Nov. 17, 1964 H. R. RASCH 3,157,251

BUILDING CONSTRUCTION

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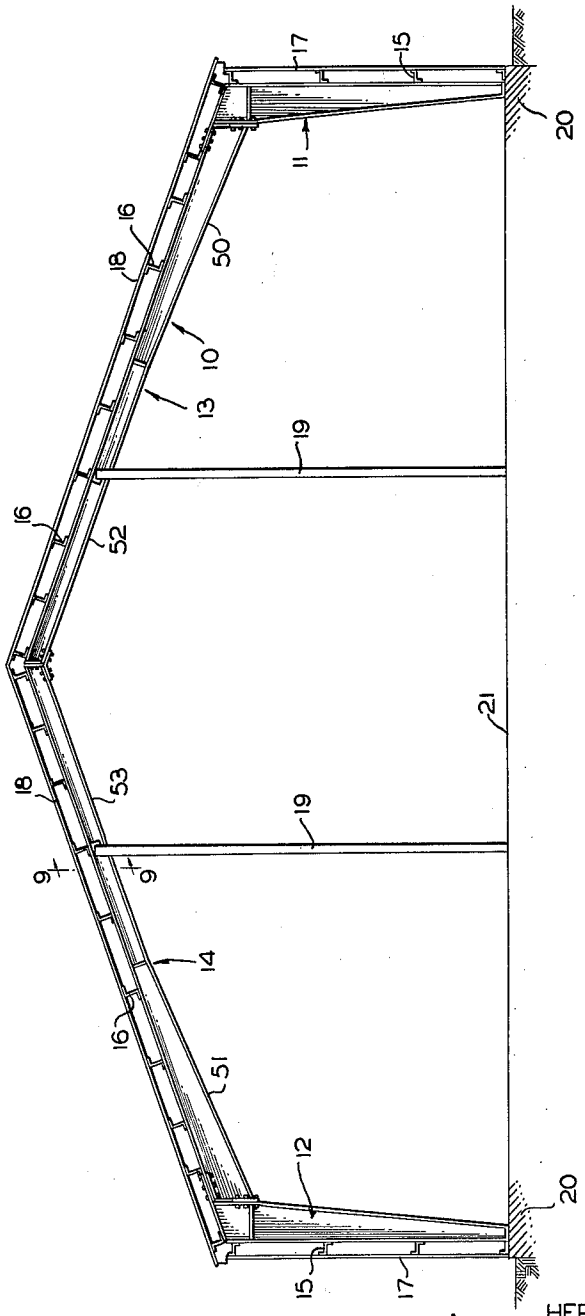

FIG. 1

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BUILDING CONSTRUCTION

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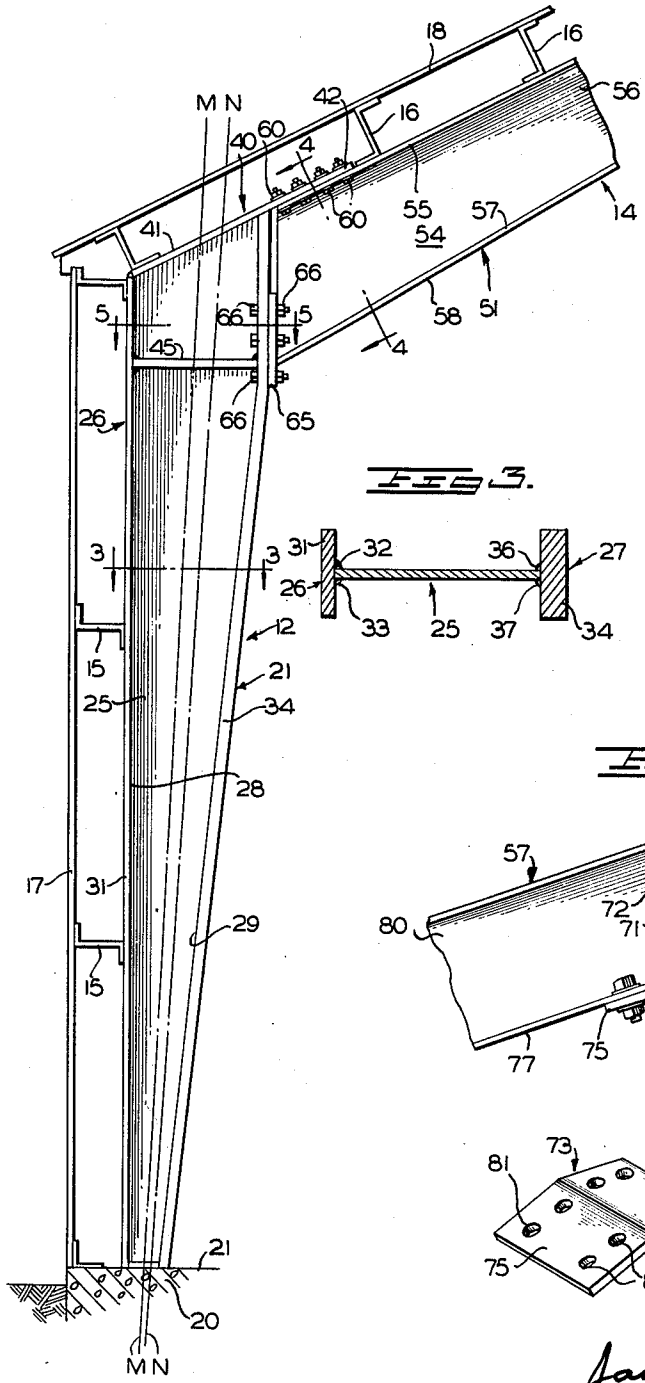

Fig 2.

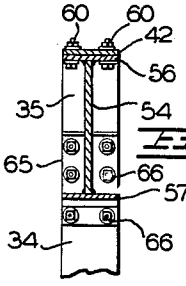

Fig 4.

Fig 3.

Fig 7.

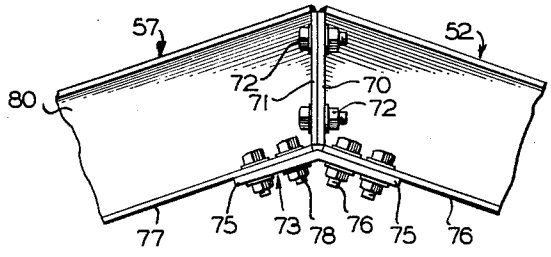

Fig 8.

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BUILDING CONSTRUCTION

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Fig 6.

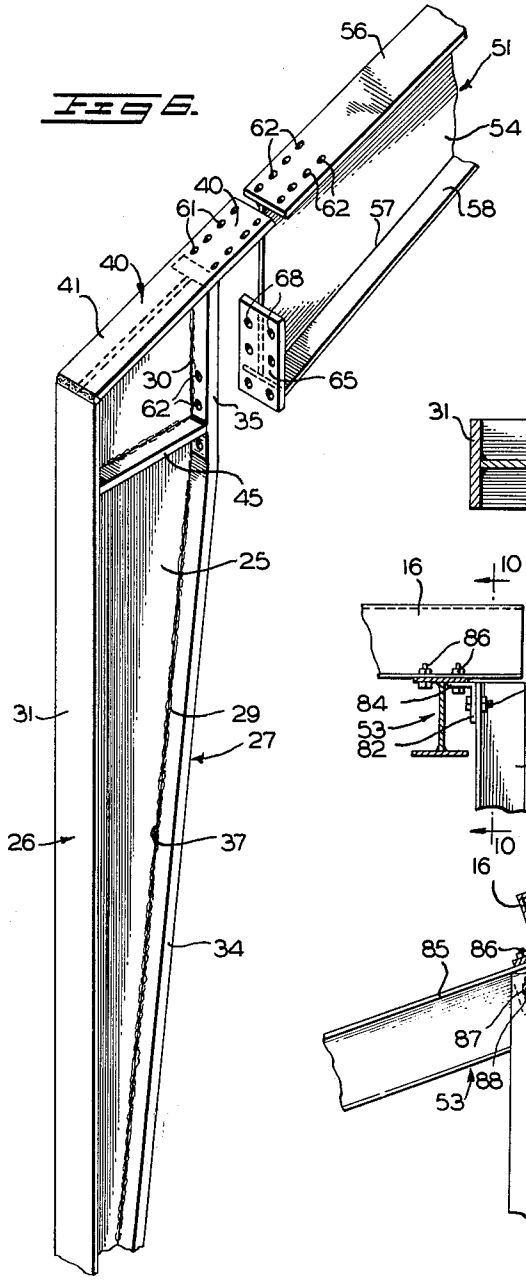


Fig 8.

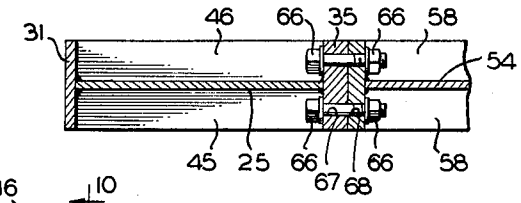
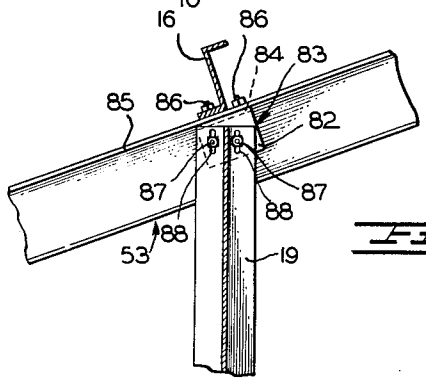


Fig 9.

Fig 10.



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BUILDING CONSTRUCTION

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Fig. 11.

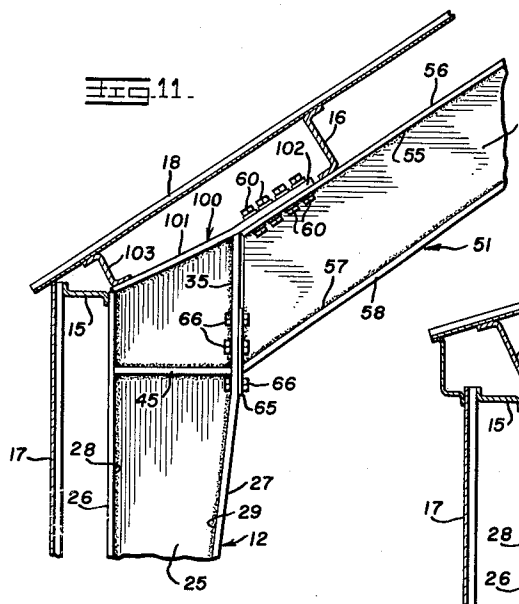


Fig. 12.

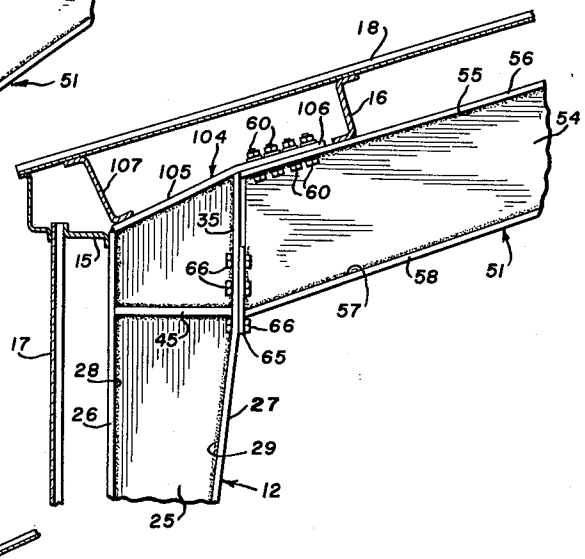


Fig. 13.

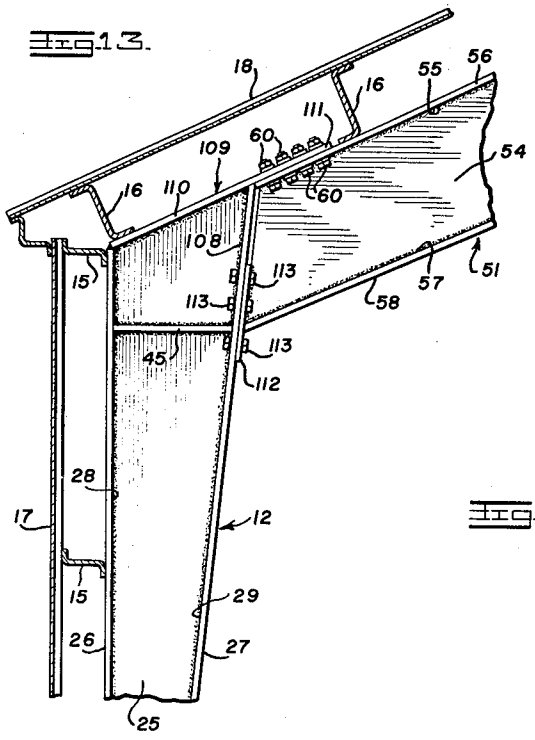
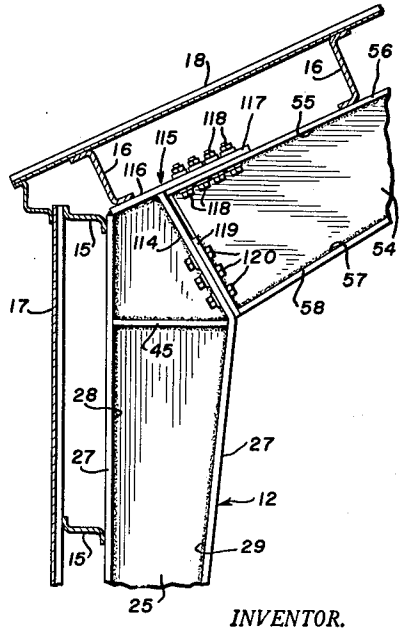


Fig. 14.



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BUILDING CONSTRUCTION

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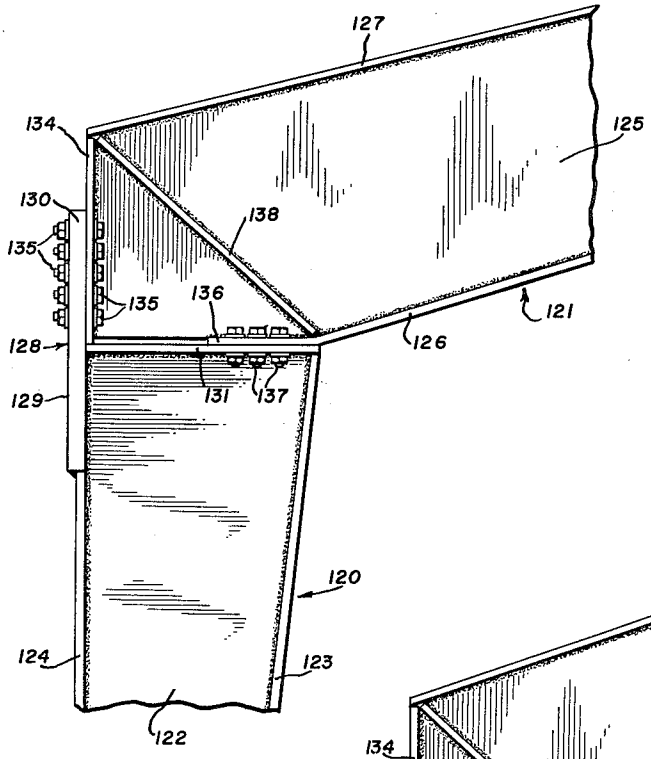

Fig. 15.

Fig. 16.

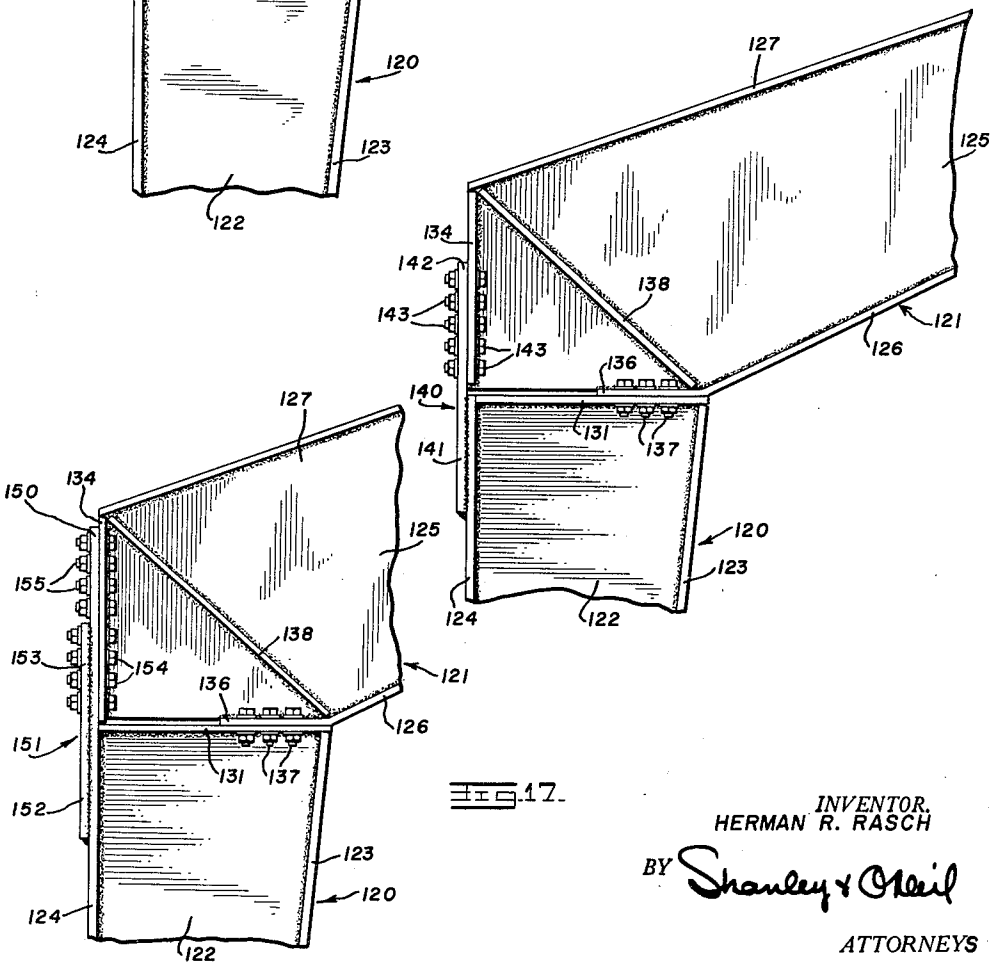

Fig. 17.

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BUILDING CONSTRUCTION

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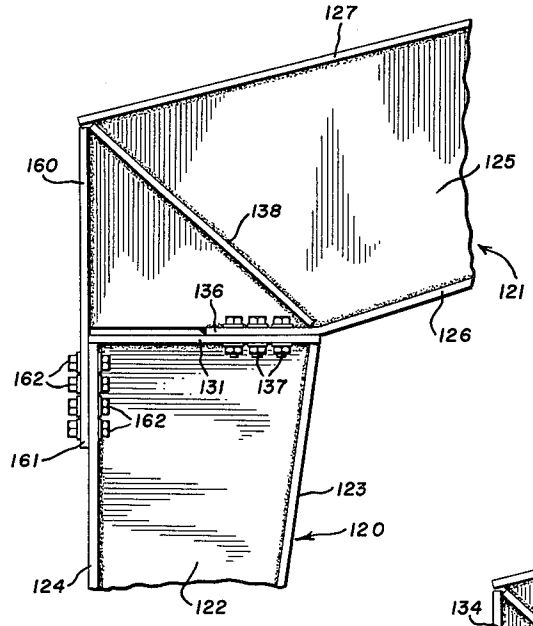
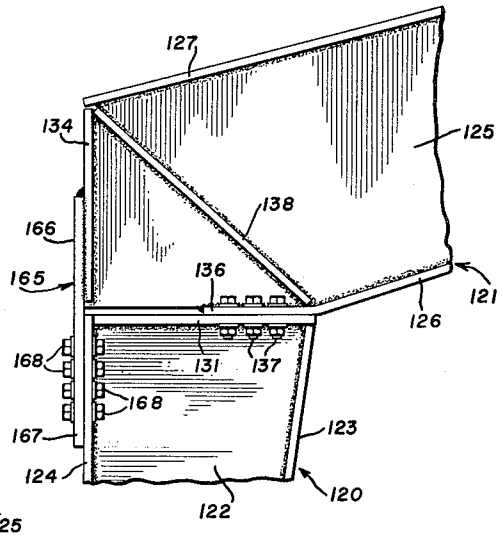


Fig. 18.

Fig. 19.



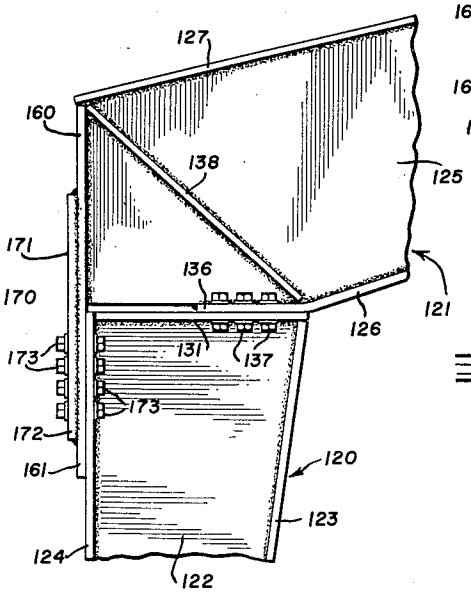


Fig. 20.

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United States Patent Office 3,157,251 Patented Nov. 17, 1964

3,157,251

BUILDING CONSTRUCTION

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Filed May 2, 1960, Ser. No. 27,466
26 Claims. (Cl. 189—1)

This invention relates to building constructions and more particularly to building constructions including rigid portal frames.

Rigid frame buildings include a plurality of rigid portal frames spaced from each other longitudinally of the building and extending transversely of the building from side wall to side wall. The rigid portal frames include a pair of upstanding side members or columns positioned at opposite sides of the building, and a pair of inclined roof members each having one end joined to the upper end of one of the side members at the haunch of the frame, with the other ends of the roof members being joined together at the ridge of the frame. Girts and purlins are secured to the side members and the roof members, respectively, for connecting the rigid portal frames to provide an integral structure and for supporting the siding and roofing of the building. Inasmuch as the maximum negative bending moment stresses occur at each haunch of the frames, and since the negative bending moment stresses gradually decrease in directions away from each haunch, toward the ridge of the frame and toward the base of the side members, it is generally the practice to utilize tapered members in the construction of rigid portal frames to present members having varying beam strength characteristics according to the varying bending moment stresses and thus effect a material saving in the amount of metal required.

In view of the fact that the maximum bending moment stresses occur at the haunch of the frames and since the side members and the roof members are joined together at an obtuse angle determined by the desired slope of the roof of the building, difficult structural problems are presented with respect to the formation of the joints between the upper end of the side column members and the outer ends of the roof members. In the past, in view of the complexity of the types of joints employed, it has been the practice to form the haunch connection at the factory and to ship, as a composite structural element of the building, the side column members and at least the outer portion of the roof members in order to insure a building construction including adequate strength in the region of the haunches of the frames. The complexity of the haunch joints employed in the past and the necessity of forming the joint at the factory and not as a step in the operation of erecting the building at the site, materially increased the cost of the prior building, and the unwieldly shape of the composite column and roof member presented shipping problems and decreased the flexibility of the building and restricted its use.

It is an object of the present invention to provide a novel rigid frame building construction which overcomes the foregoing disadvantages.

It is another object to provide a novel type of haunch construction which permits the side column members and the outer section of the roof members to be shipped as independent components of the building for assembly at the site without requiring special techniques and without impairing the strength of the frame.

Still another object of the present invention is to provide a novel form of structural member for use as a column in a rigid portal frame, the novel structure member providing an economical use of metal unattainable by following prior practices.

A still further object is to provide a novel haunch construction for a rigid portal frame which eliminates the necessity of employing outwardly extending brace members.

A further object of the present invention is to provide a rigid portal frame including a novel arrangement for joining adjacent ends of the roof members at the ridge of the frame.

A still further object is to provide a novel arrangement for supporting end wall columns in a building construction including rigid portal frames.

In general, the present invention provides a rigid portal frame including tapered side column members and tapered roof members of I-shaped cross-section made up of elongated plates joined together by welding. The elongated plates forming the web portions of the members are tapered in accordance with the bending moment stresses involved in order to reduce the metal required in accordance with conventional practice. The column members and the outer portions of the roof members are joined together at the haunch of the frame in a novel manner permitting the use of bolt type connecting means in a simple operation that may be performed at the site of erection of the building. The design of the haunch construction is such that the connecting bolts are in shear and external bracing for the column members is not required. An unbalanced type of column member is provided which not only makes it possible to obtain a more economical use of metal in the column members but aids in providing a haunch construction having the characteristics described above.

The foregoing and other objects and features of the present invention will appear more fully from the following detailed description considered in connection with the accompanying drawings which illustrate one embodiment of the invention. It is to be expressly understood, however, that the drawings are designed for purposes of illustration only and not as a definition of the limits of the invention, reference for the latter purpose being had to the appended claims.

In the drawings, in which similar reference characters denote similar elements throughout the several views:

FIGURE 1 is an end view of a building construction including a rigid portal frame embodying the principles of the present invention;

FIGURE 2 is an enlarged view in side elevation of a portion of a rigid frame showing a form of haunch construction provided by the present invention;

FIGURE 3 is a view in section taken along line 3—3 of FIGURE 2;

FIGURE 4 is a view in section taken along line 4—4 of FIGURE 2;

FIGURE 5 is a view in section taken along line 5—5 of FIGURE 2;

FIGURE 6 is an exploded, perspective view, illustrating the novel haunch construction shown in FIGURE 2;

FIGURE 7 is an enlarged view in side elevation of the joint at the ridge of a rigid portal frame constructed in accordance with the principles of the present invention;

FIGURE 8 is a perspective view of an element employed in the ridge connection shown in FIGURE 7;

FIGURE 9 is a view in section taken along the line 9—9 of FIGURE 1;

FIGURE 10 is a view in section taken along the line 10—10 of FIGURE 9;

FIGURE 11 is a view in elevation illustrating a modification of the form of haunch construction shown in FIGURE 2;

FIGURE 12 is a view in elevation illustrating another modification of the form of haunch construction shown in FIGURE 2;

FIGURE 13 is a view in elevation illustrating still another modification of the form of haunch construction shown in FIGURE 2;

FIGURE 14 is a still further modification of the form of haunch construction shown in FIGURE 2;

FIGURE 15 is a view in elevation illustrating another form of haunch construction provided by the present invention;

FIGURE 16 is a view in elevation illustrating a modification of the form of haunch construction shown in FIGURE 15;

FIGURE 17 is a view in elevation illustrating still another modification of the form of haunch construction shown in FIGURE 15;

FIGURE 18 is a view in elevation illustrating still another form of haunch construction provided by the present invention;

FIGURE 19 is a view in elevation illustrating a modification of the form of haunch construction shown in FIGURE 18; and

FIGURE 20 is a view in elevation illustrating still another modification of the form of haunch construction shown in FIGURE 18.

With reference more particularly to FIGURE 1 of the drawing, a building construction is shown therein including a rigid portal frame **10** extending transversely of the building from side wall to side wall. It is to be understood that a plurality of similar rigid portal frames, not shown, lie in vertical planes spaced longitudinally of the building. The rigid portal frames include a pair of upstanding side members or columns **11** and **12** and a pair of inclined roof members or rafters **13** and **14**. The inner ends of the roof members are connected together at the ridge of the frame in a novel manner that will be described in detail below, and the outer ends of the roof members are joined at their outer ends to upper ends of the column members **11** and **12** at each haunch of the frame. The angular relationship betweeen the longitudinal axes of respective connected column members and roof members defines an internal, obtuse angle establishing the slope of the roof of the building. The column members **11** and **12** support horizontal, vertically spaced girts **15** which extend longitudinally of the building and connect the side members of adjacent portal frames, while the roof members support parallel, transversely spaced purlins **16** which extend longitudinally of the building. The girts and the purlins support suitable siding material **17** and roofing material **18**; the siding and roofing material may comprise sheets of galvanized metal, for example. The ends of the building may be closed by any suitable structure supported by a plurality of vertically disposed end wall columns **19**. The end wall columns may support horizontally disposed girts, not shown, upon which suitable siding material may be secured. The lower ends of the side column members **11** and **12** are provided with a suitable foundation **20** to which they are positively anchored by any suitable means, not shown. The foundation **20** may comprise a concrete slab presenting a floor **21** for the building. The building construction may be of any desired length determined by the number of rigid portal frames employed.

As shown in FIGURES 2, 3 and 6, the side column members, such as the side column member **12**, include a web **25**, an outer flange **26** and an inner flange **27**. The web comprises an elongated flat plate including an outer longitudinal edge **28** disposed in a vertical plane and an inner longitudinal edge having a major portion **29** inclined with respect to the outer longitudinal edge and a minor upper portion **30** in parallel relation with the outer longitudinal edge. The ends of the longitudinal edges at the lower end of the web lie in a horizontal plane in spaced relationship at the bottom or base of the column adjacent the floor **21**, and the ends of the longitudinal edges at the upper end of the web lie in a plane disposed at an obtuse angle with the outer longitudinal edge. The outer flange **26** comprises an elongated, rectangular flat plate **31**, symmetrically positioned with respect to the web **25** and lying adjacent its outer longitudinal edge **28** and

integrally joined thereto by longitudinal fillet welds **32** and **33**. The inner flange **27** comprises an elongated, rectangular plate including an inclined portion **34** lying adjacent the inclined portion **29** of the web inner edge and a parallel portion **35** lying adjacent the parallel portion **30** of the inner edge of the web. The portions **34** and **35** of the inner flange are symmetrically positioned with respect to the plane of the web and are secured thereto by longitudinal welds **36** and **37**. The flanges **26** and **27** lie in planes perpendicular to the plane of the web and may be of equal width and extend outwardly corresponding distances from the sides of the web. The inner flange **27** is of a thickness greater than the thickness of the outer flange **26** for a purpose that will be described below.

The column member **12** is provided at its upper end with a cover member or cap **40** comprising a rectangular, flat plate **41**. The plate has a width dimension corresponding to the width of the inner and outer flanges and overlies the upper ends of the flanges and bridges the space between the flanges and lies in contact with the upper end of the web **25**. The plate **41** is weldably secured to the web and the flanges to provide an integral structure, and lies in a plane disposed at an obtuse angle with respect to the outer flange **26**. The plate **41** includes a coplanar extension **42** projecting inwardly of the building beyond the parallel portion **30** of the inner flange **27** for a purpose that will be described below. In the region of the upper end of the inclined portion **34** and the lower end of the parallel portion **35** of the inner flange, the column member is provided with horizontally disposed stiffening plates **45** and **46** positioned between the inner and outer flanges on opposite sides of the web and weldably secured to the adjacent surfaces of the web and the flanges, as shown in FIGURE 5. Column members as described above, including the cover member **40** and the stiffening plates **45** and **46** are fabricated at the plant and shipped as integral components of the building construction.

As shown in FIGURE 1, the roof members **13** and **14** include tapered outer sections **50** and **51** and uniform inner sections **52** and **53**, respectively. The sections of the roof members are of I-shape cross-section made up of elongated plates welded together in a manner similar to the construction of the column members as described above. The plates forming the webs of the uniform inner sections **52** and **53** are of rectangular shape, while tapered plates comprise the webs of the outer sections **50** and **51**. In particular, with reference to FIGURE 2, the section **51** includes a web **54** having an upper longitudinal edge **55** to which an upper flange **56** is weldably secured, and a lower longitudinal edge **57** inclined away from the upper edge in a direction outwardly of the building, to which a lower flange **58** is joined by welds.

As shown more clearly in FIGURES 2 and 6, the outer end of the upper flange **56** of the roof section **51** underlies the projection **42** of the cover member **40** and is secured thereto in parallel relation by a series of bolts and nut attaching means **60** located on opposite sides of the web **54**. The projection **42** and the upper flange **56** are provided with openings **61** and **62**, respectively, for the attaching means. The upper flange **56** lies in a plane parallel to the plane of the cover member **40** and the outer ends of the web and the upper and lower flanges of the roof section **51** lie in a plane parallel to the parallel portion **35** of the inner flange **27** of the column member. In order to form a connection between the lower flange **58** of the roof section and the column member, a butt plate **65** is weldably secured to the outer end of the lower flange **58** and to the lower end portion of the web **54**, a portion of the butt plate extending downwardly below the lower flange **58**. The butt plate **65** lies flat against the outer lower surface of the parallel portion **35** of the inner flange **27** adjacent the inner end of the lower flange and is secured to the parallel portion **35** by series of bolts

and nut type connecting means **66** located on opposite sides of the webs of the column member and the roof section. As shown in FIGURE 2, the parallel portion **35** extends downwardly from the cover member **40** in predetermined relationship with the depth of the roof section at its outermost end so that the lowermost edge of the parallel portion lies in a horizontal plane substantially coincident with the lower edge of the butt member and below the lower flange **58** a sufficient distance to permit the location of at least one of the connecting means **66** below the lower flange of the roof section on both sides of the webs. The horizontal plate stiffeners **45** and **46** are located in a horizontal plane intersecting the outermost end of the lower flange **58** of the roof section **51**.

In a rigid portal frame including a haunch construction provided by the present invention, negative bending moment stresses place the outer flange **26** of the column member, the cover member **40** and the upper flange **56** of the outer roof section under tension, and the lower flange **58** of the roof section and the inner flange **27** of the column member under compression. Thus, the connecting bolts **60** between the projection **42** and the outer end of the upper flange **56** and the bolts **66** connecting the parallel portion **35** of the column member and the butt plate **65**, are in shear, with substantially equalized shear in each of bolts **66**. This feature makes it practicable to join the column member and the roof member by the use of bolt type connections, inasmuch as the connecting bolts are not under tension. As noted in FIGURE 2, the roof section **51** is joined to the parallel portion **35** at the upper end of the column member without a continuous connection between the web **54** of the roof section and the column member. This type of construction results in prohibiting the development of undesirable stresses in the upper portion of the web **25** of the column member in the region of the haunch and increases the stability of the rigid portal frame. Inasmuch as the lower flange **58** of the roof section **51** is under compression, the major compressional forces due to positive bending moment stresses are transmitted to the column member in the region of its connection with the butt plate **65**. A major component of the compressional stress is transmitted directly to the inclined portion **34** of the inner flange **27** while a minor horizontal component is carried by the horizontal stiffening plates **45** and **46**. As a result, the portion of the web **25** above the horizontal stiffening plates is not subjected to complicated stress patterns as would be the case if the webs of the column member and the roof member were joined together either directly or through the outer flange of the column member. The horizontal plates thus constitute stiffening members which provide a rigid portal frame of high stability. In addition, the parallel portion **35** of the inner flange of the column member functions as a stiffening member and contributes to the high stability characteristic of a rigid portal frame including the construction provided by the present invention. Since the bolts forming the connections between the roof member and the column member are in shear, it is necessary to provide adequate bearing surfaces to carry the shear loads involved. The butt plate **65** is welded to the outer end of the lower flange **58** of the roof section and extends upwardly in contiguous relation with the outer edge of the web **54** a sufficient distance to provide the area of weld necessary so that the butt plate is capable of carrying the shear load. In addition, the bolted connection between the butt plate and the lower end of the parallel portion **35** must be capable of carrying the shear load and transmit the compressional stresses to the column member. The feature of the present invention of employing a relatively thick inner flange **27** of the column member improves the bearing surface of the shear bolts **66** and makes it possible to employ a butt plate extending upwardly from the lower flange of the roof section a distance determined only by the weld area required. Thus it is possible to locate the centroid

of compression close to the juncture of the horizontal stiffening members **45**, **46** and the inner flange of the column member. In addition, the use of a relatively thick parallel portion **35** provides a more efficient brace for the shear bolts **66**.

As shown in FIGURES 1, 3 and 6, the inner flange **27** of the column member is relatively thicker with respect to the outer flange **26**, not only in the region of the parallel portion **35** of the inner flange but throughout its tapered portion **34** downwardly to the lower end or base of the column member. The feature of providing column members having inner flanges of a thickness or a cross-sectional are greater than the thickness or cross-sectional area of the outer flanges results in a more economical distribution of metal throughout the column members. The inner flange of the column member is under compression due to the compressive force resulting from the negative bending moment stresses and due to the compressive force resulting from axial load, while the outer flange, although subject to a compressive force due to the axial load, is under tension as a result of the negative bending moment stresses. Column members subject to axial compressive loads and to bending moment stresses therefore require a section modulus for the inner flange which is larger than the section modulus required for the outer flange. Therefore, it is possible to move the neutral axis of the column member and displace the neutral axis of the column member in a direction toward the inner flange to obtain a higher section modulus on the inner flange and reduce compression stress due to the bending moment for a given area of section. The neutral axis of the column member may be displaced in a direction toward the compression or inner flange by increasing the cross-sectional area of the compressional flange, by decreasing the cross-sectional area of the outer flange or by increasing the cross-sectional area of the inner flange while decreasing the cross-sectional area of the outer flange. In accordance with the principles of the present invention, it is possible to provide a column member including less material which is capable of carrying design loads by increasing the cross-sectional area of the inner flange while at the same time decreasing the cross-sectional area of the outer flange. Since the cross-sectional area of the inner flange is increased, it is possible to decrease the cross-sectional area of the outer flange by an amount that would not be otherwise possible. As shown in FIGURE 2, the neutral axis N—N of the column member **12** is displaced from the medial longitudinal axis M—M in a direction toward the inner flange **27** by an amount determined by the relative proportioning of the metal in the inner and outer flanges. The neutral axis of an unbalanced column of the type shown in FIGURE 2 may not be linear as shown.

The present invention also provides a novel arrangement for joining the inner ends of the roof sections **52** and **53** at the ridge of the frame. As shown in FIGURE 7, the inner ends of the roof sections are provided with vertically disposed butt plates **70** and **71** weldably secured to the ends of respective webs and flanges, and the butt plates are secured together by means of bolts **72**. In addition, an integral member **73** including angular portions **74** and **75** is positioned on the underside of the roof members in the region of the ridge with the portions **74** and **75** in contact with the lower flanges **76** and **77**, respectively, at their inner ends. The angular portions of the member **73** are joined to respective lower flanges of the roof sections by means of bolts **78**. In accordance with the principles of the present invention, the member **73** is of non-rigid construction to permit limited flexure and place each of the connecting bolts **78** under uniform load. This performance prevents concentration of higher stresses on any one of the bolts and a correspondingly higher stress at any point of the welded joint between the lower flanges **76** and **77** and their respective webs **79** and **80**. This arrangement results in the use of a minimum

number of bolts to form a ridge connection of the required strength and prevents failure along the welded joints of the roof sections especially during erection operations.

The present invention also provides a novel arrangement for connecting the end wall column members 19 to the building construction. As shown in FIGURES 9 and 10, the upper end of an end wall column member 19 is attached to a vertical flange 82 of an angle member 83 having an inclined flange 84 located on the underside of the upper flange 85 of the roof section 53 and secured thereto by means of bolts 86, one of which functions to join a purlin 16 to the upper flange. In order to compensate for slight variations in the level of the floor 21, the upper ends of the end wall column members are provided with slotted openings 88 for receiving bolts 87 securing the column 19 to the vertical flange 82, the openings permitting limited vertical adjustment of the column member 19. With this arrangement horizontal forces applied to the end wall are transmitted directly to the rigid frame at the end of the building at a point thereon to which a longitudinally extending purlin is also connected. Thus, the horizontal forces are transmitted directly to the longitudinal members of the roof construction and twisting of the rigid portal frame is eliminated and bracing is not required.

Modifications of the form of haunch construction shown in FIGURE 2 are illustrated in FIGURES 11, 12, 13, and 14 of the drawings. The modifications illustrated in FIGURES 11 and 12 make it possible to utilize similar column members in the construction of buildings of different roof slopes. The haunch construction shown in FIGURE 11 includes a cover member or cap 100 comprising a flat plate 101 joined to the upper ends of the flanges and web of the column 12 and being provided with a planar extension 102 disposed at an angle with respect to the plate 101 and which lies coplanar with the outer flange 56 of the rafter; the angular relationship between the extension 101 and the outer flange 56 of the rafter with respect to the outer flange 26 of the column being greater than the angular relationship between the plate 101 and the outer flange of the column. The roofing 18 is parallel to the rafter 51 and a purlin 103 of reduced depth is provided in the region of the outer flange of the column and the roofing 18. The outer flange 56 of the rafter is secured to the extension 102 by means of bolts 60 and the lower flange 58 of the rafter is secured to the inner flange 27 of the column by means of the butt plate 65 and bolts 66 in a manner similar to the arrangement shown in FIGURE 2. By increasing the angular relationship between the extension 102 and the outer flange 26 of the column with respect to the angular relationship between the plate 101 and the outer flange of the column, it is possible to utilize similar columns in the construction of buildings of increased roof pitch. The arrangement shown in FIGURE 12 makes it possible to decrease the roof pitch with respect to the roof pitch of the arrangement shown in FIGURE 2. In FIGURE 12, the column includes a cover member 104 having a flat plate 105 secured to the upper ends of the flanges and web of the column in a manner similar to the arrangement of FIGURE 2. In the arrangement of FIGURE 12, however, the cover member 104 includes an extension 106 disposed at an angle with respect to the outer flange of the column which is less than the angular disposition between the plate 105 and the outer flange of the column. As in the previous arrangements, the extension 106 is coplanar with the outer flange 55 of the rafter and is secured thereto by bolts 60 and the inner flange 58 of the rafter is secured to the inner flange 27 of the column by the butt plate 65 and bolts 66. With this arrangement, the roof 18 is substantially parallel to the rafters and a purlin 107 of increased depth is positioned in the region of the outer flange of the column.

In the haunch construction shown in FIGURE 13, the column 12 includes an inner web 27 having an upper portion 108 which is coplanar with the inner flange of the column. The ends of the web and flanges of the column at its upper end terminate in a plane disposed at a predetermined angle with respect to the outer flange of the column and a cover member 109 is provided including a flat plate 110 secured to the upper edges of the web and flanges of the column and the flat plate is provided with a coplanar extension 111 overlying the outer flange 56 of the rafter and being secured thereto by bolts 60. In this form of the invention, the inner end of the rafter is terminated in a plane parallel to the plane of the upper end portion 108 of the inner flange of the column and a butt plate 112 is weldably secured to the lower flange 58 and the web 54 of the rafter to overlie the outer surface of the inner web of the column and is bolted to the inner flange of the column by means of bolts 113 in a manner similar to the previous arrangements. In the arrangement shown in FIGURE 14, the upper end portion 114 of the inner flange of the column is disposed at an acute angle with respect to the plane of the outer flange 27 of the column. The upper end of the column is provided with a cover member 115 including a flat plate 116 weldably secured to the upper edges of the outer flange 27, the web 25, and the portion 114 of the column and the flat plate 116 includes a coplanar extension 117 which overlies the outer flange 56 of the rafter and is secured thereto by means of bolts 118. The inner end of the rafter terminates in a plane parallel to the plane of the portion 114 and a butt plate 119 is welded to the outer end of the web 54 and inner flange 58 and the butt plate 119 is secured to the portion 114 by means of bolts 120. The upper end portion 114 of the inner flange of the column may be disposed in any acute angle with respect to the outer flange 27 of the column and the angular disposition of the portion 114 may be such as to establish substantially perpendicular relationship with the outer flange 56 of the rafter, if so desired. In the embodiments shown in FIGURES 13 and 14, the extensions 111 and 117 may be disposed at different angular relationship relative to respective flat plates 110 and 116 in order to provide buildings of different roof slopes in accordance with the arrangements shown in FIGURES 11 and 12.

The embodiments of the invention shown in FIGURES 15, 16, 17, 18, 19, and 20 of the drawings disclose additional forms of haunch constructions which permit the use of bolt-type connecting means to join the columns and rafters at the haunch of the building at the site of erection of the building in which the haunch construction includes the novel feature of the present invention in which the connecting bolts are in shear. These figures illustrate only the upper portion of the column and the outer end of the rafter in the manner in which these elements are connected together to form the haunch of the building and it is to be expressly understood that a building including a plurality of portal frames in which the haunch constructions are formed in the manner illustrated in FIGURES 15 through 20 may be provided in a manner similar to the haunch construction shown in FIGURE 2 and the building may include purlins and girts for supporting roofing and siding as described in connection with the embodiment of the invention shown in FIGURE 2; the purlins and girts and roofing and siding being deleted from FIGURES 15 through 20 for the sake of clarity.

One of the advantages of the forms of the invention disclosed in FIGURES 15 through 20 is the adaptability of utilizing similar columns in building constructions having different sloped roofs without requiring modification of the haunch construction.

With reference more particularly to FIGURE 15 of the drawings, a haunch construction is shown herein including a tapered column 120 and a tapered rafter 121, the column 120 including a tapered web 122 and inner and outer flanges 123 and 124 welded to the longitudinal edges of the web to form a member of I-shape cross-section similar to the construction shown in FIGURE 2.

Likewise, the rafter **121** includes a tapered web **125** and inner and outer flanges **126** and **127** welded to the longitudinal edges of the web **125** likewise to form a structure of I-shape cross-section generally similar to the cross-sectional shape of the rafter member shown in FIGURE 2.

In the construction shown in FIGURE 15, the upper end of the outer flange **124** terminates below the upper end of the web **122** and a connecting plate **128** is provided having one portion **129** extending upwardly from the upper end of the outer flange **124** and extending outwardly from both sides of the web **122** and being weldably attached to the outer longitudinal edge of the web **122** in the region of the web between its upper end and the upper end of the outer flange **124**. The connecting plate **128** includes another portion **130** extending upwardly beyond the upper end of the web **122** in substantial coplanar relationship with the outer flange **124**; the connecting plate **128** extends throughout its length from opposite sides of the plane of the web **122** and is of a thickness greater than the thickness of the web **122**. The connecting plate **128** may have a thickness corresponding to the thickness of the web **122** but of a width greater than the width of the flange **124**. However, the illustrated structure is preferred since it provides a haunch construction of uniform thickness. The upper end of the column is provided with a flat, horizontally disposed cap plate **131** extending outwardly from both sides of the web **122** and being welded to the web **122**, the inner flange **123** and the connecting plate **130**. The upper flange **127** of the rafter is inclined at the desired roof slope and the outer end of the rafter terminates in a flat plate **134** disposed in a vertical plane and extending outwardly from both sides of the web **125** and being welded to the web **125**. The flat plate **134** extends downwardly substantially throughout the depth of the portion **130** of the connecting plate and overlies the connecting plate and is secured to the connecting plate by means of nuts and bolts **132**, the nuts and bolts **132** being located on both sides of the web **125**. The inner flange **126** of the rafter terminates in a flat, horizontally disposed portion **136** welded to the adjacent portion of the web **125**. The portion **136** is coplanar with the upper surface of the horizontal column cap plate **131** and is secured to the latter member by means of nuts and bolts **137** located in groups on both sides of the webs **122** and **125**. The haunch construction also includes a stiffening member **138** located on each side of the web **125** and being welded to the web **125** and extending from the outer end of the flange **126** in the region of the inner flange **123** of the column diagonally to the joint between the outer end of the outer flange **127** and the vertically disposed end plate **134**. With this construction, the column and rafter are connected together to form a haunch construction by the mere use of nut and bolt type of connecting means which are so located with respect to the elements of the haunch construction as to be subject to shear forces as in the previous embodiments of the invention. It will be appreciated that rafter members having different angular relationships of the inner and outer flanges may be designed for connection to the column member without modification of the details of the column which relate to the haunch connecting structure. In this type of construction, the outer flange **124** of the column, the connecting plate **128**, the end plate **134** of the rafter and the outer flange **127** of the rafter are under tension when a rigid portal frame including a haunch construction of the type shown in FIGURE 15 is subject to negative bending stresses. This places the bolts **135** in shear and makes it possible to join the column and rafter members by the use of nut and bolt type of connecting means. The connecting plate **128** is of greater cross-sectional area and overlies a portion of the web **122** of the column and a portion of the web **125** of the rafter in order to carry the stresses involved and distribute the stresses to the webs of the respective members. The inner end of the rafter is connected to the upper end of the column adjacent to the inner flange **123** by means of the plate **136** which terminates in spaced relation with the vertical plate **134** joined to the end of the web **125**. This construction prohibits the development of undesirable stresses in the adjacent portions of the webs **122** and **125** and increases stability of a rigid portal frame including this type of haunch construction. The diagonal brace **138** aids in distributing the stresses between the rafter and the column.

In the haunch construction shown in FIGURE 16, the outer flange **124** of the column extends throughout the length of the web **122** and is welded to the flat plate **131** at the upper end of the column. In this construction, a connecting plate **140** is provided which includes a portion **141** overlying the outer surface of the outer flange **124** at the upper end of the column and overlying the lower portion of the vertical plate **134** connected to the end of the web **125**. The portion **141** is welded to the flange **124** while the portion **142** is secured to the vertical plate **134** by means of nuts and bolts **143** which are located on both sides of the web **125**.

In the haunch construction shown in FIGURE 17, the outer flange **124** of the column includes an extension **150** which overlies the vertical plate **134** of the rafter and which may terminate adjacent the upper flange of the rafter. In addition, the haunch construction includes a connecting plate **151** having a portion **152** overlying a portion of the outer surface of the outer flange **124** and a portion **153** overlying at least the lower part of the extension **150** of the flange **124**. The portion **152** is welded to the outer flange **124** while the portion **153** is secured to the extension **150** of the outer flange and to the vertical plate **134** by means of bolts **154** and the flange extension **150** is joined to the vertical plate **134** by means of bolts **155**, the bolts **154** and **155** being located on both sides of the web **125**.

The embodiments of the invention shown in FIGURES 18, 19 and 20 are generally similar to the arrangements shown in FIGURES 15, 16 and 17 with the exception that the bolted connection between the column and the rafter in the region of the outer flanges is located in the outer flange of the columns. In FIGURE 18, the rafter includes a vertical plate **160** extending outwardly from both sides of the web **125** and being welded to the web **125** throughout the depth of the web and including a downwardly extending portion **161** which overlies the upper end of the outer flange **124**. Bolt and nut connecting means **162**, located on both sides of the web **122**, form a connection between the extension **161** and the outer flange **124**. In FIGURE 19, a connecting plate **165** is provided having a portion **164** overlying the lower portion of the vertical plate **134** and being welded thereto and including a portion **167** extending downwardly in overlying relation with respect to the outer surface of the outer flange **124** and being secured thereto by nuts and bolts **168** located on both sides of the web **122**. In FIGURE 20, the outer end of the rafter is provided with an end plate **160** welded to the outer end of the web **125** and including a portion **161** which overlies the outer surface of the upper portion of outer flange **124** of the column. Also, a connecting plate **170** is provided including a portion **171** overlying the plate **160** in the region of the web **125** of the rafter and including a portion **172** overlying the extension **161** of the plate **160**. The upper end of the flange **124**, the extension **161** and the portion **172** of the connecting plate **170** are secured together by bolts **173** located on both sides of the web **122**.

Although several embodiments of the present invention have been disclosed and described, it is expressly understood that various changes and substitutions may be made therein without departing from the spirit of the invention as well understood by those skilled in the art. For example, the various haunch constructions may be employed with non-tapered columns and rafters. Reference therefore will be had to the appended claims for a definition of the limits of the invention.

This application is a continuation-in-part of applicant's copending application Serial No. 644,012, filed March 5, 1957.

What is claimed is:

1. A structural member for a column of a rigid portal frame comprising an elongated web portion including a first longitudinal edge and a second longitudinal edge including a portion inclined at an angle with respect to the first longitudinal edge, the longitudinal edges at one end of the web portion terminating in spaced relation and the longitudinal edges at the other end of the web portion terminating in a plane disposed at an obtuse angle with respect to the first longitudinal edge, a first elongated flange portion joined to the first longitudinal edge of the web portion, a second elongated flange portion joined to the second longitudinal edge of the web portion, the first and second flange portions lying in planes perpendicular to the plane of the web portion and extending outwardly from both sides of the web portion, a flat plate member overlying the ends of the first and second flange portions at the other end of the web portion and disposed at an obtuse angle with respect to the first longitudinal edge of the web portion and being joined to the ends of the web portion and the first and second flange portions, the flat plate member including a coplanar portion extending outwardly beyond the second flange portion, the coplanar portion of the flat plate member including connecting means and plate members connected between the first and second flange portions on both sides of the web portion and joined to the web portion in a region of the web portion displaced from the connecting plate.

2. A structure member for a column of a rigid portal frame comprising an elongated plate including a first longitudinal edge and a second longitudinal edge having a first portion extending from one end of the elongated member in inclined relation with the first longitudinal edge throughout a major part of the length of the elongated plate and a parallel portion extending in parallel relation with the first longitudinal edge throughout the remaining portion of the length of the elongated plate and terminating at the other end of the elongated plate in a plane passing through the other end of the first longitudinal edge and at an obtuse angle with respect to the first longitudinal edge, a first elongated flange joined to the first longitudinal edge of the elongated plate, a second elongated flange joined to the second longitudinal edge of the elongated plate, the second elongated flange including an inclined portion and a parallel portion complementary with the inclined portion and parallel portion of the second longitudinal edge, the first and second flanges lying in planes perpendicular to the plane of the elongated plate and extending outwardly from both sides of the elongated plate, a flat plate joined to the ends of the first and second flanges at the other end of the elongated plate bridging the space between the first and second flanges and being joined to the elongated plate, the flat plate including a coplanar extension projecting out wardly beyond the second flange, the coplanar extension of the flat plate and the parallel portion of the second elongated flange including connecting means.

3. A rigid portal frame comprising a column including a tapered web and first and second flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web and being in maximum spaced relation at one end of the column, a rafter member including a tapered web and first and second flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web and being in maximum spaced relation at one end of the rafter member, the ends of the web and flanges at the one end of the column lying in a plane disposed at an obtuse angle with respect to the first flange, connecting means joined between the flanges at the one end of the column and bridging the space between the flanges, the connecting means including an extension lying in the obtuse plane and projecting outwardly beyond the second flange of the column, means for joining the extension of the connecting means in parallel overlying relation to the first flange of the rafter member at the one end of the rafter member, the ends of the web and the flanges at the one end of the rafter member lying in a plane parallel to a portion of the second flange of the column adjacent the connecting means, and means for connecting the rafter member to the second flange of the column in the region of the second flange of the rafter member.

4. A rigid portal frame as defined in claim 3 in which the means for joining the extension of the connecting means to the first flange of the rafter member and the means for connecting the rafter member to the second flange of the column comprise bolts in shear.

5. A rigid portal frame comprising a column including a tapered web and first and second flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web and being in maximum spaced relation at one end of the column, a rafter member including a tapered web and first and second flange joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web and being in maximum spaced relation at one end of the rafter member, the ends of the web and flanges at the one end of the column lying in a plane disposed at an obtuse angle with respect to the first flange, a flat cover plate overlying the ends of the flanges and the web at the one end of the column and being connected thereto, the cover plate including a plate extension lying in the obtuse plane and projecting outwardly beyond the second flange of the column, means for joining the plate extension in parallel overlying relation to the first flange of the rafter member at the one end of the rafter member, the ends of the web and the flanges at the one end of the rafter member lying in a plane parallel to a portion of the second flange of the column adjacent the connecting means, a flat plate joined to the end of the second flange and a portion of the web adjacent the second flange at the one end of the rafter member, means for connecting the flat plate to the outer surface of the second flange of the column, and stiffening plates connected to the second flange of the column on both sides of the web and to the web.

6. A rigid portal frame as defined in claim 5 in which the means for joining the plate extension to the first flange of the rafter member and the means for connecting the flat plate to the second flange of the column comprises a plurality of bolts in shear.

7. A rigid portal frame as defined in claim 6 in which the means for connecting the flat plate to the second flange of the column includes bolts located on opposite sides of the stiffening plates.

8. A rigid portal frame as defined in claim 7 in which the stiffening plates lie in a plane passing through the end of the second flange of the rafter member at the one end of the rafter member.

9. A building construction comprising a column including a tapered web and angularly disposed flanges joined to the web and extending outwardly from the plane of the web and being in maximum spaced relation at one end of the column, a rafter including a tapered web and angularly disposed flanges joined to the web and extending outwardly from the plane of the web and being in maximum spaced relation at one end of the rafter, and a haunch structure wherein the one end of the column and the one end of the rafter are connected with their longitudinal axes defining an internal obtuse angle establishing the roof slope of the building construction, the haunch structure including a first plate member joined to the column in angular relationship with the longitudinal axis of the column and having a portion extending out-

wardly from the column and overlying a flange of the rafter, a second plate member joined to the column and presenting an outside surface lying in a plane parallel to the one end of the rafter, and means for joining the overlying portion of the first plate member to one flange of the rafter and the second plate member to the one end of the rafter in the region of the other flange of the rafter.

10. A building construction comprising a column including a tapered web and angularly disposed flanges joined to the web and extending outwardly from the plane of the web and being in maximum spaced relation at one end of the column, a rafter including a tapered web and angularly disposed flanges joined to the web and extending outwardly from the plane of the web and being in maximum spaced relation at one end of the rafter with an end plate member at its one end in the region of one of the flanges, and a haunch construction wherein the one end of the column and the one end of the rafter are connected with their longitudinal axes defining an internal obtuse angle establishing the roof slope of the building construction, the haunch construction including a first plate member joined to the column in angular relationship with the longitudinal axis of the column and having a portion extending outwardly from the column and overlying the other flange of the rafter, a second plate member joined to the column and presenting an outside surface lying in a plane parallel to the end plate member of the rafter, and means for joining the extending portion of the first plate member to the other flange of the rafter and the second plate member to the end plate member.

11. A building construction as defined in claim 10 in which the means for joining the extending portion of the first plate member to the other flange of the rafter and for joining the second plate member to the end plate member of the rafter comprises bolt and nut connecting means.

12. A building construction comprising a column including a web disposed in a vertical plane and inner and outer flanges respectively joined to the inner and outer longitudinal edges of the web and extending outwardly in angular relation from the plane of the web, a rafter including a web disposed in a vertical plane and upper and lower flanges respectively joined to the upper and lower longitudinal edges of the web and extending outwardly in angular relation from the plane of the web, and a haunch structure wherein one end of the column and one end of the rafter are connected with their longitudinal axes defining an internal obtuse angle establishing the roof slope of the building, the haunch structure including a first plate member joined to the column and extending inwardly of the building in a direction away from the outer flange of the column and overlying the upper flange of the rafter, a second plate member joined to the one end of the rafter in contact with the lower flange of the rafter and lying in a plane parallel to the inner flange of the column, means for joining the upper flange of the rafter to the first plate member, and means joining the inner flange of the column to the second plate member.

13. A building construction as defined in claim 12 in which the means joining the upper flange of the rafter to the first plate member and the means joining the inner flange of the column to the second plate member comprises nut and bolt connecting means located on opposite sides of the plane of the webs with the longitudinal axes of the bolts being perpendicular to the plane of respective plate members.

14. A building construction comprising a column including a web disposed in a vertical plane and inner and outer flanges respectively joined to the inner and outer longitudinal edges of the web and extending outwardly in angular relation from the plane of the web, a rafter including a web disposed in a vertical plane and upper and lower flanges respectively joined to the upper and lower longitudinal edges of the web and extending outwardly in angular relation from the plane of the web, and a haunch construction wherein one end of the column and one end of the rafter are connected with their longitudinal axes defining an internal obtuse angle establishing the roof slope of the building, the haunch construction including a first plate member joined to the column and overlying the upper end of the column in angular relationship with the longitudinal axes of the column and including a portion extending inwardly of the building in a direction away from the outer flange of the column in overlying relationship with the upper flange of the rafter, a second plate member joined to the one end of the rafter in contact with the lower flange of the rafter and lying in a plane parallel to the inner flange of the column, nut and bolt connecting means passing through openings provided in the portion of the first plate member and in the upper flange of the rafter rigidly securing the upper flange of the rafter to the first plate means with the axes of the bolts being perpendicular to the plane of the upper flange, and second nut and bolt connecting means passing through openins provided in the inner flange of the column and in the second plate member rigidly joining the second plate member to the inner flange of the column with the axes of the bolts being perpendicular to the plane of the inner flange of the column.

15. A rigid portal frame comprising a column including a web and first and second flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web, a rafter member including a web and first and second flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web, the ends of the web and flanges at one end of the column lying in a plane disposed at an obtuse angle with respect to the first flange, connecting means at the one end of the column including a plate bridging the space between the flanges of the column and lying in the plane disposed at the obtuse angle with respect to the first flange of the column, the connecting means including an extension projecting beyond the second flange of the column in a plane disposed at an obtuse angle with respect to the first flange of the column greater than the obtuse angle between the plate and the first flange of the column, means for joining the extension of the connecting means in parallel overlying relation to the first flange of the rafter member at the one end of the rafter member, the ends of the web and the second flange at the one end of the rafter member lying in a plane parallel to the contiguous portion of the second flange of the column, and means for connecting the rafter member to the second flange of the column in the region of the second flange of the rafter member.

16. A rigid portal frame comprising a column including a web and first and second flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web, a rafter member including a web and first and second flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web, the ends of the web and flanges at one end of the column lying in a plane disposed at an obtuse angle with respect to the first flange, connecting means at the one end of the column including a plate bridging the space between the flanges of the column and lying in the plane disposed at the obtuse angle with respect to the first flange of the column, the connecting means including an extension projecting beyond the second flange of the column in a plane disposed at an obtuse angle with respect to the first flange of the column less than the obtuse angle between the plate and the first flange of the column, means for joining the extension of the connecting means in parallel overlying

relation to the first flange of the rafter member at the one end of the rafter member, the ends of the web and the second flange at the one end of the rafter member lying in a plane parallel to the contiguous portion of the second flange of the column, and means for connecting the rafter member to the second flange of the column in the region of the second flange of the rafter member.

17. A rigid portal frame comprising a column including a web and first and second flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web, the upper portion of one longitudinal edge of the web being at an angle relative to the other longitudinal edge of the web, a rafter member including a web and first and second flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web, the ends of the web and flanges at the one end of the column lying in a plane disposed at an obtuse angle with respect to the first flange of the column, connecting means joined between the flanges of the column at the one end of the column and bridging the space between the flanges, the connecting means including an extension lying in a plane disposed at an obtuse angle relative to the first flange of the column and projecting outwardly beyond the second flange of the column, means for joining the extension of the connecting means in parallel overlying relation to the first flange of the rafter member at the one end of the rafter member, the ends of the web and the flanges at the one end of the rafter member lying in a plane parallel to the upper portion of the second flange of the column, and means including a butt plate for connecting the rafter member to the second flange of the column in the region of the second flange of the rafter member.

18. A rigid portal frame comprising a column including a web, a first longitudinal edge of the web including a first portion and a second portion at the upper end of the column inclined toward the second longitudinal edge at an obtuse angle relative to the first portion of the longitudinal edge, a first flange joined to the first and second portions of the first longitudinal edge of the web and a second flange joined to the second longitudinal edge of the web, the first and second flanges lying in planes perpendicular to the web and extending outwardly from opposite sides of the web, a rafter member including a web and first and second flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web, the ends of the web and flanges of the column at the one end of the column lying in a plane disposed at an obtuse angle with respect to the second flange, connecting means joined between the flanges of the column at the one end of the column and bridging the space between the flanges, the connecting means including an extension lying in the plane disposed at an obtuse angle relative to the second flange of the column and projecting outwardly beyond the first flange of the column, means for joining the extension of the connecting means in parallel overlying relation to the first flange of the rafter member at the one end of the rafter member, the ends of the web and the flanges of the rafter at the one end of the rafter member lying in a plane parallel to the second portion of the first longitudinal edge of the web of the column, and means for connecting the rafter member to the first flange of the column in the region of the second portion of the first longitudinal edge of the web of the column and in the region of the second flange of the rafter member.

19. A rigid portal frame comprising a column including a web and inner and outer flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web, the ends of the web and at least one of the flanges of the column at one end of the column lying in a horizontal plane, a flat cap plate secured to the web and to at least one of the flanges at the one end of the column, a rafter member including a web and upper and lower flanges joined to the longitudinal edges of the web and lying in planes perpendicular to the web and extending outwardly from opposite sides of the web, the web of the rafter at one end of the rafter including a terminating edge disposed in a substantially vertical plane, an end plate secured to the terminating edge of the web of the rafter and extending outwardly from opposite sides of the web, the end plate extending from the upper flange of the rafter at least substantially throughout the terminating edge of the web of the rafter, the lower flange of the rafter including a horizontally disposed portion spaced from the terminating edge of the web of the rafter and adapted to overlie the flat cap plate adjacent the inner flange of the column, means including bolt and nut connecting means for joining the horizontally disposed portion of the lower flange of the rafter to the flat cap plate and means including bolt and nut connecting means joining the end plate to the outer flange of the column.

20. A rigid portal frame as defined in claim 19 in which the outer flange of the column terminates below the upper end of the column, and in which the means joining the end plate to the outer flange of the column comprises a connecting plate in overlying relation with the web of the column which projects upwardly in overlying relation with the end plate, the connecting plate being welded to the web of the column and being joined to the end plate by members passing through openings in the end plate and the connecting plate and the part of the connecting plate in overlying relation with the web of the column being an extension of the outer flange of the column.

21. A rigid portal frame as defined in claim 19 in which the flanges of the column at the one end of the column are connected to the flat cap plate and in which the means joining the end plate to the outer flange of the column comprises a connecting plate overlying and joined to the outer flange of the column and including a portion overlying the end plate, and connecting means joining the end plate to the overlying portion of the connecting plate, the connecting means including members passing through openings in the end plate and the overlying portion of the connecting plate.

22. A rigid portal frame as defined in claim 19 in which the flanges of the column at the one end of the column are connected to the flat cap plate and in which the outer flange of the column includes an extension projecting upwardly beyond the upper end of the column in overlying relation with the end plate, a connecting plate including a first portion overlying and welded to a portion of the outer flange of the column joined to the web of the column and a second portion overlying a portion of the extension of the outer flange of the column, connecting means for joining the extension and the end plate and for joining the end plate, the extension and the second portion of the connecting plate, the connecting means including members passing through openings in the connected members.

23. A rigid portal frame as defined in claim 19 in which the flanges of the column at the one end of the column are connected to the flat cap plate and in which the means joining the end plate to the outer flange of the column comprises an extension of the end plate which extends downwardly in overlying relation with the outer flange of the column, the extension of the end plate being joined to the outer flange of the column by connecting means including members passing through openings in the extension of the end plate and the outer flange of the column.

24. A rigid portal frame as defined in claim 19 in which the flanges of the column at the one end of the column are connected to the flat cap plate and in which the means joining the end plate to the outer flange of

the column comprises a connecting plate including a first portion overlying and joined to the outer flange of the column and a second portion overlying and joined to a portion of the end plate, the first portion of the connecting plate being joined to the outer flange of the column by means including members passing through openings in the first portion of the connecting plate and the outer flange of the column.

25. A rigid portal frame as defined in claim 19 in which the flanges of the column at the one end of the column are connected to the flat cap plate and in which the means joining the end plate to the outer flange of the column comprises an extension of the end plate which extends downwardly in overlying relation with the outer flange of the column, a connecting plate which overlies and is joined to a portion of the end plate joined to the web of the rafter and which overlies a portion of the end plate overlying the outer flange of the column, and connecting means joining the connecting plate and the end plate extension to the outer flange of the column, the last-named means including members passing through openings provided in the last-named connected members.

26. A building construction comprising a column including a tapered web and angularly disposed flanges joined to the web and extending outwardly from the plane of the web and being in maximum spaced relation at one end of the column, a rafter including a tapered web and angularly disposed flanges joined to the web and extending outwardly from the plane of the web and being in maxmium spaced relation at one end of the rafter, and a haunch structure wherein the one end of the column and the one end of the rafter are connected with their longitudinal axes defining an internal obtuse angle establishing the roof slope of the building construction, the haunch structure including a first plate member at the one end of the column joined to the flanges of the column and overlapping one of the flanges of the rafter, bolts in shear connecting the first plate member and the one flange of the rafter in the overlapping region, a second plate member, first connecting means joining the second plate member to the web of the rafter, and second connecting means joining the second plate member to one of the flanges of the column, at least one of the first and second connecting means including bolts in shear.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,157,251 November 17, 1964

Herman R. Rasch

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 22, for "drawing" read -- drawings --; column 6, line 13, for "are" read -- area --; column 11, line 32, for "structure" read -- structural --.

Signed and sealed this 22nd day of June 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents