

May 22, 1934.

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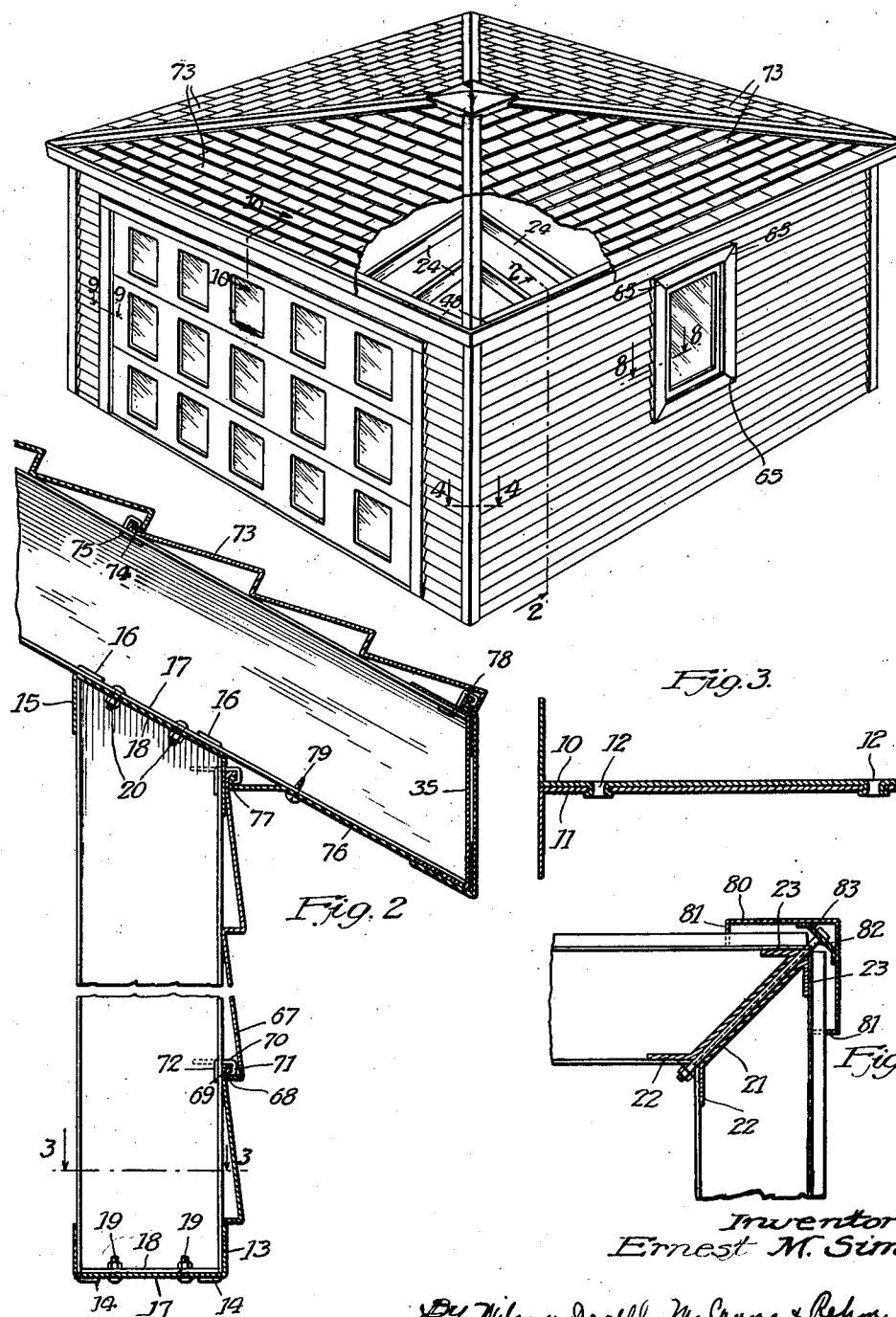
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METAL BUILDING STRUCTURE

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Fig. 1.



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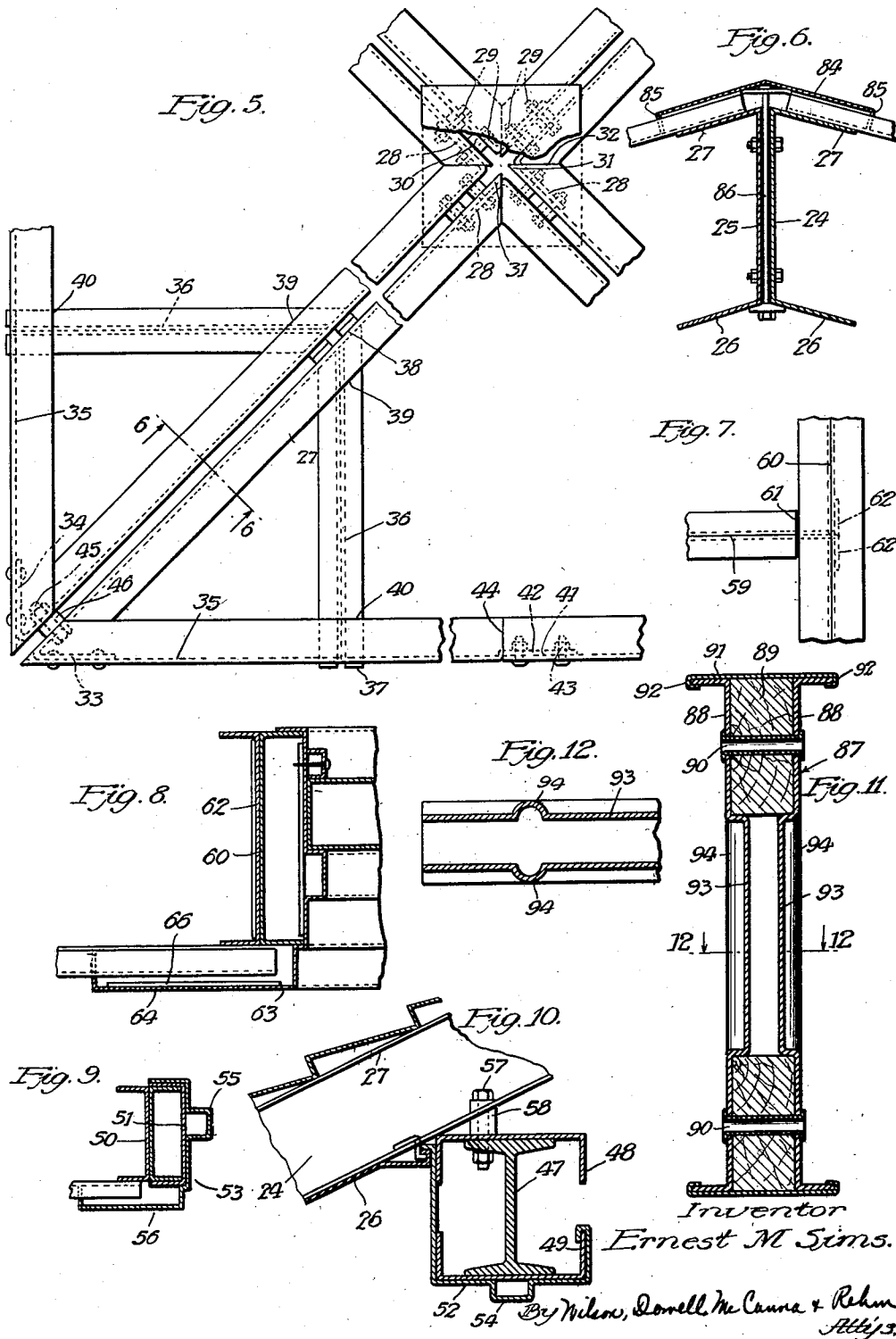
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METAL BUILDING STRUCTURE

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9 Claims. (Cl. 189—1)

This invention relates to metal structural members for building and their manufacture; and among other objects aims to provide, at a cost consistent with competitive structures, metal construction for small buildings whose character and size do not adapt them to the conventional metal construction employing rolled or other heavy gauge metal shapes.

The nature of the invention may be readily understood by reference to one illustrative construction embodying the invention and illustrated in the accompanying drawings.

In said drawings:

Fig. 1 is a perspective view (in which certain portions have been broken away for the sake of illustration) of a two-car garage or other small structure.

Fig. 2 is a vertical section (on an enlarged scale) through a wall and portion of the roof, taken on the plane 2—2 of Fig. 1.

Fig. 3 is a plan section taken on the plane 3—3 of Fig. 2 showing a stud or other structural member, other parts of the section having been eliminated for the sake of simplicity.

Fig. 4 is a plan section of a corner construction taken on the plane 4—4 of Fig. 1.

Fig. 5 is a fragmentary plan view of the roof supporting structure.

Fig. 6 is a transverse section taken on the plane 6—6 of Fig. 5, showing the rafter construction at the hip of the roof.

Fig. 7 is a detail elevation showing the connection of transverse members to stud members such for example as occur at a window opening.

Fig. 8 is a plan section of a detail at a window opening taken on the plane 8—8 of Fig. 1.

Fig. 9 is a detail of a door jam construction taken on the plane 9—9 of Fig. 1.

Fig. 10 is a vertical transverse section taken on the plane 10—10 of Fig. 1 showing a detail of a door lintel.

Fig. 11 is a transverse section of another form of stud or structural member.

Fig. 12 is a fragmentary vertical section thereof taken on the plane 12—12 of Fig. 11.

A small building such as a residence or private garage etc. cannot be economically constructed with rolled metal or other shapes which possess such an excessive surplus of strength for such purposes and which are made by such costly methods of manufacture, as to make them prohibitively expensive, and whose erection costs would be prohibitive, since in many cases they would require the services of skilled iron workers. Moreover it is not possible to roll struc-

tural members sufficiently thin to suit the requirements of the aforesaid construction, even if they were otherwise suitable. Sheet metal structural members have been influenced by conventional structural design and employ too much metal, and are made with such heavy gauge metal and by such expensive methods as to be prohibitive for many classes of construction of the type above referred to. The inventive structural material is given practically universal utility, since it may be erected by carpenters, and according to the methods and technique employed in ordinary wood construction.

The desired economy in metal is secured by the use of sheet metal of relatively thin gauge, but of sufficient strength when formed into the proper shapes and used as herein explained, to provide adequate strength without waste of metal. Further economy is effected by shaping the sheet metal into the desired cross-sectional shapes by passing a strip of sheet metal of the proper width through a series of forming rolls or dies which gradually bring it into the proper shape. With practically no manual labor, the material may be formed in this way in indefinite lengths and then cut transversely to the desired length. The economy of this method of manufacture is to be contrasted with the formation of structural shape from sheet metal by breaking short cut lengths down over dies. Such dies are expensive, have low production, and have relatively high unit labor costs. The rolling method, on the other hand, requires little labor and has a high production.

The illustrative construction has been built entirely of incombustible materials. Such construction is advantageous for garages placed on narrow lots in localities where the building codes do not permit close proximity to the lot line unless the construction is of a prescribed character. My building units, however, may be employed in conjunction with combustible materials such as combustible roofing, siding, etc. In other words different types of roofing and siding may be employed in connection with the illustrative structural members.

The structural members used herein for studing, rafters, etc. embody a thin sheet metal web with marginal stiffening flanges at an angle thereto, such as a channel shape. Those here shown comprise a pair of sheet metal channels 10 and 11 placed back to back and appropriately secured together. The securing means herein shown consists of a plurality of "self-rivets" 12 formed by piercing up eyelets from the metal of the web

of one channel, passing it through registering openings in the web of the other channel, and riveting or upsetting the metal to hold the channels together. The gauge of metal used is relatively thin and may be as little as thirty-five thousandths (.035) of an inch in thickness for stud members equivalent to the conventional 2 x 4 inch wood stud, and can be sawed through by a hack saw about as quickly as sawing a wood stud. An equivalent single channel would require slightly heavier gauge metal and flanges whose width was substantially the aggregate width of the flanges of the double channel stud. The stud members are intended to be erected according to conventional methods of erecting and arranging wood studs. In the present case the studs are seated in a sheet metal channel 13 which serves as a plate and rests upon the foundations provided and to which it may be bolted or otherwise secured, and they may be spaced at the conventional wood stud spacing. The studs are connected to the channel by bendable lugs or ears 14 which project from the flanges of the stud. The ears are integral with the webs and may be provided either at the point of erection, by cutting away adjacent sheet metal, or preferably at the factory when the studs are cut to size. The bendable lugs pass through registering slots in the plate or channel 13, which slots are preferably provided at conventional spaced intervals, but the sheet metal is thin enough to be easily punched to provide a slot at any desired point. After passing through the slots the ears are bent over by a hammer or other tool. The upper ends of the studs are covered by a similar plate or channel member 15 which in the present case is shaped to conform to the pitch of the roof rafters (see Fig. 2). In such a case the upper ends of the studs are also advantageously cut to the intended shape of the roof and are provided with integral bendable lugs 16 which pass through registering openings in the plate 15 and are then bent down.

The side wall structure thus described may advantageously be made in sections of a length convenient for erection. Sections are joined together to make a complete side wall by overlapping the webs 17 and 18 of adjacent top and bottom plates and bolting or otherwise securing them together as at 19 and 20. In this way practically all the labor of assembling the main structural members is performed at the point of manufacture. Two-story structures would be formed by assembling together a plurality of single story side wall units with intervening floor beams. In such a case, the upper plate and the upper ends of the studs for the lower story would be square instead of inclined to the roof pitch.

The side wall units are advantageously joined together at the corners by providing a corner post or stud member 21 whose flanges 22 and 23 are inclined to the web of the stud so as to register with the wall line. The web of the stud is arranged diagonally at the corner.

The roof structure herein illustrated is of the hip roof type for square buildings. A hip roof construction for rectangular buildings would be similar except that the hip rafters would not all meet at one point but would be connected together by a short ridge which represented the difference between the width and length of the building. The hip rafters (see Figs. 5 and 6) are each formed of a pair of channel members 24 and 25 made of the aforesaid thin sheet metal and arranged back to back with their webs spaced for purposes hereinafter referred to. The flanges 26 and 27 are built at an angle to the webs corresponding with the pitch of the roof. One of the webs, in this case web 25, is arranged to project beyond the upper end of the rafter, the adjacent flange having been cut away (Fig. 5). This projecting portion 28 of the web of each of the rafters is bent at an angle to the plane of the web and connected (as presently described) to the web of the adjacent rafter by bolts 29 (with intervening spacers 30) which pass through registering openings. The other web of each of the rafters terminates with the end of the rafter as at 31. The adjacent flanges 27 are mitered as at 32 at their meeting edges. The flanges at the lower ends of the rafters are cut away so as to leave bolting webs 33 and 34 projecting. These are bent at an angle to the web of the rafter to correspond with the eave lines of the roof (see Fig. 5) and are connected with channels 35 (similar to the plate members) which cover the ends of the rafter. Intervening rafters 36 of a section similar to the stud member (Fig. 3) are arranged at properly spaced distances and connected to the main hip rafters and the eave channels by bendable lugs 37 and 38, similar to the lugs 14, which pass through registering slots in the webs of the members which they abut. If it be desired to have the flanges of the rafters 37 lie flush with the flanges 27 of the hip rafters, the former are cut back so as to register at 39 with the margins of the flanges 27. The rafter flanges may also be cut back as at 40 to register with the edge of the flanges of the channels 35.

The roof structure is also advantageously arranged for assembly (at the factory) of the members into unit sections which are later connected together at the point of erection of the building to form the complete roof. In the case of a structure corresponding generally to the size of a garage, each face of the roof may be formed into two sections or halves, thus a complete hip roof of the character illustrated would be formed in eight sections. Thus each section includes one channel member of a hip rafter. For this purpose the channels 35 are jointed as at 41 and one of the flanges 42 of each of the abutting channels is offset and overlaps the flange of the abutting channel and is bolted thereto or otherwise connected as at 43. The flanges of the channel having the projecting web 41 are cut back as at 44 to abut the flanges of the other channel. It should be understood that a plurality of rafters 36 may be used in each section, it being preferable however that no rafter fall exactly at the dividing line 44 of each section. At the point of erection the upper ends of the hip rafters are bolted together as previously described and the lower ends are bolted together by the bolts 45 with an intervening spacer 46.

For wide door openings, such as occur in garages, it is desirable to adhere to the practice of using rolled structural members in the lintel construction. This is particularly desirable if the opening be a double car opening or if the weight of the door or roof be carried by the lintel. The lintel member herein shown is a rolled I-beam 47 preferably partly encased by the sheet metal channels 48 and 49 similar to the plate members which are connected to the upper and lower flanges of the I-beam. The stud members 50 at the sides of the door opening are preferably each reinforced by an additional channel 51 in order to provide adequate strength for carrying the load imposed by the lintel. The lintel and

door jams are faced with sheet metal members 52 and 53 whose conformation depends somewhat upon the character of door employed, whether it be an overhead door as herein shown or swinging door. The member 52 is shown formed with a stop 54 and the jam covering with a stop 55. The face 56 of the jam members advantageously are wide enough to finish the door opening and to extend over the edges of the siding material.

19 The roof rafters passing over the lintel are connected thereto by bolts 57 with an intervening spacer 58 shaped to fit the wedge-shaped space.

Windows or similar openings are formed by placing headers 59 between the stud members 60 which border the sides of the opening (see Fig. 7), which headers are similar in construction to the studs and have their flanges cut back as at 61 to lie flush with the edges of the stud flanges. The remaining web extends between the flanges of the stud and passes through an opening in the web thereof and is thereafter spread and bent over, as is indicated at 62, against the web of the stud. Intermediate short length stud members above and below the window opening may be headed against the headers 59 and connected thereto in the same manner as the headers are connected to the studs. The window openings may be faced by appropriate window framing material whose window framing members 63 and whose contour depend upon the character of window employed. Generally such members are simple in character. Standard steel sash may of course be employed. The face 64 of the window members is made wide enough to finish the opening and to cover the ends of the siding. The corners of the window members are mitered as at 65 (see Fig. 1) and are connected together by plates 66 spot welded to the backs thereof.

40 The structure here shown is provided with sheet metal siding 67 in this case shaped to simulate clapboards. Each longitudinal section of the siding is formed to represent a plurality of clapboards, and the upper and lower edges thereof are shaped to provide interlocking members 68 and 69 (see Fig. 2) by means of which the sections may be interconnected. The siding is attached to the stud members by bendable clips 70 each having a hook 71 at one end fitting over the hook-shaped ends of the interlocking siding sections and passing through a slot in the web of the studs and afterward bent down as indicated at 72 to complete the connection. The hook-shaped construction of the interlocking siding serves therefore not only to lock the siding sections together but to provide means for their attachment.

The siding sections are made of thin gauge metal of approximately twenty-two thousandths (.022) of an inch thick and may of course be easily cut on the job if special cutting or fitting be necessary.

The roofing material 73 is herein shown as made of sheet metal, likewise about twenty-two thousandths (.022) of an inch thick, and shaped to simulate shingles. In the present case each section of the roofing material is formed to simulate a plurality of courses of shingles and the upper and lower ends thereof are hooked as indicated at 75 in a manner similar to the siding construction, to provide means for interlocking or connecting the sections. These sections are attached to the rafters by bendable clips 75 similar to and cooperating in a manner similar to the clips 70.

The space between the rafters and the upper plate is advantageously closed by a sheet metal cover 76 (made of thin gauge sheet metal, about twenty-two thousandths (.022) of an inch in thickness) which extends over the ends of the rafters, underneath their projecting edges, and is connected to the top course of the siding. For purposes of connection the inner edge of the cover is provided with a hook 77 cooperating with the hook on the siding and its outer or upper edge is flanged as indicated at 78 so as to be engaged by the lower roofing attaching clip. If necessary the cover may be connected to the lower flanges of the rafters by a "metal" screw 79. The cover is particularly desirable where the building is built close to the lot line and the overhang of the eaves must necessarily be very short. In such cases it excludes rain which would be otherwise certain to creep in.

The siding is covered at the corners by finishing strips 80 (see Fig. 4) whose flanges 81 are notched to conform to the contour of the siding. The strips are connected to the structure by bolts 82 whose heads rest against attaching clips 83 welded across the corner of the strip, and which pass through the space between the webs of the channels forming the corner stud. The sides of the facing strips are bent at an angle somewhat less than 90° to each other so that tension applied by the attaching bolts 82 will cause them to hug the siding closely.

The ends of the roofing material are covered at the hips of the roof by similar strips 84 whose sides are inclined to each other at an angle corresponding with the angle of the roof sections. The flanges 85 of the strip are notched to conform to the contour of the shingles. The strip is attached by bolts 86 passing through the space between the webs 24 and 25 of the rafters in a manner similar to that for the corner stud.

In Figs. 11 and 12 I have illustrated a stud or other structural member 87 adapted for use particularly in those constructions in which the siding or roofing is attached by nails. Such structural member comprises a pair of channels 88 arranged back to back with intervening nailing material 89. The nailing material is advantageously made of wood although it is obvious that other nailing material might be employed. The channel members are shown in this case to be connected by a plurality of tubular rivets 90 although other means of connection may obviously be employed. The exposed edges of the nailing material are covered by thin sheet metal facing strips 91 (about twenty-two thousandths (.022) of an inch in thickness) which are flanged over the channel flanges as at 92. The covering strips are thin enough to be easily nailed through and yet they serve to enclose the nailing strip and render the same non-inflammable. In other words although a fire might be hot enough to char the wood nailing material, its complete enclosure by metal would prevent its catching fire.

For smaller structural members such as those serving the place of 2 x 4 studs, the wood nailing material may consist of a single strip of wood extending from one edge to the other of the structural member. For larger structural members a pair of spaced strips (such as shown in Fig. 11) may be employed. In such larger structural members it may be desirable to add further rigidity by offsetting the central portions of the webs 88 inwardly as at 93. Further reinforcement may be provided by forming transverse ribs 94 in the offset portions 93 of the webs.

The strength of the studs, beams, rafters, etc. may be increased (for larger buildings or those carrying greater floor or other loads) not only by increasing the depth of the webs of the members but by using thicker sheet metal, such as sixty-five thousandths (.065) of an inch in thickness, but for present purposes where wood construction is simulated, great increase in thickness of metal is not necessary. The members may always be readily sawed and manipulated.

Particularly where the various elements are assembled or united at the factory, spot welding may advantageously be employed as a mode of connection instead of bolts, rivets, etc.

As stated above, the stud members, plates, rafters, etc. are formed from sheet metal strips which are passed longitudinally through a set of forming rolls or dies which gradually bend the strip into the proper shape. Such forming dies when adjusted can form an indefinite amount of shaped material with little manual attention. The strip material is bought in coil form directly from the steel mill, containing many hundred linear feet of material. This method is therefore suited to the quantity production at low cost of this type of structural material. The formed material is advantageously cut into stock or standard size as it is formed and stored away. It is obvious that for garages and other small building construction the shape and length of the various structural members may be largely standardized. The above described method also admits of a substantial saving in the cost of material by the use of "mill edge" strips, that is, strips which are not sheared after being rolled, the shearing involving a substantial cost. In other words, the coiled strip is used just as it comes from the mill. The slight variation in width of the mill edge material is not objectionable in forming the structural members.

It is not necessary in forming the aforesaid structural members to have a complete set of dies for every shape. For example the flanges on the channels may be arranged at any desired angle to the webs by appropriate adjustment of certain of the final dies or rolls. This applies also to the formation of the transverse ribs 94 in the members 87 which may be formed in the sheet in some of the final operations without necessitating a complete set of rolls or dies.

Obviously the invention is not limited to the details of the illustrative construction since these may be variously modified. Moreover it is not indispensable that all features of the invention be used conjointly, since various features may advantageously be employed in different combinations and sub-combinations.

Having described my invention I claim:

1. In a building of the character described the combination of a wall section comprising a plurality of sheet metal stud members having the spacing usual for wood studs, said stud members comprising a plurality of channels made of relatively thin sheet metal and arranged back to back and connected together through the webs of said channels, the said sheet metal being thin to avoid an excessive surplus of strength in said stud members, the ends of said stud members being provided with bendable ears, and a plate member channel-shaped in section arranged over the ends of the said studs and having slots therein through which the respective ears pass, said channels provided with means whereby they may be connected end to end so as to connect a

plurality of wall sections to form a wall structure of the desired length.

2. In small building construction of the character described, the combination comprising a structural member formed by a pair of channels made of relatively thin sheet metal, said channels being arranged back to back and having an interposed nailing material between said back, said nailing material extending substantially to the edge of said structural material, and sheet metal binding strips engaging the flanges of said channels and covering the exposed face of said nailing material for binding said channels and nailing material in a unitary structure, said binding strip being of sufficiently thin gauge to be readily nailed through by nails passing into said nailing material.

3. In small building construction of the character described, the combination comprising a structural member formed by a pair of channels made of sheet metal sufficiently thin to be readily severed through, said channels being arranged back to back and having an interposed nailing material between said back, said nailing material extending substantially to the edge of said structural material, and sheet metal binding strips engaging the flanges of said channels and covering the exposed face of said nailing material for binding said channels and nailing material in a unitary structure, said binding strip being of sufficiently thin gauge to be readily nailed through by nails passing into said nailing material.

4. In small building construction of the character described, a structural member comprising in combination a pair of sheet metal channel members arranged back to back and having their central portions offset inwardly, leaving the edge portions spaced apart by a greater distance than the central portions, nailing material in said wider spaces, and binding strips of sheet metal sufficiently thin to be readily nailed through and extending across the edges of said structural members and engaging the channel flanges to bind said channels and nailing material into a unitary structure.

5. In small building construction of the character described, a structural member comprising in combination a pair of sheet metal channel members arranged back to back and having their central portions offset inwardly, leaving the edge portions spaced apart by a greater distance than the central portions, nailing strips filling and conforming to said space between said edge portions, and sheet metal binding strips bent around the respective channel flanges to bind said channels and nailing strips into a unitary structure.

6. In a building of the character described the combination comprising a plurality of stud members made of thin sheet metal bent to provide a web and stiffening flanges at an angle thereto, said sheet metal being thin enough to be readily sawed through at the place of erection, said studs being spaced at the usual spacing for wood studs and being arranged according to conventional practices for wood studs, the ends of said stud members being provided with bendable ears, and a channel shaped plate member made of thin sheet metal and having slots therein registering with said ears, said ears being bent over upon the web of said plate to connect said studs and plate together.

7. In small building construction of the character described, the combination comprising a sawable structural member formed by a pair of

thin sheet metal channels arranged back to back and having an interposed nailing material between said back, said nailing material extending substantially to the edge of said structural material, and rivets passing through said channels and nailing material and drawing the same together to form a unitary structure and to hold the same relatively immovable during a sawing operation.

8. In a small building construction of the character described, a structural member comprising in combination a pair of thin sheet metal channel members arranged back to back and having their central portions offset inwardly, leaving the edge portions spaced apart by a greater distance than the central portions, the latter being formed with transversely extending stiffening ribs, nailing material in said wider spaces, and means for clamping said channels and nailing material together into a unitary structure, the gauge of said metal being thin to avoid excessive surplus

strength and to render the members readily sawable at the point of erection.

9. A metal stud member for buildings of the character described adapted to be used and substituted for wood studs, said stud member comprising a plurality of channels made of relatively thin flexible sheet metal of not more than sixty-five thousandths (.065) of an inch in thickness and arranged back to back and solidly connected together through the webs of said channels to secure rigidity to the stud member, the sheet metal itself being so thin as not alone to contribute substantially to the rigidity of the stud member, thereby avoiding an excessive surplus of strength in said stud member and rendering the same readily sawable at the point of erection so that it may be installed according to practices employed for wood.

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