

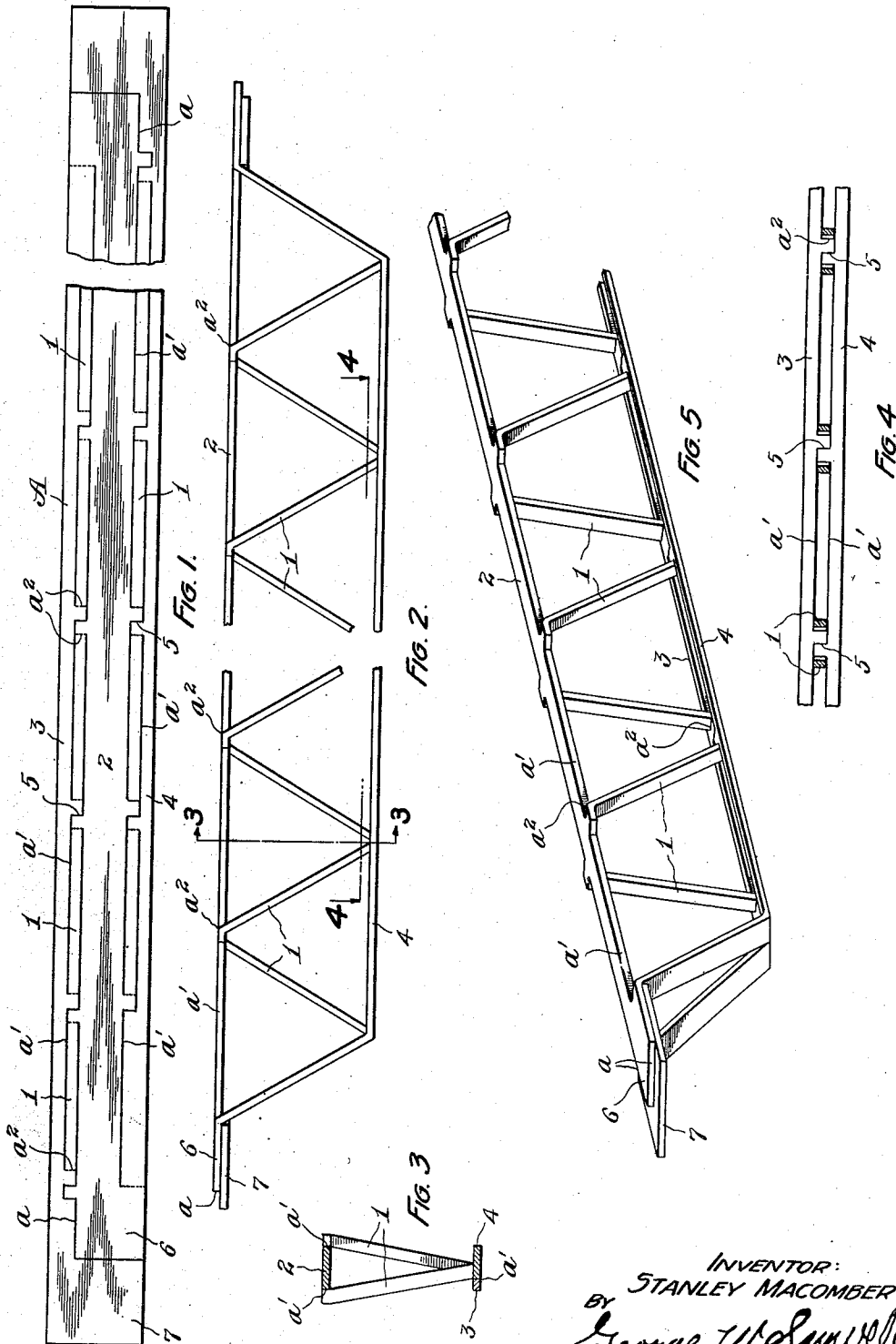
Feb. 25, 1930.

S. MACOMBER

1,748,423

METHOD OF MAKING STRUCTURAL UNITS

Original Filed Feb. 16, 1923 2 Sheets-Sheet 1



INVENTOR:
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ATTORNEY.

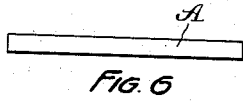
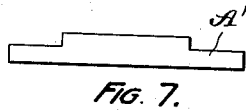
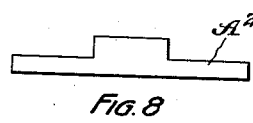
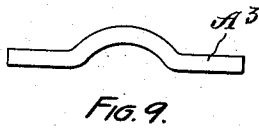
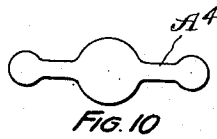
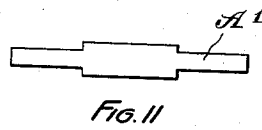
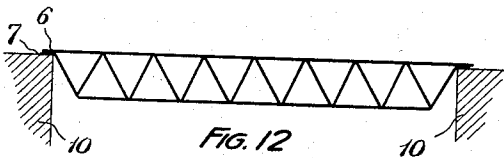
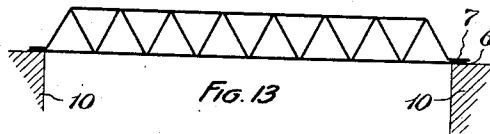
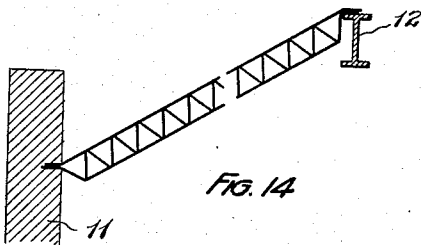
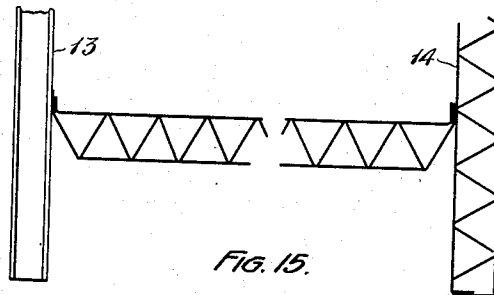
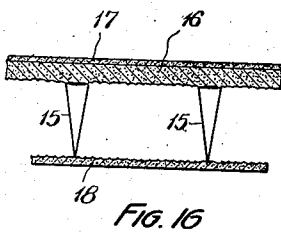
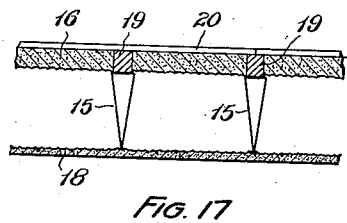
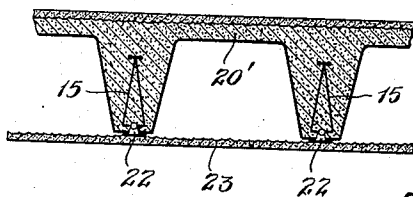
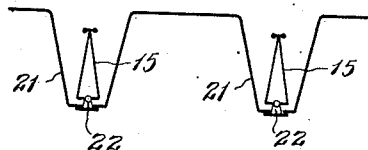
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METHOD OF MAKING STRUCTURAL UNITS

Original Filed Feb. 16, 1923 2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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METHOD OF MAKING STRUCTURAL UNITS

Original application filed February 16, 1923, Serial No. 619,401. Divided and this application filed April 13, 1928. Serial No. 269,713.

The subject matter of this application has been divided out of my pending application Serial No. 619,401, filed February 16, 1923, upon structural units and methods of making same.

This invention relates more particularly to the method of fabricating a truss section or other structural unit for buildings and the like from a single piece, i. e., sheet of metal, the operation involved in the formation of such section being performed, if desired, without reheating the metal. While the particular object of the invention is the provision of a light weight section adapted to act as a beam in carrying light loads, as in the case of joists in floor construction, the utility of the invention is not limited to any such particular field or for that matter to any method for producing such particular type of structural element. In other words, the unit produced by my improved method, which unit is particularly claimed in said pending application Serial No. 619,401, may be also advantageously employed in the construction of columns, as a roof purlin and as a reinforcement for concrete in floors and the like.

To the accomplishment of the foregoing and related ends, the invention then consists in the steps hereinafter fully described and particularly pointed out in the claims, the annexed drawings and the following description setting forth in detail one method exemplifying my invention, such disclosed procedure constituting, however, but one of the various applications of the principle of my invention.

In said annexed drawings:

Figure 1 is a plan view of the initial or starting plate from which a structural unit is fashioned by the succession of steps constituting my novel method of manufacture, such plate being shown as slit or punched preliminarily to the performance of succeeding operations;

Figure 2 is a side elevation illustrating the form assumed by such plate as the result of such subsequent operations when it is desired to fashion the plate into a truss member;

Figure 3 is a vertical transverse section of

such truss member, the plane of the section being indicated by the line 3—3, Figure 2;

Figure 4 is a horizontal section of the same, taken on the plane indicated by the line 4—4, Figure 2;

Figure 5 is a broken perspective view of such member;

Figures 6, 7, 8, 9, 10 and 11 illustrate various sections of the initial or starting plate which may be used in fashioning such element or structural unit;

Figure 12 is a diagrammatic representation in side elevation of such truss element showing its use as a beam or a girder hung below supports;

Figure 13 is a view similar to Figure 12 but showing such element inverted above supports;

Figure 14 similarly shows the same employed as a roof purlin;

Figure 15 illustrates the use thereof as a beam or girder between columns, one of the latter consisting of such element in modified form;

Figures 16 and 17 are sections likewise more or less diagrammatic in character illustrating the employment of such an element in steel truss joist floor construction; and

Figure 18 shows such element used as a support and reinforcement for concrete floor construction.

The initial or starting plate A, shown in plan in Figure 1, to which the procedure of my improved method is applied to produce the forms of structural unit shown by way of illustration in the accompanying drawings, is of elongated rectangular form and of a cross-section illustrated in Figure 6. The overall dimensions of the plate A, as well as its thickness, will vary, of course, with the length which it is desired the finished structural unit shall have and the calculated strains and stresses which such unit will be required to sustain. As already indicated, the initial step in the fabrication of such unit from the plate consists in the shearing, slitting or punching of the same along oppositely disposed, irregular L-shaped lines *a* adjacent the respective ends thereof and along two parallel series of similar Z-shaped

lines a' intermediately of such ends. It will be noted that the longitudinally extending portions of the slits a and adjacent slits a' overlap and that similarly such longitudinally extending portions of the slits a' overlap each other; also, that the narrow portions 1 of the metal sheet lying between such longitudinally extending slit portions are designed to be bent transversely of the median line of the slit as a whole at points a^2 .

As a result of the form and arrangement of slits a and a' , when such portions 1 of the sheet are bent downwardly at the points a^2 , the effect will be to displace from the central portion 2 of the sheet the continuous, i. e., uncut, lateral portions 3 and 4, such continuous lateral portions being at the same time shifted longitudinally in opposite directions relatively to the main portion 2. The lateral portions are then brought together, it being noted that the transverse portions of the zig-zag or Z-shaped slits a' , when the portions of the sheet are thus displaced, present shoulders 5 that are adapted to interlock, as shown in Figure 4, substantially in the transverse plane of said central member 2. It will also be noted that the adjacent portions 1 of the strip extend in opposite diagonal directions, when viewed in side elevation, from the central strip portion 2 and the lateral strip portions 3 and 4 when these are thus brought into juxtaposition and interlocked in the fashion just described (see Figs. 2 and 5). Finally, it will be noted that, as shown in Figure 3, such portions 1 incline inwardly or converge at their lower ends, such lower ends being substantially in longitudinal alignment while their upper ends are alternately attached to opposite sides of the mid-portion 2 of the sheet.

It will be obvious from the description thus given of the manner in which a sheet of metal is first cut or slitted and the resultant parts thereupon bent and fitted together, that a truss-like structure is formed, the mid-portion or rib 2 of the sheet constituting one chord, the juxtaposed and interlocked lateral portions 3 and 4 constituting the other chord and the diagonal portions 1 constituting the web members of the truss. The ends of such resultant truss member may be variously formed or arranged. Thus, as illustrated in Figures 2 and 5 (see also Figures 12 and 13), the relatively wide terminal portions 6 constituting the ends of the mid-rib portion 2 and the relatively wide terminal portions 7 constituting one end of the lateral chord member 3 and one end of the lateral chord-member 4, which relatively wide terminal portions 6 and 7 remain attached to the mid-rib portion 2 and the lateral portions 3 and 4, are brought into overlapping relation in approximately the plane of such mid-rib portion and there riveted, welded or otherwise permanently secured together in

any desired manner. As a result, not only is a true truss structure presented, but the terminal portions 6 and 7 thus secured together provide a convenient projection at each end of the truss for use as a bearing plate for such truss, whether the latter is hung below supports 10, as illustrated in Figure 12, or is inverted above such supports, as shown in Figure 13. It is also possible by bending these terminal portions 6 and 7, so that they will lie at an obtuse angle to the plane of mid-portion 2, or, in other words, to the median line of the truss, to adapt the latter for use in an inclined position between supports 11 and 12, as shown in Figure 14, where use of the truss member as a roof purlin is illustrated. For that matter such terminal portions 6 and 7 may be bent at a right angle to the median line of the truss and the latter thus adapted to be secured against the vertical faces of columns 13 and 14, as shown in Figure 15. In this last-mentioned figure, the column 14 at the right illustrates still another adaptation of a truss produced by my improved method, viz, as a column or vertical support, the only change involved being the overlapping of such terminal portions 6 and 7 so as to form a box-like end for the structure instead of a projection, as in the several forms hereinbefore described.

The specific form of structural element produced by my improved method, shown in Figures 2, 5 and 12, will find a large field of use as a joist in floor construction, examples of such use being illustrated in Figures 16 and 17, where a series of such elements 15 are shown in diagrammatic cross-section. In Figure 16 a concrete floor 16 with concrete finish 17 is shown as being supported by such joist, while a plaster ceiling 18 is hung therefrom in the usual manner. The only difference in the construction shown in Figure 17 is that the concrete portion 16 of the floor has incorporated therein nailing strips 19 to which a wood floor finish is attached.

The use of the element as a column illustrated in Figure 15 renders unnecessary the separate illustration of the use of such element as a partition stud, except to note that where employed in this last mentioned manner, successive elements will be disposed so as to face in opposite directions, thus additionally bracing and strengthening the wall.

Such element 15, as illustrated in Figure 18, is very well adapted for use in reinforcing concrete, the particular use illustrated in the figure in question being in a reinforced concrete floor or roof structure 20 of generally familiar form where the elements are wholly embodied in the concrete. The use of such elements in this connection presents the advantage that wood forms may be eliminated since permanent or removable steel forms 21, as shown at the right of said

Figure 18, may be supported on hangers attached to the elements 15. The latter, in other words, will support the dead load of the floor construction until the concrete has set and the same hangers 22 may be conveniently utilized to suspend the ceiling 23, if desired.

It is not considered necessary to show or describe any special machine or instrumentality, in the way of dies or the like, such as may be used in the commercial fabrication of a structural unit by my improved method inasmuch as it is a matter of indifference how the slits be formed in the initial sheet A and the several portions of the latter thereupon brought into the relationship illustrated in Figures 2 and 5. Obviously such unit can be fabricated by hand with ordinary tools where made from a sheet of light section. Moreover, while all the operations involved may be performed in the cold, I do not mean to exclude the possible use of hot bending where due to the thickness of the original sheet or for other reason this should be found advantageous. It is emphasized, however, that the unit is formed wholly by slitting and bending the original sheet or plate, there being no expanding or stretching of the metal whatever.

It has already been indicated that the thickness and the dimensions of the sheet employed in the carrying out of the procedure of the improved method will be selected with a view to providing the necessary strength for the particular use to which the unit is to be put. Instead of being of plain, i. e., flat cross-section, as shown in Figure 6, such plate may be of irregular cross-section in order to provide additional thickness of material in certain of the parts of the unit when finished. Thus, as shown in Figure 7, the central portion of the sheet A', from which the mid-rib or chord element 2 is cut, may be thicker than the respective lateral portions. A similar modification is illustrated in Figure 8, except that such thickened central portion is narrower and somewhat higher; while in the plate or strip A², shown in Figure 9, such central portion is transversely curved or humped. In Figure 10, the modified strip or plate A⁴ there shown is rolled with the central portion as well as the lateral portions thickened, the additional material being of curved cross-section, so that the mid-rib and lateral portions of the fabricated unit will take on the form of rods. Finally, in Figure 11, I show a form of strip or plate similar to that shown in Figure 7, except that the central portion is thickened on both sides.

It has already been explained that the terminal portions 6 and 7 when brought into overlapping relation may be secured together in any desired manner. Similarly, the lateral portions 3 and 4 of the unit when brought

into juxtaposed relation may be welded, riveted or tied together at longitudinally spaced points, if desired.

It, of course, will be understood that while I have illustrated and described a number of practical applications or uses for the structural unit produced by my improved method, it is not meant to restrict its use to any particular purpose.

What I claim is:

1. In a method of making a truss-like structural unit, the steps which consist in slitting a plate along an L-shaped line adjacent an end thereof and along a series of Z-shaped lines intermediate the ends thereof, said L-shaped line being overlapped by the adjacent Z-shaped line, thus forming a longitudinally continuous portion adapted to form a chord-member and a series of longitudinally aligned shorter portions adapted to form web-members, said web-members remaining attached at one end to said chord-member, and then bending said web-members into angular position relatively to the plane of said chord-member.

2. In a method of making a truss-like structural unit, the steps which consist in slitting a plate along L-shaped lines adjacent the respective ends thereof and along two parallel series of Z-shaped lines intermediate said L-shaped lines, the outer Z-shaped lines of each series overlapping the adjacent L-shaped lines, respectively, to form a longitudinally continuous portion adapted to form a chord-member and two plurality of series of longitudinally aligned shorter portions, one on each side of said chord-member, adapted to form web-members, said web-members remaining attached at one end to said chord-member, and then bending said web-members into angular position relatively to the plane of said chord-member.

3. In a method of making a truss-like structural unit, the steps which consist in slitting a plate into a longitudinally continuous portion adapted to form a chord-member and into two series of longitudinally aligned shorter portions, one on each side of said chord-member, adapted to form web-members, said web-members remaining attached at one end to said chord-member, then bending said web-members along one side of said chord-member into similarly inclined position relatively to the plane of the latter and longitudinally thereof, similarly bending said web-members along the other side of said chord-member but in the opposite direction, and finally bending said respective series of web-members to incline transversely of said chord-member and so converge at their outer ends.

4. In a method of making a truss-like structural unit, the steps which consist in slitting a plate into a plurality of parallel longitudinally continuous portions adapted

to form chord-members and into a series of longitudinally aligned shorter portions lying between said continuous portions and each connected at one end to one of said continuous portions and at the other end to another such portion, separating said continuous portions in a direction transverse to the plane thereof, whereby said shorter portions are bent into angular relation to such plane and form web-members between adjacent chord-members, and finally bending said respective series of web-members to incline transversely of said chord-members, said web-members being thus bent transversely so as to converge in pairs at their outer ends.

5. In a method of making a truss-like structural unit, the steps which consist in slitting a plate along L-shaped lines adjacent the respective ends thereof and along two parallel series of Z-shaped lines intermediately said L-shaped lines, the adjacent Z-shaped lines of each series overlapping and the outer Z-shaped lines of each series overlapping the adjacent L-shaped lines, respectively, to form three parallel longitudinally continuous portions adapted to form chord-members and two series of longitudinally aligned shorter portions, one series lying on each side of the central continuous portion and the several portions thereof being connected at one end to such central portion and at the other end to the adjacent continuous portion, and then separating said continuous portions in a direction transverse to the plane thereof, whereby said shorter portions are bent into angular relation to such plane and form web-members between said chord-members.

6. In a method of making a truss-like structural unit, the steps which consist in slitting a plate into three parallel longitudinally continuous portions adapted to form chord-members and into two series of longitudinally aligned shorter portions, one series lying on each side of the central continuous portion and the several portions thereof being connected at one end to such central portion and at the other end to the adjacent continuous portion, then separating the two outer continuous portions from such central portion both in the same direction, and such direction being transverse to the plane thereof, whereby said shorter portions are bent into angular relation to such plane and form web-members between said chord-members, and then bringing said outer continuous portions together.

7. In a method of making a truss-like structural unit, the steps which consist in slitting a plate along an L-shaped line adjacent an end thereof and along a series of Z-shaped lines intermediate the ends thereof, said L-shaped line being overlapped by the adjacent Z-shaped line, thus forming a longitudinally continuous portion adapted to form

a chord-member and a series of longitudinally aligned shorter portions adapted to form web-members, said web-members remaining attached at one end to said chord-member, bending said web-members into angular position relatively to the plane of said chord-member, and then bringing the extreme end plane portions formed by the L-shaped line into overlapping relation.

8. In a method of making a truss-like structural unit, the steps which consist in slitting a plate along L-shaped lines adjacent the respective ends thereof and along two parallel series of Z-shaped lines intermediately said L-shaped lines, the outer Z-shaped lines of each series overlapping the adjacent L-shaped lines, respectively, to form a longitudinally continuous portion adapted to form a chord-member and two series of longitudinally aligned shorter portions, one on each side of said chord-member, adapted to form web-members, said web-members remaining attached at one end to said chord-member, bending said web-members into angular position relatively to the plane of said chord-member, and then bringing the extreme end plane portions formed by the respective L-shaped lines into overlapping relation.

9. In a method of making a truss-like structural unit, the steps which consist in slitting a plate into a longitudinally continuous portion adapted to form a chord-member and into two series of longitudinally aligned shorter portions, one on each side of said chord-member, adapted to form web-members, said web-members remaining attached at one end to said chord-member, bending said web-members into angular position relatively to the plane of said chord-member, and finally bending said respective series of web-members to incline transversely of said chord-member and to converge at their outer ends.

10. In a method of making a truss-like structural unit, the steps which consist in slitting a plate along L-shaped lines adjacent the respective ends thereof and along two parallel series of Z-shaped lines intermediately said L-shaped lines, the adjacent Z-shaped lines of each series overlapping and the outer Z-shaped lines of each series overlapping the adjacent L-shaped lines, respectively, to form three parallel longitudinally continuous portions adapted to form chord-members and two series of longitudinally aligned shorter portions, one series lying on each side of the central continuous portion and the several portions thereof being connected at one end to such central portion and at the other end to the adjacent continuous portion, separating said continuous portions in a direction transverse to the plane thereof, whereby said shorter portions are bent into angular relation to such plane and form web-members between said chord-members.

bers, and then bringing the extreme end plate portions formed by the respective L-shaped lines into overlapping relation in approximately the plane of the central continuous portion and securing them together to form terminal supports.

Signed by me this 28 day of March, 1928.
STANLEY MACOMBER.

CERTIFICATE OF CORRECTION.

Patent No. 1,748,423.

Granted February 25, 1930, to

STANLEY MACOMBER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, line 100, claim 2, strike out the words "plurality of"; page 4, line 1, claim 4, before the word "series" insert the words "plurality of"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of April, A. D. 1930.

(Seal) -

M. J. Moore,
Acting Commissioner of Patents.

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