Fig. 1.

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COLLAPSIBLE FORM FOR CONCRETE-STEEL CONSTRUCTIONS.
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FIG. 2.

FIG. 3.

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COLLAPSIBLE FORM FOR CONCRETE-STEEL CONSTRUCTIONS.


To all whom it may concern:

Be it known that I, LOUIS F. BRAYTON, a citizen of the United States, residing at St. Paul, in the county of Ramsey and State of Minnesota, have invented certain new and useful Improvements in Collapsible Forms for Concrete-Steel Constructions; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My present invention has for its object to provide an improved collapsible or knock-down system of forms for use in the erection of concrete-steel constructions, and especially adapted for use in the erection of concrete-steel constructions of the character set forth and claimed in my pending applications, Serial No. 220,745, filed of date August 13, 1904; Serial No. 221,593, filed of date August 22, 1904, and Serial No. 222,056, filed of date August 25, 1904, all entitled "Concrete-steel construction."

To the above ends the invention consists of the novel devices and combinations of devices hereinafter described, and defined in the claims.

The invention is illustrated in the accompanying drawings, wherein like characters indicate like parts throughout the several views.

Figure 1 is a bottom plan view of several of the forms set up in position for use. Fig. 2 is a transverse vertical section on the line $x'x'$ of Fig. 1, the parts being shown on a larger scale than in said Fig. 1. Fig. 3 is a vertical section on the line $y'y'$ of Fig. 1, the parts being shown on the same scale as in Fig. 2. Figs. 4 and 5 are views corresponding to Fig. 3, but illustrating modified constructions of the forms. Fig. 6 is a view corresponding to Fig. 5, but showing a form designed and arranged for use in the erection of concrete-steel roof-trusses. Fig. 7 is a transverse vertical section taken on the irregular line $a'a'$ of Fig. 6; and Fig. 8 is an enlarged section taken on the same line as Fig. 7, but showing only the lower portion of the truss-form.

Referring first to the construction illustrated in Figs. 1, 2, and 3, the numeral 1 indicates an I-beam which constitutes the rigid chord member of one of the girders of the structure, and the character 1 likewise indicates an I-beam which constitutes the rigid chord member of one of the beams of the structure. Beams and girders are of course from a broad point of view the same thing, and trusses are a form of beam; but in this detail description for the purposes of clearness the term "girder" is used to designate the relatively deep beams, the term "beams" is used to indicate those beams which extend transversely of and are supported by the girders and have less depth than the girders, while the term "truss" is specifically used to indicate a trussed and tapered form of beam.

Fig. 2 shows a cross-section of the form which is used in the construction of the beam, and Fig. 3 shows a form which is used in the construction of the girders. Both of these forms are in most respects alike.

The lower portions of the rectangular trough-like forms are, as shown in Figs. 2 and 3, made up of a pair of long angle-plates 2, which are approximately L-shaped in cross-section and are normally set with their upper legs parallel and with their lower legs abutting in the same horizontal plane. These sections 2 are connected at their bottoms by hinges 3, which are bolted thereto, and between which and the said sections 2 in the construction illustrated are clamped the horizontally-turned lower ends of a pair of metallic straps 4. The upturned ends of the straps 4 are bolted or otherwise rigidly secured to the outer surfaces of the vertical legs 5 of the angle-plates 2, and at their extreme upper ends they are provided with laterally-projecting pivot-bolts 6, which, as shown, are also held by short straps 8, spaced apart from said straps 4 and bolted or otherwise rigidly secured to the vertical legs of said angle-plates 2. The hinge members 3 of the one angle-plate 2 are provided with laterally-projecting hinge-pins 7, which work loosely in seats formed in the hinge members 3 of the other angle-plate 2, thereby making it possible to separate the two angle-plates 2 by endwise movements of the one with respect to the
other. The bolts 8, which connect the hinge members 3 to the angle-plates 2, work through slots 3°, formed in said hinge members, as best shown in Fig. 1. These slots 3°, when the nuts of the bolt 8 are loosened, permit the angle-plates 2 to be separated, and this being done a filling-strip 9, such as shown in Figs. 7 and 8, may be introduced between the horizontal legs of the said angle-plates 2. Hence with this adjustment and by the use of filling-strips the form may be set for any desired width of concrete beam or girder body. The vertical legs of the angle-plates 2, both of the beam and the girder forms, are provided between the straps 4 and 6 with narrow slots, through which work comparatively thin metallic grapple-plates, so-called, (indicated by the numeral 10.) These grapple-plates at their upper extremities are pivoted on the bolts 5, heretofore noted, and at their inner extremities they are notched at 11 to form seats that are adapted to engage the lower flanges of the I-beams 1 or 1', as the case may be. At their outer and lower portions said grapple-plates are, as shown, formed with depending hooks 12, through which project clamping-bolts 13, which clamping-bolts, as shown, are set into the lower legs of the angle-plates 2 and at their outwardly-projecting threaded ends are provided with nuts 14, which when tightened press the grapple-plates into engagement with the flanges of the I-beams. The extreme upper portions of the sides of the beam and girder forms are alike and are made up of plates or strips 15, which, as shown, are beveled at 15°, so as to produce fillets at the junctions of the beams and girder with the floor-slab, which floor-slab in Figs. 2 and 3 is indicated by the dotted line marked z. Also, as shown, strips 15 are reinforced by cleats 15', rigidly secured thereto. In Fig. 2 the upper side strips 15 are placed directly against the upper legs of the angular plates 2, while in Fig. 3 in order to produce a girder of greater depth filling-strips 16 are interposed directly between said side strips 15 and the upper legs of the said angle-plates 2.

To support the floor-sections of the form in position, a plurality of joists 17 are employed. These joists extend parallel with the girder and abut at their ends against the sides of the beam-forms and hold the same against lateral spreading movements. The joists are supported by blocks 18, rigidly secured on the vertical legs of the angle-plates 2 of the beam-forms, as best shown in Figs. 1 and 3. The joists 17 are held against lateral displacement by stops 19, having projecting pins 20, which project through perforations in said joists and are provided at their projecting ends with lugs-keys 21. The floor-sections 22 of the form construction rest upon the joists 17, and certain thereof at their edges rest upon the cleats 15° of the upper strips or plates 15. Said floor-sections 22 are provided with cleats 22°, that engage with the joists 17 and with the said cleats 15° to hold the said floor-sections in their proper relative positions.

In placing the forms above described in working positions the lower trough-forming sections—that is, in the construction described, the hinged angle-plates 2 of the girder-forms—are first applied, and the grapple-plates 10 are pressed onto the lower flanges of the I-beam 1. The said grapple-plates being once set in proper relative position with respect to the angle-plates 2 by adjustments of the nuts 14 are applied to the flanges of the I-beam and removed therefrom by the hinge-like movements of the said angle-plates with respect to each other. The adjustment of the said grapple-plates by means of the nuts 14 is for the purpose of setting them for proper engagement with I-beams or similar metallic members varying in their width. Next the angle-plates 2 of the beam-forms are placed in working position in the manner already described, and when they are thus supported from the I-beams 1 they abut against the angle-plates 2 of the girder-forms and lock them in working positions against spreading movements. Next the joists 17 are applied in working positions, and when thus applied they abut against the angle-plates 2 of the beam-forms and lock them in working positions and against spreading movements. Next the filling-strips 16 are set in position, and then the upper side strips or plates 15 are placed on working position both for the beam and girder forms. Then, and finally, the floor-sections 22 are placed in working position. The forms thus applied, as is evident, will be supported entirely by the self-sustaining steel structure, and the concrete in plastic condition may be then filled into the channel-like forms and spread over the floor-sections to form the concrete bodies of the girders, beams, and floor-slabs. After the concrete has properly set the several parts of the forms may be removed in the following order: First, the keys 21 are removed from the pins 20, and the joists 17 are taken down. This will permit the hinged angle-plates 2 of the beam-forms to swing apart and release their grapple-plates from the beams 1, thereby permitting the ready removal of the said beam forming plates 2. The removal of the angle-plates 2 of the beam-forms releases the angle-plates of the girder-forms and permits the latter to be removed by hinge-like separating movements. Then the fillers 16 may be removed, then the upper side plates or strips 15, both of the girder and beam forms, may be removed, and then, and lastly, the floor-sections 22 may be removed.

In practice it is only necessary to provide enough forms for a single floor or even a portion of a floor, as these forms may be used successively to form the different floors or different sections of the same floor.
The construction illustrated in Figs. 6, 7, and 8 is designed for use in forming roof-slabs, purlins, and roof-trusses and requires but a slight modification of the construction illustrated in Figs. 1 to 5, inclusive. The same lower sections of the trough-like forms used for the girders and beams in the former illustration are employed for the purlin-forms and for the truss-forms; but slight modifications of the upper side plates or strips 15 used in the purlin-form are made necessary by the inclination of the roof, as clearly shown in section in Fig. 6. Also in the truss-form illustrated in section in Fig. 7 the form of the truss makes necessary the use of wide and tapered filling-strips 16 in lieu of the filling-strips 16 used in the girder-form. Also to hold the filling-plates 16 in position I preferably employ retaining-stakes 23, which, as shown, are supported at their lower ends by keepers 24, secured to the angle-plates 2 of the girder-form. At their upper ends the stakes 23 bear against the joists 17, which in this arrangement, as well as the slab-sections 22 (hitherto termed “floor-sections”) are of course given the proper inclination to form the roof-slab, (indicated by dotted lines marked z in Fig. 6.) As indicated in Figs. 7 and 8, the rigid chord member of the truss is formed by a pair of steel angles 18, to which the angle-plates 10 of the truss-form are applied. Also in view of the width of the truss the bottom filling-strips 9, heretofore noted, are interposed between the horizontal legs of the angle-plates 2.

Figs. 4 and 5 illustrate modified forms of the grapple-plates and of the trough-forming angle-plates. In these modifications the vertical and horizontal legs of the angle-plates 2 are connected by hinges 2, which permit the said sections when the forms are removed to be turned flatwise together; but hold them against outward pivotal movement when the forms are in a vertical position. The legs of said angle-plates 2 are connected by hinges 2, which resemble the hinges 2 to 7, before described. The grapple-plates 10 (illustrated in Fig. 4) work through slots in the horizontal legs of the angle-plates 2, are pivoted thereto at 10, and are formed with depending hooks 10, in which loosely rest headed nut-blocks 25. A clamping-screw 26, having right and left threads, works with screw-threaded engagement through the nut-blocks 25. As is evident, by means of the clamping-screws 26 the grapple-plates 10 may be forced onto the lower flanges of the beam and may be released therefrom by the proper movement. The vertical legs of the angle-plates 2 must be slotted or cut away to afford clearance for the grapple-plates 10, and the same is true of the construction shown in Fig. 5. In the construction illustrated in Fig. 5 the grapple-plates 10 are pivoted on the bolts of the hinges 2 and they are provided with overlapping perforated legs 10. A short nutted bolt 27, passing through certain of the aligned perforations of the legs 10, serves to lock the grapple-plates onto the said beam 1.

From what has been said it will be understood that the construction described is capable of modification within the scope of my invention as herein set forth and claimed.

What I claim, and desire to secure by Letters Patent of the United States, is as follows:

1. The combination with a collapsible form, of grapples applied thereto and applicable to the metallic member of a beam or similar concrete-metal structure, to secure said form in proper position for molding the concrete about the metal parts, substantially as described.

2. The combination with a collapsible form, of grapples working through the plates of said form and engageable with the metallic chord member of a concrete-metal beam or similar structure, to anchor said form in position for molding the concrete about the metallic parts, and adjustable locking means for said grapples, substantially as described.

3. The combination with a collapsible form, having extensible sides, of grapples applied thereto and applicable to the metallic member of a beam or similar concrete-metal structure, to secure said form in position for molding the concrete about the metal parts, substantially as described.

4. The combination with a collapsible form, having an extensible bottom, of grapples applied thereto and applicable to the metallic member of a beam or similar concrete-metal structure, to secure said form in proper position for molding the concrete about the metal parts, substantially as described.

5. The combination with a collapsible form, having extensible sides and an extensible bottom, of grapples applied thereto, applicable to the metallic member of a beam or similar concrete-metal structure, to secure said form in proper position for molding the concrete about the metal parts, substantially as described.

6. The combination with a form for containing concrete in position for molding, of grapples applied thereto and adapted for application to the metallic member of a beam or similar concrete-metal structure, substantially as described.

7. The combination with a form for containing concrete in position for molding, of grapple-plates thereon engageable with the metallic member of a beam or similar concrete-metal structure, and means for adjusting one of said grapples with respect to the other, substantially as described.

8. The combination with a trough-like form, of opposing grapples mounted thereon, and means for adjusting said grapples with
respect to the sides of said form, substantially as and for the purposes set forth.

9. In combination, collapsible girder-forms and collapsible beam-forms, the members of one of said class of forms being arranged to hold against collapsing movements the members of the other class of forms, substantially as described.

10. The combination with collapsible girder-forms and beam-forms, members of one class of said forms serving to lock members of the other class of said forms against collapsing movements, and means for supporting said forms from the metallic members of the concrete-metal beams and girders, substantially as described.

11. The combination with collapsible beam-forms and collapsible girder-forms, members of one class of said forms locking members of the other class of forms against collapsing movements, detachable joists abutting against and locking certain of the members of said forms against collapsing movements, thereby directly or indirectly locking all the forms against collapsing movements, and means for supporting said forms from the metallic members of the concrete-metal beams and girders, substantially as described.

12. The combination with collapsible beam-forms and collapsible girder-forms, members of one class of said forms locking members of the other class of forms against collapsing movements, detachable joists abutting against and locking members of certain of said forms against collapsing movements, whereby directly or indirectly locking all the said forms against collapsing movements, floor or slab sections supported by said joists and filling in the space between the forms, and means for supporting said forms from the metallic members of the concrete-steel girders and beams, substantially as described.

13. In separable forms for building concrete structures, a beam-form comprising a bottom plate and removable side plates and opening at intervals the length of said side plates, in combination with intersecting beam-forms removably supported opposite said openings.

14. In separable forms for building concrete structures, the main beam-forms provided with joist-joists, in combination with supplemental beam-forms open at their ends to said main beam-forms and removably connected therewith, joists removably supported upon said rests, and floor-plates removably supported upon said joists and forms.

In testimony whereof I affix my signature in presence of two witnesses.

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Witnesses:

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