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FABRICATED STRUCTURAL PART

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3 Sheets-Sheet 1
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This invention relates to structural parts such as trusses and strength members for use in building frames of buildings and similar constructions. It is a primary object of the invention to provide a novel arrangement of parts so that a series of construction members may be produced that are capable of use in a variety of ways so that they may be attached together to form a number of different constructions of various shapes and sizes. It is intended that the invention is capable of use either for the making of construction members for use in the construction of large buildings, barns, hangars or bridges; or that it be used to provide a miniature form of building members for use in an educational and instructive manner.

In accordance with my invention, fabricated trusses which are preferably constructed of metal stampings riveted together are provided so that they may be interchangeably attached together in a variety of ways. To this end the sides of the trusses are provided with a series of attaching holes suitably spaced apart in a uniform manner, and suitably arranged along the side of the truss so that the trusses may be attached together with apaxes of adjacent trusses at a common point.

Each truss is preferably made with its sides formed of a pair of angle pieces riveted together, and for use in large trusses for the construction of large buildings it has been found that an angle section of increased vertical height and a thinner section than usual, provided with an outwardly projecting flange at the lower end of the angle piece gives strength to the truss far in excess of that which can be produced by the use of common angle iron of present day construction of the same weight.

The three forms of trusses, by means of which a large number of buildings of any sort may be constructed, are of triangular form, each truss having an angle which is an even multiple of 22-1/2°, that is, the trusses have angles of 22-1/2°, 45°, 67-1/2°, 90° and 135°. An important feature of this truss form, in accordance with this invention, is the fact that each truss has a side with a length corresponding to the side of another truss. In the preferred form, the hypotenuse of the 45° angle truss, which will be termed the b truss, has a length substantially equal to the short side of the truss having angles of 22-1/2°, 45° and 135°, which is termed the a truss. The short side of the b truss has a length which is equal to the side of the 67-1/2° truss opposite to the 67-1/2° angle. This 67-1/2° truss will be termed the o truss.

The various trusses may be constructed of heavy structural steel for use in the construction of large buildings, the various trusses all being provided with the attaching bolts or rivet holes so that the trusses can be produced in quantity lots and at a minimum expense in a few standard shapes and sizes. The buildings may be readily designed so that they may use the standard trusses manufactured by combining these trusses to build other trusses of larger form and by combining these trusses with other structural members such as angles, pivot members, gusset, wire fittings, columns, channels, girts, purlins and fish plates.

The various accessory members to be used with the trusses, such as the members just mentioned, are all fabricated to the proper 50 standard shape selected so that they may be interchangeably connected in a variety of manners and any one part may be attached to almost any other part in almost any manner desired. The spacing of rivet holes along the sides of the members, such as the angles, pivot members, channels, etc., is a uniform arrangement so that the rivet holes are spaced a uniform distance apart and the series of holes are so located from the ends of the various members that the members may be attached together with their ends at a common point. The various structural trusses and members may be made in a small form of miniature size so that they may be used for educational and instructive purposes and for the construction of small models of buildings. These miniature members are preferably made of thin sheet metal, and are of substantially the same general arrangement as in the large structural steel members. It is intended that the miniature trusses shall be as
sembled in various ways in a detachable manner as by the use of small bolts; and that they be accompanied in use by other structural members in the same manner as the large structural steel trusses so that a variety of buildings of different shapes and sizes may be made.

With the above objects in view and others which will be more fully set forth in the following description and in the drawings, reference is made to the various figures of the drawings in which:

Fig. 1 is an end view of a building showing one arrangement of trusses and other structural members.

Fig. 2 is a side elevation corresponding to the end of the building shown in Fig. 1.

Fig. 3 is a detailed view of the three trusses of heavy structural steel used in the building shown in Fig. 1.

Fig. 4 is a view of a side of one end of a truss.

Fig. 5 is a section on the line 5—5 of Fig. 3.

Fig. 6 is an end view of a building of modified fied form, of the three pin truss type.

Fig. 7 is a side view of a pivot fitting assembly.

Fig. 8 is a front view of the pivot assembly shown in Fig. 7.

Fig. 9 is a view of an end of a channel strength member.

Fig. 10 is a section on the line 10—10 of Fig. 9.

Fig. 11 is a section through a column.

Fig. 12 is a side view of an angle fitting.

Fig. 13 is a detailed view of the guy wire or cable attachment.

Figs. 14 to 22 inclusive are views of the structural parts of miniature size, Fig. 14 being a view of the three trusses of miniature size for use in educational purposes.

Fig. 15 is a detail of a blank used in the construction of the 45° truss shown in Fig. 14.

Fig. 16 is a section on the line 16—16 of Fig. 14.

Fig. 17 is a section on the line 17—17 of Fig. 14.

Fig. 18 is a blank used in the construction of the miniature angle fittings.

Fig. 19 is an end view of one of the channel members used with the trusses shown in Fig. 14.

Fig. 20 shows the construction of a column from two channel members.

Fig. 21 is a side view of a channel member.

Fig. 22 is a view looking in the side of an end of one of the trusses shown in Fig. 14.

Referring more particularly to the drawings by reference numerals, 1 indicates a truss of triangular form which is used in conjunction with the trusses 2 and 3, as shown in Fig. 3, it being intended that the various trusses shall be fabricated to the form shown and produced in quantity and provided with means so that they may be attached together in a variety of different ways.

The truss 1 is composed of the sides 4, 5, and 6, each of which is composed of a pair of angle pieces 7 and 8 (see Fig. 5), which are riveted together by the rivets 9. The angle pieces 7 and 8 are formed as shown with a main back part 10, which is provided with the upper outwardly projecting side 11, and the lower small flange 12. The height of the back 10 is considerably in excess of the extent of the side 11, and the shape of the angle piece as a whole is considerably thinner and deeper than the standard form angle iron at present in use in structural steel work. The form shown has an immense advantage over the present shape angle iron, for use in the fabricated trusses to be more fully described, since the same strength may be produced in a truss at much less weight using the new and preferred form of angle section. In this preferred form of angle section, see Fig. 5, the thickness of metal is 1/8" for a 5"x21/4" section.

In the truss 1 the angle between the sides 5 and 6 is 135°, and the angle between the side 5 and 4, and between 5 and 6 is 92 1/2°. The length of the sides 5 and 6 which are equal, is equal to the length of the side 13 of a 45° angle truss, which is fabricated in the same manner as described for the truss 1, which will be termed the a truss. The 45° angle truss will be termed the b truss. By placing the two trusses together and attaching them together with the side 13 of the b truss against the side 6 of the a truss, a truss will be formed of larger size than either of them and one which is itself a triangle. The two sides, 14 and 15 of the b truss, are of course of equal length, and this length corresponds to that of side 16 of the third truss 3, which will be termed the c truss. The side 15 is constructed of material of the same thickness as that forming the angle pieces of the side 15, but the depth of the angle pieces forming the side 14 is greater than that employed in the other angle pieces. This makes the side 14 of the b truss of heavier formation than other sides of other trusses. Thus, when two b trusses are placed together the heavy side 14 is intended to be the side which is unattached to other structural members. Where the side 15 is to be attached to other structural members it is, of course, rigidified by reason of this attachment. The angle between the side 16 of the hypotenuse 17 of the c truss is 22 1/2°, and the c truss like the b truss is a right-angled triangle. Since all of the trusses have acute angles of an even multiple of 22 1/2°, that is, either 22 1/2°, 45°, 67 1/2°, or 135°, the various trusses may be assembled together in a variety of ways with their apexes at a common point and produce useful trusses of desirable shapes.

The various trusses are provided with fish...
plates 19, which are placed between the two angle pieces 7 and 8, the various parts being held together by the rivets 9. The various fish plates are attached together by means of the angle braces 20 to rigidify the truss as a whole, it being desirable that the plate at the center of the longest side of a truss should be connected to a fish plate in the corner of the truss opposite to that side. These braces are fabricated together on opposite sides of the fish plates in pairs by means of rivets 21.

The sides 11 of the angle pieces 7 and 8 are provided with a series of attaching bolt or rivet holes 22, to form a double series of holes along each side of a truss. The holes in each of these series are spaced apart by a distance s uniformly. The length of sides 14, 15 and 16 of the b and c trusses are preferably so chosen as to be an even multiple of this distance s, so that the rivet holes will not only be evenly spaced apart but will be spaced at the same spacing distance away from each end of the side of the truss, or in other words away from an apex. With such an arrangement, it is possible to assemble the b and c trusses together in a reversible manner, that is, the 22½° angle apex of the c truss may just as readily be placed at the 90° corner of the b truss. That two sides of any truss taken through its plane of symmetry will, of course, be identical. The short side 18 of the c truss is provided with the rivet holes 23 so positioned that the spacing of the first hole from the 90° corner of the truss corresponds to the spacing distance s. This is done so that the 90° corners of the trusses may be placed in any 90° space provided by other members and so that with the attaching holes of the mating members in proper agreement, they will exactly fit in the corners. The holes provided in the sides of the a truss and those provided in the hypotenuse of the b and c trusses are centrally positioned along the length of these sides.

It is desirable that the size of the trusses be made such that the distance from an end hole of the attaching series of holes from an end of its side of the truss be approximately equal to the spacing distance s to as great an extent as possible in all the truss sides so that trusses may be joined with their apaxes in substantial agreement. It is, of course, impossible to have all the sides of all the trusses provided with their attaching holes the exact distance s away from the ends of all the sides. However, this is not especially essential since the trusses are assembled together usually either with their sides in the relations shown in Fig. 3 or with such a relation but with one or more of the trusses reversed end for end or with trusses attached to other trusses of the same shape. With the spacing holes arranged centrally of the long sides of the trusses, and also centrally of the sides 5 and 6 of the a truss, any side of a truss may be attached to a corresponding side of a similar truss in a reversible manner with their apaxes at a common point. The sides 4 and 5, and 4 and 6 of the a truss do not meet at a common point or apex, as the ends of this truss are of such pointed nature that they would have little strength and consequently it is desirable that these trusses should be shaped as shown in Fig. 3 with their sharp apaxes cut off, so that some rigidity may be attained in the apexes by maintaining the heavy section of the angle pieces practically to the end of the truss. It will be obvious that since sides 6 and 13 of the a and b trusses are equal, the cut off end of the a truss will coincide with the short side of the b truss.

It will now be clear that the various trusses shown in Fig. 3 may be assembled together by riveting together the sides of the various fabricated trusses to form a large truss, indicated generally at 28 in Fig. 1. This large truss as will be seen is composed of the a truss, the two b trusses and the top c truss on each side of the building. Each truss 28 forms a support in one plane for the building and a number of these trusses 28 are used to form a large building, part of which is shown in Fig. 2. The trusses may be assembled in a variety of manners to form buildings of various sorts and of various shapes and sizes, for example. Fig. 6 shows a construction of a hangar for airplane use which is formed of vertical sides constructed of a series of c trusses, and the roof of which is constructed of a series of a trusses attached together by a pivot fitting. An extension indicated generally at 24 shows a roof truss formed of a and b trusses.

In conjunction with the various structural trusses a number of accessory parts are utilized in the making of any structure. The building shown in Fig. 1 is supported by a series of vertical columns 25, which are of H section, as shown in Fig. 11. These columns are drilled at their ends with a series of attaching bolt holes 26 so that they may be assembled in position and so that the spacing of the holes 26 from the ends of columns coincide with the spacing 3 employed in the trusses. The columns 25 are attached together by a series of girts 27 of channel section as shown in Fig. 10. These channels may be made of one or two main sizes so that they may be either used as girts or may be used as purlins as indicated at 28 in Fig. 1, and at 29 in Fig. 6. The purlins 28 or 29 support the roof or cover of the structure as indicated at 30. The channels 27 are provided with a series of attaching holes 31, which are spaced a distance t from the end of the channel. This distance t corresponds substantially with the distance t shown in Fig. 4 between a hole 22 and the medial line of the truss side. These channels 27 may also be used for columns, girders, or may be employed in a variety of manners.
Small angle fittings 32 are used to interbrace the columns and the truss sides. These angle fittings are formed of angle pieces 33 and 34, which are attached in pairs to a fish plate 35 in the same manner as shown in Fig. 5 by the rivets 36, it being understood that the fish plate 35 is held in position between angle pieces of each pair. These angle pieces are provided with the holes 37, which are spaced a distance apart equal to \( s \) and the holes nearest the 90° corner of the angle fitting are likewise spaced a distance \( s \) from this corner so that these fittings may be inserted in any 90° corner with the assurance that the rivet holes will match up with the holes in the pieces forming the corner. The length of each of the short sides of the angle fitting is preferably also an even multiple of the distance \( s \).

The shape of the section of the pieces 33 and 34 may be either in accordance with the usual angle section at present in use in structural steel work, or may coincide with the section shown in Fig. 5, in which the thickness of the metal is considerably less than standard angle sizes.

In order to attach trusses to other members or other trusses, particularly where the angle made by the side of a truss does not exactly fit in the position that it is intended to be placed, the truss is attached to a pivot piece 38, which is formed of a pair of angle pieces 39 and 40 riveted together and to a series of plates 41, which extend downwardly and form the hinge end 42. This hinge end 42 is attached by pin 43 to a hinge end 44, which is constructed of a series of plates riveted together to form a fabricated anchor arrangement as indicated at 45. Means are provided for attaching the fabricated arrangement 45 to a fixed support by holes 46. A pair of pivot fittings 38 may be attached together by joining their two pivot ends 42 together by a pin 43. The sides of the angles 39 and 40 are provided with the holes 47 spaced the customary distance \( s \) apart so that these holes may be attached to the trusses or to other members and form a support. The two pivot members shown at 48 in Fig. 6 are used to attach together the two a trusses forming the roof truss of the structure. The pivot pieces 49 and 50 are used to attach the building to the point of attachment at the ground.

The various trusses 23 shown in Figs. 1 and 2, and the various trusses shown in Fig. 6, are attached together by means of guy wire cables 51, which are crossed as shown in Fig. 2 and extend in a vertical plane above the column 25. The second series of cables lies in a horizontal plane passing through the lower sides of the trusses, and attaching the various trusses together in fixed relation. The two obtuse angles of the two a trusses of Fig. 6 are attached together by guy wire cable 51 as indicated. Each of these cables 51 is attached by means of turnbuckle 52, clamps 53 and cable 54 to an end fitting of substantially \( U \) shape 55, which is attached by means of a bolt 56 to one of the holes in a truss or other structural part.

It is intended that the various trusses and the various accessory parts will be made in large quantities of a standard size and a standard shape. These trusses may be then assembled together in various relations to form large structures or frames of any sort. These frames may be salvaged in case the building is to be torn down or may be used in the reconstruction of a building by merely burning out the rivets. The trusses being of standard sizes and shapes may be used many times and in a knocked down manner if desired. It is intended that the angle pieces shown in Fig. 5 will be made in the form of a stamping, one operation being all that is necessary to cut the holes in the back and the sides of the angle pieces and then immediately bend up the two ends of the angle pieces. It is intended that the material used for the construction of large buildings will be structural steel of a thickness of about \( \frac{3}{16}'' \) where the section shown in Fig. 5 is employed. This section corresponds to a length of about 20 to 30 ft. of a truss side.

My invention is susceptible of use in the construction of educational and instructive structural members, which may be assembled in the same manner employed with the structural steel members just described. It is contemplated that a miniature set of a large number of various trusses with a number of accessory parts, such as the angle fittings, pivot members, channel braces or columns, and guy wire clamps and fittings should be supplied so that they may be used to make various model buildings or structures. These miniature trusses are of small size, say about a foot long, and the weight they are employed to brace is comparatively small as compared with the regular structural steel. They can therefore be made of thin sheet metal in the form of stampings and to this end a blank for such stampings is shown in Fig. 15. This blank designated as 57 is intended to be cut and stamped and have its edges bent up in a single operation. The same operation also cutting the attaching holes in the faces and bent up sides of the blank. The blank 57 is bent along the dotted lines 58 and provided with attaching holes in sides 59 and 60 of the truss blank. The material is cut away from the openings 61 and the metal bent along the dotted line 62 so as to form a rigidifying brace from the center of the hypotenuse to the 90° corner of the blank. The four holes 63 stamped in the piece and the rivets 64 (see Fig. 16) form means to attach two stampings together, back to back, to form a fabricated miniature truss.

The number of rivets necessary to attach the pairs of blanks together to form a truss.
in the miniature construction is small, and the blanks are therefore stamped with depressions 65, which imitate rivet heads and which will be effective in increasing the strength of the truss by the bulge which is produced. Fig. 17 shows the construction of such an imitation rivet at 66.

Fig. 14 shows three trusses, A, B and C, which correspond to the trusses a, b and c previously described. The truss A, built of thin sheet metal stampings has angles of 29 1/2°, 90° and 135°, the B truss is a 45° angle truss and the C truss is a 67 1/2° right-angled triangle. All three of these trusses are exactly triangular in section as shown, although if desired the sharp apexes may be cut away as shown and described in Fig. 3 for the heavy structural steel trusses. The spacing of the rivet holes, by means of which various trusses are attached together, correspond essentially to the spacing described for the structural steel trusses, so that the various trusses may be assembled together in various manners. The distance S is uniform in the three A, B and C trusses and the attaching holes are spaced from the apexes of the trusses in such a way as already described in detail so that the various trusses may be variously assembled together or assembled with a similar truss in any manner.

Fig. 18 shows a blank, two of which are adapted to be attached together after being bent and stamped so that an angle fitting is provided, which corresponds to the other angle fitting shown in Fig. 12. The uniform spacing of attaching holes in the angle fitting 66 shown in Fig. 18 still applies, this distance being indicated as S.

Fig. 19 shows the standard channels which are supplied with the various trusses, these channels being likewise made of stamped sheet metal and provided with attaching holes in their ends so that they may be assembled in various manners. Two channels, for instance, may be attached together as shown in Fig. 20 by means of the attaching bolts and nuts 67 and 68, which are supplied in quantity for the assembly of the various trusses and strength members.

If desired, a number of wire fittings and turnbuckles corresponding to the turnbuckles and fittings shown in Fig. 13, but of miniature size, shall be supplied with the trusses shown in Fig. 14, and in addition accessories such as pivot members, etc., corresponding to those shown in Figs. 7 and 8, may also be used in the construction of miniature buildings for educational purposes or as models of larger buildings.

I am aware that various forms of my invention may be employed but I do not intend to be limited to the precise construction which has been chosen for purposes of illustration of my invention.

I claim:

1. An article of manufacture comprising a series of three triangular trusses adapted to be attached together in a variety of ways, two of said trusses being right-angled triangles, one of said right-angled triangles having two 45° angles, and the other of said right-angled triangles having angles of 67 1/2° and 90°, each truss having a side of the same length as another truss of the series.

2. A series of triangular trusses of fabricated metal adapted to be attached together in a variety of ways and comprising a, b and c trusses, the a truss having angles of 29 1/2°, 90° and 135°, the b truss having angles of 45°, 45° and 90°, and the c truss having 29 1/2°, 67 1/2° and 90°, each truss having a side of the same length as another truss of the series.

3. A series of triangular trusses of fabricated material adapted to be attached together along their sides in a variety of ways and comprising a, b and c trusses, the a truss having angles of 29 1/2°, 29 1/2° and 135°, the b truss having angles of 45°, 45° and 90°, and the c truss having 29 1/2°, 67 1/2° and 90°, the short side of the a truss being substantially equal in length to the hypotenuse of the b truss, and the short side of the b truss being substantially equal to a side of the c truss.

4. A series of triangular trusses adapted to be attached together in a variety of ways and comprising a, b and c trusses, the a truss having angles of 29 1/2°, 29 1/2° and 135°, the b truss having angles of 45°, 45° and 90°, and the c truss having 29 1/2°, 67 1/2° and 90°, the short side of the a truss being substantially equal in length to the hypotenuse of the b truss, and the short side of the b truss being substantially equal to a side of the c truss, said trusses all having sides provided with a series of attaching bolt or rivet holes uniformly spaced apart so that a side of a truss may be attached to another similar or dissimilar truss of the series in a variety of ways.

5. A series of triangular building trusses of fabricated metal adapted to be attached together in a variety of ways and comprising a, b and c trusses, the a truss having angles of 29 1/2°, 29 1/2° and 135°, the b truss having angles of 45°, 45° and 90°, and the c truss having 29 1/2°, 67 1/2° and 90°, the short side of the a truss being substantially equal in length to the hypotenuse of the b truss, and the short side of the b truss being substantially equal to a side of the c truss, said trusses all having sides provided with a series of attaching holes uniformly spaced apart so that a side of the truss may be attached to another similar or dissimilar truss of the series in a variety of ways, said series of attaching holes being positioned from the 90° corners of the trusses a distance equal to the distance between adjacent bolt holes, and the series of attaching holes in the other sides of the trusses being substantially centrally located of the length of the side.

6. A series of triangular trusses of fabrica-
cated metal adapted to be attached together in a variety of ways and comprising a, b and c trusses, the a truss having angles 22½° and 135°, the b truss having angles 45° and 90°, and the c truss having angles of 67½° and 90°, said trusses all having sides provided with a series of attaching bolt or rivet holes uniformly spaced apart so that a side of the truss may be attached to another similar or dissimilar truss in a variety of ways, said series of attaching holes being positioned from the 90° corners of the trusses a distance equal to the distance between adjacent bolt holes, and the series of attaching holes in the sides of the trusses being substantially centrally located of the length of the side.

In testimony whereof I affix my signature.

URBAN C. THIES.