May 22, 1934. W. B. MILLER ET AL 1,959,836

BUILDING CONSTRUCTION

Filed Feb. 26, 1929 2 Sheets-Sheet 1

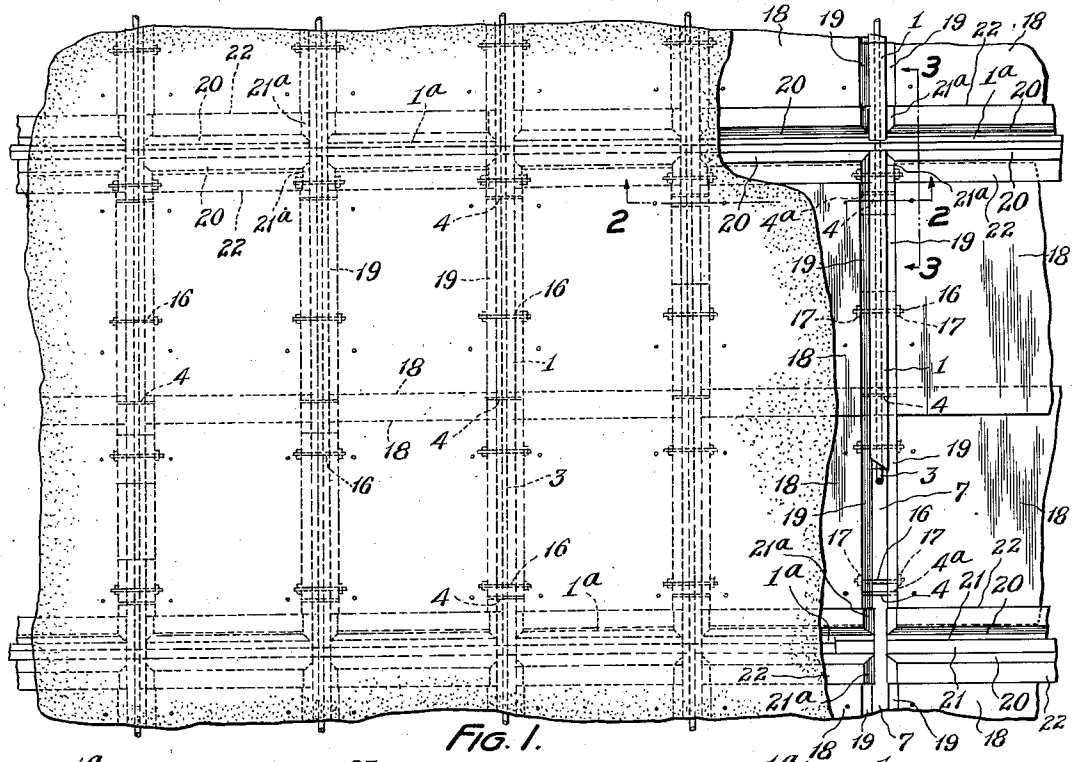


FIG. 1.

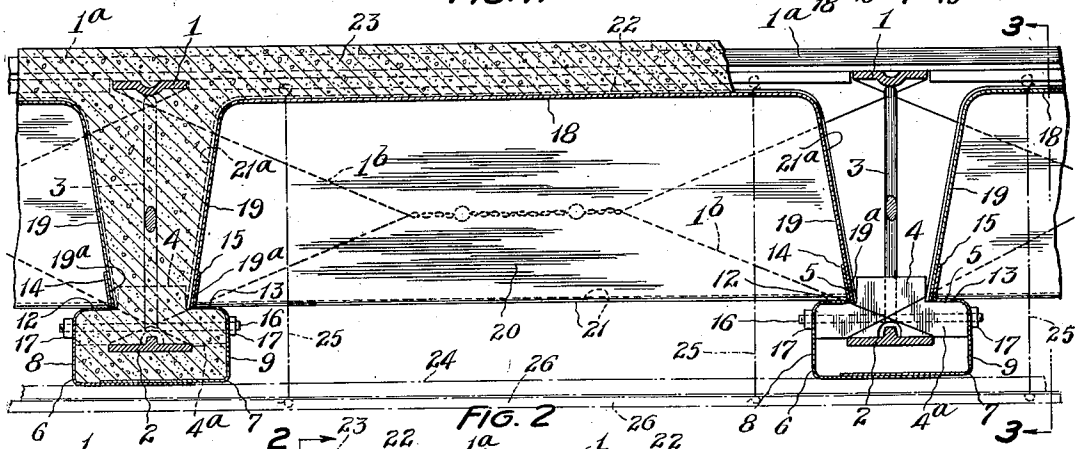


FIG. 2

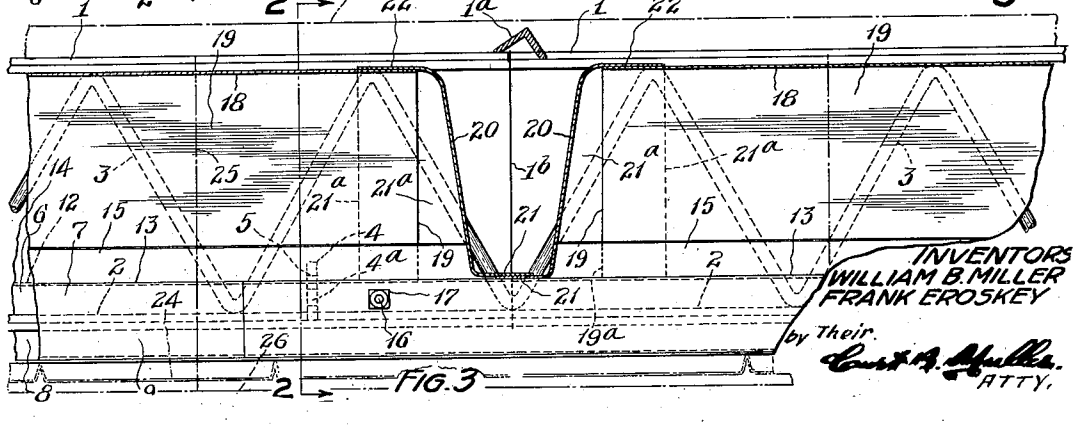


FIG. 3

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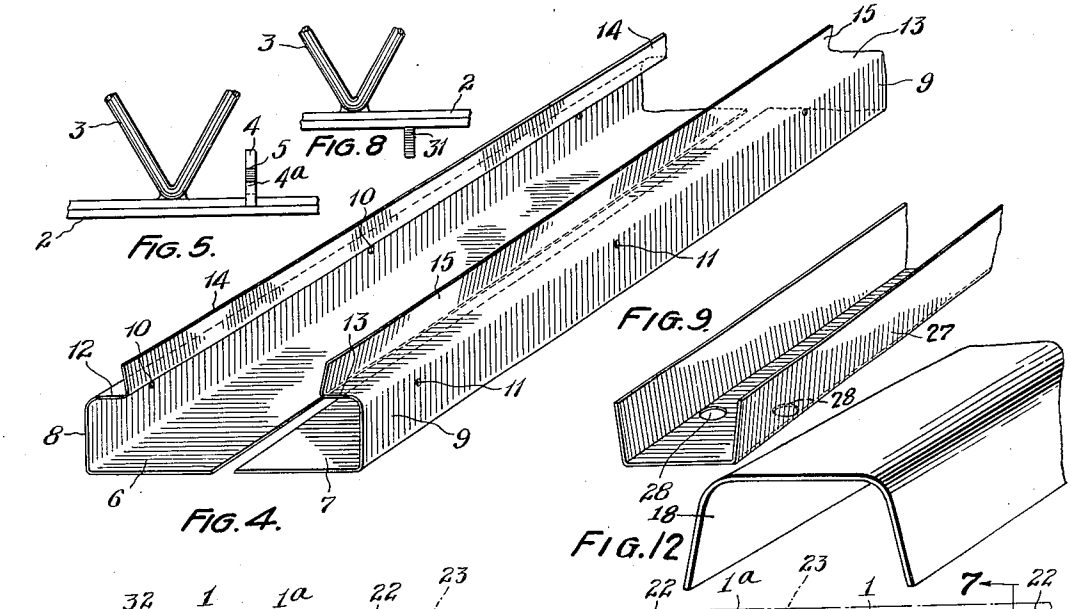


FIG. 8 FIG. 5. FIG. 4. FIG. 9 FIG. 12

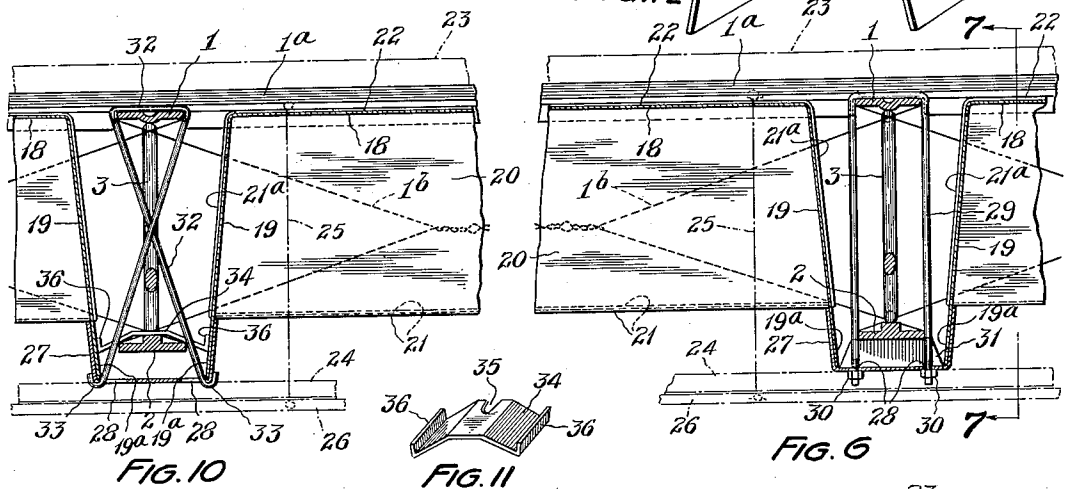


FIG. 10 FIG. 11 FIG. 6

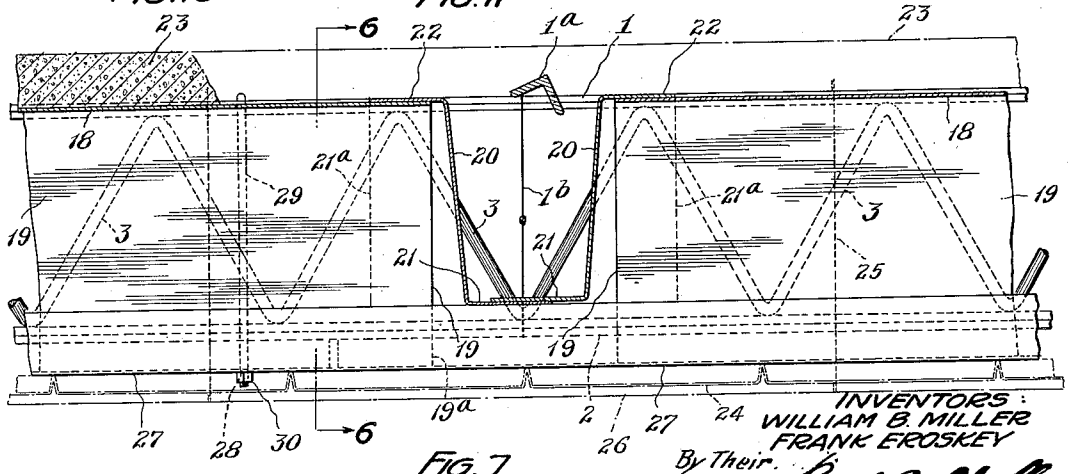


FIG. 7

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1,959,836

BUILDING CONSTRUCTION

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Application February 26, 1929, Serial No. 342,838

24 Claims. (Cl. 72—66)

Our invention pertains to a building construction and more particularly to a composite deck, room covering, or, as exemplified, to a flooring.

The object of our invention is similar to that declared in two patents of William B. Miller issued April 14th, 1931, No. 1,800,951 and No. 1,800,952.

While a company in which both of us are interested is already successfully exploiting a construction embodying the principle underlying this type of concrete building section using ceramic units, we have realized the possible advantage, for certain kinds of jobs, of substituting sheet metal stampings for the ceramic tiles and have conceived and herein have portrayed and described a preferred and two modified adaptations. Fabricated metal units adapted to be provisionally self-sustaining as interfitted between joists preparatory to indurated unification promise the advantage of less weight, ultimately less cost and yet to be adequately fire and sound proof. A specific object has been to design the composite units so that individual metal stampings of simple and economical design may be used and so that their assembly may be easily and quickly accomplished.

It is to be realized that the scope of our invention comprehends many equivalent constructions. The showing of the drawings and the particular description are merely specific exemplifications of a plurality of mechanical embodiments and arrangements.

Adverting to the drawings:

Figure 1 is a plan view of a portion of a building construction, exemplified as flooring, and built to comprise sheet metal forms adapted to be assembled without scaffolding or shoring and also showing part of the unifying concrete.

Figure 2 is an enlarged vertical section on line 2—2 of Figure 1, or across a pair of joists.

Figure 3 is a vertical section viewed on line 3—3 of Figure 2.

Figure 4 is an enlarged perspective view of a pair of cooperating or complemental forms for embracing opposite lower longitudinal edges respectively of a joist.

Figure 5 is a fragmentary detail of the bottom chord of a long marketed type of open truss-type joist provided for use with this invention of form centering elements, one of which appears endwise in this figure.

Figure 6 is a fragmentary view crosswise of one joist connection illustrating a modified form of construction.

Figure 7 is a vertical sectional view on line 7—7 of Figure 6.

Figure 8 is a view similar to Figure 5 showing a modified location of the centering elements carried by the joist bottom and adapted for use with the modified form, shown in Figures 6 and 7.

Figure 9 is a fragmentary perspective view showing a one part form for enclosing a joist bottom as employed in the modifications of Figures 6 and 10.

Figure 10 is another fragmentary sectional view corresponding to Figure 6, but of a second modification.

Figure 11 is a perspective view of one of the centering elements appearing in end view in Figure 9.

Figure 12 is a perspective view of one of a series of forms employed.

It is to be understood that slight modifications will expectably be made in respect to the design of some component parts which are to cooperate according to the principle underlying this invention, depending upon the standard type of joist selected as the primary supporting element. The type of joist disclosed in the drawings includes a top chord 1, a bottom chord 2 and a zig-zag connecting webbing 3, which is welded or otherwise attached at spaced points in staggered relation to the two chords. It is common practice in the art to hold the joists properly spaced apart by spacer angles 1*a*, shown at the middle top of Figure 1 and also to tie together positioned joists with tension bridging 1*b*, which is clearly shown in Figure 2. In the form shown in Figures 1–5 inclusive, the joists, for use with this invention, are additionally provided across the upper sides of their bottom chords 2 with form-centering or spacing elements having a shape most clearly seen at the right end of Figure 2 and in Figure 5, to comprise an upper part 4 of less length (measured crosswise of the longitudinal joist dimensions) than the lower part 4*a*, to form recesses 5. The upper corners of the lower part of each centering or spacing element may be beveled or rounded as shown, and the spacing elements may be spot-welded or fixed in any other appropriate manner to the joists.

A pair of complemental forms 6 and 7, illustrated in Figure 4, cooperate to produce a trough-like form for enclosing the bottom chord of a joist. The forms 6 and 7 each have raised sides 8 and 9 supplied at intervals with alined apertures 10 and 11. Just above the rows of apertures the forms 6 and 7 are bent inwardly to form sections 12 and 13, the inner ends of which are flanged upwardly at 14 and 15. The flanges 14 and 15 form angles with the sections 12 and 13 of slightly less than ninety (90°) degrees so that

when the two forms are assembled with their bottoms lapped, as shown in Figure 2, the flanges 14 and 15 recede slightly in an upward direction with reference to each other. Tie rods 16 provided with screw-threaded extremities are passed through the holes 10 and 11 and nuts 17 serve to draw the forms 6 and 7 toward each other and to hold them in the position desired. Actually, the approach of the flanges 14 and 15 toward each other is so contrived that a slight space is left between the opposed sides of the flanges 14 and 15 and the end edges of the upper parts 4 of the form centering elements and for a purpose to be next explained.

Concavo-convex forms 18 are, when positioned as shown in Figure 2, of approximately inverted trough-shape form and while to date fabricated as metal stampings they may be of any other commercially feasible material. The forms 18 have substantially flat tops and, as exemplified, are open below and defined by two downwardly flared sides 19. It will be observed that the sides 19 are spaced apart in a direction transverse to the direction of extent or parallelism of the joists. The lower edge sections or margins 19*a* of the ends 19 are plain and are snugly fitted between the near end edges of the upper parts 4 of pairs of the centering elements and juxtaposed flanges 14 and 15 of a pair of the trough-like forms 6 and 7 which pairs are carried by a pair of adjacent joists respectively. The arrangement is such that the edges of the margins 19*a* gravitationally rest in the recesses 5 and are there held against displacement by the flanges 14 and 15 which contact and substantially conform to the opposed or inner sides of the margins 19*a*. The forms 18 are therefore self-sustaining and require no shoring or temporary scaffolding.

It is to be understood that the forms are in telescopic or slightly overlapped arrangement in any one row between joists except at spaced intervals where it is desired to provide headers. There the two forms or inverted pans 18 are spaced apart as shown in the middle of Figure 3 and two cooperating so-called end pans 20 of zig-zag cross-section are provided and they have lower lapped flanges 21, side flanges 21*a* and tops 22 overlapped with adjacent forms 18. It will be further observed upon inspection of Figure 3 that the interjacent sections of the end pans 20 are spaced apart and that the spaces therebetween communicate at the corners of the forms 18 with the spaces between the sides 19 and the joists. Grouting material or concrete 23 is then caused to fill the troughs formed by the forms 6 and 7, to completely embed the joists and spacer angles 1*a* between the sides 19, to fill the communicating spaces between the sides 20 and to cover the tops of the joists and forms 18 to any level desired thereby unifying the entire structure after the concrete has become set. Previously any form of wire mesh or metal lath 24 will have been tied across the forms 6 and 7, as by tie wires 25 connected with the spacer angles 1*a*, or supported from the pans, as shown, preparatory to coating with plaster 26 and forming a ceiling after removal of the forms 6, 7, 18 and 20.

The modifications to which Figures 6–9 inclusive pertain consist first in the substitution for the two forms 6 and 7 of a single trough 27 provided at intervals with pairs of holes 28 and supported by U-bolts 29 which hang from the top of the joists and extend through the holes 28 after which nuts 30 are screwed on the ends of the bolts to bring the troughs 27 to the proper elevation. For cooperation with this type of trough 27 depending form centering elements 31, shown in Figures 6 and 8, are carried by the lower joist chords 2. The same type of forms 18 may be employed so that the margins of their sides 19 are fitted between the bottom corners of the centering elements 31 and the inner corners of the troughs 27.

According to the modification of Figures 10 and 11 the same one-piece trough 27 is employed, but instead of the suspension bolts 29, a wire 32 is looped around the upper chord of the joists, its two ends crossed and its two extremities passed through the holes 28 in the form of hooks 33, the holes 28 in this case being sufficiently larger to permit the passage therethrough of the hooks 33. A type of centering element 34, shown in detail in Figure 11, is fashioned with a notch 35 adapted to be occupied by the webbing 3, and wedged or welded or otherwise affixed in the position in which it appears in Figure 10. End flanges 36 are designed to engage the outer sides of the lower margins 19*a*.

Advantages which this invention has over older types of floor construction are:—

1. No temporary formwork, centering or shoring required during construction.
2. Speed of erection. (Faster than older types of flooring.)
3. Economy in the use of material, i. e. no material thrown away when job is complete.
4. A shop-fabricated job with very small field erection expense.
5. Makes possible a better winter concreting operation than older types.
6. No possibility of field mistakes on account of shop-fabricated reinforcing units having a predetermined spacing which cannot be altered.
7. Reinforced concrete floor construction (reinforced at top and bottom), affords an ideal flexural unit.
8. On multiple story jobs, floors can be erected at any level due to the absence of shoring.

We claim:

1. In a building construction in the course of erection, the combination of a pair of spaced joists, forms partially enclosing a lower portion of each of said joists and loosely hung therefrom, and elements arranged in a row between said supports some having one pair of oppositely disposed end portions interfitted with a pair of forms carried thereby and others having adjacent crosswise extending end portions lapped whereby to prevent exudation of a covering of induratable material.

2. In a building construction in the course of erection, the combination of spaced joists, elements arranged in a row between said joists, said elements having flanged lower edge portions lapped with corresponding portions of adjacent elements in said row and means associated with said joists for supporting said elements and for preventing their movement in both directions crosswise of said row.

3. In a building construction in the course of erection, the combination of spaced joists, inverted trough-shaped elements having ends converging in an upward direction and arranged in a row crosswise between said joists, means carried by said joists for locking lower edges of said elements against displacement crosswise of said row, other elements having some lower edge flanges lapped with corresponding flanges of adjacent elements in said row whereby to provide

upwardly widening recesses extending crosswise of said row between adjacent elements and whereby to prevent exudation of indurated material for filling said recesses above said flanges.

4. In a building construction in the course of erection, parallelly spaced primary supports, elements extending across and gravitationally carried by said supports and means solely carried by said supports enclosing the bottoms of said supports and elements and adapted as an independently sustained assembly to retain indurated material embedding said supports.

5. In a building construction in the course of erection, parallelly spaced joists provided with opposed ledges, a row of inverted trough-shaped elements each extending across and gravitationally resting upon said ledges, means carried by said joists for confining sections of the lower edges of said elements, other elements alternately arranged with and similarly carried as said first mentioned elements and having sections of their lower edges fashioned as flanges extending crosswise of said row, the near flanges of adjacent elements being lapped and indurated material for unifying the elements with each other and with said joists.

6. In a building construction in the course of erection, the combination of spaced substantially parallel primary supports, spacer members carried by lower portions of said supports, a trough-like form enclosing the lower portion of each of said supports, inverted trough-shaped elements arranged as a contiguous row between said supports and having one pair of oppositely disposed edges inserted each between a spacer member and one side of one of said forms said assembly being self-sustaining and adapted by itself to support induratable material filling said forms and the spaces between said supports and row of elements.

7. In a building construction in the course of erection, the combination of spaced substantially parallel primary supports, crosswise extending spacer members carried by lower portions of said supports, a trough-like form enclosing the lower portion of each of said supports, means for securing said form in place and inverted trough-shaped elements and pans alternately arranged as a row between said supports and having one pair of oppositely disposed edges inserted each between a spacer member and one side of one of said forms, the opposed sides of adjacent of said pans in the row being spaced apart and having adjacent lower edges lapped whereby below to close the space therebetween for the support of indurating material to be supplied thereto.

8. In a building construction in the course of erection, the combination of spaced substantially parallel primary supports, crosswise extending spacer members carried by lower portions of said supports, complemental forms enclosing opposite lower corners respectively of each of said supports, detachable means for securing said form in place, inverted trough-shaped elements and pans of zig-zag cross section arranged as a row between said supports and having one pair of oppositely disposed edges inserted each between a spacer member and one side of one of said composite forms, the opposed sides of adjacent of said pans in the row being spaced apart and having adjacent lower edges lapped whereby below to close the space therebetween, and indurated material filling the communicating space around said elements.

9. In a building construction in the course of erection, the combination of a pair of spaced joists directly carrying spacing elements ledges in opposite sides and near their bottoms, a row of elements of approximately inverted U-shape in section arranged crosswise between said joists and having lower end edges gravitationally resting upon said ledges and troughs enveloping the bottoms of said joists temporarily carried thereby and overlapping the lower edges of said elements, said assembly being self-sustaining and adapted to support induratable material occupying the space defined by each joist, ledge and said row of elements quite independently of extra or temporary support.

10. In a building construction in the course of erection, the combination with a support, of a self-sustaining assembly, comprising; a plurality of spaced joists, troughs hung underneath said joists, spacing elements in said troughs, forms of approximately inverted U-shape in section and having edges gravitationally resting upon said spacing elements at adjacent joists, the said joists, troughs and forms being together adapted properly to sustain induratable material occupying the space defined by the joists, the troughs and the adjacent sides of said elements.

11. In a building construction in the course of erection, the combination for support by a pair of spaced walls of parallelly extending open reticulated joists extending across from one wall to the other, trough-like forms partially enclosing lower portions of said joists supports and solely carried thereby, and a row of concavo-convex metal forms extending between said joists and having opposite end edges interfitted with a pair of said trough-like forms and solely carried thereby, said assembly being quite by itself adapted to support induratable material filling said trough-like forms imbedding said joists and covering said concavo-convex forms.

12. In a building construction in the course of erection, the combination of a pair of spacedly-supported metal joists, an upwardly presented trough-like form partially enclosing a lower portion of each of said joists and loosely hung therefrom, inverted cup-shaped elements extending as a row between said joists and having lower end portions loosely interfitted with a pair of trough-like forms carried thereby and means for holding said lower end portions of said element against excessive movement in said forms, said assembly being entirely carried by said joists preparatory to unification with indurated material.

13. In a building construction in the course of erection, the combination of a pair of spacedly-supported joists, a composite form including upwardly projecting zig-zag flanges and lapped bottom sections and partially enclosing a lower portion of each of said joists, said forms being hung from said joists, and an element extending crosswise of said joists and having end portions interfitted with the flanges of a pair of said forms and spacer members attached to said joists for holding said lower end portions of said element against the flanges of said forms, said assembly being entirely carried by said joists preparatory to unification with indurated material.

14. In a building construction in the course of erection, the combination of a pair of spaced parallelly extending joists, forms carried solely by said joists so as to enclose the lower portions thereof respectively, concavo-convex elements arranged in a row between said joists having lower bordering edges gravitationally resting on said forms and with another pair of oppositely dis-

posed relatively transverse edge sections lapped with corresponding edge sections of adjacent elements in said row to prevent exudation of indurable material filling said forms, embedding said joists and the entire outer surfaces of each of said elements.

15. In a building construction in the course of erection, the combination of spaced joists, and temporary concavo-convex forms arranged in a row between and each gravitationally supported crosswise by a pair of said joists, differing forms between some pairs of said first mentioned forms and gravitationally carried thereby, said concavo-convex forms having their lower end portions lapped with parts of said joists and crosswise extending edge portions of some lapped with corresponding portions of said differing forms in said row to prevent exudation of indurable material for covering said self-sustaining assembly.

16. In a building construction in the course of erection, the combination of spaced joists, inverted trough shaped forms and different forms of zig-zag cross section alternately arranged in a row between and gravitationally supported by said joists, some of said forms having flanged lower edge portions lapped with corresponding edge portions of adjacent elements in said row whereby to provide recesses extending crosswise of said row between adjacent elements adapted to retain indurated material filling said recesses above said flanges.

17. In a building construction in the course of erection, the combination of a pair of spacedly-supported metal joists, an upwardly presented trough-like form partially enclosing a lower portion of each of said joists and hung therefrom, inverted trough-shaped elements arranged as a row between said joists and having lower end portions loosely interfitted with a pair of trough-like forms carried by adjacent joists, means for holding said joists in predetermined spaced relation at their lower edges whereby to stabilize the whole assembly preparatory to unification with indurable material.

18. In a building construction in the course of erection, the combination of a pair of spacedly-supported metal joists, each comprising a stem provided below with a flange, a composite trough-like form partially enclosing a lower portion of each of said joists and hung therefrom, inverted trough-shaped elements arranged as a row between said joists and having lower end portions loosely interfitted with a pair of trough-like forms carried by adjacent joists, said forms being composed of complemental parts each extending around one end of a joist flange and having an upwardly flanged extremity closer to the stem of a joist, and means for holding said complemental form parts in such position, said means adapted when released to permit withdrawal of said complemental forms and of said row of inverted trough-shaped elements.

19. In a building construction in the course of erection, the combination of spaced substantially parallel joists of approximate I-shaped section, trough-like forms enclosing the lower portion of said joists, said forms having their upper portions of less width than their lower portions, inverted trough-shaped forms arranged as a row between said joists, said inverted trough-shaped forms being of such length measured crosswise of the row to adapt their lower ends for interfitting with the upper portions of a pair of said joist-enclosing forms as far as their narrower upper width permits and indurable material filling said forms, embedding said joists and covering said inverted trough-like forms whereby to lessen the quantity of indurated material adjacent the joists and to achieve an approximate I-shape for the reinforced concrete joist section.

20. In a building construction in the course of erection, the combination of a pair of spacedly-supported metal truss-type joists, an upwardly presented trough-like form partially enclosing a lower portion of each of said joists and hung therefrom, inverted concavo-convex elements extending crosswise to and arranged as a row between said joists and having lower end portions interfitted with a pair of trough-like forms carried thereby, means for holding said joists in predetermined spaced relation, and means for holding said lower end portions of said elements against excessive movement in said forms, said assembly being entirely carried by said joists preparatory to unification with indurated material.

21. In a building construction in the course of erection, the combination of a pair of spacedly-supported metal truss-type joists, an upwardly presented trough-like form partially enclosing a lower portion of each of said joists and hung therefrom, inverted trough-shaped elements extending as a row between said joists and having lower end portions loosely interfitted with a pair of trough-like forms carried thereby, means for holding said joists at both top and bottom in predetermined spaced relation and indurable material intersecting said joists and embedding said holding means.

22. In a building construction in the course of erection, the combination with a support, of a self-sustaining assembly, comprising; a plurality of spaced joists spacing elements carried by lower portions of said joists, troughs hung underneath said joists and fashioned with flanges receding relatively to each other in an upward direction, forms of approximately inverted U-shape in section and having edges gravitationally resting upon said spacing elements at adjacent joists, the edges of said forms being confined between said spacing elements and trough flanges to maintain the desired self-sustaining assembly during application and setting of an indurable covering therefor.

23. In a building construction in the course of erection for support solely by a pair of spaced walls, parallelly spaced fabricated joists resting on said walls and provided on opposite longitudinal sides with ledges, elements extending across and gravitationally resting upon said ledges, distinct means carried by said joists for confining opposite sides of the bottoms of said elements and adapted properly to position them on said ledges during the support entirely by the mentioned assembly of indurable material.

24. In a building construction in the course of erection, a self-sustaining gravitationally supported assembly comprising, parallelly spaced joists, trough-like forms hung underneath said joists, a row of hollow elements each extending crosswise between said joists and gravitationally resting in said forms whereby to confine the inner sides of sections of the lower edge of said elements and whereby to prevent exudation of indurable material for unifying the assembled parts described.

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