

Sept. 1, 1964

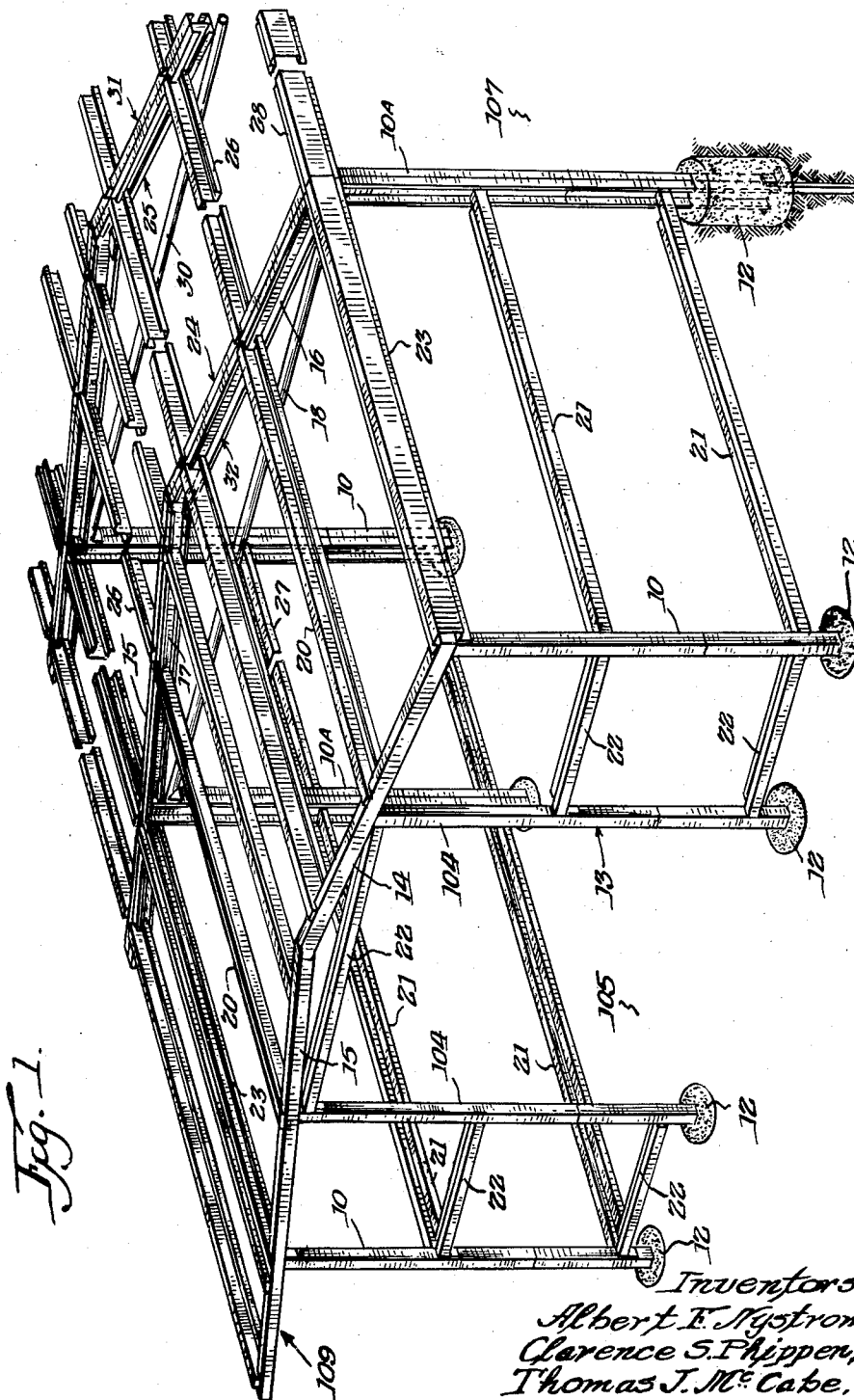
A. F. NYSTROM ET AL

3,146,864

METAL BUILDING

Filed Sept. 26, 1958

7 Sheets-Sheet 1



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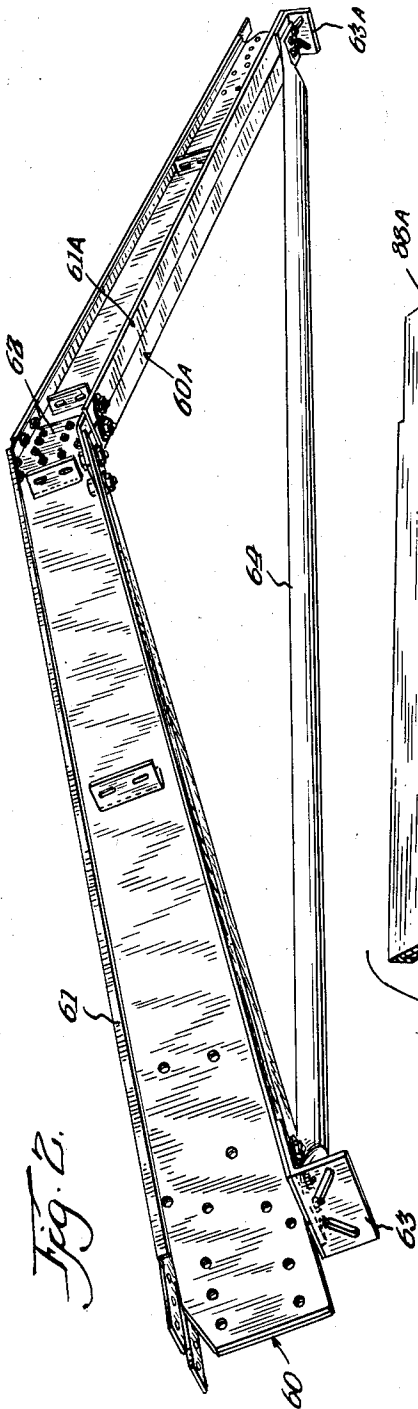


Fig. 2.

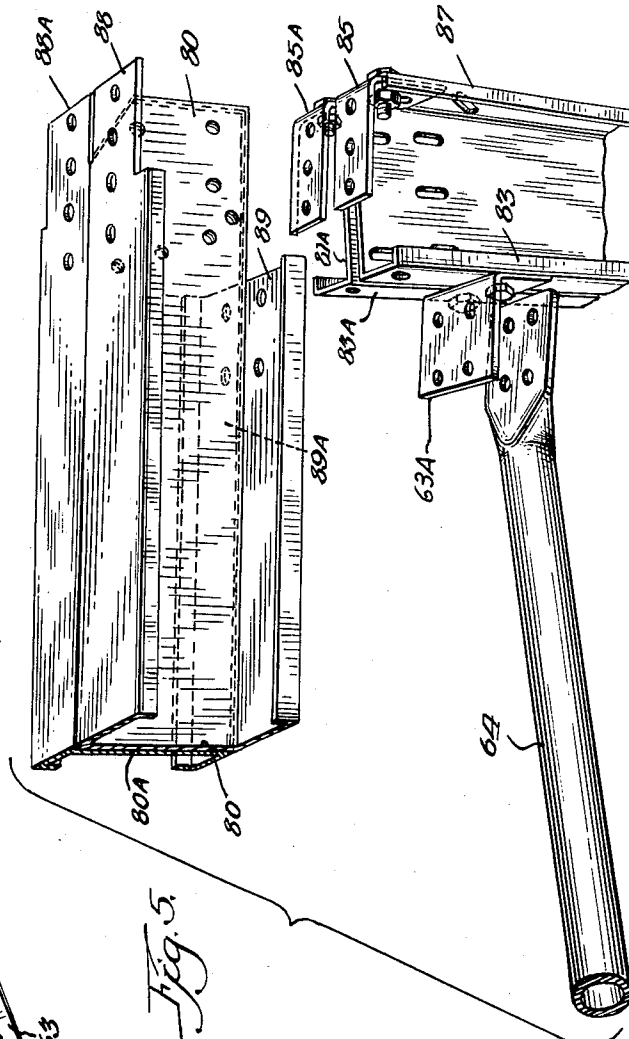


Fig. 5.

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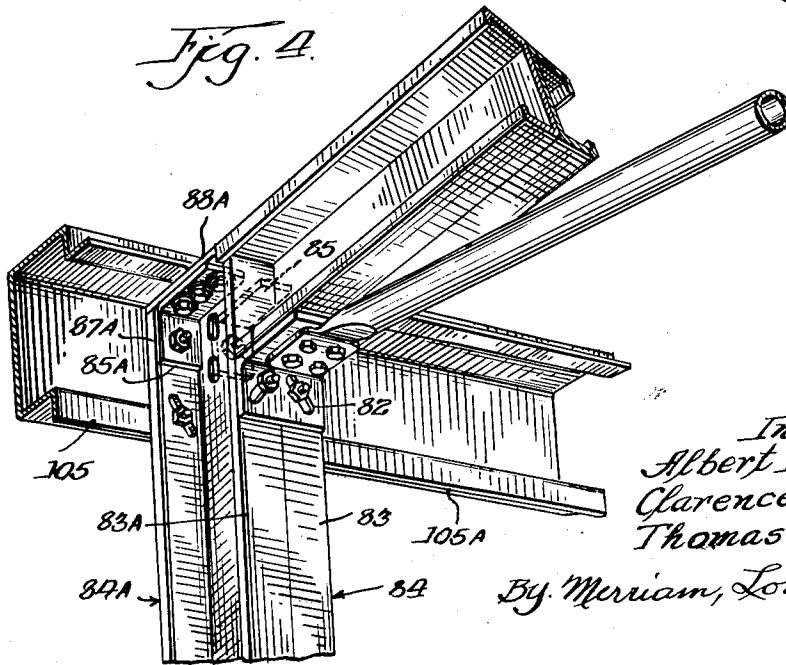
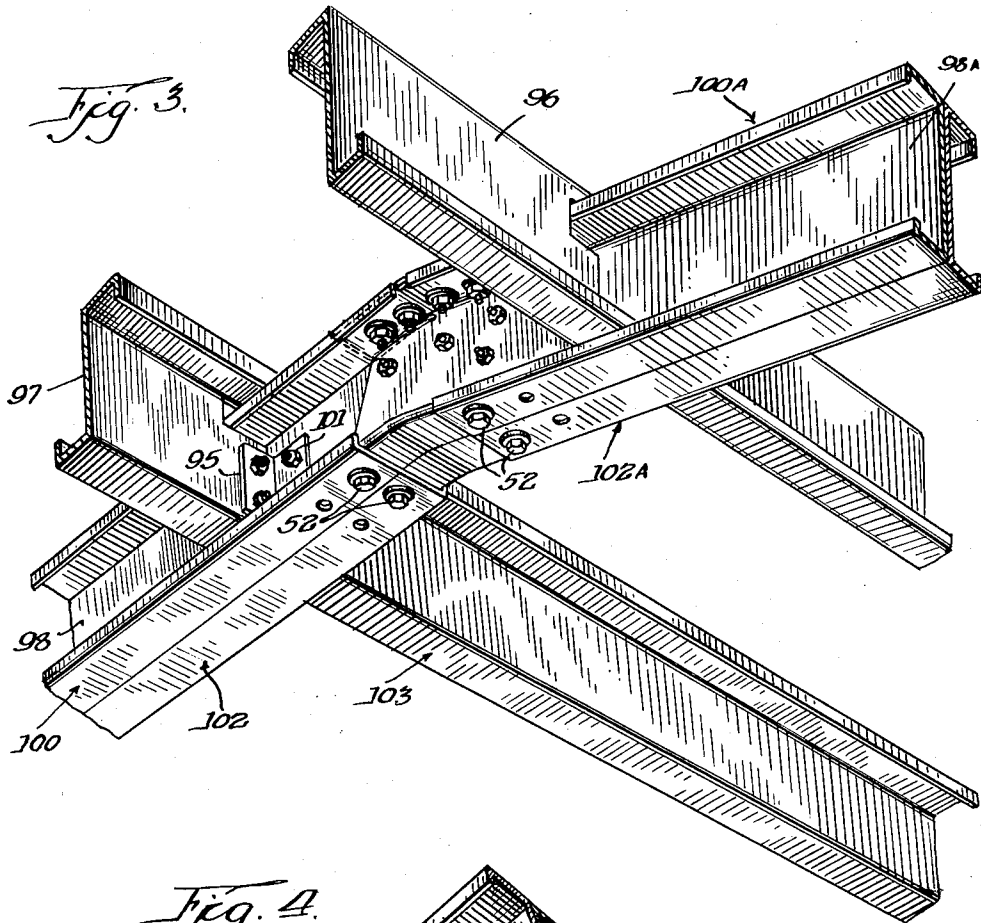
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7 Sheets-Sheet 3



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Fig. 8.



Fig. 16.

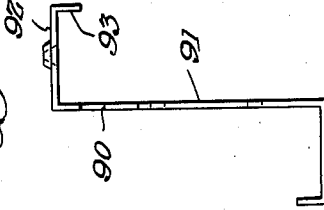


Fig. 6



Fig. 7

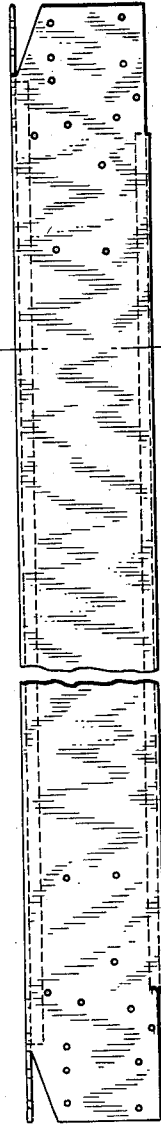


Fig. 14

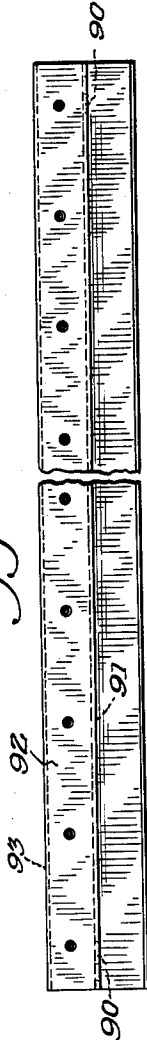
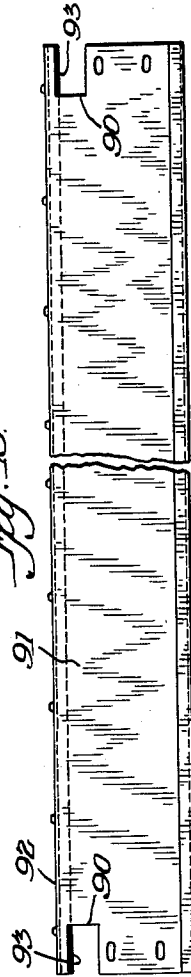


Fig. 15



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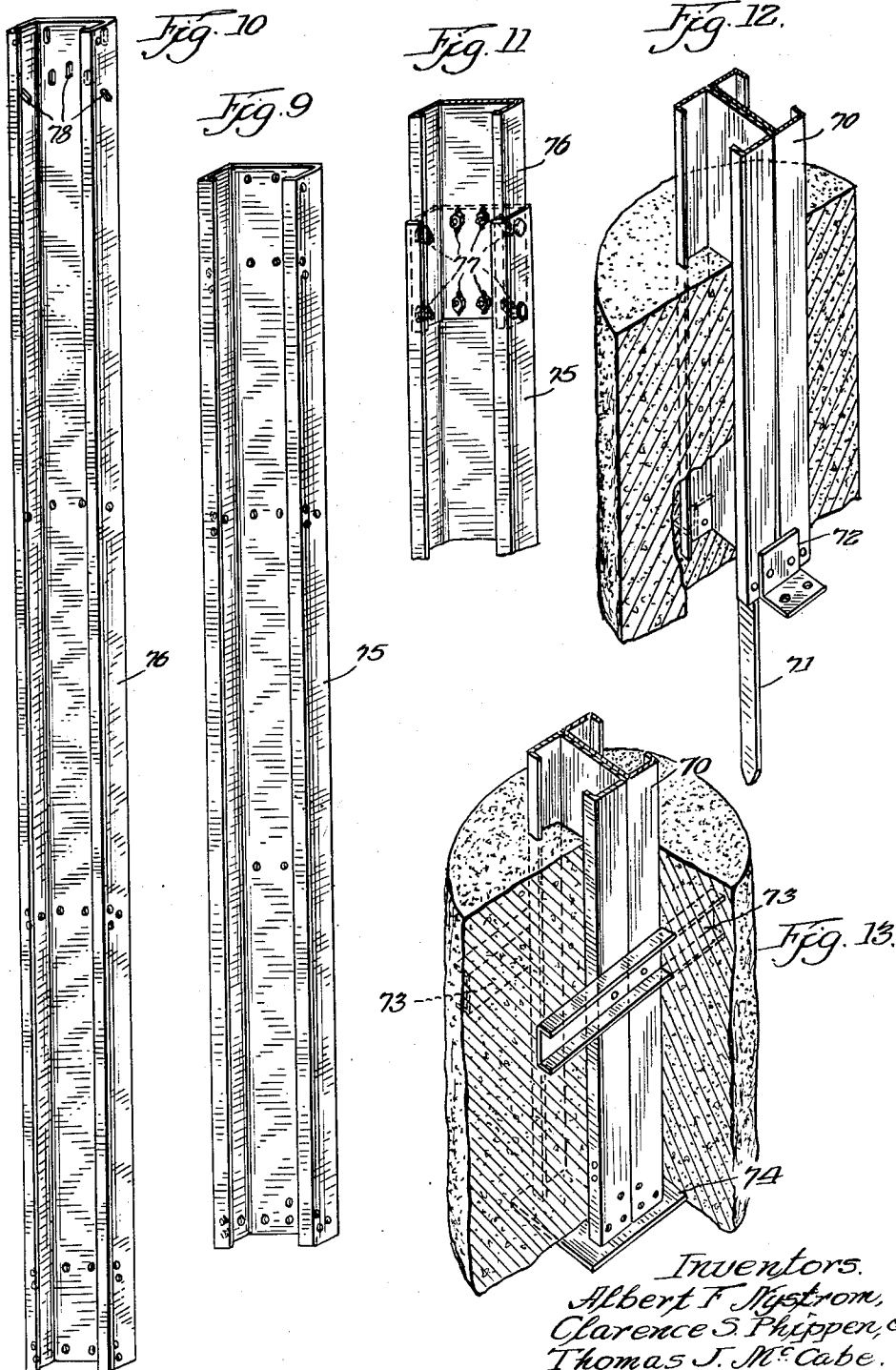
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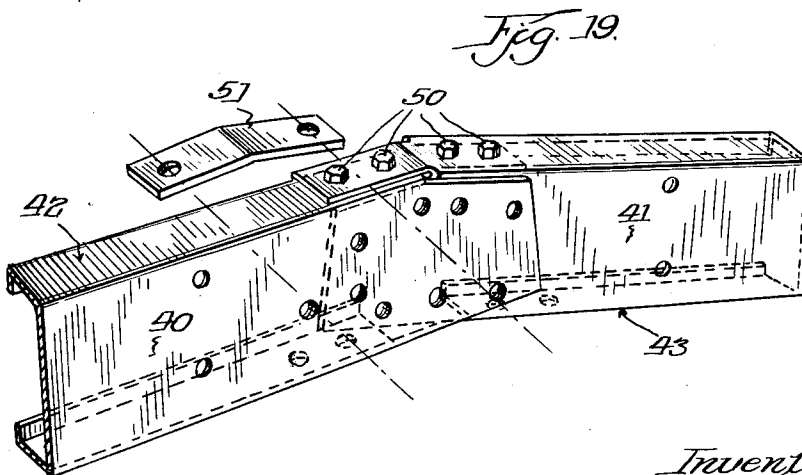
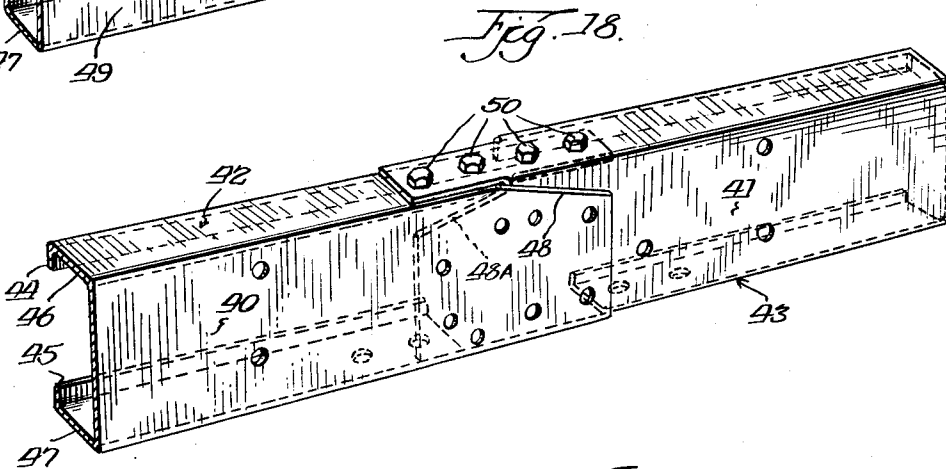
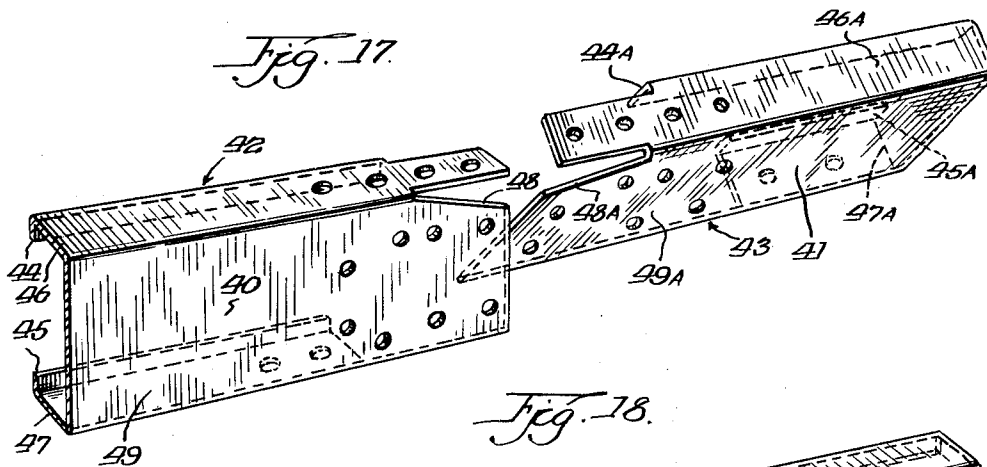
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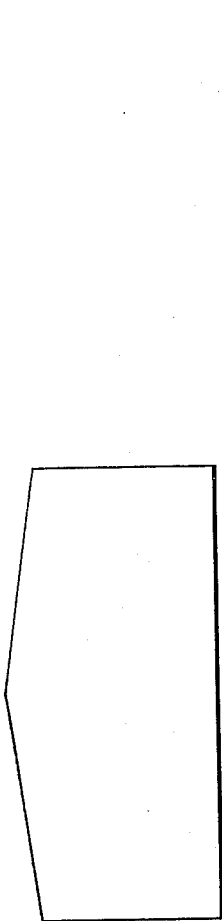


Fig. 20.

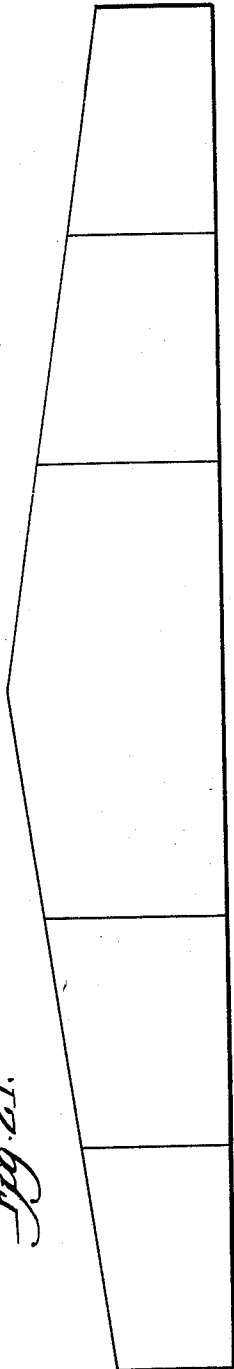


Fig. 21.

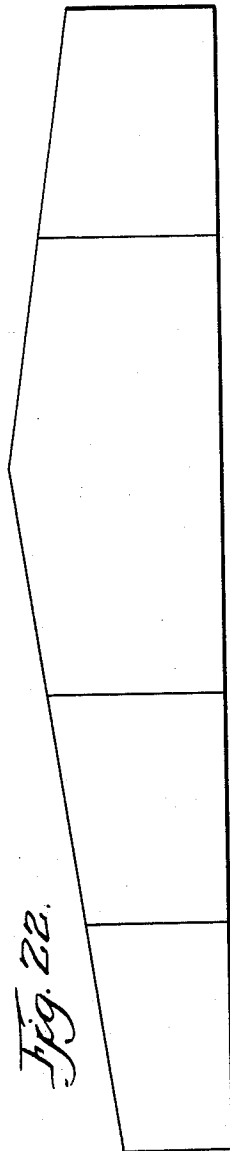


Fig. 22.

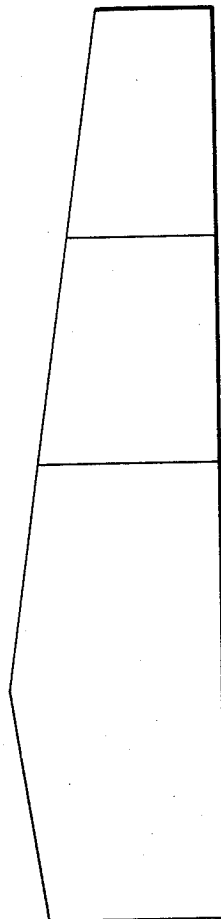


Fig. 23.

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METAL BUILDING

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17 Claims. (Cl. 189-1)

This invention relates to metal buildings. It is especially concerned with a flexible system for the construction of metal buildings in which the upper framing is supported by column members erected and positioned in excavated, back-filled, earthen cavities.

Conventional metal building construction generally requires extensive and expensive foundation work upon which the upper structural elements are supported. In light weight metal building construction a continuous footing is provided to distribute concentrated loads over a sufficiently large area to bring the pressure within the safe bearing capacity of the soil or rock. Although foundations of this type are used in wooden building construction, one of the earliest forms of construction utilized vertical columns consisting of wooden poles driven into the ground or embeded in pre-excavated holes which are suitably backfilled after the pole has been installed. After a sufficient number of poles are provided, rafter assemblies are attached to the upper portions of the poles and a roof constructed. Only an approximate elevation is used in setting the poles. In order to maintain a horizontal eave line the pole members are topped by sawing when the rafter assemblies are attached. If desired, metal or wooden sheathing is installed on the sides to enclose the interior. Buildings so fabricated are designated as pole type buildings.

This method of construction permits the easy erection of economical buildings for industrial and agricultural use. Although it has been adapted for the general construction of metal buildings, its greatest commercial acceptance has been in the field of farm buildings. According to this invention there is provided a metal building construction of the pole type having construction features which permit the simple erection of economical, rigid frame, metal buildings by skilled or unskilled labor with simple tools without requiring special erection equipment.

This invention is illustrated by the accompanying drawings in which:

FIGURE 1 illustrates a simplified specific embodiment of a basic, gable roof, frame assembly employed in the metal building construction of this invention.

FIGURE 2 shows a complete rafter assembly which is interconnected to the column members to form the intermediate building framing members.

FIGURE 3 is a fragmentary perspective view of the crown or crest connection of the rafter assembly.

FIGURE 4 is a fragmentary view of the haunch section of the framing member.

FIGURE 5 is an exploded view of the haunch assembly showing the interrelationship of the rafter, column, and tie rod elements of the framing member to provide a rigid frame construction.

FIGURE 6 is a top plan view of a basic rafter element.

FIGURE 7 is an elevation view of the rafter element shown in FIGURE 6.

FIGURE 8 is a cross sectional view through line 8-8 of the rafter element shown in FIGURE 6.

FIGURE 9 is a perspective view of the bottom member of the column assembly.

FIGURE 10 is a perspective view of the top member of the column assembly.

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FIGURE 11 illustrates an illustrative telescoping connection for assembling the top and bottom members of the column assembly.

FIGURES 12 and 13 describe illustrative expedients for embedding the bottom element of the column assembly in the pre-excavated earthen cavity.

FIGURE 14 is a top view of a purlin or girt employed in connecting the framing members illustrating the notched ends for facilitating the connection between the framing member and purlin or girt.

FIGURE 15 is an elevation view of the purlin or girt shown in FIGURE 14.

FIGURE 16 is an end view of the purlin or girt shown in FIGURE 14.

FIGURES 17, 18, and 19 show progressively the steps initially employed in assembling the roof rafter members.

FIGURES 20, 21, 22, and 23 represent schematically the outline of various framing members which can be constructed employing the features of this invention.

In typical pole type metal building construction the column and rafter elements of the framing members, which are interconnected by purlins, girts and other girder members to form the building framework which is subsequently enclosed, are connected by pin type fittings. This means of assembly does not have the strength obtained in so-called rigid frame assemblies which have a continuous beam action. Generally rigid frame assemblies are shop fabricated in single units of a weight and size requiring heavy duty erection equipment. In addition, pole type metal building construction presents the problem of maintaining a horizontal eave line because the column members cannot be conveniently sawed at the job site.

According to this invention a rigid framing member having continuous beam action is easily assembled and adjusted at the job site by employing the several construction features of this invention which include adjusting means for providing a horizontal eave line without sawing or manipulating the column elements, as well as novel haunch section and crown connections.

Referring to the drawings, in FIGURE 1 is seen a specific embodiment of a basic gable roof unit 24 feet wide with 16 foot long bay units. The height at the roof gable is 14 feet and the roof has a 2 inches in 12 inches pitch. The unit comprises columns 10 which are installed in an upright vertical position in excavated earthen cavities 11 and backfilled with concrete 12. End framing member 13 is constructed by coupling rafter members 14 and 15 at the crown and connecting the rafter assembly to the top of columns 10 to provide a rigid frame assembly. The intermediate framing member similarly comprises columns 10A joined with rafter elements 16 and 17 to provide an opposed rigid framing member. The columns of the intermediate framing members are tied together by means of tie rod 18 which prevents a lateral or horizontal separation at the haunch sections of the framing members. The framework is completed by purlins 20, sidewall girts 21, endwall girts 22, and other girder members such as eave girder 23. The adjacent framework unit comprising framing members 24 and 25 joined by purlins 26, sidewall girts 27, and eave girders 28 is connected to the end framework unit to provide an integral structure. Additional intermediate framework units can be integrated into the assembly or the framework construction can be finished by joining an end framework unit to the assembled units. It is to be noted that a single tie rod 18 and 30 is common to each pair of intermediate framing members 32 and 24, and 25 and 31, which are joined web to web as will hereinafter be discussed.

In this invention, rafter elements or members 40 and 41 shown in FIGURES 17-19 are used which consist of C

channels 42 and 43. The strength of these channels is increased and heavy duty units provided by adding inwardly directed lip flanges 44 and 45 to flanges 46 and 47. The terminal ends of each rafter member are provided with right triangular notch 48 cut from web 49 of channels 42 and 43 adjacent the marginal edge of head flanges 46 and 46A. The angle at the apex of the notch is at least equal to the selected roof slope. A portion of lip flange 44 equal or greater in extent than the depth of notch 48 is also removed from the end of channels 42 and 43. The edge of head flange 46 adjacent notch 48 in a leg portion or web 49 is cut away an amount slightly greater than the thickness of the sheet metal from which the rafter members are fabricated. The apex angle formed thereby is defined by the head flange 46 at the one end of one rafter element and a plane passing through the leg portion 49 converging inwardly from the terminal end of the element and intersecting the head flange 46. An entire length of lip flange 45 and flange 47 sufficient in extent to avoid interference between flanges 47 when the rafter members are angularly displaced each to the other to the selected roof slope angle is also removed from the channel end. A suitable hole pattern is provided in webs 49 and flanges 46 and 47 to permit the use of threaded fasteners and clips as hereinafter described. To initiate the construction of the rafter assembly the rafter members are joined at the crown connection by rotating one rafter slightly on its longitudinal axis and moving the rafter elements into engagement to interlock notches 48. The rafter elements are again rotated each to the other and repositioned as shown in FIGURE 19. In this position head flange 46A of rafter member 41 lays on the outside of head flange 46 of rafter member 40 and web 49A of rafter member 41 will lay on the inside of web 49 of rafter member 40 as opposed to an internal relationship of both web and flange produced when channel members are conventionally nested. With the holes provided in head flange 46 and 46A in register threaded fasteners 50 are used to connect the rafter members. To obtain the proper roof pitch, the rafter members are rotated about a transverse axis through the interlinked apexes of notches 48 and 48A to the desired angle and secured in this position by threaded fasteners joining webs 49 and 49A through a suitable hole pattern provided therein. In standardized rafter members, the apex angle of notch 48 and 48A will be about the same as the roof slope angle and a suitable hole pattern will be pre-punched in the web so that when the joined rafter members are rotated into position the hole pattern in each of the webs will be in register at the desired roof slope angle. The ends of side flange clip 51 having an interior angle equaling the opposed roof slope angles is fastened respectively to side flanges 47 and 47A with threaded fasteners 52 as shown in FIGURE 3.

From FIGURES 6-8 it will be seen that the terminal ends of each standard rafter element are identically formed. This eliminates the need for right hand elements and left hand elements and permits the fabrication of a single standard rafter element design which can be used for gable buildings as well as one slope roofs. Although in the illustrative embodiment preferred channel shaped sections are utilized in the fabrication of the rafter elements, other structural metal shapes which have a head flange and a depending leg portion, such as angles, T's, etc. can be used to provide rafter elements which will mutually cooperate to form the interlocking rafter crown connection of this invention. In using these shapes lip flanges secured to the flange portions of the shapes are preferred but not essential. These alternative structural sections can be assembled in various combinations to provide an interlocking rafter assembly with or without a bottom flange, although it is preferred that a bottom flange connection be provided.

Single rafter units so assembled are employed as the rafter assemblies for the end framing members of the

building framework. In constructing the intermediate rafter assemblies shown in FIGURE 2 a pair of rafter units 60 and 61 are joined web to web employing a single set of fasteners 62 which are common to both rafter units to interconnect them at the crown connection. The terminal ends of the rafter units are coupled by means of full clip brackets 63 and 63A which span the side flanges of the rafter elements and are fastened thereto. Tie rod 64, which preferably is installed before the rafter assembly is mounted on the supporting column members, is fastened at its ends to clip brackets 63 and 63A to complete the rafter assembly.

To install the several column members, a suitable number of excavations are made and the bottom elements 70, as seen in FIGURE 9, of each column set in place. The excavated cavities must be deep enough to suit local soil and frost conditions. Generally holes 20 to 28 inches in diameter and 3 to 5 feet deep will provide satisfactory bearing for the column members. To provide an approximately horizontal eave line the tops of bottom elements 70 are aligned at the selected elevation and held in place by suitable expedients during the pouring of the concrete fill into the holes. For example, metal stakes 71 longitudinally mounted on the web of bottom element 70 as shown in FIGURE 12 are used. These stakes attached to the bottom column element are pushed into the ground until the desired elevation of the column element is obtained. The bottom element is vertically plumbed and held in place by suitable bracing while the excavation in which the column element is placed is filled with concrete or other suitable fill. To prevent settling of the assembled column member outwardly depending feet 72 are installed on the flange. An alternative arrangement for holding bottom element 70 in place is shown in FIGURE 13 wherein a horizontal channel 73 or other suitable horizontal bearing member is affixed to the flange and vertical bearing plate 74 attached to the terminal end of the bottom element. This assembly is especially adaptable for use with suitable back-fills other than concrete, such as dirt, gravel, cinders, or the like, as shown, or in combination with concrete at the base of the column only.

In the illustrative embodiment, the column assemblies are fabricated from C-shaped channels having the same transverse cross-sectional configuration as that used in manufacturing the rafter element. Bottom element 75 is preferably shorter than top element 76 shown in FIGURE 10. To facilitate assembling the framework the top and bottom elements are provided with the required openings which are pre-punched. In this embodiment top element 76, while longer, has a narrower cross section than bottom element 75 in order that the former can fit within the latter and be joined by suitable fasteners 77 passed through the registering holes provided in the mating ends of the top and bottom elements as shown in FIGURE 11. As in the construction of the rafter assemblies employed in the end frame construction single column units are used, whereas double units mounted web to web are employed in constructing the intermediate columns. Upon attaching the upper element to the lower column element, a substantial alignment of the column tops should result. In the event that a slight misalignment occurs slotted openings 78 are provided in the web and side flanges at the upper end of each upper column element to permit whatever vertical adjustment is necessary in the rafter assembly to achieve a horizontal eave line. If desired, slotted openings can also be provided in the column end connection of the rafter element or adjustability can be obtained by means of slotted openings positioned in the rafter element only.

After several column assemblies are erected, the rafter assemblies for the basic gable unit are lifted into place and fastened to the tops of the columns outlining this basic unit. The holes in the web of the rafter units are brought into register with the corresponding holes in the web of the upper column element. On the end frames

the rafter unit is attached to the outer face of the web of the column member and clips used to join the adjacent side flanges of the column and rafter units. For the intermediate frames, contiguous webs 80 and 80A of the rafter assembly are positioned intermediate webs 81 and 81A of the pair of upper column elements as shown in FIGURES 4 and 5. Clip bracket 63A is loosely fastened to side flanges 83 and 83A of upper column elements 84 and 84A and suitable fasteners inserted in the registering web holes. It will be noted that the respected slots in the side flanges of the upper column element and the leg of the clip bracket have opposed slopes so that regardless of the position of the clip bracket leg in relation to the column side flange at the final vertical adjustment the width of the exposed opening will be only slightly greater than the diameter of the threaded fastener. After the rafter assembly is vertically adjusted to the proper elevation the fasteners are tightened and the assembly secured in place. Half clips 85 and 85A are connected to adjacent column and rafter side flanges 87 and 88, 87A and 88A to complete the frame assembly and provide a tied, rigid framing member having a continuous beam action.

Although vertical adjustment of the rafter assembly is preferably obtained as above described, other expedients for adjusting a column unit to obtain a horizontal eave line can be used in conjunction with the rafter assembly of this invention.

In order that roofing and side sheathing can be attached to the framework, the framing members are spanned by means of suitable girts and purlins. A preferred girder element for this purpose is shown in FIGURES 14, 15, and 16. This element has a Z-shaped section which has a rectangular notch 90 cut in web 91 adjacent one of the side flanges 92. Marginal edge 93 of notch 90 adjacent side flange 92 is spaced from the inner edge of side flange 92 an amount equal to the width of lip flange 94 in order to secure maximum support and is notched to an extent not less than the width of a rafter or column side flange. This structural element is mounted on the rafters or columns such that the upper side flange of the rafter unit or outer side flange of the column unit enters the notch. The marginal edges of the lip flange and notch rest on the outer face of the side flange of the framing member element. The other side flange of the girder rests on the adjacent side flange of the rafter or column. This is seen in FIGURE 3 where the preferred girder elements are used as purlins 96 and 97. To secure purlins 96 and 97 in place clip angles 95 interconnect webs 98 and 98A of rafter units 100 and 100A with the purlin web using suitable fasteners 101. This is an intermediate rafter assembly from which the tie rod has been omitted for the purposes of simplicity. The paired rafter units 100 and 102 and 100A and 102A are connected at the crown as heretofore described. The assembly is further integrated by employing fasteners 101 as a connector common to the opposed rafter elements as well as the mounting clip 95 used to join purlin 103 to the rafter assembly. The various framing elements such as clips, purlins, girts, etc. are provided with slots to permit adjustment due to slight irregularities in column positions.

In order to complete the framework construction additional framing elements are generally employed. Added column assemblies 104 are included in the end rigid framing members, as shown in FIGURE 1, and attached to the rafter assembly at the bottom side flange of the rafter element by suitable clips. The several column assemblies used in the end rigid framing members are spanned by suitable sidewall girts 22 which obviate the need for tie rod elements. Various arrangements of column assemblies and girder elements can be used in order to provide opening 105 which can be closed by smaller personnel service doors or larger sliding doors which permit large units to be brought inside the interior of the building. Openings 107 can also be provided in the sidewalls by omitting

the upper and lower sidewall girts between next adjacent framing members.

The roof, sidewalls, and end walls can be covered with various types of conventional metal or wooden sheathing. In employing metal sheathing, self tapping metal screws are preferably used. An eave purlin 105, 105A having the configuration shown in FIGURE 4 is preferably employed to permit fastening the roof panels and sidewalls panels, or to suspend a sliding door assembly. In the illustrative specific embodiment shown in FIGURE 1 eave purlins 23 are employed to connect the peripheral columns employed in assembling the framework.

The basic framework provides a gable roof unit which can be modified by the addition of "lean-to" units which extend outwardly from the basic unit. The rafter elements employed are the same as those utilized in fabricating the rafter assembly for the basic unit. One or more "lean-to" units can be added to a single side or each side of the basic unit to provide symmetrical or asymmetrical designs as shown in FIGURES 20 to 23. If desired, the roof line overhang can be extended by a canopy 109 cantilevered from the peripheral columns and transversely connected by standard girder elements as shown in FIGURE 1. As in the connection between the column assembly and the rafter assembly of the basic gable roof unit, the "lean-to" rafter elements and canopy rafter are interposed between the webs of the column assemblies. A further modification can be made to provide basic gable roof units having opposed roof portions with different slopes.

The structural elements employed in the metal building framework of this invention are fabricated from conventional materials of construction such as aluminum or steel. The illustrated column, rafter, and girder units were formed by conventional sheet metal working techniques from relatively light gauge, viz. 16 gauge, sheet steel. Other gauges, however, can be used depending upon the service requirements of the building. Standard size bolts are used to secure the structural system. In completing the building construction corner closure angles can be used for trimming out the corner of the building. Ridge cover flashing secured by suitable fasteners is employed to enclose the open seam at the crown of the basic unit. Roof fascia can also be utilized to cover the joint between the roof line and end wall sheathing.

Although the hereindescribed building has been designed for use with unfinished earthen floors, concrete or other type flooring systems can easily be installed in the conventional manner.

It will be apparent from the foregoing description of the specific embodiments of this invention that various modifications can be made of the various structural elements involved without departing from the scope of this invention. Although the various construction features of this invention have particular application in the erection of pole-type buildings, they can be used separately or in combination with each other or other types of structural elements in the fabrication of other types of rigid frame as well as non-rigid frame buildings. For example, single slope roof buildings can be constructed utilizing several of the subject construction features; the rafter unit crown connection has application in a variety of building designs; multiple span buildings can be assembled. In this latter variation the hole pattern provided in the illustrated rafter and upper column elements is such that standardized elements or piece parts can be used without requiring a different hole pattern for the valley connection at the column members. Accordingly, the subject invention is to be limited only in the manner defined by the appended claims.

What is claimed is:

1. A tied, rigid, metal building frame construction having a continuous beam action which comprises a pair of spaced, upright metal columns, a double pitched rafter assembly mounted between said columns, and a tie rod interconnecting said columns and said rafter assembly

whereby a rigid framing member is provided, said columns being adapted for at least partial subterranean installation in an excavated cavity, means for vertically adjusting said rafter assembly into position, said rafter assembly comprising a pair of oppositely pitched rafters, each rafter being fabricated from a pair of C-shaped structural metal channel sections joined web to web and being provided with an end connection fastened to the terminal end of a cooperating top of one of said columns at the flanges and throughout the width of web section of the C-shaped structural elements of the rafter to form a rigid haunch section, a fixed crown connection which permits the transmission of stresses across the flanges and webs of said rafters, and said tie rod being interconnected at the haunch section of said frame to form a tied, fixed, rigid frame whereby horizontal separation of said haunch sections is prevented.

2. A tied, rigid, metal building frame construction having a continuous beam action which comprises a pair of spaced, upright metal columns, a double pitched rafter assembly mounted between said columns, and a tie rod interconnecting said columns and said rafter assembly whereby a rigid framing member is provided, said columns comprising a bottom column element adapted for at least partial subterranean installation in an excavated earthen cavity and an upper column element, each column element being fabricated respectively from a pair of C-shaped structural metal channel sections joined web to web, said upper column element being connected to said bottom element, means for vertically adjusting said rafter assembly into position, said rafter assembly comprising a pair of oppositely pitched rafters at the desired roof slope, each rafter being fabricated from a pair of C-shaped structural metal section elements joined back to back and being provided with an end connection fastened to the terminal end of a cooperating upper column element of one of said columns at the flanges and throughout the width of the web section of the C-shaped structural metal channel sections of the rafter and upper column element to form a rigid haunch section, said rafters having a fixed crown connection which permits transmission of stresses across the flanges and webs of said rafters, and said tie rod being interconnected at the haunch section of said frame to form a tied, fixed, rigid frame whereby horizontal separation of said haunch sections is prevented.

3. A tied, rigid, metal building frame construction having a continuous beam action which comprises a pair of spaced, upright metal columns, a double pitched rafter assembly mounted between said columns, and a tie rod interconnecting said columns and said rafter assembly whereby a rigid framing member is provided, said columns comprising a bottom column element adapted for at least partial subterranean installation in an excavated earthen cavity and an upper column element, each part being fabricated respectively from a pair of C-shaped structural metal channel sections joined web to web, said upper column element being connected to said bottom column element, means for vertically adjusting said rafter assembly into position, said rafter assembly comprising a pair of oppositely pitched rafters at the desired roof slope, each rafter being fabricated from a pair of C-shaped structural metal channel sections joined web to web and being provided with an end connection fastened to the terminal end of a cooperating upper column element of one of said columns throughout the flanges and the width of the webs of the C-shaped structural metal channel sections of the rafter and upper column element, the other end of said rafter being provided with a crown connection wherein the terminal end of each element of the rafter of said crown connection comprises an inwardly converging triangular notch in the web of the element adjacent the upper flange thereof, the apex of said angle being not less than the angle of the roof slope, the lower flange of said element being removed for a distance at least coextensive with the depth of said notch, the notches of

the adjacent oppositely pitched rafter elements being interlocked to position the terminal portion of the upper flange of one rafter element on the outer surface of the upper flange of the other rafter element and the web of said one rafter on the inner surface of the web section of said other rafter, means for fastening said rafters at said crown connection to permit the transmission of stresses across the flanges and webs of said rafters, and said tie rod being interconnected to the haunch section of said frame to form a tied, fixed, rigid frame whereby horizontal separation of said haunch sections is prevented.

4. A tied, rigid, metal building frame construction which comprises a pair of spaced, upright metal columns, a double pitched rafter assembly mounted between said columns, and a tie rod interconnecting said columns and said rafter assembly whereby a rigid framing member is provided, said columns comprising a bottom column element adapted for at least partial subterranean installation in an excavated earthen cavity and an upper column element, each column element being fabricated respectively from a pair of C-shaped structural metal channel sections joined web to web, said upper column element being connected to said bottom part, the structural metal channels of said upper column element slidably interfitted with the opposed structural metal channel sections of said bottom column element, the contiguous surfaces of said structural elements closely engaging each with the other, means for vertically adjusting said rafter assembly into position, said rafter assembly comprising a pair of oppositely pitched rafters at the desired roof slope, each rafter being fabricated from a pair of C-shaped structural metal channels and being provided with an end connection fastened to the terminal end of a cooperating upper column element of one of said columns at the flanges throughout the width of the web section of the C-shaped structural metal channel sections of the rafter and upper column element, the other end of said rafter being provided with a crown connection wherein the terminal end of each element of the rafter of said crown connection comprises an inwardly converging triangular notch in the web of the element adjacent the upper flange thereof, the apex of said angle being not less than the angle of the roof slope, the lower flange of said element being removed for a distance at least coextensive with the depth of said notch, the notches of the adjacent oppositely pitched rafter elements being interlocked to position the terminal portion of the upper flange of one rafter element on the outer surface of the upper flange of the other rafter element and the web of said one rafter on the inner surface of the web section of said other rafter, means for fastening said rafters at said crown connection to permit the transmission of stresses across the flanges and webs of said rafters, and said tie rod being interconnected to the haunch section of said frame to form a tied, fixed, rigid frame whereby horizontal separation of said haunch sections is prevented.

5. An end frame in accordance with claim 4 in which the structural sections of the upper column elements of said columns are slidably fitted within the opposed structural sections of the bottom column elements of said columns.

6. A building frame in accordance with claim 4 in which said means for adjusting said rafter assembly includes a column being provided with slotted apertures adjacent the free terminal end which register with openings in the end connection of said rafter assembly.

7. A rafter assembly for metal frame building construction comprising a pair of rafter elements oppositely pitched to a desired gabled roof slope, each rafter element being fabricated from a structural metal section having a head flange and a depending leg portion and being provided with an end connection adapted for fastening said rafter element to an upright column member, the other end of each rafter element being provided with an inwardly converging triangular notch adjacent said

head flange, the apex angle of said notch being not less than the roof slope, said oppositely pitched rafter elements being joined at the crown connection wherein the notches of the rafter elements are interlocked to position the terminal portion of the head flange of one rafter element on the outer surface of the upper flange of the other rafter element and the depending leg portion of said one rafter element on the inner surface of the depending leg portion of said other rafter element, and means for fastening said rafters at said crown connection to permit the transmission of stresses across the flange and leg portion of said rafters and provide a continuous beam action.

8. A rafter assembly for metal frame building construction which comprises a pair of rafter elements oppositely pitched to a desired gabled roof slope, each rafter element being fabricated from a C-shaped structural metal channel section and being provided with an end connection adapted for fastening said rafter element to an upright column member, the other end of each rafter element being provided with an inwardly converging triangular notch adjacent said head flange, the apex angle of said notch being not less than the roof slope, the lower flange of said structural metal section being removed for a distance at least coextensive with the depth of said notch, said oppositely pitched rafter elements being joined at the crown connection wherein the notches of the rafter elements are interlocked to position the terminal portion of the head flange of one rafter element on the outer surface of the upper flange of the other rafter element and the depending leg portion of said one rafter element on the inner surface of the depending leg portion of said other rafter element, and means for fastening said rafters at said crown connection to permit transmission of stresses across the flange and leg portion of said rafters and provide a continuous beam action.

9. A rafter assembly for metal frame building construction which comprises a first pair of rafter elements oppositely pitched to a desired gabled roof slope, each rafter element being fabricated from a C-shaped structural metal channel section and being provided with an end connection adapted for fastening said rafter element to an upright column member, the other end of each rafter element being provided with an inwardly converging triangular notch adjacent said head flange, the apex angle of said notch being not less than the roof slope, the lower flange of said structural metal section being removed for a distance at least coextensive with the depth of said notch, said oppositely pitched rafter elements being joined at the crown connection wherein the notches of the rafter elements are interlocked to position the terminal portion of the head flange of one rafter element on the outer surface of the upper flange of the other rafter element and the depending leg portion of said one rafter element on the inner surface of the depending leg portion of said other rafter element, a second pair of rafter elements joined in the same manner as said first pair, said first and second pairs being connected web to web, and means for fastening said first and second pairs of rafter elements at said crown connection to permit the transmission of stresses across the flanges and webs of said rafter elements and provide a continuous beam action.

10. A rafter assembly in accordance with claim 9 including a tie rod interconnecting the free terminal ends of said assembly.

11. A roof rafter element comprising a structural metal channel section element having a web and flanges depending therefrom, one end of said element being provided with an inwardly converging, right triangular notch in said web of the structural section having the side of said notch adjacent the apex angle thereof contiguous with one of said flanges, the apex angle of said notch being not less than a desired roof slope, the other side flange being removed for a distance at least coextensive

with the depth of said notch, and means provided in said side flanges and web for interconnecting said rafter with adjacent rafter elements to provide a continuous beam action.

12. A roof rafter element in accordance with claim 11 in which the terminal ends thereof are substantially identical.

13. A column structure for metal frame construction which comprises a bottom column element adapted for at least partial subterranean installation in an excavated earthen cavity and a top column element, each part being fabricated respectively from a C-shaped structural metal channel section, said upper column element being connected to said bottom part, the structural section elements of said upper column element slidably interfitting with the opposed structural section elements of said bottom elements, the contiguous surfaces of said structural elements closely engaging each with the other, slotted apertures being provided in the web and inclined slotted apertures being provided in the side flanges of said upper element adjacent the free terminal end.

14. A column structure in accordance with claim 13 in which the upper column element of said column is slidably fitted within the opposed lower column element.

15. A rigid, metal building frame construction which comprises a pair of spaced, upright metal columns, a double pitched rafter assembly mounted between said columns, and a tie rod interconnecting said columns and said rafter assembly whereby a rigid framing member is provided, said columns being adapted for at least partial subterranean installation in an excavated earthen cavity, means for vertically adjusting said rafter assembly into position, said rafter assembly comprising a first pair of rafter elements, each rafter element being fabricated from a structural metal section having a head flange and a depending leg portion and being provided with an end connection adapted for fastening said rafter element to an upright column member, the other end of each rafter element being provided with an inwardly converging triangular notch adjacent said head flange, the apex angle of said notch being not less than the roof slope, said oppositely pitched rafter elements being joined at the crown connection wherein the notches of the rafter elements are interlocked to position the terminal portion of the head flange of one rafter element on the outer surface of the upper flange of the other rafter element and the depending leg portion of said one rafter element on the inner surface of the depending leg portion of said other rafter element, a second pair of rafter elements joined in the same manner as said first pair, said first and second pairs being connected leg to leg, the end connections being affixed to cooperating column members to form a rigid haunch section, and means for fastening said first and second rafter pairs at said crown connection to permit the transmission of stresses across the flanges and legs of said rafters, and said tie rod being interconnected adjacent the haunch section of said frame to form a tied, fixed, rigid frame whereby horizontal separation of said haunch sections is prevented.

16. A rafter assembly having a pair of rafter elements adapted to be overlapped at their adjacent ends to provide a continuous beam action, each of said rafter elements comprising a structural metal section having a flange and a depending leg portion, one end of said element being provided with a notch defined by the flange at the one end of said element and a plane passing through said leg portion converging inwardly from the terminal end of said element and intersecting said flange, said notches permitting said flanges and said leg portions of said pair of rafter elements to be overlapped, and means for securing said pair of rafter elements to each other at their overlapped adjacent ends.

17. A roof rafter element comprising a structural metal section having a head flange and a depending leg

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portion which are adapted to overlap an adjacent head flange and an adjacent depending leg portion, respectively, of an adjacent rafter element to provide a continuous beam action, one end of said rafter element having a notch defined by the head flange at the one end of said element and a plane passing through said leg portion and converging inwardly from the terminal end of said element and intersecting said head flange, the apex angle formed by said notch being not less than a desired roof slope and means in said head flange and leg portion for interconnecting said rafter element with an adjacent rafter element.

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