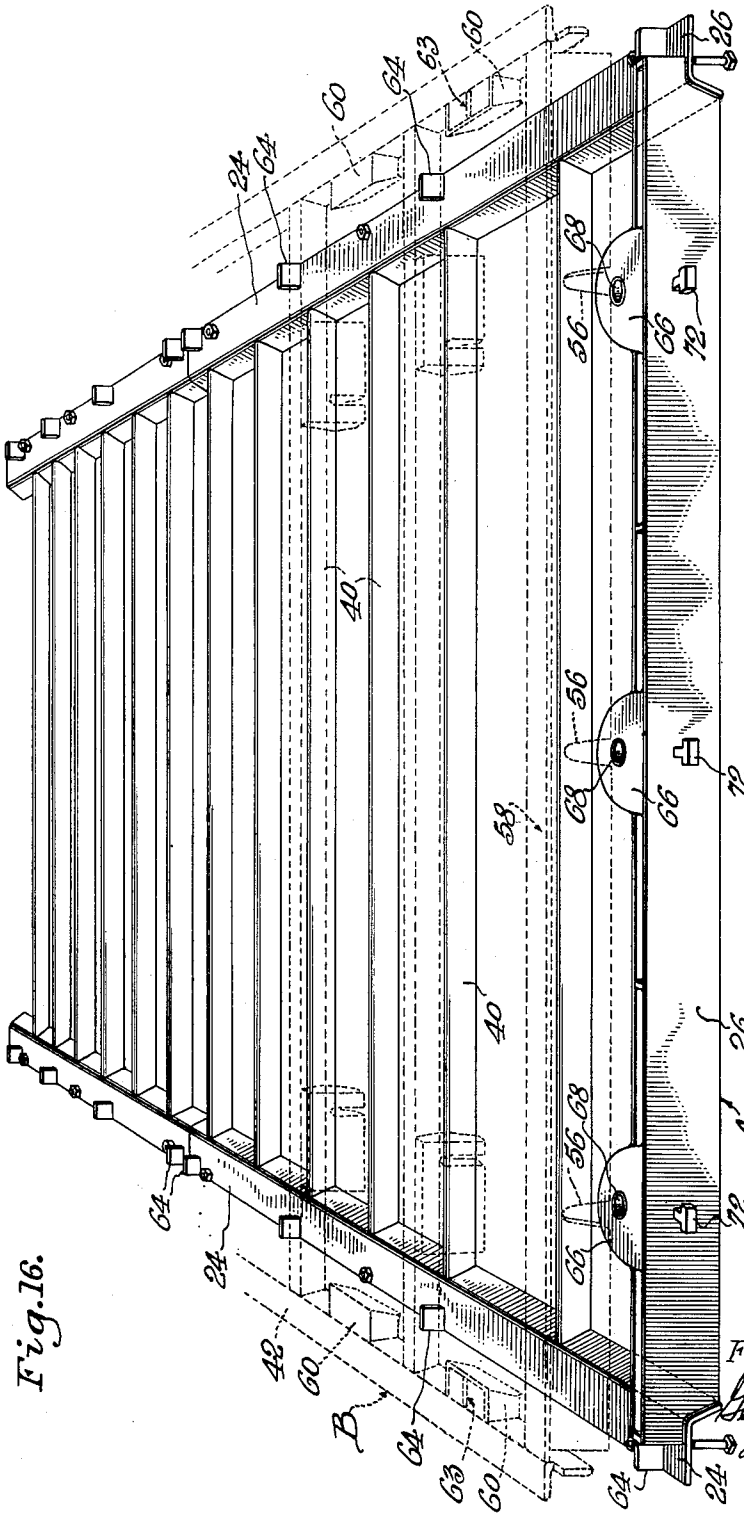


Fig. 16.

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MOLD FOR CASTING FLEXIBLE REVETMENT MATS

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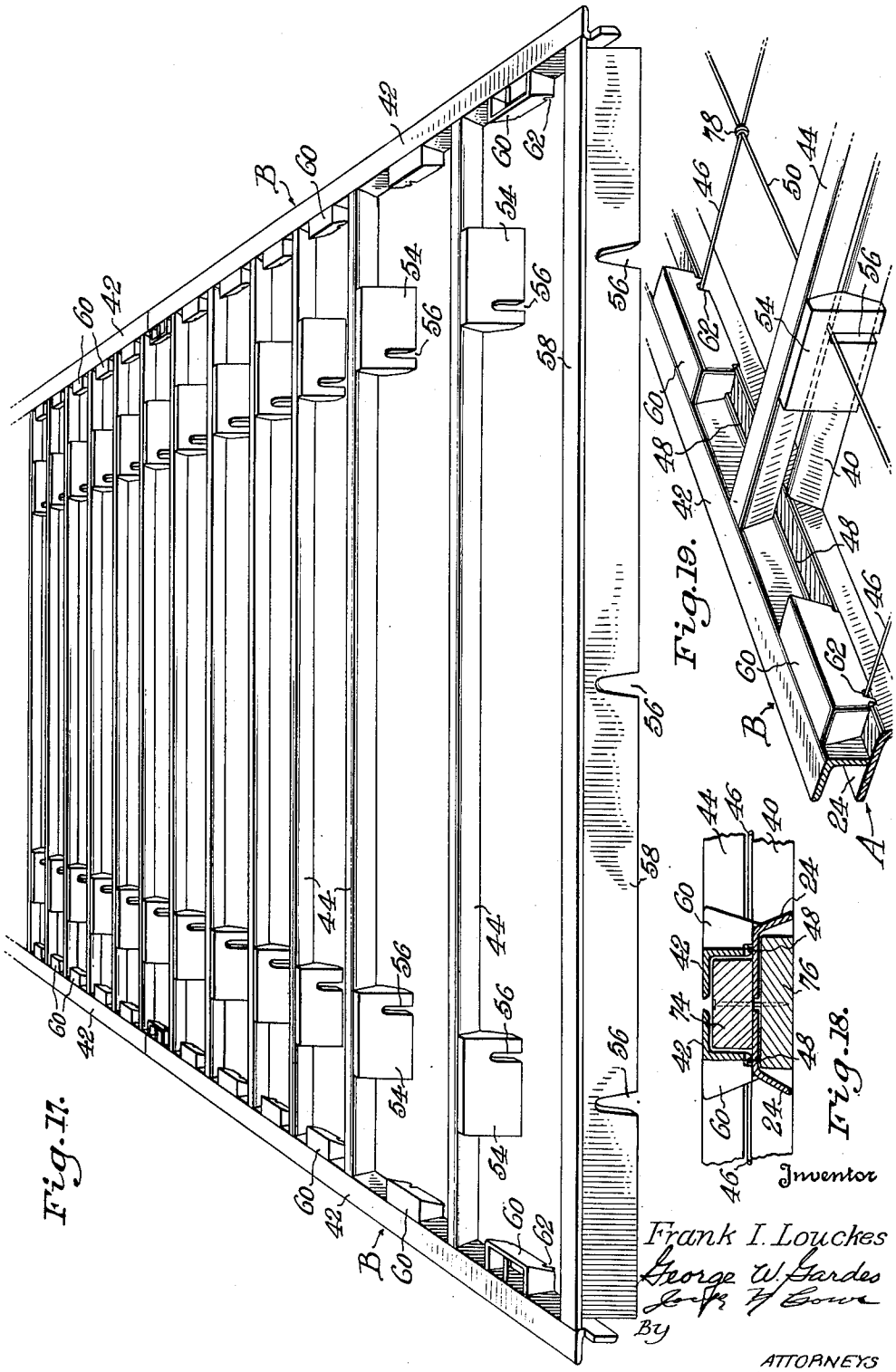


Fig. 17.

Fig. 19.

Fig. 18.

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Patented Apr. 29, 1952

2,594,324

UNITED STATES PATENT OFFICE

2,594,324

MOLD FOR CASTING FLEXIBLE REVETMENT MATS

Frank I. Louckes, Memphis, Tenn.

Application May 2, 1950, Serial No. 159,563

7 Claims. (Cl. 25—121)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without payment to me of any royalty thereon.

The present invention relates to improvements in the casting of concrete revetment mats that are employed for the protection of shore lines, river banks, beaches and the like, from erosion through the action of waves, currents and other erosive effects.

These revetment mats usually are of the flexible type, which is composed of reinforced concrete slabs that are interconnected flexibly in both longitudinal and transverse directions. Generally speaking, these revetment mats, when placed, constitute permanent installations. Therefore, they must be of sufficient weight to prevent displacement or dislocation through the actions of currents and waves, and they must be sufficiently flexible in all directions to enable them to be self-accommodating to irregularities of the shore line.

The flexible revetment mats of the present type comprise a plurality of interconnected flexible sections or "squares," which are built up to the requisite length and width by flexibly interconnecting thereto similar flexible sections in side-by-side and end-to-end relation. Each of these squares is composed of concrete blocks or slabs, generally rectangular in shape, which are interconnected by flexible reinforcing cables that form flexible hinge connections between the blocks. When the blocks are assembled into squares and the squares interconnected in end-to-end and side-by-side relation, a revetment mat is formed of any necessary length and width, and which is sufficiently flexible to permit considerable bending or flexure of the mat in both directions, thus enabling the mat to conform to the irregularities of the bank or beach, and assuring complete coverage thereof. However, the usual type of revetment mat is open to certain disadvantages, one of which is the tendency of adjacent blocks to open up and to become separated to an extent that erosion of the underlying surfaces may occur.

That is to say, the usual or "standard" revetment mat is composed of a plurality of flexible, and flexibly interconnected, squares, each square being composed of concrete blocks or slabs, and consisting usually of twenty flexibly interconnected blocks or slabs, each of which is about three inches thick by fourteen and three-fourths inches wide, and three feet ten and one-fourth inches long, the long dimension of the blocks being disposed transversely of the square, which measures usually three inches in thickness, three feet ten and one-fourth inches wide and twenty-four feet eleven and one-half inches long, there being open spaces between consecutive blocks one and five-eights inches wide by three inches deep. These measurements are regarded as being only approximate, and are noted by way of illustration only. The whole structure is reinforced and bound together by a continuous structure of wire fabric located in a plane midway between the top and bottom surfaces of the square. The open spaces between the blocks are left to provide necessary flexibility between the blocks to permit the mat to be launched from the launching plant, and to render the mat self-accommodating to irregularities in the underlying surface. When the mat squares are assembled on the sinking or launching plant and sunk as revetment, or placed on a bank as paving, open spaces one and three-fourths inches wide are left between longitudinal edges of consecutive squares. This construction is necessary in order to provide openings through which the squares may be connected together and to the launching cables between them to form the revetment. The launching cables are required to support the weight of the squares while they are being launched from the sinking plant and sunk to the river bed. The standard type of revetment mat is cast in stacks with one square upon another and with paper separators between them. When the concrete poured into a form has set sufficiently, the form is lifted off vertically and the paper separators are spread over the square. The form then is reset on the paper and again is filled with concrete.

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The deficiencies in the present standard articulated concrete revetment lies in the fact that river bed and river bank materials wash out through the openings between the concrete blocks composing the squares, and between the squares themselves, frequently causing an early failure of the revetment. This is true particularly where the foundation is of sandy material.

From the foregoing, it will be apparent that the present invention relates to an improved revetment mat which is fully flexible in both longitudinal and lateral directions for enabling the revetment to adapt itself to irregular and changing contours of a river bank or bed on which the revetment is placed, while at the same time maintaining the concrete slabs of each square in closely adjacent relation both side-by-side and end-to-end for preventing the foundation material

washing out from beneath the positioned revetment mat.

The improved revetment mat to which this invention relates is produced by casting the slabs with square butt ends, the top portions of which overhang the lower portions and with the sides of the slabs in the form of double V-shaped grooves oppositely disposed in a vertical plane above and below the horizontal plane of the reinforcing grid wires, so that close end-to-end and side-by-side interfit with adjacent slabs can be obtained for preventing washing out of the underlying embankment. The individual slabs are provided with sutiable recesses affording access to the reinforcing wires for enabling insertion of a lifting tool and for tying together corresponding wires of adjacent slabs and sections.

More specifically, the present invention relates to a casting assembly of a plurality of molds for casting the concrete slabs and mat squares of the improved character.

The invention has for one of its objects, the provision of a multiplicity of molds for casting concrete slabs of the improved configuration, the said molds being adapted to cast a complete square of a revetment mat, and comprising upper and lower separable mold sections with transverse elements in connection with the respective sections for the purpose of forming the V-shaped grooves of the mattress construction, the slabs being cast with the flexile reinforcing and connecting wires embedded therein.

Further objects of the invention will become apparent as the description proceeds, and the features of novelty will be pointed out in particularity in the appended claims.

The invention will be understood more clearly by reference to the accompanying drawings in which:

Fig. 1 is a fragmentary plan view of a casting assembly adapted to cast a plurality of revetment squares composed of the improved concrete slabs of the present invention, the molds forming each of the squares being shown placed in end-to-end relation, the top section of the view showing the bottom mold assembly ready to receive the concrete, the top assembly being removed and the reinforcing wires being indicated in position, but by dotted lines, the remainder of the view showing the top assembly in position on the bottom forms;

Fig. 2 is a sectional elevation taken on the line II—II of Fig. 1 looking in the direction of the arrows, the molds being shown as being assembled;

Fig. 3 is a similar sectional elevation taken on the line III—III of Fig. 1 looking in the direction of the arrows;

Fig. 4 is a fragmentary longitudinal sectional elevation, taken on the line IV—IV of Fig. 1, looking in the direction of the arrows;

Fig. 5 is a view similar to Fig. 4, but showing the top form only;

Fig. 6 is a further view similar to Fig. 4, but showing the bottom form only;

Fig. 7 is a view similar to Fig. 4, but showing the forms filled with concrete;

Fig. 8 is a fragmentary plan view of the lower left hand portion of Fig. 1, showing the top form in position, with an end plate and molding shape in position, the view showing the manner of retention of the end plate and end molding shapes in position by the top mold form;

Fig. 9 is a sectional elevation on line IX—IX of Fig. 8, looking in the direction of the arrows;

Fig. 10 is a fragmentary plan view of a portion of the assembly shown in Fig. 8 with the top mold form removed;

Fig. 11 is a transverse sectional elevation through the elements shown in Fig. 8, the view being taken on the line XI—XI of Fig. 8, looking in the direction of the arrows;

Fig. 12 is a sectional plan view taken on the line XII—XII of Fig. 11, looking in the direction of the arrows;

Fig. 13 is a sectional elevation taken on the line XIII—XIII of Fig. 8, looking in the direction of the arrows;

Fig. 14 is a longitudinal sectional elevation, taken on the line XIV—XIV of Fig. 13, looking in the direction of the arrows;

Fig. 15 is an enlarged detailed plan view of the bottom mold assembly, showing the reinforcing wires for the concrete slabs in position with terminal loops of the longitudinal wires secured in position for receiving the concrete;

Fig. 16 is a fragmentary perspective view of the bottom mold assembly, with the end member in position, the top form being shown in dotted lines above the bottom mold assembly;

Fig. 17 is a fragmentary perspective view of the top mold form, which is adapted to interfit with the bottom mold assembly;

Fig. 18 is a fragmentary detailed sectional view of adjoining mold assemblies, the view showing the provision of wooden filler blocks for preventing entry of concrete into the blocked off spaces, the view being similar to Fig. 13;

Fig. 19 is a fragmentary perspective view showing a portion of the upper and lower mold forms in assembled position with portions of the reinforcing wires being shown in position; and

Fig. 20 represents a fragmentary perspective view of adjacent side-by-side concrete slabs produced with the mold assembly of the present invention.

Referring more particularly to the drawings, the improved mold for casting flexible revetment mats comprises a lower mold assembly A and a top mold form B of similar dimensions to the lower assembly A and adapted to interfit therewith as will be described in greater detail hereinafter. The lower assembly A rests upon, and is bolted to, a substantially flat casting floor **28** and is provided with side bars **24** and end bars **26**. The casting floor **28** is of sufficiently large dimensions to permit assembling of the requisite number of mold units, each unit being of the same dimensions and having the same structural features. Rails **30** extend laterally along the mold forms, these rails being similar to railroad rails, and are adapted to support concrete spreading and finishing instrumentalities, not shown, which travel along the rails **30** for spreading and leveling concrete into the molds for casting the slabs forming the flexibly interconnected units of a revetment mat to which this invention pertains. The casting floor **28** is provided with an angle beam **31** for defining an abutment for each end of the floor.

Side bars **24** are angle bars and are positioned on the casting floor **28** at a distance such that the slabs cast in the mold forms will have the desired requisite length, for example, that which has been mentioned hereinabove.

As will be seen from Fig. 20, the slabs, which are designated by reference numeral **32**, are distinguished by having their sides formed with dou-

ble V-shaped grooves 33 oppositely disposed in a vertical plane above and below the horizontal plane passed through the center of the slabs. The slabs are characterized further by having square butt ends 34, which overhang the lower portions of the slabs, so that when corresponding slabs are assembled in end-to-end relationship, there will be formed end recesses for the reception and tying together of corresponding reinforcing wire loops and launching cables as will be pointed out further hereinafter. The slabs are characterized further by spaced stirrup openings 36 suitably spaced on a side of each of the slabs so as to register with reinforcing wires, and enable access to be had for inserting of a lifting tool for lifting the cast slabs from the mold and stockpiling the same by suitable instrumentalities, not shown. Adjacent to each end of the slabs there is a scarf opening 38 which enables access to be had to the ends of the corresponding reinforcing loops which join each pair of slabs, and the launching cables.

The mold assemblies of the present invention are designed for the casting of slabs of the described shape and characteristics.

In addition to the lateral bars 24 which extend the length of the lower mold assembly, there are transversely extending bars 40, which are shaped like an inverted V.

The top mold form B comprises lateral angle bars 42 of the same length as the said bars 24 of the bottom mold assembly A. The side angle bars 42 are connected by transversely extending V-shaped bars 44 which are adapted to register with the lower bars 40 to keep the double V-shaped configuration to be imparted to the sides of the cast slabs. Reinforcing wires 46 are laid across the lower mold assembly, these reinforcing wires being in the form of endless rectangular frames that extend across and around adjacent mold cavities forming end loops 48. Also, additional reinforcing means are shown as spaced wires 50 which extend through the entire length of the square being cast, these terminating in end loops 52, which serve a purpose to be described hereinafter. In practice, however, the reinforcing fabric is procured already assembled, such being purchased in assembled condition from the manufacturer or fabricator.

The upper form B is provided with spaced blocks 54 which are welded to corresponding sides of the V-shaped cross beams 44, these blocks 54 being in alignment and being provided to form the stirrup openings in the cast slabs. The outer faces of these blocks 54 have straight outer surfaces and are notched as indicated at 56 for the accommodation of the reinforcing wires 50. The end bars 58 of the top form are notched similarly for the same purpose. Welded to each of the side bars 42 of the top form and equidistant between the V-shaped transverse bars 54 are the hollow scarf box members 60 which are designed to form the scarf openings in the ends of the slabs. The outer surfaces of the boxes 60 slope inwardly so as to give a tapered configuration for the scarf openings. The boxes 60 are notched as is indicated at 62 for the reception of the reinforcing loop wires 46; and end boxes of each top molding frame are provided with lifting means 63.

In casting, the top form is placed on the bottom assembly. The side bars 24 of the bottom assembly are provided with upstanding lugs 64 which are provided for facilitating accurate positioning of the top frame. The end members 26 of the bottom mold assembly actually are end

plate members, as will be apparent in Fig. 16, provided with semi-circular horizontally extending end loop box forms 66, each of which has an opening 68 therein for the reception of a wooden pin 70 which holds the end loops 52 of the reinforcing wires 50 when the mold parts are assembled. The end frame 26 has outwardly projecting T-shaped lugs 72 which are adapted to receive the end notches 56 of the end bar 58 of the top form B.

In order to avoid the pouring of concrete between the corresponding side bars of adjacent mold forms placed in end-to-end relation, there may be inserted wooden filler blocks 74 and 76 as shown in Fig. 18.

It will be apparent from the foregoing description that the bottom assembly A and the top form B are made of any suitable metal such as steel, and that the bottom assembly A and the top form B are complemental parts which cooperate to form the slabs shown in Fig. 20. It will be observed that the V-shaped sides of these slabs are in close engagement, the reinforcing wires 50 forming flexible hinges between the slabs. Also, it will be seen that the ends of the slabs which are formed by the configuration of the ends of the top and bottom forms as defined by the side angles 26 and 42 are square at the top portions and recessed along the lower portions of the ends so that when similar squares are assembled in end-to-end relation, the overhanging portions and the recessed lower portions define the channel for housing the loops 48 of the reinforcing wires 46 and also launching cables for the revetment mat which are not shown in the drawings. The end scarf openings in the slabs provide access to these loops and permit the tying together of such loops of contiguous slabs disposed end-to-end, while the stirrup openings enable access to the longitudinally extending reinforcing wires 50. When these reinforcing wires 46 and 50 are assembled they may be tied together in any suitable manner as by a wrapping of wire or the like 78. In practice, this reinforcing fabric is procured in pre-assembled condition.

The configuration of the slabs in the cast squares enables one square to be attached readily to another of similar size and shape so that all parts will be maintained in close juxtaposition so that erosion of the surface upon which the revetment is laid will be avoided, while the revetment retains sufficient flexibility to enable it to be self-accommodating to irregularities in the contour of the surface on which it is laid.

While the embodiment of the invention as herein described in the accompanying drawings represents a simple and the preferred manner of constructing molds suitable for casting of the improved revetment slabs to which this invention relates, it will be apparent that various structural details may be altered to suit any variations in structural details of the slabs without departing from the inventive concept and, therefore, it will be understood that it is intended and desired to embody within the scope of this invention such modifications and changes as may be necessary to adapt it to varying conditions and uses as defined in the appended claims.

Having thus described my invention, what I claim as new and wish to secure by Letters Patent is:

1. A mold flask for casting unit sections of articulated slab revetment mats in stacks of sec-

tions, comprising an upper mold section consisting of a frame having end pieces, connecting side pieces for molding the longitudinal side faces of a section and V-shaped cross pieces carried in spaced relation between the side pieces for forming V-shaped grooves in the upper face of a mat section, an underlying lower mold section complementary to the upper mold section and having sides and ends and inverted V-shaped cross pieces aligned with the upper cross pieces in vertical planes, the said cross pieces being permanently united with the sides and ends, means permanently securing the lower mold section to a casting floor, and means adjacent to the sides and cross pieces of the mold flask for molding lifting means in the mat sections for lifting the said sections out of the permanently secured lower mold section subsequently to the upper mold section being lifted from the mat sections.

2. A mold flask for casting unit sections of articulated slab revetment mats comprising an upper mold section having side pieces arranged to mold the longitudinal upper side faces of a unit mat section, end pieces joining the side pieces at opposite ends thereof, and spaced connecting cross pieces rigidly joined to the side pieces respectively shaping the ends and forming grooves across the top of the mat section, a lower mold section comprising sides underlying the sides of the upper mold section and extending inwardly from the molding faces thereof having socket openings therein, end pieces connecting the sides, and cross pieces rigidly connected at their ends to the sides and aligned vertically with the cross pieces of the upper mold section and serving to mold grooves in the bottom of the unit mat section underlying those in the top surface, the side members of the lower mold section having inwardly sloping sides and flange portions extending below and spaced from the side members of the upper mold section, and fastening means projecting through the flange portions and permanently uniting the lower mold section to a casting floor.

3. A mold flask for casting unit sections of articulated slab revetment mats comprising an upper mold section comprising a frame 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 said side pieces respectively, shaping the ends and forming grooves across the top of the mat section, a lower mold section comprising a frame including sides underlying the sides of the upper mold section and extending inwardly from the molding faces thereof having socket openings therein, end pieces rigidly connecting the sides of the lower mold section, cross pieces rigidly connecting the sides of the lower mold section in alignment with the cross pieces of the upper mold section and serving to mold grooves in the bottom of the unit mat section underlying those in its top surface, means for aligning the upper mold section and the lower mold section, and means for releasably connecting together the upper and lower mold sections.

4. A mold for casting uniform unit sections of an articulated slab revetment mat, which mold consists of an assembly of complementary rectangular upper and lower frames, the frames having cooperating members for securing a continuous bonding-reinforcing grid between them, transverse V-shaped cross pieces in the lower frame, the said cross pieces serving to define slabs to be connected by the interposed grid, both of the said upper and lower frames being permanently rigid structures throughout, cooperating means on the upper and lower frames for maintaining the frames in registering engagement during casting of the slab, means on the upper frame for lifting the said frame from the slab after the said slab has initially set, and means on the lower frame for molding lifting apertures in the slab for enabling the slab to be lifted out of the bottom frame following casting and setting of the slab.

5. A rectangular mold for prefabricating uniform unit sections of an articulated slab revetment mat including continuous wire bonding-reinforcing grids extending through all slabs of each section, the mold consisting of two superposed complementary rectangular, rigidly constructed, open-faced frames having longitudinal side bars and transverse end bars with corresponding, associated, complementary transversely extending groove-forming members in each frame, means on a corresponding side of a side bar of the top frame and on corresponding sides of the groove-forming members for molding corresponding openings in each section of the mat and positioned in an open zone formed by the groove-forming members being spaced apart, the said opening-molding means being recessed for receiving wire bonding-reinforcing grid for incorporation within a unit mat section casting, the side bars, end bars and transverse members of the mold frames being rigidly and permanently interconnected, the transverse members of the mold consisting of a series of complementary parallel pairs of triangular bars oppositely and inversely disposed 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, and an opening molding means including vertical form boxes attached to the inside faces of the side bars and transverse 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, each unit section comprising a series of slab elements, the said mold comprising 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, the interior members of the upper frame being triangular in cross section, each cooperating with a similar interior member in the lower frame to form V-shaped grooves between slabs above the wire fabric, and similar vertical inverted V-shaped grooves in the opposed position between slabs below the wire fabric, the interior members of the lower frame being separable from the casting when finished by lifting the casting from the frame, both of the mold frames comprising completely rigidly interconnected lateral and transverse members, means for securing registering alignment between the frames when assembled, and form boxes around the interior borders of the mold to form clip-fastening recesses around the borders of the mat section.

7. A mold for casting uniform unit sections of

an articulated revetment mat in unit sections, each unit section comprising a series of slab elements, the 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, the interior members of the upper frame being triangular in cross section, each cooperating with a similar member in the lower frame to form V-shaped grooves between slabs above the wire fabric, and similar vertical inverted V-shaped grooves in opposed position between slabs below the wire fabric, all elements of both the upper and lower frames being permanently rigidly secured together, aligned block means permanently secured to the triangular interior members of the upper frame, the said block means having straight outer surfaces and notched under surfaces for accommodating the said wire fabric, box members rigidly mounted on the side bars of the top frame having inwardly

sloping outer surfaces and notched bottoms for receiving the wire fabric, the block means forming stirrup openings in the cast slab and the said box members forming scarf openings in the cast slabs, end box members of the top molding frame having lifting means therein for receiving lifting instrumentalities for lifting the top frame from the cast slab, the resulting openings in the cast slab enabling the slab to be lifted out of the botto mframe, and means for anchoring the bottom frame to a permanent casting floor.

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