Aug. 14, 1956 C. R. CARLSON ET AL 2,758,353

MEANS FOR CASTING CONCRETE BEAMS

Filed Nov. 20, 1953 3 Sheets-Sheet 1

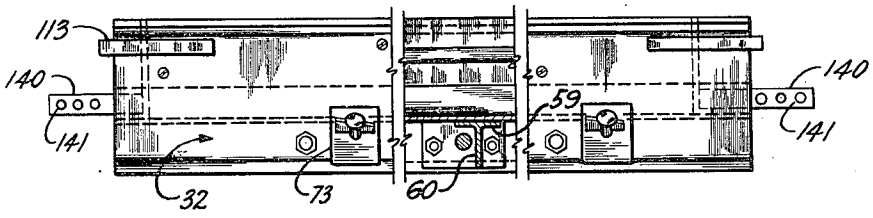


Fig. 1

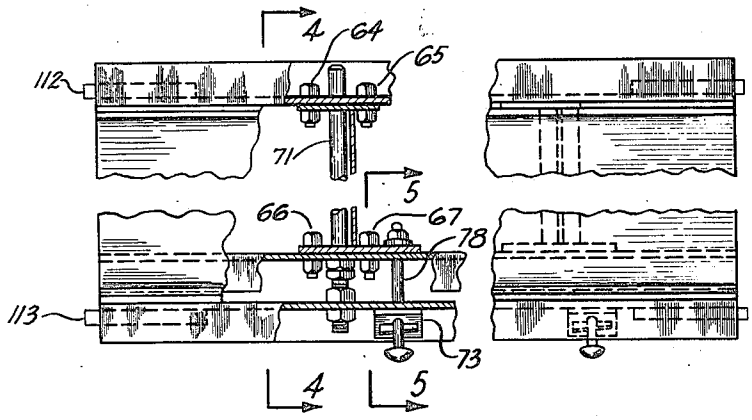


Fig. 2

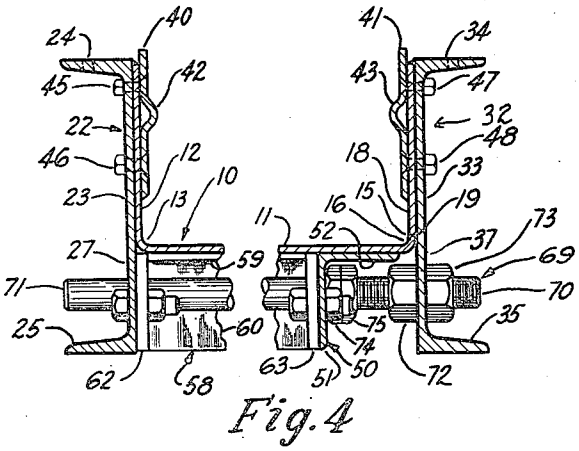


Fig. 4

INVENTORS
Carl R. Carlson, Archie R. Gagne
& Eugene M. Swenson
BY Robert G. Kalin
Attorney

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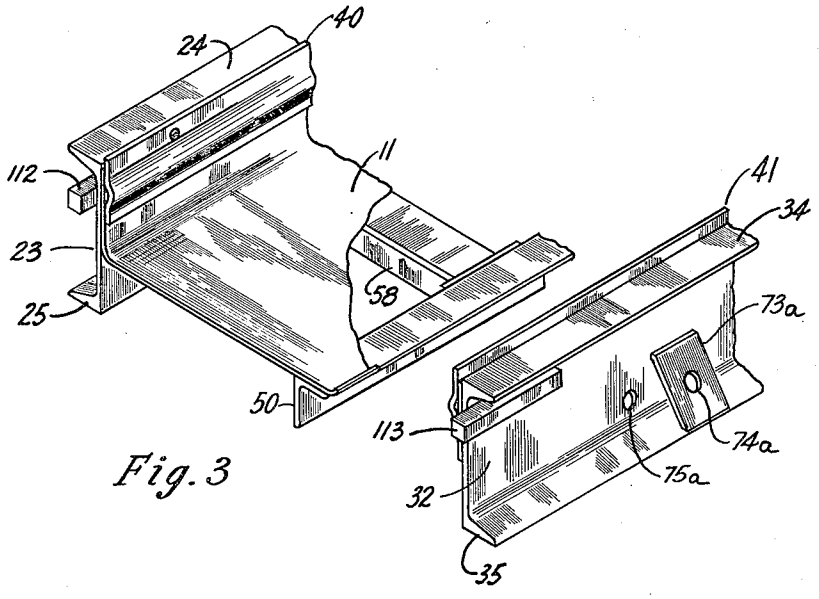


Fig. 3

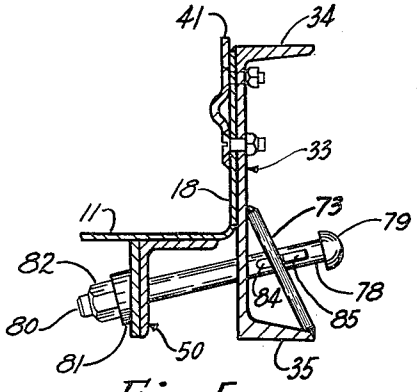


Fig. 5

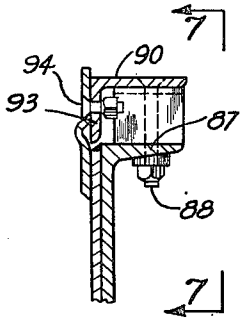


Fig. 6

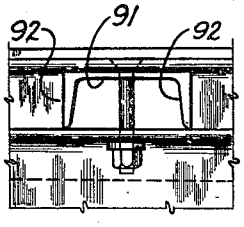


Fig. 7

INVENTORS
Carl R. Carlson, Archie R. Gagne
& Eugene M. Swenson
BY Robert L. Kahn
Attorney

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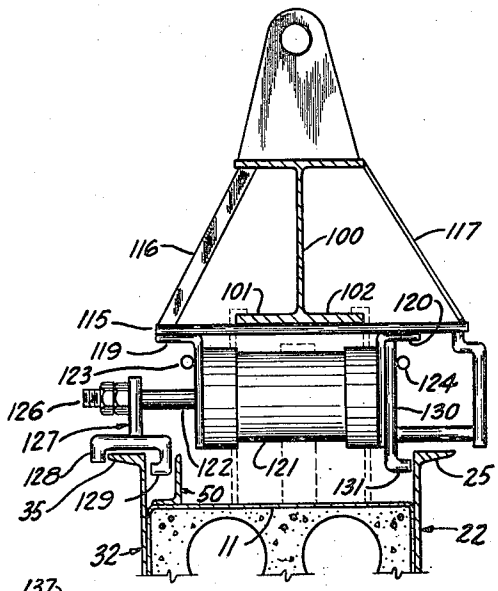


Fig. 8

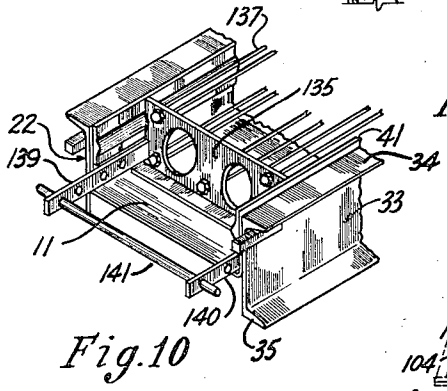


Fig. 10

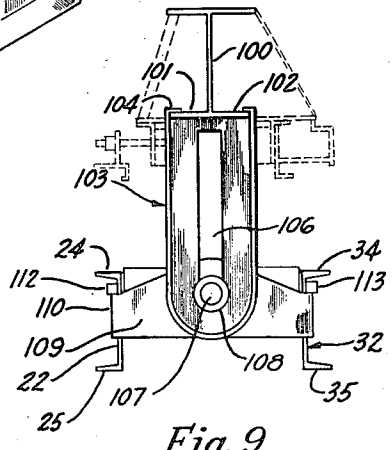


Fig. 9

INVENTORS
Carl R. Carlson, Archie R. Gagne
& Eugene M. Swenson
BY Robert L. Kahn
Attorney

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MEANS FOR CASTING CONCRETE BEAMS

Carl R. Carlson, Harvey, Archie R. Gagne, Homewood, and Eugene M. Swenson, Hazelcrest, Ill., assignors to Calumet Flexicore Corporation, a corporation of Indiana

Application November 20, 1953, Serial No. 393,288

3 Claims. (Cl. 25—121)

This invention relates to means for casting concrete beams. While the casting means may be used for casting any desired type of concrete beam, it is particularly useful for casting concrete beams or slabs as disclosed and claimed in United States Patents 2,299,070, 2,299,071, 2,299,072 and 2,299,111. In these patents there is disclosed an elongated beam of concrete having cored passages therethrough and provided with prestressed steel reinforcement. The invention to be hereinafter disclosed and claimed constitutes an improvement upon the casting mold described in said patents. It will be understood, of course, that the new casting mold may be used for any type of elongated concrete beam.

In United States Patent 2,614,309 issued on October 21, 1952, there is disclosed a casting mold having a generally U-shaped section, said mold being adapted to be sprung open for releasing the cast beam. This invention provides a mold which is so constructed that it may readily be opened to release the cast beam. The mold in the present invention is adapted to be closed to present a substantially smooth unbroken surface of the concrete so that no sensible ridge appears at the mold break in the cast concrete. Because of the requirement for curing concrete, it is desirable that the mold itself be as simple as possible so that a large number of molds may be kept in stock for continuous production. The mold embodying the present invention is provided with means which are simple and effective for maintaining the mold in tightly locked position while the concrete is curing, the mold and contents being susceptible to conventional handling as with other molds. The invention also provides means cooperating with the mold so that when said mold and means are in proper cooperative relation, the mold may be opened to release the cast beam or the empty mold may be closed for the purpose of receiving concrete preliminary to the casting of a beam.

The mold embodying the present invention, together with the means cooperating therewith for operating the mold, is so constructed that long beams may be handled effectively. In order that the invention may be understood, an exemplary embodiment will be disclosed in connection with the drawings. The embodiment illustrated is exemplary and may be varied without departing from the scope of the invention except as defined by the appended claims.

Referring now to the drawings,

Figure 1 is a side elevation of a casting mold embodying the present invention.

Figure 2 is a plan view of the mold illustrated in Figure 1, certain parts being broken away.

Figure 3 is a perspective exploded view of parts of the mold to illustrate the manner in which the mold splits.

Figure 4 is a section along line 4—4 of Figure 2.

Figure 5 is a sectional detail along line 5—5 of Figure 2.

Figure 6 is a sectional detail of a part of a mold wall illustrating the manner in which the depth of the mold may be changed.

Figure 7 is a side elevation along line 7—7 of Figure 6.

Figure 8 is an end view in section illustrating the supporting means for the mold, the supporting means being in a mold-releasing position.

Figure 9 is an end view of the suspension means for the mold.

Figure 10 is an isometric detail of the mold when closed and showing one bulkhead.

The mold proper has angle iron, generally indicated by 10, having bottom portion 11 and side portion 12 joined by rounded corner portion 13. Angle iron 11 has edge portion 15 extending from rounded corner portion 16. The mold proper is completed by flat strip 18, having edge 19 cooperating with edge portion 15 of the angle iron. Edges 15 and 19 abut and a snug fit between the opposed edges is provided.

Angle iron 10 is rigidly united to channel 22, having web 23 and flanges 24 and 25. The width of web 23 (the distance between flanges 24 and 25) is greater than the width of side portion 12 of the angle iron. Flange 24 of the channel is about in line with the edge of side 12, precise alignment being unimportant. Web portion 23 has part 27 extending below bottom 11 of the angle iron. Mold strip 18 is also permanently attached to channel 32, having web 33 and flanges 34 and 35 respectively. Flange 34 is also about even with the free edge of strip 18, while the web of the channel has portion 37 extending below bottom 11 of the angle iron when the mold is in assembled condition, as illustrated in Figures 1 and 2, for example.

In casting the beams, it is desirable to define regions at the sides of the beam near the top surface of the beam for accommodating grout. This region at each side may be created by providing liners 40 and 41. These liners may be of steel or of any other suitable material, and have suitable width so that the liners extend downwardly along sides 12 and 18 for desired distances. Liners 40 and 41 as illustrated are bent or shaped to provide longitudinal channels 42 and 43 respectively. Liners 40 and 41 are rigidly attached to the respective mold sides by bolts 45 to 48 inclusive. These bolts have flat heads with tapered sides and are accommodated by conical apertures in the liner body. Thus the bolt heads will be substantially flush with the liners. Suitable nuts are provided to maintain the bolts in position. The bolts may be loosened and removed to permit different liners to be used or to permit a rearrangement of the liners for accommodating beams having different width, as will be more fully disclosed later. It is understood that the liners extend the full length of the form and that bolts 45 to 48 inclusive are disposed at regular intervals along the form sides as required.

Carried by bottom portion 11 of the form outside thereof is angle iron, generally indicated by 50 and having flanges 51 and 52 respectively. Flange 52 is in contact with the exterior surface of part of bottom 11 of the mold. The free end of flange 52 is near the free end of part 11 of the mold angle iron, while the corner of angle iron 50 is back of the free end. Flange 51 extends away from the bottom of the mold. Flange 51 is long enough so that the free end of the flange is approximately in line with flanges 25 and 35 of channels 22 and 32.

The length of the mold may be as great as desired and in practice, may be 30 feet and even longer. At suitable intervals along the length of the mold, means are provided on the mold for maintaining the two parts of the mold in tightly clamped position and additional means are provided for causing mold separation to occur when the clamping means are inoperative. The distance between adjacent mold clamping means will depend upon such factors as the thickness of the various mold parts and

channels and the tolerances in the final product. Inasmuch as the various means for clamping and guiding the mold parts are similar, only one will be described in detail.

Disposed below bottom portion 11 of the mold and between web portion 27 of channel 22 and flange 51 of angle iron 50 is T beam, generally indicated by 58 and having top portion 59 and web 60. Top portion 59 of the T is disposed so that it is against the adjacent surfaces of bottom portion 11 of the mold and may be welded thereto. The ends of T 58 are rigidly secured as by welding to plates 62 and 63. Plates 62 and 63 are disposed against the inner surfaces of portion 27 of web 23 and flange 51 of angle iron 50. These plates are maintained rigidly in position by bolts 64 to 67 inclusive. Portion 37 of channel 32 has rigidly bolted thereto pin 69 having threaded portion 70 and smooth portion 71. Threaded portion 70 is long enough to extend from flange 51 of angle iron 50 through a suitable aperture in part 37 of the web of channel 32 and somewhat beyond the web, as illustrated in Figures 2 and 4. Threaded portion 70 carries lock nuts 72 and 73 disposed on opposite sides of web portion 37. Threaded portion 70 also carries nut 74 and 'ock nut 75 for providing a shoulder which may engage the surface of flange 51 of the angle iron. Smooth portion 71 of the pin passes through suitable alined apertures in flange portion 51 and plates 63 and 62 and web portion 27. Smooth portion 71 functions as a guide pin and normally in the closed position of the mold will extend beyond web 23 of channel 22. The closed position will be determined by the adjustment of nuts 74 and 75 and in the proper position of the mold parts, the free edges of the parts of the mold will be alined. As previously pointed out, the gap between the opposed edges is preferably reduced substantially to zero by having the opposed edges in contact. It is clear, therefore, that the two parts of the mold, one part consisting of angle iron 10 and the other part consisting of strip 18, will be movable relative to each other along the length of pin 69.

The locking means are all similar and will now be described. Disposed across the corner formed by flange 35 and web 33 is bearing plate 73*a*. This plate may have any desired shape and is conveniently rectangular, as illustrated in Figure 3. The angle of inclination to the web is unimportant. Bearing plate 73 is provided with aperture 74*a*. Web portion 37 of channel 32 is also apertured at 75*a*. Flange 51 of angle iron 50 is provided with a suitable aperture which is in line with apertures 74*a* and 75*a* for accommodating pin 78 having head 79 and threaded portion 80. When plate 63 will be present, a suitable aperture will be provided through this plate. Where the locking means is not near any pin guiding means or mold guiding means, then plate 63 will not be present and may be replaced by a suitable strip of metal or may be omitted entirely. Bolt 78, as illustrated in Figure 5, when threaded through the various alined apertures, will be disposed at an angle to the plane of bottom 11 of the form. Accordingly, wedge shaped washers 81 may be disposed around threaded part 80 of the bolt so that one side of the washer will be flush against the surface of plate 63 or whatever surface is present, while the other side of the washer may be engaged by nut 82 on the bolt. Bolt 78 has slot 84 extending transversely through, the slot being long enough and wide enough to accommodate tapered wedge 85. The position of bolt 78 is selected so that the short end of wedge 85 may enter slot 84 and then the wedge may be driven home to maintain the two parts of the mold together.

Flanges 24 and 34 may have suitable apertures therethrough along the length of the form for the purpose of accommodating auxiliary angle irons to increase the depth of the mold. Thus referring to Figurese 6 and 7, the top flanges 24 and 34 are provided with apertuers 87 through which bolt 88 may extend. Bolt 88 has a flat head disposed in a conical aperture in part 90 of spacing member 91 having legs 92 resting upon the outside surface of the flange of the channels. Spacing member 91 has side portion 93 lying generally in the plane of the side of the mold and having a suitable aperture for accommodating bolt 94 to support a liner. By disposing the spacing members at suitable intervals along the length of the form on both sides thereof, the liners will extend the sides of the mold and thus permit the depth of the mold to be adjusted. By having mold portions 10 provided with different size bottom portion 11, it is possible to provide molds for beams of different widths.

Means are provided for handling the mold so that the mold may be filled or emptied, as desired. In general, this means provides power means for opening and closing the mold, assuming that the locking means on the mold have been disabled.

Referring to Figures 8 and 9, I beam 100 is carried by a hoist. I beam 100 has bottom flanges 101 and 102 from which depend a pair of end supports, of which one is shown in Figure 9. This end support, generally indicated by 103, has fingers or claws 104 extending over the edges of flanges 101 and 102. Depending end support 103 has slot 106. Riding in slot 106 is pin 107 having head 108 to lock the pin in the slot. Pin 107 carries end plates 109 having ends 110 bent to extend along the outside of webs 23 and 33 of the mold. Lugs 112 and 113 carried by the channel irons for retaining the bulkheads are also large enough to rest upon the top edges of parts 110 of the end plates when the mold is in a position so that the open end is on top. The mold is supported at the two ends in the manner illustrated in Figure 9 and the mold may be rocked on pin 107 so that the mold may be disposed upside down as illustrated in Figure 8.

As illustrated in Figure 8, power means are provided for opening or closing the mold when the mold is upside down. It is understood that the wedges for locking the mold will be pulled out of the pins. When the mold is upside down, as illustrated in Figure 8, air cylinder means are provided at spaced intervals along the length of the mold for opening or closing the same. These air cylinders are alike and are operated simultaneously. As illustrated in Figure 8, I beam 100 has attached to bottom flanges 101 and 102 transverse plate 115. Plate 115 has the ends rigidly supported by reinforcing rods 116 and 117 welded between the ends of plate 115 and the ends of the flanges at the top of I beam 100. Rigidly attached to plate 115 as by angle irons 119 and 120 is air cylinder 121 having a piston not shown inside, the piston being attached to and operating piston rod 122. Air pipes 123 and 124 controlled by suitable valves are provided on opposite sides of the cylinder so that compressed air may be admitted to the cylinder on one side of the piston or the other side of the piston, as desired. Piston rod 122 has end 126 threaded and supports a double claw member, generally indicated by 127. Member 127 has portions 128 and 129 on opposite sides of flange 35 of the form.

The other side of air cylinder 121 is provided with frame 130 having stop portion 131 bent at right angles thereto. Stop portion 131 is adapted to engage portion 27 of the channel when claw member 127 is urged to the left, as seen in Figure 8, to open the mold. Since the greatest force used on the mold is applied in opening the same, this arrangement tends to relieve pivot pins 107 from the shear strain incident to opening the mold. For mold closing movement, part 128 of the claw will engage flange 34 of the channel to move the same to a mold closing position. When this occurs, pivot pins 107 will suffice to maintain the body of the mold against the closing force thereof. If desired, however, additional means for engaging flange 25 to hold the mold against the force necessary to close the mold may be provided. Such means may provide a stop to engage the free edge of web 23.

In order to release the cast beam from the mold, the mold is supported at the ends as illustrated in Figure 9. The entire mold support is itself carried by a hoist so

the mold is in the air. In this position, pins **107** are at the bottom of slot **106** so that the entire mold may be turned on pins **107**. The mold is turned so that it is upside down with the open part of the mold facing downwardly. Thereafter, the hoist lowers the mold and mold support low enough so that the floor or any suitable supports take the weight of the mold from end plates **103**, causing pins **107** to rise in slots **106**. By raising the mold sufficiently high, the parts of the mold may be brought into proper relationship with the air cylinder release mechanism, as illustrated in Figure 8, so that claw portions **129** and stop **130** may be disposed in proper relationship, as illustrated in Figure 8. The air valves are operated to move the piston in each unit to the left, as illustrated in Figure 8, causing the mold to open. The hoist may now raise the opened mold free of the cast beam. Thereafter, the hoist moves the open mold clear of the beam and the mold is closed by operating the air pressure means. The closed mold is now locked by the wedges previously described, after which the hoist is raised to drop the empty but locked mold to the position illustrated in Figure 9. The mold may now be turned over and deposited on a floor or suitable support. End plates **105** are moved longitudinally of the mold so that arms **110** will clear the mold and leave the mold free to be filled with concrete.

Referring to Figure 10, there is shown a detail of a locked mold in condition for receiving a concrete mix. The mold has the liners suitably bolted thereto and has bulkheads, one of which is illustrated. Bulkhead **135** has suitable apertures for accommodating the inflatable forms used in the manufacture of the cored beams, and also has small apertures for accommodating the ends of the prestressing rods **137**. These prestressing rods may be distributed in any desired pattern and the ends may be rigidly retained and tensioned by any suitable means. As an example, the means for engaging the tensioning rods or wires may be as illustrated in the co-pending applications of Gayle B. Price and Paul L. Osweiler, Serial No. 304,524, filed August 15, 1952, or Gayle B. Price and Paul L. Osweiler, Serial No. 378,714, filed September 8, 1953.

The bulkheads are maintained in suitable position against the tension of prestressing wires. Such means, for example, may consist of arms **139** and **140** rigidly attached thereto, the arms extending away from the bulkhead toward the open end of the form. Arms **139** and **140** are provided with suitable apertures for accommodating rod **141** adapted to extend beyond the arms and engage the free ends of the form. It is understood, of course, that rod **141** will be disposed against the free ends of the form to resist the force of the bulkhead when the wires are properly tensioned.

The other end of the form not shown may be provided with similar bulkhead means. When the form is ready to receive the concrete, the mix is poured into the form while the form is vibrated. It is understood that after the beam has been cast and prior to the opening of the mold, the inflatable forms for providing the cored out portions in the beams are removed, these forms being first deflated, and then the bulkheads are removed or the attaching means for anchoring the ends of the prestressing wires to the bulkhead are either removed or cut so that the cast beam may be released when the mold is opened.

While the cut in the mold has been shown as illustrated, it may be disposed at any desired part of the mold. The two-piece form or mold having cooperating edges **15** and **19** as shown may be manufactured in a number of ways. The entire procedure for making the mold may be conventional except for obtaining the cut or slit to provide separate cooperating edges **15** and **19**. Inasmuch as these molds or forms may have lengths running into many feet, it is not practical to start with two pieces making up the mold or form channel and attempt to machine opposing edges **15** and **19** to fit.

It is preferred to start with a complete channel for the mold proper, said channel consisting of bottom **11** and sides **12** and **18**. The entire structure illustrated in Figures 3 to 7 inclusive is fabricated and assembled as a one-piece mold except for pins **69**. It will be observed that in the finished two-piece construction, pin **69** passes through aligned apertures in channels **23** and **32**. In making the one-piece mold assembly, it is therefore desirable to allow for metal lost in cutting. Assume, for example, that the cut has a width of ¼" so that ¼" of metal from original side **18** is lost. This means, therefore, that side **18** together with channel **32** will drop ¼" as seen in Figure 4 when edges **15** and **19** are fitted against each other. Accordingly, channel **32** is preferably permanently secured to side **18** of the original one-piece channel in such a way that channel **32** is ¼" higher than channel **22** and the apertures in web **37** for accommodating pin **69** are also drilled ¼" higher, all as seen in Figure 4. After the form channel has been slit and has resulted in the removal of ¼" of metal, as an example, channel **32** and side **18** can then be dropped as seen in Figure 4. This will line up channels **22** and **32** and also line up the apertures in web **37** with the apertures in web **23** for accommodating pins **69**.

It is possible to drill an oversize aperture through web **37** somewhat larger than pin **69** and have pins **69** positioned even before the slitting. After the slitting, nuts **72** and **73** may be loosened, if they had been tight, and permit channel **32** to drop into position. Nuts **72** and **73** will thus serve to rigidly maintain pins **69** in web **33** even though oversize apertures are provided. In any event, the entire construction as illustrated in the drawing is initially made as one piece and slitting will occur thereafter.

The actual slitting of the original mold-forming channel is accomplished in a simple manner by a portable tool consisting of a circular milling cutter driven by an electric motor. The milling cutter is provided with two gauges. One gauge maintains the cut at a predetermined distance with respect to side **18** so that the cut will be along a generally straight line parallel to the free edge of side **18**. The other gauge is a depth gauge for insuring that the milling cutter will go through the entire thickness of side **18** but will not cut through web **33**. The milling cutter has a diameter which is generally smaller than the width of bottom **11** of the form. Thus in practice, bottom **11** of the form may have a width of about 8", as an example. The milling cutter may have a diameter of 3" or 4".

The plane of the milling cutter need not be parallel to bottom **11** but may be tilted with respect to bottom **11** so that the cut may be located as illustrated in Figure 4. As is well known, such cutters have suitable clamping means for rigidly securing them to a motor shaft and in practice, the side of the cutter disc away from the motor will have a motor shaft and clamping nuts extending axially beyond the cutter. Thus the average portable cutting means would not permit the side of the cutter to be brought close enough to bottom **11** to have the cutter parallel to bottom **11** and the cut near corner **16** as illustrated.

If the cut is higher up on side **18**, then sufficient clearance may exist for having the plane of the cutter parallel to bottom **11**. However, the location of the plane of the cutter with respect to bottom **11** is not important and the cuting or slitting may be done at an angle other than 90° to the plane of side **18**. This will result in the opposing edges **15** and **19** of the two form parts being at an angle other than 90° to the plane of side **18**.

The accuracy of the cut with respect to bottom **11** or with respect to the free edge of side **18** is not important within limits which are easily maintained. Thus if the slit has some tendency to go up or down with respect

to bottom 11 along the length of the form, the tight fit between the form parts will in no wise be impaired. It is, of course, true that in such case, the two form parts can only work together and cannot be interchanged with other form parts. All the parts are of steel or other suitable metal and the wall thickness of the various channels, angles and plates will be sufficient to render the entire form rigid.

The actual slitting may be accomplished by having the one piece assembled form on the ground with side 18 horizontal and supporting bottom 11 and channel 22 so that the mold parts will be retained in position after slitting. The mold may also be supported as in Figure 4 with bottom on the ground.

What is claimed is:

1. A separable mold for casting elongated concrete beams, said mold having a generally U-shaped section, said mold consisting of a generally L-shaped member forming the bottom and one side of said mold and a generally flat member forming the remaining side of the mold, the two mold members having abutting edges when the mold is closed, a channel having a web and two flanges at one side of said mold, said channel having the web thereof disposed along the outside of one side of said mold, a second channel similar to the first disposed along the outer face of the remaining mold side, said two channels being rigidly attached to the corresponding mold sides, said two channels having portions extending below the mold bottom when the mold is assembled, an auxiliary angle iron outside of and extending the full length of the mold, said angle iron having one portion thereof rigidly attached to the mold bottom near the free edge of the L-shaped elongated member, the angle iron having the other part thereof extending away from the mold bottom and lying between the opposed web portions of the channels, elongated pins passing through the web on the opposed channel on the flat member and other part of the auxiliary angle iron at spaced intervals along the length of the mold and means carried by said elongated pins and cooperating with said channel and angle iron for locking the two mold portions together.

2. A separable mold for casting elongated concrete beams, said mold having a generally U-shaped section, said mold consisting of a generally L-shaped member forming the bottom and one side of said mold and a generally flat member forming the remaining side of the

mold, the two mold members having abutting edges when the mold is closed, a channel having a web and two flanges at one side of said mold, said channel having the web thereof disposed along the outside of one side of said mold, a second channel similar to the first disposed along the outer face of the remaining mold side, said two channels being rigidly attached to the corresponding mold sides, said two channels having portions extending below the mold bottom when the mold is assembled, an auxiliary angle iron outside of and extending the full length of the mold, said angle iron having one portion thereof rigidly attached to the mold bottom near the free edge of the L-shaped elongated member, the angle iron having the other part thereof extending away from the mold bottom and lying between the opposed web portions of the channels, elongated pins passing through the web on the opposed channel on the flat member and other part of the auxiliary angle iron at spaced intervals along the length of the mold, said pin having a portion extending beyond the angle iron and web on the opposed channel on the flat member, one part of such extending pin portion being threaded and having a nut thereon and the other part of such extending pin portion having a transverse slot therethrough and a wedge adapted to pass through such slot and exert force against said channel for maintaining the mold locked.

3. The construction according to claim 2 wherein the channel portion through which said pin passes is provided with a sloping plate extending between the flange and web with said pin passing through such sloping plate.

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