July 14, 1942. F. KOGL 2,289,439

METHOD OF PRECASTING CONCRETE STAIR STRUCTURES

Filed June 12, 1939 4 Sheets-Sheet 1

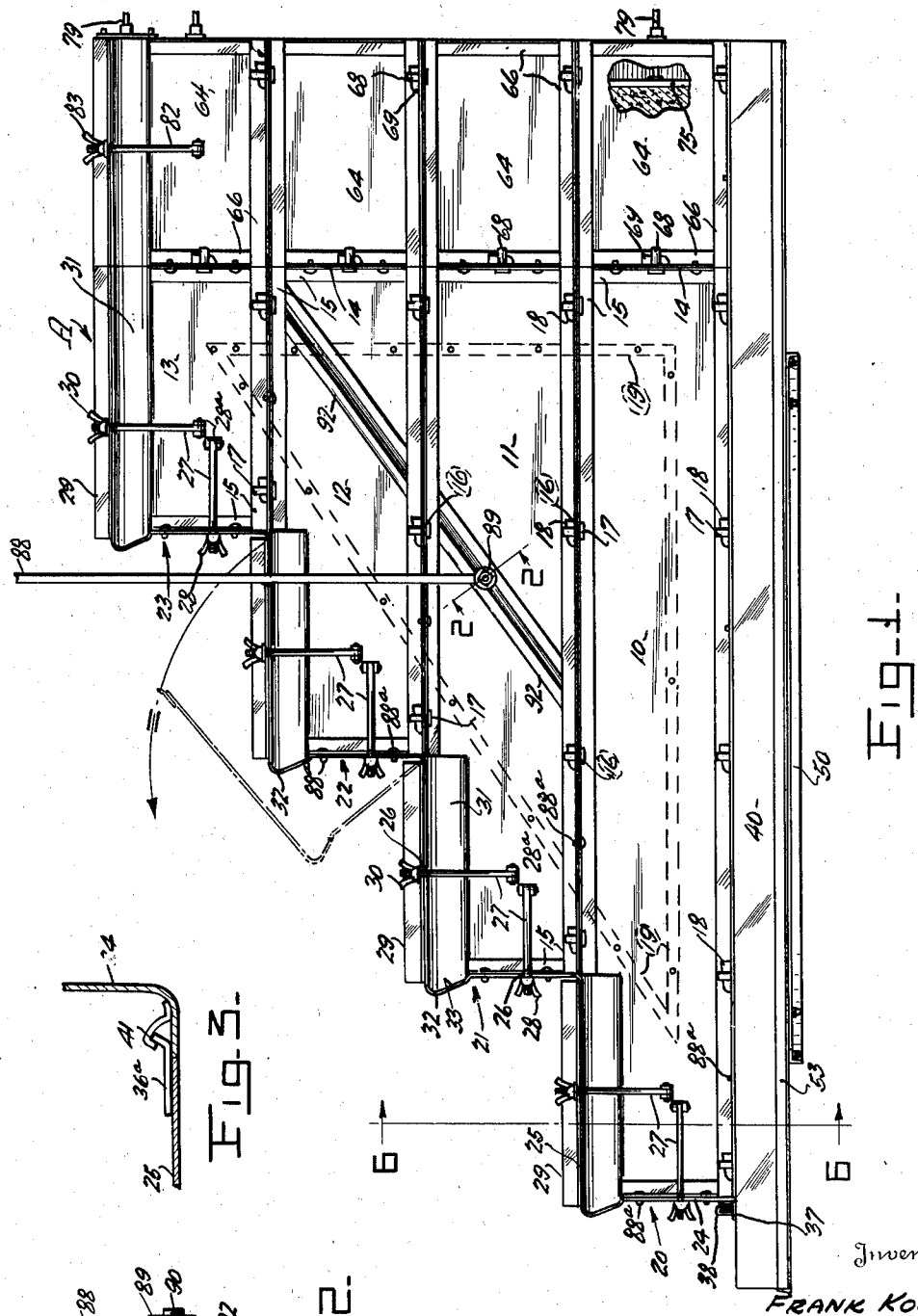

Fig-1.

Fig-3.

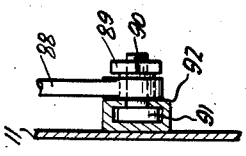

Fig-2.

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METHOD OF PRECASTING CONCRETE STAIR STRUCTURES

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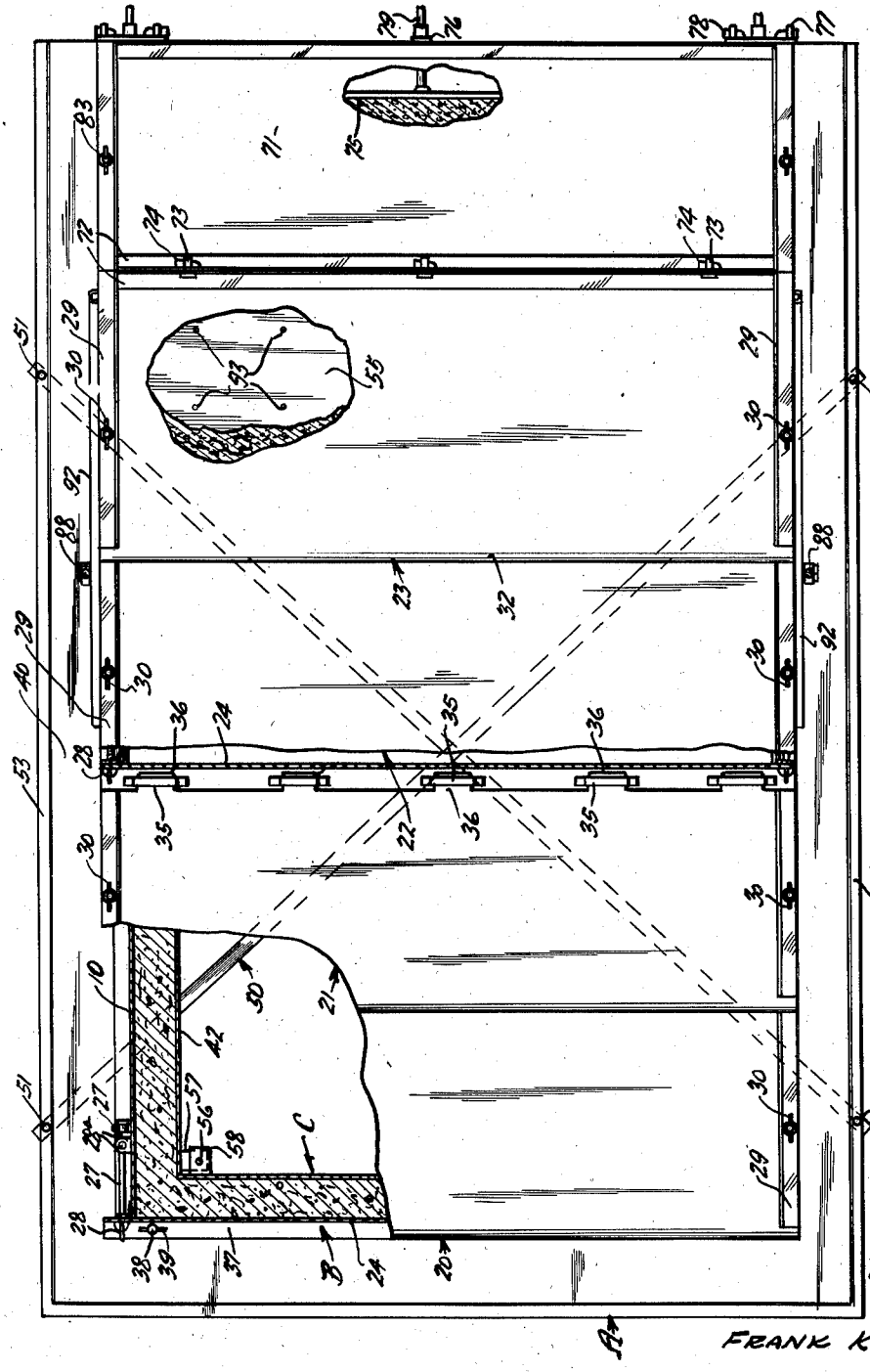

Fig. 4.

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METHOD OF PRECASTING CONCRETE STAIR STRUCTURES

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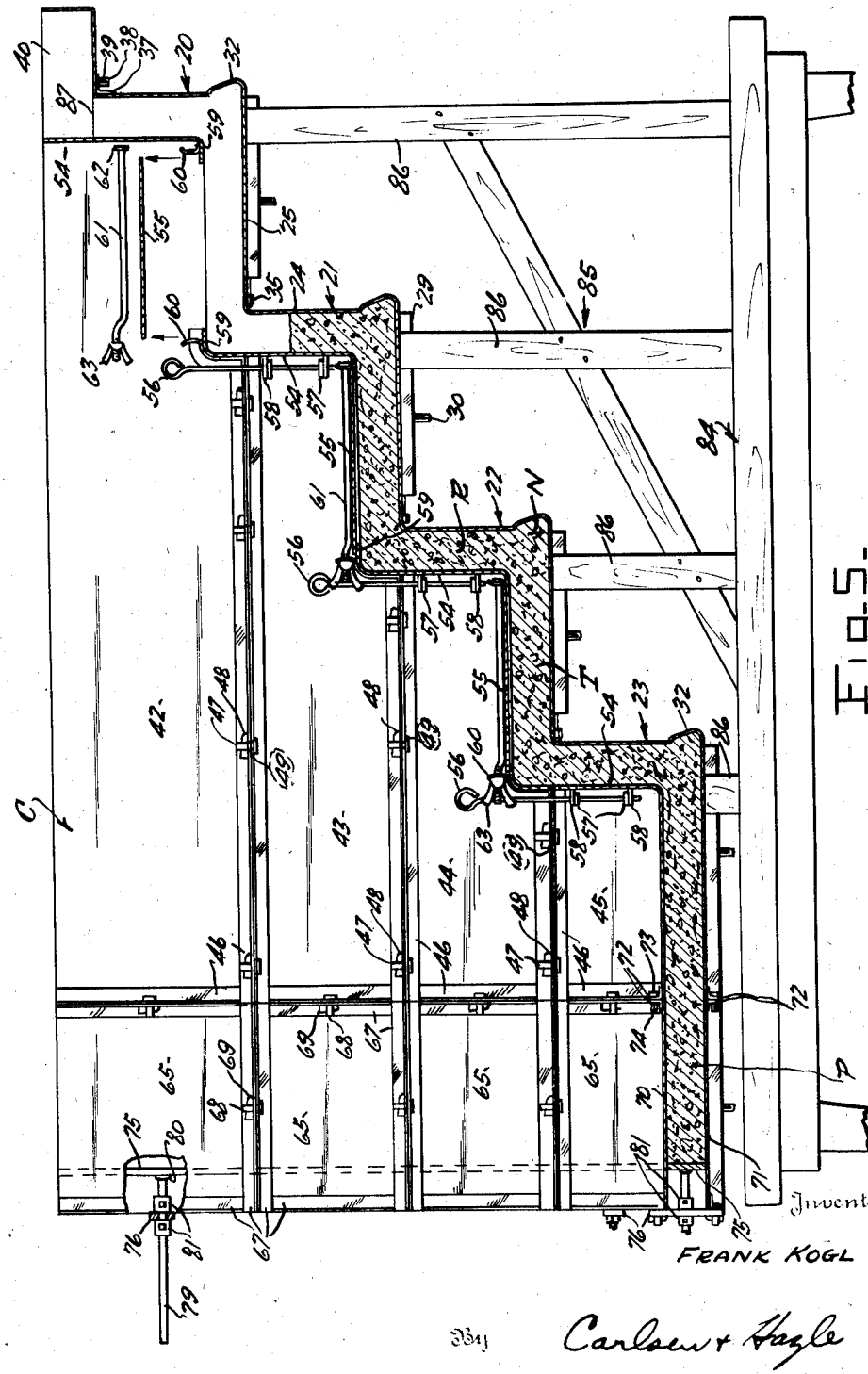

Fig-5.

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METHOD OF PRECASTING CONCRETE STAIR STRUCTURES

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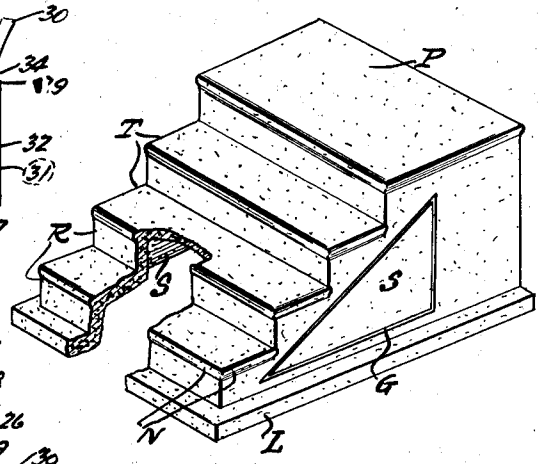
Fig. 7.



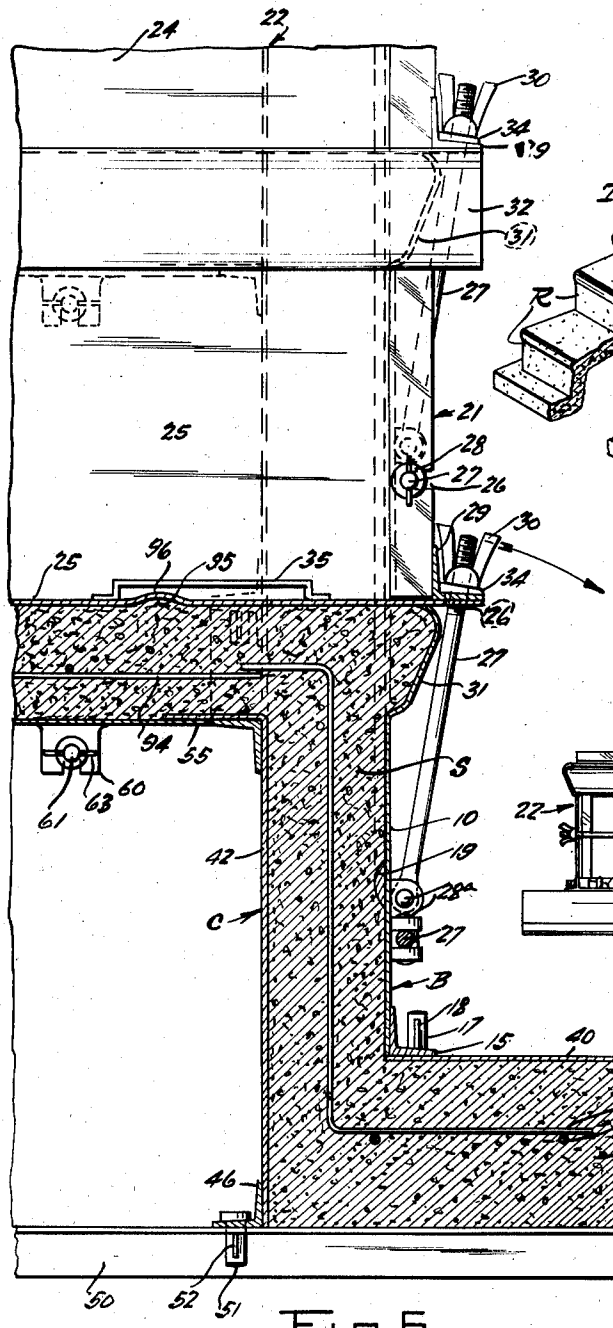


Fig. 6.

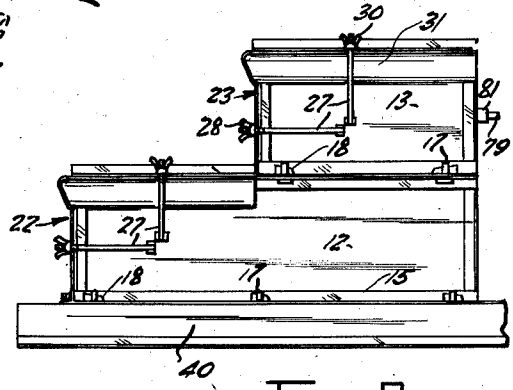


Fig. 8.

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Patented July 14, 1942

2,289,439

UNITED STATES PATENT OFFICE

2,289,439

METHOD OF PRECASTING CONCRETE STAIR STRUCTURES

Frank Kogl, St. Paul, Minn., assignor of two and one-half per cent to Walter H. Carlson, two and one-half per cent to Ora E. Carlson, four per cent to Minnie C. Schneider, four per cent to Genevieve Clark and ten per cent to Ruby S. McBride, all of St. Paul, Minn.

Application June 12, 1939, Serial No. 278,711

5 Claims. (Cl. 25—155)

My invention relates to an apparatus and method for precasting concrete stair structures.

The primary object of my invention is to provide an improved mold form for the monolithic casting of concrete stairs or stoops particularly suitable for use at the outer doors of a residence or at lawn terraces, and to provide a mold of such nature that it may be adjusted to cast any of several numbers of steps and to provide a surmounting platform of a selected length or area, thus suiting the stairs to each particular installation. Another object is to provide a mold form of this kind which may be set up and dismantled in progressive and retrogressive order to permit it to be properly filled with the cementitious mixture and then to permit the cast structure to be exposed for inspection and removal without difficulty or damage. A further object is to provide a mold form which may be arranged to cast a nosing or marginal projection on each step tread and a lower marginal base ledge or shoulder around the structure to form a base for brick veneering or buttresses on the finished steps.

Still another and important object of my invention is to provide an improved method for the monolithic precasting of stair structures in which the cementitious mixture is poured into an inverted mold downwardly toward what are finally the finished surfaces of the steps and with vent means provided for the escape and exudation of excess air and water to insure the proper settling and setting of the material. It is thus possible to provide a finished product having tread and riser surfaces of any desired texture or surface configuration without the necessity of additional or supplementary finishing operations of any kind.

These and other more detailed and specific objects will be disclosed in the course of the following specification, reference being had to the accompanying drawings, in which—

Fig. 1 is a side elevation of the mold or apparatus set up for casting a series of four steps, a platform and surrounding base for buttressing.

Fig. 2 is an enlarged fragmentary section along the line 2—2 in Fig. 1.

Fig. 3 is an enlarged sectional detail view of a connecting means for mounting and connecting the outer riser and tread forms.

Fig. 4 is a plan view of the mold shown in Fig. 1, sections being broken away to better disclose interior construction.

Fig. 5 is a longitudinal vertical sectional view through the mold, showing the same inverted on a supporting stand and partially filled with the cementitious mixture.

Fig. 6 is an enlarged vertical cross section along the line 6—6 in Fig. 1.

Fig. 7 is a perspective view, on a reduced scale, showing the steps cast by the form and with a portion broken away and in section to show the construction thereof.

Fig. 8 is a fragmentary side elevation, also on a reduced scale, showing the form assembled for casting only two steps and a narrow platform.

Referring now with more particularity and by reference characters to the drawings, the mold or apparatus constituting my invention is indicated generally at A and is seen to comprise as its basic elements an outer form B and inner form C. These forms are assembled, in the set up condition of the mold shown in Figs. 1, 4, and 5, to provide intervening cavities and recesses which when filled with the cementitious mixture will form and cast a step structure of the type shown in Fig. 7. This structure comprises a series of four steps each having a tread T, and a riser R, a surmounting flat platform P, the panelled sides or side walls S and the surrounding lower marginal ledge or base L, all of monolithic construction, as shown. The wall thickness at all points may be of any desired dimension but it is of course understood that the entire underside of the structure is hollow in order to reduce weight and quantity of material required. A nosing N surrounds the ends and outer exposed edge of each tread T as clearly shown.

Turning now to the construction of the mold itself, the outer form B thereof comprises a plurality of side sections or side plates which, in their assembled relation, are set and joined on edge vertically and define the outer surfaces of the stair sides S. Each side section is of a width (vertically) corresponding to the height of the risers R and the sections accordingly are in number equal, at each side of the form, to the number of steps to be cast. In the mold shown a maximum of four steps may be cast and the side sections are accordingly represented by the reference numerals 10, 11, 12, and 13 in progressive order, it being understood, however, that the mold may be constructed to have a maximum step capacity either more or less than that here shown.

These side sections 10 through 13 are formed of flat metal sheets or plates of rectangular shape and grow progressively shorter each successive step upward, to thereby terminate at a common vertical plane at their rear ends 14. The

margins are braced by angle irons designated generally at **15**, spot welded or otherwise secured in place, and which also form means for attaching the sections to each other and to other component parts of the mold. To this end, and as a representative fastening means, I provide the angle irons with registering apertures **16** in their outwardly turned webs and through which are placed diametrically slotted pins **17** for the reception of wedges or keys **18** which, when driven tight, hold the parts rigidly together. This type of fastener meets the requirement of a rigid and quickly manipulated means for assembling the sections, but I may of course employ bolts, spring latches, or other suitable means as may be desired.

In the mold assembly, therefore, four of the side sections are set up on edge and secured together at each side of the mold, and present a plane inner surface well adapted to form and define the outer sides of the steps. Runners or strips **19** of rounded cross section may be secured, in aligned parts or sections, to the inner surfaces of the side sections **10**—**13** as shown in order to form depressed grooves G in the stair sides S and give a panelled effect thereto. Other suitable ornamentation may also be provided as desired, and particularly is this true since the side sections are progressively removable from the cast structure as will hereinafter appear.

The forwardly projecting forward ends and upper edges of the side sections **10** through **13** form supports for the four riser and tread forming members or outer riser and tread forms **20**, **21**, **22**, and **23** which are removably secured transversely across these edges of the assembled mold sides. Each of these forms **20** through **23** is substantially identical in shape and size and comprises a vertical riser plate **24** and horizontal tread plate **25** forming a right angled structure as shown. The ends of the forms are provided with notches **26** in both their vertical and horizontal portions for the reception of clamp bolts **27** which are pivoted at their ends **28a** to each side section **10** to **13** in position to swing at their free ends into said notches. The vertical plates **24** are then drawn tight against the forward angle irons **15** by wing nuts **28** screwed on the forwardly directed bolts **27** and the horizontal plates **25**, which are braced by the end angle irons **29**, are similarly drawn tight by the wing nuts **30** screwed upon the upwardly directed draw bolts as clearly shown in Fig. 1.

It will be noted that the forwardly projecting upper edges of each side section **10** through **13** are provided with outwardly bulged and rounded portions **31** and the connecting frontal edge portions of the plates **24** and **25** of each outer tread and riser form **20** through **23** are similarly formed as designated at **32**, the said portions **31** being coped at **33** into the portions **32** to fit nicely thereinto. As a result the ends and forward edges of the treads T of the finished stair structure will be provided with the desired nosing N as heretofore described. Due to this lateral projection of the nosing portions **31** on each side section the length of the forms **20** through **23** is made sufficient to overlap the mold sides substantially and provide for reception of the draw bolts **27**, and the upper draw bolts are provided with angularly faced washers **34** to form a proper bearing with the angle irons **29** as best shown in Fig. 6.

The lower margins of the outer forms **20** through **23** are turned smoothly forward a short distance to provide a rounded junction line between the step risers R and treads T and these margins, in all but the lower form **20**, are provided with laterally spaced and elongated brackets or loops **35** in which are adapted to fit the extended clips or tongues **36** secured to the opposite or upper margins of said forms. The lowermost form **20** carries an angle iron **37** at its lower edge adapted to be detachably connected by pins **38** and wedges **39** with a trough form **40** which surrounds the forward and lateral edges of the mold and is secured at the sides thereto by pins **17** and wedges **18** as shown. The interconnection between the forms **20** through **23** provides rigid fastening means at their edges but permits the forms to be swung clear in progressive order as shown in Fig. 1, and as will hereinafter appear. The meeting edges of the forms abut in a common plane to provide a smooth surface for the treads T and if so desired I may employ in lieu of the brackets **35** and tongues **36**, the clips **41** and similarly formed tongues or hooks **36a** as detailed in Fig. 3.

The inner form C is somewhat similarly constructed and comprises, in the embodiment shown, four inner side sections **42**, **43**, **44**, and **45** at each side and which are formed of sheet material with marginal angle irons **46** secured to their inner faces. These inner side sections are set up on edge within the mold and are secured together by pins **47** and wedges **48** which pass through registering aperture **49** in the inwardly turned webs of the horizontal angle irons **46**. The necessary forms for defining the inner surfaces of the stair sides **5** are thus assembled and of course these inner sides are spaced from the outer sides of the mold to provide a suitable wall thickness. For this purpose the lower inner side sections **42** are made sufficiently wide (vertically) to fall flush with the lower edges of the trough form **40**, and a cross frame **50** of angle iron is secured at its ends to both these side sections and the trough form by means of pins **51** and wedges **52** which lock the frame to the lower angle iron **46** and to marginal angle irons **53** secured to said trough form. The frame **50** thus serves to properly space the assembled inner mold sides in the mold and to support the inner and outer forms as will be apparent.

The inner surfaces of the risers R and treads T are defined by inner riser and tread forms which in this case take the form of separate vertically disposed and transversely extended inner riser plates **54** and similarly extended but horizontally laid inner tread plates **55**. The forward ends and upper forward margins of the inner side sections **42** through **45** are arranged to fall short of the respective outer riser and tread forming portions **24** and **25** of the outer form and the inner riser plates **54** are therefore secured flush with said forward ends by means of pins **56** which are inserted through apertured, interdigitating lugs **57** and **58** secured, as by welding, to adjacent ends of the inner side sections and said inner riser plates. Upper and lower transverse margins of these inner riser plates are turned, in nicely rounded shape, respectively rearwardly and forwardly, as indicated at **59**, to form seats or footings upon which the inner tread plates **55** may be rested at their margins. The said margins **59** are provided with aligned forks or brackets **60** in which may then be placed the removable retaining bolts **61** which traverse the inner tread plates **55** and have their headed ends **62** hooked in the forward forks. Wing nuts

63 are turned up on the rear ends of the bolts to rigidly retain said inner tread plates in place as clearly shown in Fig. 5. The foregoing assembly spaces the inner riser and tread plates inwardly to provide suitable wall thickness for the risers and treads as will be evident.

The uppermost inner tread plate 55 may well be formed as an integral continuation of the adjacent inner riser plate 54 as it is here shown.

The uppermost tread T defined by the tread forming portions 25 and 55 of the mold may be integrally extended in the form of the platform P, this being accomplished by the provision of outer extension sections 64 and inner extension sections 65 which are identical in number, width, and construction to their complementary side sections 10 through 13 and 42 through 45. These extensions 64 and 65 are of equal length, however, and are provided with marginal angle irons 66 and 67 on their outer and inner faces respectively. Pins 68 and wedges 69 thus may be employed to fasten the individual sections together edgewise and also to secure the assembled inner and outer extension mold sides thus formed to the rear ends of the inner and outer mold forms as clearly shown. The trough form 40 is of sufficient length to fit along lower edges of these extension sides and the inner and outer platform plates 70 and 71 complete the extension of the mold. These plates 70 and 71 are of course secured marginally to the uppermost tread forming members 55 and 25, and for this purpose transverse angle irons 72 are secured to the abutting edges for the reception of the pins 73, and wedges 74 are inserted through the pins to draw the parts tightly together. Clamp bolts 82 and wing nuts 83 are also provided for locking the plate 71 in a manner similar to the outer tread plates 25.

The rear end of the mold is closed by an adjustable, substantially U-shaped yoke or end member 75 which is of such width that it may slip nicely within the opening between the outer and inner forms B and C. For supporting the member 75 in position I provide cross bars 76 which may be secured to the rear angle irons on the inner and outer forms by pins 77 and wedges 78 or other suitable means, and which are apertured to slidably pass rods 79 secured at their inner ends at 80 to said end member. Collars 81 are placed on the rods at each side of the cross bars 76 and it will be apparent that the end member 75 may be secured at any adjusted position within the form to thus determine the length forwardly and rearwardly of the completed structure. This end assembly may furthermore be assembled either within the rearward extension of the mold or within the main portion thereof to give a further variation in size.

In the actual operation of the mold and its use for casting the stair structure described, the outer form B is first completely assembled and is supported in an inverted position upon a work table 84 or other suitable support with a frame 85 having uprights 86 of graduatel length for holding the form level. The inner form C is also completely assembled, except for the inner tread plates 55, and is then supported inside the outer form in the manner described by the frame 50, and the pouring may be started. The extension members 64, 65, 70, and 71 are of course also assembled if the type and length of platform desired requires their use.

The cementitious mixture is then poured in the open sides of the mold and through the openings provided by the detached plates 55, and as fast as the tread portions fill these plates are put in place. The operation continues rapidly and without interruption until all parts of the mold are completely filled, after which the mold is allowed to set until the mixture hardens. Under some circumstances, and where the mixture is of proper consistency, the pouring may be done into the mold sides only, leaving the plates 55 in place and thus saving the time required for their replacement, when the mold is made ready for use again.

The trough form 40 may be filled, or not, accordingly as a base ledge L may or may not be desired, and it is of course readily possible to fill only to the line 87 shown in Fig. 5, where the ledge is not required. To facilitate the assembly of the various mold forms, dowel pins 88*a* are provided at appropriate locations on the meeting surfaces of the parts.

When the mixture has hardened sufficiently the plates 55 are removed and by prying upwardly the entire inner form C is pulled free. Cross bars or some similar members (not shown) replace the frame 50 to temporarily hold the molded structure in the outer form, and the form is now reverted by means of a bail 88 which is connected to a crane or other lifting means (not shown). The lower ends of the bail are pivoted upon shouldered clamp nuts 89 which screw upon the studs 90 of slide blocks 91 slidably mounted in channels 92 secured to the sides of the mold, and these channels are formed in angularly extended sections so that adjustments may be made to properly balance the mold in the bail for easy turning or inverting and reverting movements therein.

With the mold in this reverted position the outer tread and riser plates 20 through 23 are removed in progressive order, thus freeing the sides of the molds which are then pulled clear, leaving the cast structure free of the mold for further curing before installation. The mold is then ready for further use, and it will be evident that since the sides are not taken apart, the operation of assembling and disassembling the mold may be carried out rapidly and easily.

It will be noted that in this operation the mold parts all are swung or pulled away from the finished surfaces of the casting and the removal of parts is thus greatly facilitated. This operation further makes it possible to impress any desired ornamentation on the finished surfaces of the casting in either intaglio or relief, and the treads T may if desired be provided with nonskid bosses or beads 95 by forming complementary impressions 96 in the outer tread forming plates 25, as shown only in Fig. 6.

An important feature of my invention resides in the adjustability of the form and the ease with which the size of the completed structure may be varied. Thus the length, and the platform area, may be readily adjusted as desired by the use, or the elimination of, the mold extension members 64, 65, 70, and 71 and adjustment of the end member 95. Also any number of steps, from one to four in the specific embodiment shown, by using the desired number of inner and outer side sections and their corresponding riser and tread forming cross member. The mold is shown in Fig. 8 as set up for casting only two steps, and it is thought that the manner of making these adjustments will be evident without further description. To facilitate these adjustments, however, the holes for the fastening pins 17 and 47 are arranged so that the base sections 10 and

42 may be readily aligned with and connected to any of the other upper sections. The width of the steps may of course be varied by the provision of riser and tread forming members of any desired length.

In the practice of molding the stair structure by my improved mold as described, there is embodied and carried out also an improved method of doing such work. This resides in the provision of a mold in which the members 24 and 25 which define and mold the finished tread and riser surfaces are downwardly disposed with reference to the point at which the cementitious mixture is poured into the mold. Accordingly the pouring is toward said finish surfaces and the normal tendency of the mixture to settle causes it to assume a perfectly smooth texture on these surfaces. Such obviously would not be the case were the finished surface uppermost as has hitherto been the practice. Furthermore, the material as it is poured down into the tread forming portions of the mold, where greatest exterior smoothness or nicety of finish is desired, is compressed by weight of the material within contiguous riser and side forming portions of the mold. The upper members 55 confining the mixture in these tread forming recesses of the mold are provided with spaced vent openings 93 so that excess water and air bubbles may exude therethrough, and further insure the proper density in the treads. As a further aid in settling the material vibratory effects may be used, either by bodily shaking the mold or by the application of an air hammer or similar tool locally to various parts of the mold.

The inner mold form C may also be conceivably of one piece construction, particularly where the trough form 40 is not used and such variation from the disclosed construction is held to be within the scope of my invention.

The type of mixture employed may be any of those known to persons skilled in the art, and an advantageous result of using the lighter forms of aggregate now on the market will result in the ease with which the cast structure may be handled and installed. Reinforcing rods or similar material, designated at 94 in Fig. 6, may of course be installed as the casting operation proceeds to further aid in the provision of a light but strong structure.

The use of metal for all parts of the form prevents checking due to the shrinkage and moisture absorption of the more usual wood form, and aids in the provision of a practical and long lasting structure. Proper setting of the mixture is also increased since the entire operation may be carried out indoors under controlled temperature and is not therefore subject to the vagaries of outdoor weather conditions.

It is understood that suitable modifications may be made in the structure as disclosed, provided such modifications come within the spirit and scope of the appended claims. Having now therefore fully illustrated and described my invention, what I claim to be new and desire to protect by Letters Patent is:

1. The method of precasting a concrete stair structure having a series of integrally formed steps and sides in a mold having members for forming the treads and risers of the steps and the said sides, which comprises positioning the mold with the tread forming members inverted with respect to the normal position of the steps and so that said tread forming members are substantially level and constitute the bottom of the mold, pouring a wet cementitious material downwardly into the sides of the mold to fill the spaces between the tread, riser and side forming members, and finally removing the mold when the structure has hardened.

2. The method of casting a monolithic stair structure having a plurality of steps in a mold having inner and outer spaced forms shaped to define the corresponding surfaces of the component treads and risers, which includes positioning the mold so that the cast structure will initially be in upside-down position, pouring a wet cementitious material between the forms to fill the spaces forming the then lowermost step and then the remaining steps in succession, removing the inner form when the material has hardened, reverting the outer form to dispose the structure in normal position, and then removing the said outer form.

3. The method of casting a monolithic stair structure having a plurality of steps in a mold having inner and outer spaced forms shaped to define the corresponding surfaces of the steps and with pouring openings in the inner form adjacent the position of each step, which includes inverting the mold to dispose the steps initially in an upside down position, pouring a wet cementitious mixture through first the lowermost opening in the inner form to fill the lower space between the forms, closing said opening when the pouring thereat is completed, repeating the pouring and closing operations at each step in upward succession, removing the inner form when the material has hardened, reverting the mold, and removing the outer form.

4. The method of casting a monolithic stair structure having a plurality of steps in a mold having inner and outer spaced forms shaped to define the corresponding surfaces of the component treads and risers, which includes positioning the mold so that the cast structure will initially be in upside-down position, pouring a wet cementitious material between the forms to fill the spaces forming the then lowermost step and then the remaining steps in succession, and separately removing the inner and outer forms when the material has hardened.

5. The method of casting a monolithic stair structure having a plurality of steps in a mold having inner and outer spaced forms shaped to define the corresponding surfaces of the component treads and risers, which includes positioning the mold so that the cast structure will initially be in upside-down position, pouring a wet cementitious material between the forms to fill the spaces forming the then lowermost step and then the remaining steps in succession, reverting the mold when the material has hardened, and removing the inner and outer forms.

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