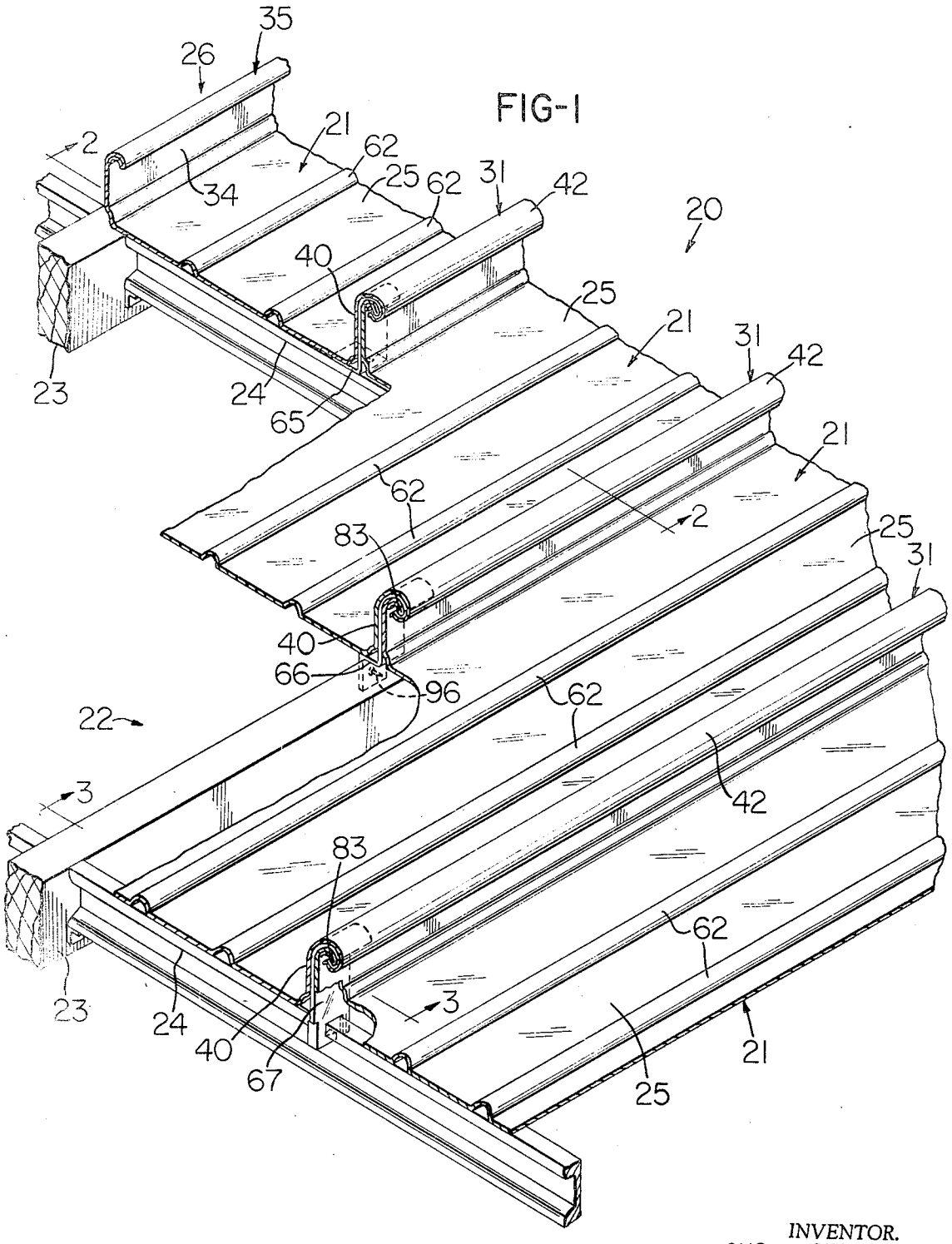
May 12, 1970 G. STRAUS 3,511,011

METAL PANEL AND BUILDING CONSTRUCTION USING SAME

Filed Dec. 5, 1968 5 Sheets-Sheet 1

FIG-1



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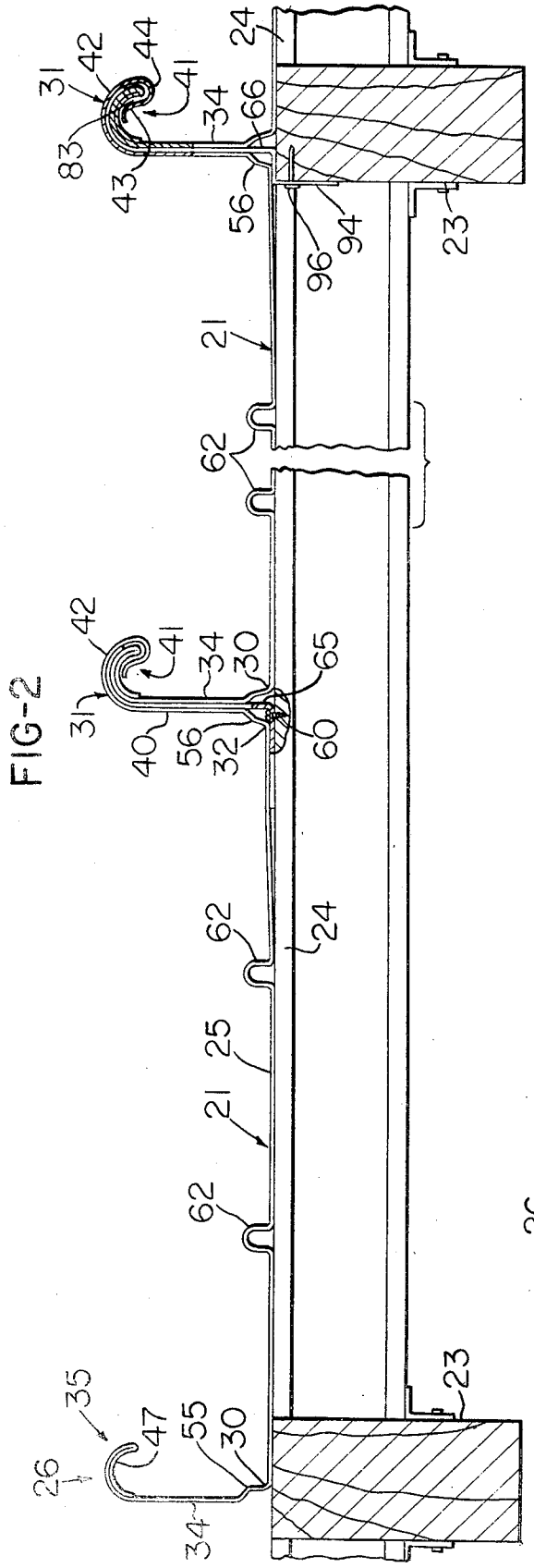
BY Glenn, Palmer & Lyne

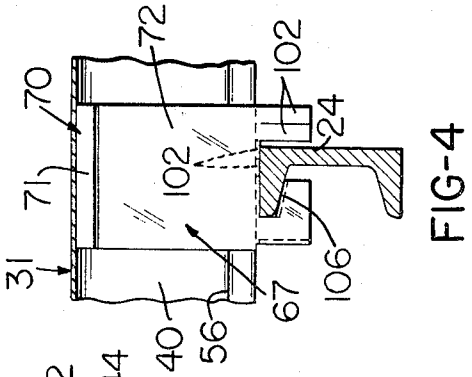
HIS ATTORNEYS

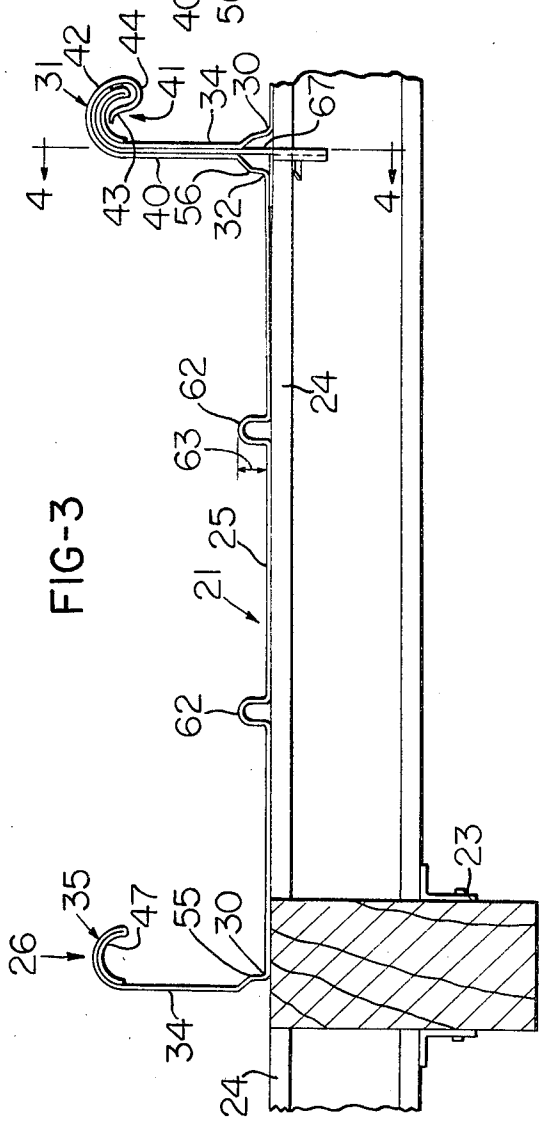
May 12, 1970 G. STRAUS 3,511,011

METAL PANEL AND BUILDING CONSTRUCTION USING SAME

Filed Dec. 3, 1968 5 Sheets-Sheet 2







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May 12, 1970 G. STRAUS 3,511,011

METAL PANEL AND BUILDING CONSTRUCTION USING SAME

Filed Dec. 3, 1968 5 Sheets-Sheet 3

FIG-5

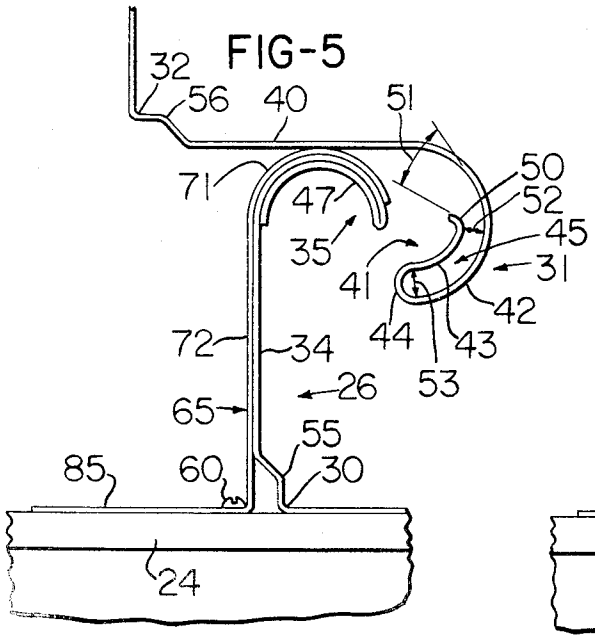


FIG-6

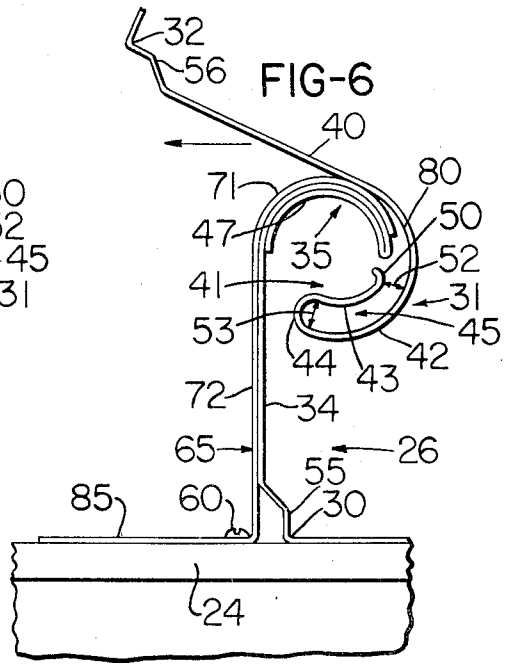


FIG-7

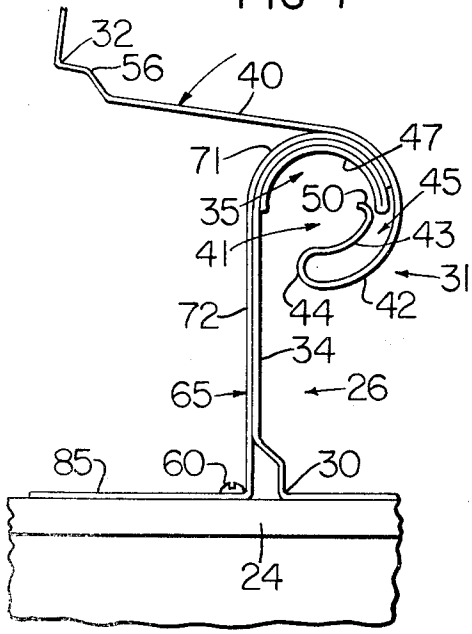
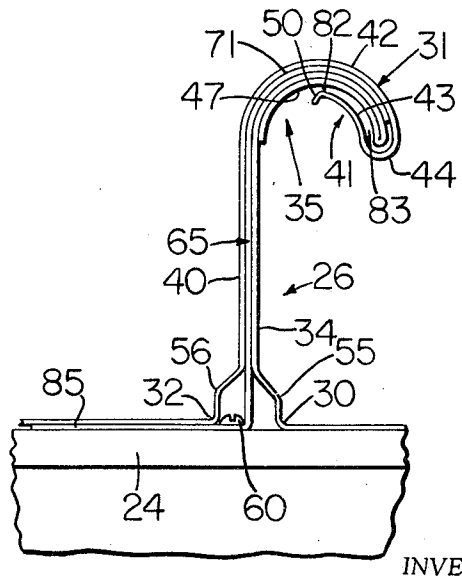


FIG-8



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May 12, 1970 G. STRAUS 3,511,011

METAL PANEL AND BUILDING CONSTRUCTION USING SAME

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FIG-9

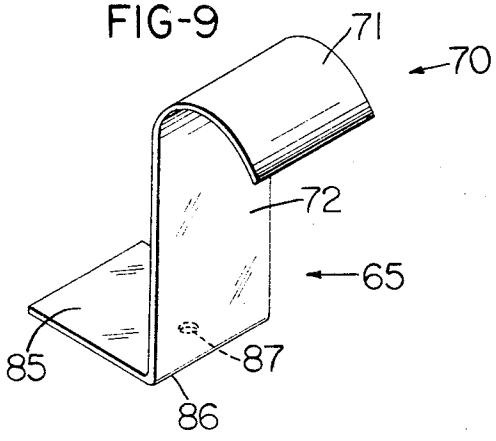


FIG-10

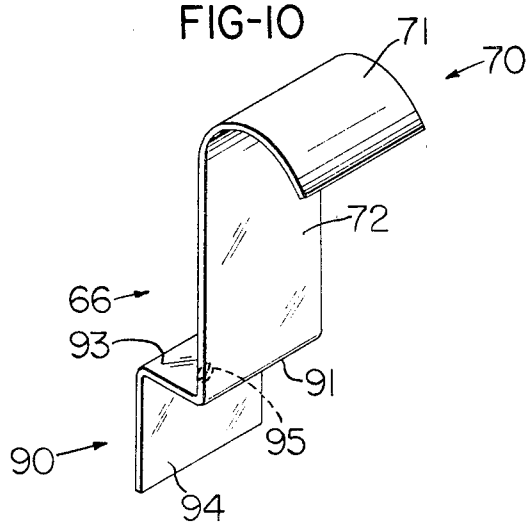


FIG-11

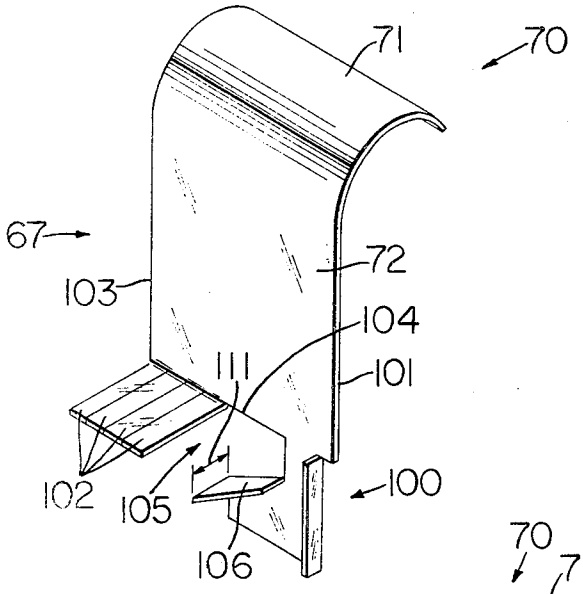


FIG-12

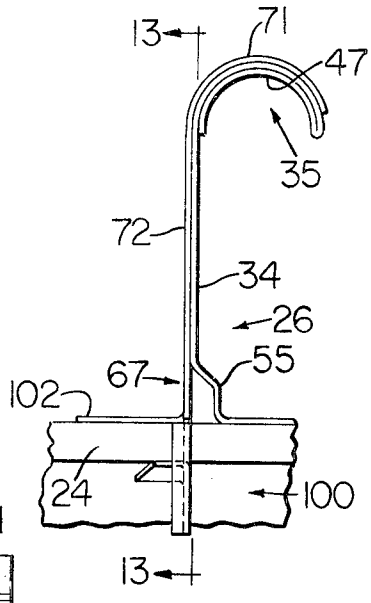
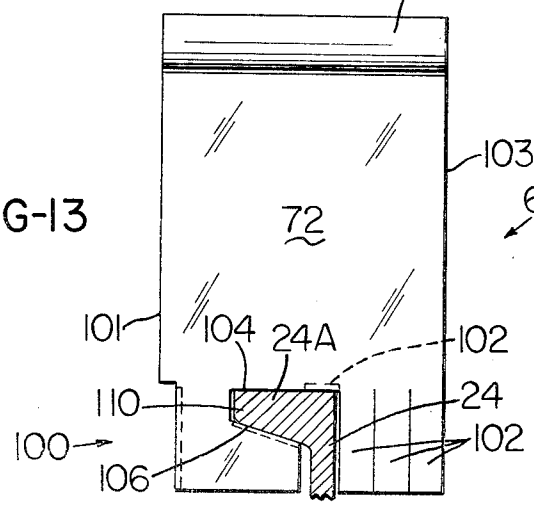


FIG-13



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METAL PANEL AND BUILDING CONSTRUCTION USING SAME

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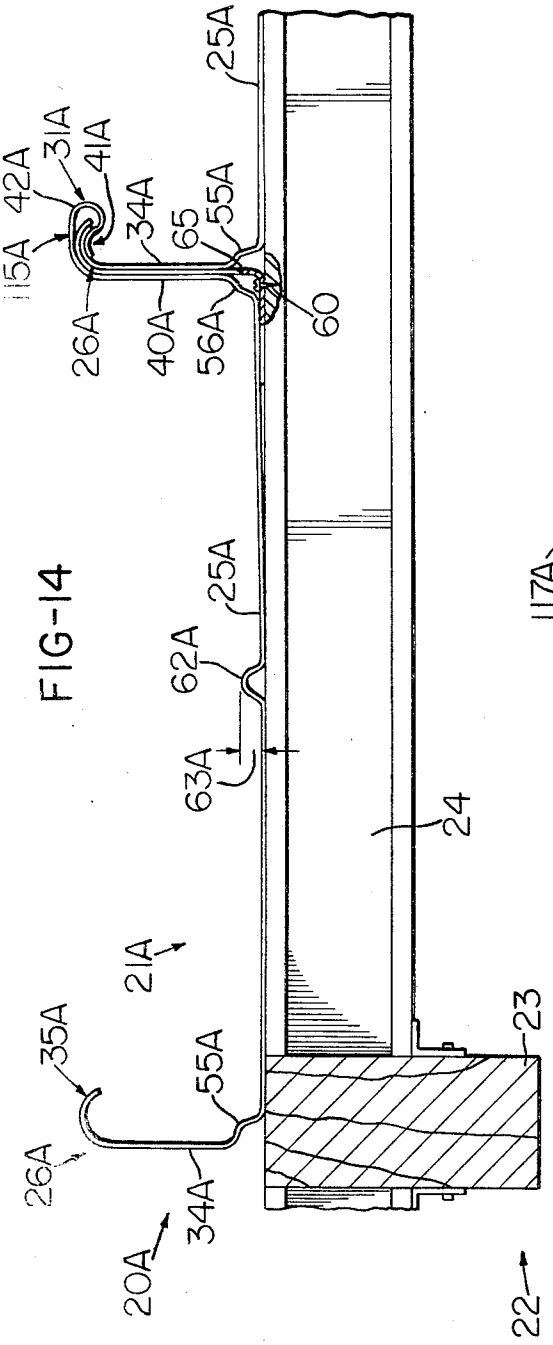


FIG-14

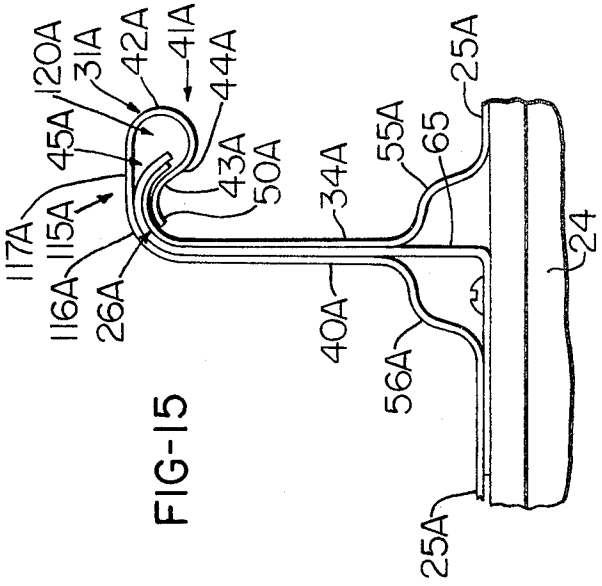


FIG-15

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United States Patent Office 3,511,011 Patented May 12, 1970

3,511,011

METAL PANEL AND BUILDING CONSTRUCTION USING SAME

Gus Straus, Henrico County, Va., assignor to Reynolds Metals Company, Richmond, Va., a corporation of Delaware

Continuation-in-part of application Ser. No. 716,079, Mar 26, 1968. This application Dec. 3, 1968, Ser. No. 780,826

Int. Cl. E04d 3/362, 3/30

U.S. Cl. 52—478 22 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to a metal panel for roofing and sliding, for example, which is fastened to an associated substructure using concealed fasteners and has a central body and simple upstanding male and female fastening flanges extending in the same direction from opposite side edges of the central body. Each fastening flange has a planar main portion arranged transverse the central body and has an associated substantially semicylindrical terminal portion arranged outwardly of its associated planar portion.

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of application Ser. No. 716,079, filed Mar. 26, 1968 now abandoned.

BACKGROUND OF THE INVENTION

The building industry currently utilizes many sheet metal panels which are installed using unexposed or concealed fasteners. However, many of the present metal panels of this general type are expensive to produce in that they use excessive metal to provide both the concealed fastening feature and the required structural strength. In addition, many of such present panels require special tools for installation while others of such panels can only be installed by skilled technicians.

SUMMARY

This invention provides an improved metal panel for use in a building construction wherein such panel has high structural strength, is easy to install without special tools, and is comparatively inexpensive in that it utilizes a minimum amount of metal, yet such panel is fastened in position utilizing concealed fastening clips and provides optimum weatherproofness. Further, this invention provides an improved building construction and method of making same utilizing such a metal panel.

Other details, uses, and advantages of this invention will become apparent as the following description of the embodiments thereof presented in the accompanying drawings proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings show present preferred embodiments of this invention, in which

FIG. 1 is a perspective view with parts in section and parts broken away illustrating one exemplary embodiment of a plurality of identical metal panels of this invention suitably fastened in position against a supporting substracture to define a roof;

FIG. 2 is a view substantially on the line 2—2 of FIG. 1 with parts in section and parts broken away and illustrating two types of fastening clips utilized to fasten the metal panels in position against the associated supporting substructure;

FIG. 3 is a view substantially on the line 3—3 of FIG. 1 and particularly illustrating one side edge portion of a metal panel fastened in position utilizing a self-attaching clip which is fastened in position around a metal purlin comprising the exemplary supporting substructure illustrated in FIG. 1;

FIG. 4 is a view on the line 4—4 of FIG. 3;

FIGS. 5 through 8 illustrate a series of four sequential steps which may be utilized to fasten each metal panel of this invention in position against an adjoining previously fastened identical metal panel yet without requiring special tools or special training on the part of installing personnel;

FIG. 9 is a perspective view illustrating one type of fastening clip utilized to fasten a metal panel of this invention against an associated supporting substructure;

FIG. 10 is a perspective view illustrating another type of fastening clip;

FIG. 11 is a perspective view illustrating still another type of fastening clip which is self attaching;

FIG. 12 is an end view of the self-attaching clip of FIG. 11 fastened in position around a male flange of an associated panel and against an associated metal purlin, with portions of such purlin and metal panel broken away;

FIG. 13 is a view substantially on the line 13—13 of FIG. 12 and showing only the attaching clip in elevation and the associated purlin in cross section;

FIG. 4 is a view similar to the left-hand portion of the presentation of FIG. 2 and particularly illustrating another exemplary embodiment of the metal panel of this invention; and

FIG. 15 is an enlarged fragmentary view showing cooperating male and female fastening flanges of the panel of FIG. 14 suitably installed in position.

DESCRIPTION OF ILLUSTRATED EMBODIMENT

Reference is now made to FIG. 1 of the drawings wherein a building construction **20**, shown as a roof construction, is illustrated and comprises one exemplary embodiment of a plurality of identical metal panels of this invention, each designated generally by the reference numeral **21**, which are supported by a supporting substructure which in this example comprises a roofing substructure **22**.

The roofing substructure **22** comprises a plurality of wooden rafters **23** with a plurality of metal purlins **24** suitably fastened thereagainst and supported thereby. Although the rafters **23** are presented as wooden rafters and the purlins **24** are presented as metal purlins, it will be appreciated that these two components may be made of the same structural material or of other materials, as desired. The supporting structural members of this example of the invention are illustrated as being made of different materials merely to highlight that the improved metal panels **21** may be used with any desired type of supporting substructure.

As seen particularly in FIGS. 1–3 of the drawings, the exemplary metal panels **21** are of substantially identical construction and each metal panel **21** has a substantially flat central body **25** provided with a male flange **26** extending in one direction, i.e., upward, in this example, from one side edge **30** of the body **25** and a female flange **31** extending in the above-mentioned upward direction from an opposite side edge **32** of the central body **25**.

The male flange **26** has a planar main portion **34** which extends transverse, i.e., substantially perpendicular, in this example, to the central body **25** and has a terminal end **35** (which may be referred to as first terminal end **35**) of substantially semicylindrical configuration adjoining the outer edge of the main portion **34** and positioned completely on one side of main portion **34**. In particular, it

will be seen that the semicylindrical first terminal end **35** is positioned on the right side of the planar main portion **34** as viewed in FIG. 3 of the drawings.

The female flange **31** has a planar main portion **40** which extends transverse (i.e., substantially perpendicular) to the central body **25** and hence the planar main portions **34** and **40** are arranged in substantially parallel relation. The female flange **31** has a terminal end designated generally by the reference numeral **41** and the terminal end **41** may also be referred to as second terminal end **41**, adjoins the main portion **40**, and is positioned completely on one side thereof and in the same relative position as the first terminal end **35** of male flange **26** is arranged with respect to its main body portion **34**. Thus, it is seen that the terminal end **41** of female flange **31** is also arranged to the right of its main body portion **40** and at a corresponding position above the central body **25** and as viewed in FIG. 3 of the drawings.

As best seen in FIG. 5 of the drawings, the terminal end portion **41** of female flange **31** has a substantially semicylindrical outer portion **42** which adjoins the outer edge of the planar main portion **40**. End portion **41** also has an integral lip **43** which extends from the terminal end **44** of its semicylindrical outer portion **42**, in spaced apart relation from (i.e., beneath) such semicylindrical outer portion **42**, and along the outer end portion of the semicylindrical outer end portion **42** to define a channel **45** in the terminal end portion **41** of the flange **31**. The channel **45** is adapted to receive a terminal end of a cooperating male flange **26** of an associated identical metal panel **21** utilized to form a building construction such as the roofing structure illustrated in FIG. 1 of the drawings, for example.

From the above detailed description it will be readily apparent that the flanges **26** and **31** comprising each metal panel **21** are each in the form of an inverted substantially J-shaped flange and as will be seen from the drawings each flange **26** and **31** utilizes a minimum amount of metal to thereby enable the provision of each metal panel **21** at minimum cost; yet, each panel **21** has high strength and in particular has optimum resistance to longitudinal deflection because of the unique construction and arrangement of its fastening flanges **26** and **31**. It will also be seen that the fastening flanges **26** and **31** define, in effect, the opposite side edges of the panel **21** and thereby facilitate easier installation.

As seen in FIGS. 1 and 3 of the drawings the male flange **26** of each exemplary metal panel **21** has a double thickness comprising its semicylindrical terminal end **35**. This double thickness is defined by folding a terminal end portion **47** of the male flange **26** over on itself. This double thickness in the semicylindrical arrangement of the terminal end **35** of male flange **26** effectively increases the section modulus of the flange **26** and hence of the associated panel **21**. In addition, the forming of the double thickness end **35** helps compensate for camber in sheet metal stock, which may be in coil form, used to make the panels **21**.

The integral lip **43** comprising the terminal end **41** of a female fastening flange **31** extends from the terminal end **44** of the semicylindrical outer portion **42** through an arc of roughly ninety degrees (90°) and terminates in an arcuate end **50** which turns away from semicylindrical outer portion **42**, see FIGS. 5 and 6. The arcuate outer end **50** of integral lip **43** serves a dual purpose of providing an outwardly flaring entrance to the channel **45**, the angle of flare being indicated at **51**, to enable the end portion **41** of female flange **31** to be more easily positioned initially around an associated male flange **26** of an adjoining panel **21** and further the arcuate outer end **50** provides a camming action as flange **31** of a metal panel **21** being installed in position is hooked around the associated male flange **26** of an adjoining panel to assure complete installation around such male flange while keeping the structural integrity and configuration of the associated terminal ends **35** and **41** substantially intact. To further clarify this point, the construction and arrangement of the integral lip **43**, with its arcuate end **50**, is such that it cooperates with a male flange **26** of a panel **21** against which it is installed so that the end position **41** of the female flange **31** is not sprung open during the process of installation and likewise such male flange is not damaged.

The integral lip **43** is spaced apart from the semicylindrical outer portion **42** a smaller distance adjacent its arcuate outer end **50** as indicated at **52** than adjacent its inner end as indicated at **53** and this structural arrangement helps to tightly interlock the adjacent panels **21** as they are installed in position in an associated construction.

As will be apparent particularly from FIG. 3 of the drawings the male flange **26** has an offset portion **55** of comparatively small height connecting its main portion **34** with the central body **25** and offset portion **55** has its lower edge coinciding with side edge **30** of central body **25**. The female flange **31** has a similar offset portion **56** connecting its main portion **40** with the central body **25** and the lower edge of offset portion **56** coincides with the side edge **32** of the central body **25**.

The offset portions **55** and **56** are adapted to receive a portion of an associated fastening member which is utilized, together with a fastening clip, to fasten the panels **21** to an associated substructure such as substructure **22**. In particular, and as will be readily apparent from FIG. 8, the offset portion **56** of female flange **31** receives the head of a self-tapping screw **60** which is used to hold an attaching clip to an associated metal purlin **24**. The construction and manner in which fastening or attaching clips are utilized to hold the panels **21** in position will be described in detail subsequently in this specification.

Each panel **21** also has a pluality of equal height integral ridges **62** extending outwardly from the central body **25** and in the same direction from central body **25** as the direction of flanges **26** and **31**, i.e., upwardly as viewed in FIG. 3.

The integral ridges **62** of this example extend parallel to the longitudinal axis of each metal panel **21** and each extends only a small height **63**, when compared with the height of the flanges **26** and **31**, above the central body **25** so that the central body **25** is comparatively flat and lies substantially in one plane.

In metal panels which have a flat central body similar to the body **25** of the panel **21** but without stiffening ridges there is a tendency for the central body to produce what is commonly referred to as an oil-can effect when it is formed, for example. The integral ridges **62** stiffen and increase the structural rigidity of each panel **21** as well as prevent such oil-can effect.

The metal panels **21** utilize a plurality of clips to fasten the panels **21** to the supporting substructure **22** in a concealed manner. As will be apparent from FIG. 1 of the drawings three exemplary types of fastening clips are utilized in this disclosure to fasten the panels **21** in position and comprise a clip **65** which is utilized to fasten an associated panel **21** to an associated purlin **24**, a clip **66** which is utilized to fasten an associated panel **21** to an associated rafter **23**, and a self-attaching clip **67** also utilized in attaching a metal panel to an associated purlin. The clips **65–67** have identical upper portions which for convenience and easy reference thereto will be designated by the same reference numeral in each instance; however, the lower end portions of clips **65–67** are different and particularly adapted for a special purpose and each lower end portion of each clip **65–67** will be described in detail subsequently.

The upper portion of each clip will be designated generally by the reference numeral **70** in each instance and comprises a semicylindrical terminal end **71** adjoined and supported by a planar portion **72** so that each clip has a substantially inverted J-shaped configuration as viewed

in cross section. Each clip 65–67 is adapted to be hooked around an associated male flange 26 so that its planar portion 72 lies against the planar main portion 34 of an associated male flange 26 and the semicylindrical end 71 of each clip hooks around the semicylindrical end portion 35 of such associated male flange 26. The lower portion of each clip is attached to an associated substructure utilizing a suitable attaching member such as a suitable fastening or attaching screw or nail in the case of clips 65 and 66 and being self attached in the case of clip 67.

The unique constructions of the metal panels 21 and their associated clips are such that high strength building constructions of the type illustrated in FIG. 1, for example, may be completed efficiently, without requiring special tools and without requiring that the installation be made by specially trained technicians.

Reference is now made of FIGS. 5–8 of the drawings for a detailed presentation of the sequential steps utilized to install a plurality of exemplary panels 21 together and against an associated substructure. Thus, it will be seen in FIG. 5 of the drawings that one panel 21 is shown attached in a substantially horizontal position against an associated purlin 24 by hooking the upper end portion 71 of a clip 65, in this examplary illustration, around male flange 26 and attaching clip 65 against the purlin 24 utilizing a self-tapping screw 60. The opposite side edge portion of the metal panel 21 shown in FIG. 5 is suitably attached in position either against another associated metal panel 21 or directly to the supporting substructure.

With the first metal panel 21 attached in position as shown in FIG. 5, it is a simple matter to then lift another panel 21 to be fastened thereto so that the planar main portion 40 of its female flange 31 is supported primarily by the associated male flange 26 of the previously attached panel 21 and with the clips 65 suitably fastened against flange 26 at spaced apart intervals corresponding to the spacing of the supporting rafters and/or purlins comprising the substructure. The metal panel 21 being installed is then lifted slightly upwardly and pulled so that the inside surface of the semicylindrical outer portion 42 of terminal end portion 41 is arranged immediately adjacent the terminal outer end of semicylindrical portion 71 of clip 65 and hence adjacent the terminal outer end of semicylindrical portion 35 of male flange 26. The main portion 40 of female flange 31 of the panel being installed is slightly inclined with the terminal end 41 resting on male flange 26 and essentially as shown in FIG. 6. The metal panel 21 being installed is then pulled until an inside surface portion 80 of terminal end 41 engages and is stopped by the terminal outer end portion of male flange 26 and associated ones of the spaced apart clips 65 holding male flange 26 in position.

The metal panel 21 being installed is then rotated counterclockwise as viewed in FIG. 7, and the substantially semicylindrical terminal end 35 of male flange 26 is received within channel 45 of the metal panel 21 and the further counterclockwise movement of such metal panel moves it into the position illustrated in FIG. 8 of the drawings whereby its female flange 31 is hooked around the male flange 26 of the previously installed panel and its associated fastening clips.

With the last-installed metal panel 21 thus lowered in position a plurality of fastening clips are then hooked around its male flange 26 and fastened to the supporting substructure so that the male flange 26 of the last-installed metal panel is fastened to such substructure. The operation described in connection with FIGS. 5–8 is repeated for each additional metal panel.

Thus it is seen that with this method and technique of installation, each of the fastening clips is sandwiched between a male flange 26 and an associated female flange 31 upon fastening an adjoining panel in position and the fasteners or clips which are utilized to fasten or attach the metal panels to the supporting substructure are thus attached in a concealed, i.e., unexposed manner. This concealed attachment of the metal panels 21 to the supporting substructure assures the provision of a roof or exterior wall which is substantially weatherproof. In particular, it will be appreciated that if the metal panels were to be punctured by fastening nails or screws in fastening such metal panels to their supporting substructure, any movement of the metal panels due to exterior loading would result in the particular fasteners possibly pulling partially away from their associated substructure to partially expose the opening through which a fastening nail extends whereby water, for example, could seep through and create a leak.

It will also be seen that the installation of each metal panel 21 in the manner illustrated in FIGS. 5–8 of the drawings is such that the male and female flanges 26 and 31 respectively are not damaged, distorted, subjected to great stresses or otherwise weakened during the process of installing the panels in position. Further, it will be seen particularly from FIGS. 1 and 8 of the drawings that in the completed assembly the arcuate end 50 of integral lip 43 comprising the terminal end 41 of each female fastening flange 31 is positioned comparatively close to the bottom surface, as indicated at 82, of the male flange 26. This arrangement is provided (see FIG. 8) because the terminal end portion of lip 43 is arranged comparatively close to semicylindrical outer end 42 due to the smaller previously described distance 52 between lip 43 and outer semicylindrical portion 42; thus, optimum weather-tightness is assured. Also, because of the greater distance at 53 between the inner end of lip 43 and outer portion 42, a greater space is provided, as shown at 83, between the terminal end of the male flange 26 and the base portion of lip 43, whereby certain imperfections in each panel are compensated for.

The length of the integral lip 43 does not have to be closely controlled and may vary along the length of a given panel 21 without affecting the structural integrity thereof. Thus, the lip 43 may help compensate for camber in the sheet metal stock used to make a given panel 21. In addition, the manner in which space is provided between adjoining male and female flanges at locations between clips provides a siphon break and precludes any condensation or moisture from being drawn beneath adjoining panels.

Having described the improved metal panel 21 of this invention in detail and the simple technique employed to install each panel in position without requiring special tools, or highly trained personnel, a detailed description will now be made of the exemplary fastening clips 65, 66, and 67 utilized in the building construction of this example of the invention.

The clips 65–67 have identical upper portions as previously described, therefore a detailed description of the upper portion of each clip will not be repeated; and, in each instance each upper portion will be designated generally by the reference numeral 70, each substantially semicylindrical end portion by the reference numeral 71, and each planar central portion by the numeral 72.

The clip 65 is illustrated in FIG. 9 of the drawings and has a supporting leg portion 85 adjoining its main portion 72 along an adjoining edge 86. An opening 87 is provided in the supporting leg portion 85 and is adapted to receive any suitable fastening member such as a self-tapping metal screw, attaching nail, threaded bolt, or the like. The clip 65 may be used to attach metal panels 21 to a purlin, a rafter, or any other suitable supporting substructure.

The clip 66 as illustrated in FIG. 10 of the drawings has a substantially inverted L-shaped supporting base designated by the reference numeral 90 and which adjoins the lower edge of its main planar portion 72 along a line 91. The inverted L-shaped supporting leg 90 has a horizontal leg portion 93 and a vertical leg portion 94 with an opening 95 extending through its vertical leg portion 94. The clip 66 is particularly adapted to be used in fastening

a metal panel 21 to an associated rafter 23 as illustrated in central portion of the perspective view presented in FIG. 1 and such fastening may be achieved by inserting a suitable fastening member, such as a nail 96, for example, through the opening 95 and into rafter 23.

Each of the clips 65 and 66 previously described requires an additional attaching member such as a screw, nail, or the like. However, to enable a more rapid installation, the self-attaching clip 67 illustrated in FIGS. 4 and 11 through 13 of the drawings may also be utilized.

The clip 67 has a support indicated generally by the reference numeral 100 adjacent one side edge portion 101 thereof and the support 100 is adapted to be hooked around an associated purlin 24 to prevent the clip 67 from being pulled upwardly or outwardly away from the purlin in a direction away from its side edge portion 101. The clip 67 also has a plurality of tabs each designated by the same reference numeral 102 adjacent its opposite side edge 103 and the tabs initially extend from the lower edge 104 of the planar portion 72 in a direction opposite from the direction in which the semicylindrical portion 71 extends away from the planar portion 72 of clip 67. Thus, upon installing clip 72 in position it will be seen that the tabs 102 extend in a direction away from the associated male flange 26 against which the clip 67 is being installed.

Each of the tabs 102 is bendable so that it extends substantially coplanar with the planar portion 72 of clip 67. The clip 67 is easily installed in position by initially hooking support portion 100 in position around the top flange 24A of an associated purlin 24 utilizing the comparatively large access opening 105 provided in the clip 67 and with the clip 67 thus initially fastened in position three of the bendable tabs 102, for example, are bent vertically downwardly beneath the main central portion 72 of clip 67 as illustrated in FIG. 13 leaving one of the tabs 102 so that it extends horizontally above and thus supports the clip 67 on the top surface of its associated purlin. The horizontally extending tab 102 illustrated in FIG. 13 assures that the clip 67 will not be tilted away from the male flange 26 against which it is fastened and the three tabs 102 upon being bent downwardly in the manner illustrated in FIG. 13 assure that the clip 67 is firmly fastened around its associated purlin 24 to thereby attach the metal panels 21 firmly in position on their supporting structure.

The support portion 100 of clip 67 has an inclined ramp portion 106 which in this example of the invention comprises a substantially planar inclined surface which is adapted to engage tightly against the lower corner 110 of the top flange 24A of an associated purlin 24, as illustrated in FIG. 13, to assure that the clip 27 is held in position in a rattle-free manner. During the installation of the clip 67 and prior to bending the proper number of tabs 102 downwardly, the clip 67 is pushed tightly in position to assure that the lower corner 110 of the top flange 24A causes ramp portion 106 to flex slightly due to the pushing action which further assures a rattle-free construction.

The comparatively wide width indicated at 111 of the inclined ramp portion 106 engages the lower surface of an associated purlin 24 and further assures that the clip 67 cannot be tilted from its vertical position. Further, although the ramp portion 106 is shown arranged so that it extends in the same direction as tabs 102 away from central portion 72 it will be appreciated that ramp portion 106 could be defined so that it extends in the opposite direction, i.e., substantially beneath the semicylindrical portion 71 of clip 67 so that the resulting clip 67 would have even greater vertical stability.

Each clip 67 is dimensioned to correspond to the size of the most commonly used purlins and may be formed so that any desired number of bendable tabs 102 are provided thereon and bent down as required. For example, it will be seen that in FIG. 4 two tabs are required to be bent downwardly to fasten the particular self-attaching clip 67 to its associated purlin while in the illustration of FIG. 13 three bendable tabs are bent downwardly. Thus, one clip size may be effectively utilized with purlins of different standard sizes merely by bending a different number of tabs into holding position.

The attaching clip 67 is easily formed utilizing a minimum amount of structural material. In particular, it will be appreciated that the entire clip may be made from a substantially rectangular strip of material and the inclined ramp portion 106 is easily formed from the portion of metal normally provided to occupy the space within which an associated purlin 24 is to be received.

Another exemplary embodiment of the panel of this invention is illustrated in FIGS. 14 and 15 of the drawings. The panel illusrtated in FIGS. 14 and 15 is very similar to the panel 21; therefore, such panel will be designated generally by the reference numeral 21A and parts of panel 21A which are very similar to corresponding parts of panel 21 will be designated by the same numeral as panel 21 also followed by the letter designation A and not described again. Only those component parts which are substantially different from corresponding parts of panel 21 will be designated by a new reference numeral also followed by the letter designation A and described in detail.

In the fragmentary views shown in FIGS. 14 and 15 a plurality of panels 21A are utilized and comprise part of a roof construction 20A similar to the roof construction 20 shown in FIGS. 1 and 2. The panels 21A are suitably supported on an associated purlin 24 and an exemplary attaching clip 65 holds the male flange 26A against the purlin 24 utilizing a self-tapping screw 60 in the manner previously described in connection with the panels 21 of the previous exemplary embodiment of this invention. Purlin 24 is suitably fastened to an associated rafter 23 to comprise an exemplary roofing substructure which will also be designated generally by the reference numeral 22 as in the previous embodiment of this invention.

The metal panel 21A has a substantially flat central body 25A and the central body of this example is shown being provided with an integral stiffening ridge 62A. The panel 21A has a male flange 26A and a female flange 31A extending from opposite side edges of its central body 25A and the flanges 26A and 31A extend upwardly and transverse the central body 25A in a similar manner as described previously for the panel 21.

The male flange 26A of panel 21A has a planar main portion 34A arranged substantially perpendicular to the central body 25A and a first terminal end 35A of substantially semicylindrical configuration adjoining the outer edge of its planar main portion 34A. The terminal end 35A of the exemplary panel 21A has a single thickness.

The female flange 31A has a planar main portion 40A also arranged substantially perpendicular to the central body 25A and a terminal end portion 41A, which may also be referred to as second terminal end 41A. The terminal end 41A has a substantially semicylindrical outer portion 42A which defines the outer end portion of the female flange 31A. The flange 31A has a transition section designated generally by the reference numeral 115A comprising an integral part thereof and such transition section will now be described in detail.

The transition section 115A is defined by an arcuate portion 116A adjoining the planar main portion 40A and a substantially flat portion 117A extending between the arcuate portion 116A and the semicyclindrical outer portion 42A of the female flange 31A. In this example of the invention the flat portion 117A of transition section 115A is arranged substantially perpendicular to the planar main portion 40A.

As seen in FIGS. 14 and 15 of the drawings the male flange 26A has its terminal end 35A arranged completely

on one side of and adjoining its planar main portion **34A**. Similarly, female flange **31A** also has its terminal end portion **41A** arranged completely on one side of its planar main portion **40A** and in a relative position which corresponds to the position of end portion **35A**. As previously explained in connection with the panel **21** this arrangement of the end portions **35A** and **41A** of flanges **26A** and **31A** respectively enables each panel **21A** to be installed in position in an easier manner.

The semicylindrical outer portion **42A** of female flange **31A** adjoins its flat portion **117A** in the manner best seen in FIG. 15. The end portion **41A** also has an integral lip **43A** which extends in an arcuate path from the terminal end **44A** of its semicylindrical outer portion **42A** and the lip **43A** is arranged substantially vertically beneath the central portion of the flat portion **117A**. The integral lip **43A** also terminates in an arcuate outer end **50A** which turns away from the flat portion **117A**. The integral lip **43A** cooperates with the semicylindrical outer portion **42A** and the transition section **115A** to define a channel **45A** in the end portion **41A** of the female flange **31A**. The channel **45A** is adapted to receive a single thickness terminal end of a cooperating male flange **26A** of an associated identical metal panel **21A** utilized to form a building construction and in a similar manner as described in detail earlier in connection with panel **21** and its associated similar channel **45**.

As mentioned above, the integral lip **43A** comprising the terminal end **41A** of the female fastening flange **31A** terminates in an arcuate outer end **50A** which curves away from the flat portion **117A**. The arcuate outer end **50A** serves the dual purpose of providing an outwardly flaring entrance to the channel **45A** and thereby enable its associated terminal end **41A** to be more easily positioned initially around an associated cooperating male flange of an associated panel by providing a camming action to assure complete installation around the cooperating flange while keeping structural integrity and configuration of the adjoining terminal ends **35A** and **41A** of the associated flanges **26A** and **31A** respectively substantially intact.

It will also be seen that the terminal inner end portion of the lip **43A** is arranged comparatively close to the transition section **115A**. Thus, upon installing the female flange **31A** in position around the male flange **26A** of an associated panel **21A** optimum weather proofness is also assured for the resulting building construction.

With the above presentation of the detailed configuration and construction of the panel **21A** considered together with the drawings, the similarity of the panel **21A** to the panel **21** previously described in more detail will be readily apparent. In addition, the sequential steps used to install a plurality of panels **21A** together and on an associated substructure are very similar to the sequential steps previously described in connection with the exemplary panel **21**. Thus, it will be appreciated that the panels **21A** may also be installed in position using sequential steps essentially as presented in FIGS. 5–8; however, for simplicity and conciseness of presentation, a step-by-step presentation describing the installation of panels **21A** will not be repeated. Further, it is to be understood that the various embodiments of connector clips (**65–67**) used with the panels **21** may be used as desired with the panels **21A**.

Upon fastening a plurality of panels **21A** in position on an associated supporting substructure the semicylindrical outer portion **42A** of each female flange **31A** is arranged, in the completed installation, so that the major part thereof extends outwardly of the first terminal end **35A** of a male flange **26A** of an associated panel **21A** previously installed in position and as seen at **120A** in FIG. 15. This arrangement assures that imperfections which may be present in adjoining panels are compensated for. For example, any tendency for a semicylindrical end portion **35A** of a male flange **26A** or a semicylindrical outer portion **42A** of a female flange **31A** to have a nonstandard size or configuration is easily taken care of in the comparatively large space provided at **120A**.

The comparatively large space or opening provided at **120A** acts not only as a siphon break but also serves as a built-in drainage gutter. For example, if a roof having a slope of ¼ inch in 12 inches is covered with ice, leaves, or other debris so that water cannot run off at the eaves in a rapid manner, the water will flow into the space at **120A** between lip **43A** and the terminal end **35A** of the associated male flange **26A** and such water will then flow downwardly along the inside surface of semicylindrical outer portion **42A** and be discharged at the eaves.

It has been found that a roof made of panels **21A** provides optimum weathertightness. For example, it is necessary to flood such a roof to a depth of approximately 5/16 inch above the top surface of the flat portions **117A** of the female flanges **31A** in order for water to leak through the roof construction into an associated building.

The exemplary panel **21A** has each of its arcuate portions formed on a comparatively large radius arc. This construction lends itself to the economical manufacture of the panels **21A** and with minimum likelihood of damage to each panel **21A** during the forming process as well as assuring that stress concentrations, which might be created by small arcs, are avoided.

The purlins **24** may be made of any suitable material and in any suitable manner, such as by brake forming, for example, and as required by the particular building installation.

To assure the provision of a building construction of minimum weight and having optimum high structural strength the metal panels **21** and **21A** are preferably made of metal containing aluminum. However, such metal sheets may be made to contain other metals, such as steel, for example. Also, the metal panels **21** and **21A** may be formed using any suitable process such as roll forming, extruding, etc.

The improved metal panels **21** and **21A** of this invention may have any desired width and as determined by the particular building requirements in each instance. Some typical widths which may be employed may range from 12 inches to 18 inches. In addition, the length of each metal panel **21** and **21A** of this invention may be any desired length and range from 3 feet to 120 feet.

The male and female fastening flanges for each panel **21** and **21A** are of almost equal height (as will be apparent from the drawings) and such height in each instance is determined by the character of the metal utilized, the desired section modulus for the particular sheet metal panel, and the desired slope of the surface, such as roof, formed by a plurality of associated panels, which determines the run-off. Some typical heights for the male and female fastening flanges which have been considered acceptable for the sheet metal panels **21** and **21A** of this invention may range from 2 inches to 3 inches.

Each exemplary panel **21** and **21A** illustrated in this example of the invention is shown as having a substantially flat central portion with one or more stiffening ridges provided in such flat central portion. However, it will be appreciated that the single and unique male and female fastening flanges comprising opposite side edges at each panel of this invention may be provided in panel constructions where the central portion may be of any desired configuration.

It will also be appreciated that although the planar main portions of the male and female flanges of each panel **21** and **21A** are shown in this disclosure as extending transverse to their associated central body in a substantially perpendicular manner, it will be appreciated that the planar main portions in each instance may ex-

tend transverse to their associated central body at any desired angle.

What is claimed is:

1. A metal panel comprising, a central body, a male flange extending in one direction from one side edge of said central body, said male flange having a planar main portion which extends transverse said central body and having a first terminal end of substantially semicylindrical configuration adjoining said main portion and being arranged on one side of said main portion, and a female flange extending in said one direction from an opposite side edge of said central body, said female flange having a planar main portion which extends transverse said central body and having a second terminal end arranged on one side of its main portion and arranged in a corresponding relative position as said first terminal end is arranged with respect to its planar main portion, said second terminal end having a substantially semicylindrical outer portion and having an integral lip which extends from the terminal end of said semicylindrical outer portion and in spaced apart relation therebeneath to define a channel in said second terminal end, said integral lip having an arcuate outer end which curves away from said semicylindrical outer portion, said channel being adapted to receive a terminal end of a cooperating flange of an associated metal panel which is substantially identical to said male flange, said arcuate outer end serving the dual purpose of providing an outwardly flaring entrance to said channel to enable said second terminal end to be more easily positioned initially around said associated cooperating flange of said associated panel and providing a camming action to assure complete installation around said cooperating flange while keeping the structural integrity and configuration of said second terminal end substantially intact, said metal panel with its male and female flanges being inexpensively formed by utilizing a minimum amount of metal yet providing said metal panel having optimum strength and resistance to longitudinal deflection.

2. A panel as set forth in claim 1 and further comprising a transition section integrally formed between said planar main portion and said second terminal end of said female flange.

3. A panel as set forth in claim 2 in which said transition section is defined by an arcuate portion adjoining said planar main portion of said female flange and a substantially flat portion extending between said arcuate portion and said second terminal end, said flat portion being arranged substantially perpendicular to said planar main portion of said female flange.

4. A panel as set forth in claim 1 in which said male flange has said first terminal end arranged completely on one side of its adjoining planar main portion and said female flange has said second terminal end also arranged completely on one side of its planar main portion and in said corresponding relative position, said arrangement of said first and second terminal ends completely on one side of an associated planar main portion enabling said panel to be installed in position in an easier manner.

5. A panel as set forth in claim 1 in which said semicylindrical terminal end of said male flange has a double thickness defined by folding a terminal end portion of said male flange over on itself to thereby increase the section modulus of said panel.

6. A panel as set forth in claim 1 in which said male flange and said female flange each has an offset portion connecting its planar main portion with said central body, each offset portion being adapted to receive a portion of an associated attaching member.

7. A panel as set forth in claim 1 and further comprising a transition section integrally formed between said planar main portion and said second terminal end of said female flange, said transition section being defined by an arcuate portion adjoining said planar main portion of said female flange and a substantially flat portion extending between said arcuate portion and said second terminal end, said flat portion being arranged substantially perpendicular to said planar main portion of said female flange and enables even easier installation of said female flange around said cooperating flange, said integral lip being arranged substantially vertically beneath said flat portion, and said semicylindrical outer portion being aranged so that its major portion extends outwardly of the terminal end of said cooperating flange to define a comparatively large space which serves to compensate for irregularities in associated end edges of both said metal panel and said associated metal panel as well as provide a built-in drainage gutter.

8. A panel as set forth in claim 1 in which said integral lip extends from the terminal end of said semicylindrical outer portion of said second terminal end through an arc of roughly 90 degrees and terminates in said arcuate outer end.

9. A panel as set forth in claim 8 in which said integral lip is spaced from its associated semicylindrical outer portion a smaller distance adjacent its arcuate outer end than adjacent its inner end to thereby provide a greater space between the terminal end portion of said cooperating flange and a base portion of said integral lip, said greater space serving to compensate for irregularities in associated end edges of both said metal panel and said associated metal panel.

10. A panel as set forth in claim 6 and further comprising an integral ridge extending outwardly from said central body in said one direction and having a height which is substantially less than the height of said flanges, said ridge preventing an oil-can effect in said central body.

11. A building construction comprising; a supporting structure; a plurality of substantially identical metal panels; each of said metal panels having, a central body, a male flange extending in one direction from one side edge of said central body, said male flange having a planar main portion which extends transverse said central body and having a first terminal end of substantially semicylindrical configuration adjoining said main portion and being arranged on one side of said main portion, and a female flange extending in said one direction from an opposite side edge of said central body, said female flange having a planar main portion which extends transverse said central body and having a second terminal end arranged on one side of its main portion and arranged in a corresponding relative position as said first terminal end is arranged with respect to its main portion, said second terminal end having a substantially semicylindrical outer portion and having an integral lip which extends from the terminal end of said semicylindrical outer portion and in spaced apart relation therebeneath to define a channel in said second terminal end, said integral lip having an arcuate outer end which curves away from said semicylindrical outer portion; and a plurality of clips holding said panels against said supporting structure; each of said clips having an upper portion corresponding in cross-sectional configuration to said male flange and being hooked thereabout and having a lower portion attached to said supporting structure; each pair of adjoining metal panels being interconnected merely by hooking the second terminal end of the female flange of one panel around the first terminal end of the male flange of a previously installed panel causing said first terminal end of the previously installed panel to be received within the channel in the second terminal end of said one panel and causing associated clips to be sandwiched between said pair of adjoining panels and in a concealed manner, with the arcuate outer end of said one panel serving the dual purpose of providing an outwardly flaring entrance to its channel to enable said second terminal end of said one panel to be more easily positioned initially around said male flange of said previously installed panel and providing a camming action to assure complete installation around said associated male

flange while keeping the structural integrity and configuration of said second terminal end substantially intact; said building construction having high structural strength and being easily and economically completed using conventional tools.

12. A building construction as set forth in claim 11 in which each of said panels has a transition section integrally formed between said planar main portion and said second terminal end of said female flange, said transition section being defined by an arcuate portion adjoining said planar main portion of said female flange and a substantially flat portion extending between said arcuate portion and said second terminal end, said flat portion being arranged substantially perpendicular to said planar main portion, and upon interconnecting each pair of adjoining panels said semicylindrical outer portion of said second terminal end is arranged so that its major portion extends outwardly of the first terminal end of a male flange of an adjoining panel previously installed in position.

13. A building construction as set forth in claim 11 in which each semicylindrical terminal end of each of said male flanges has a double thickness defined by folding a terminal end portion of said male flange over on itself to thereby help provide a building construction of improved structural strength.

14. A building construction as set forth in claim 11 in which each panel has its male flange and its female flange each provided with an outwardly offset portion connecting its main portion with its central body, each offset portion being adapted to receive an associated attaching member utilized to attach an associated clip to said supporting structure.

15. A building construction as set forth in claim 11 in which in each of said panels said integral lip is spaced from said semicylindrical outer portion a smaller distance adjacent its arcuate outer end than adjacent its inner end to thereby help compensate for irregularities in associated end edges of adjoining panels of said building construction.

16. A building construction as set forth in claim 11 in which said supporting structure includes at least one purlin and said plurality of clips includes a self-attaching clip attached around said purlin.

17. A building construction as set forth in claim 16 in which said self-attaching clip comprises a planar central portion which lies flatly against the main portion of an associated male flange, a support for hooking one side edge portion of said self-attaching clip around said purlin, and a plurality of tabs adjacent an opposite side edge of said central portion and extending from and perpendicular to the lower edge of said central portion in a direction away from said associated male flange, at least one of said tabs being bendable substantially coplanar with said central portion, said self-attaching clip being fastened to said purlin by hooking its support in position and then bending at least one of said tabs in position to thereby firmly attach said self-attaching clip in position while an unbent tab helps maintain the upright position of said self-attaching clip.

18. A building construction as set forth in claim 17 in which said support of said self-attaching clip has an inclined ramp portion provided with a comparatively wide planar surface which is adapted to engage a lower portion of its associated purlin, said ramp portion holding said adjustable clip perpendicular to said associated purlin and assuring said self-attaching clip is held in position in a rattle-free manner, and said ramp portion being comprised of a portion of said planar central portion and being foldably connected thereto.

19. A method of installing a plurality of substantially identical metal panels on an associated supporting structure to define a building construction; each of said panels having a central body, a male flange extending in one direction from one side edge of said central body, said male flange having a planar main portion which extends transverse said central body and having a first terminal end of substantially semicylindrical configuration adjoining said main portion and being arranged on one side of said main portion, and a female flange extending in said one direction from an opposite side edge of said central body, said female flange having a planar main portion which extends transverse said central body and having a second terminal end arranged on one side of its main portion and positioned in a corresponding relative position as said first terminal end is arranged with respect to its planar main portion, said second terminal end having a substantially semicylindrical outer portion and having an integral lip which extends from the terminal end of said semicylindrical outer portion and in spaced apart relation therebeneath to define a channel in said second terminal end, said integral lip having an arcuate outer end which curves away from said semicylindrical outer portion and said arcuate outer end providing an outwardly flaring entrance to said channel; said method comprising the steps of; fastening a first of said metal panels against said supporting structure with its flanges extending outwardly; hooking a plurality of clips around the male flange of said first panel and in spaced apart relation therealong; attaching each of said clips to said supporting structure; each of said clips having an upper portion corresponding in cross-sectional configuration to the cross-sectional configuration of each male flange; and hooking the second terminal end of the female flange of a second panel around the first terminal end of the male flange of said first panel causing said first terminal end of said first panel to be easily inserted in the channel in said second terminal end of said second panel through its outwardly flaring entrance and causing said clips to be sandwiched between said pair of adjoining panels and in a concealed manner; said building construction having high structural strength and being easily and economically completed using available conventional tools.

20. A method as set forth in claim 19 in which said step of attaching each of said clips to said supporting structure comprises self attaching the lower portion of at least one of said clips to an associated member of said supporting structure independently of separate attaching members.

21. A method as set forth in claim 19 in which said step of hooking said second terminal end of said second panel around said first terminal end of the male flange of said first panel comprises the steps of raising said second panel so that the main portion of its female flange is supported primarily by said male flange of said first panel, then inclining said main portion of said second panel upwardly and pulling said second panel until an inside surface portion of its female flange engages the terminal outer end portion of the male flange of said one panel and also engages the terminal ends of associated clips, and then rotating said second panel downwardly toward said supporting structure, said arcuate outer end of each panel also providing a camming action during said hooking step which enables each panel to be easily installed to an adjoining previously installed panel while keeping the fastening flanges of adjoining panels substantially intact in structural strength and configuration while assuring a leak-proof building construction.

22. A method as set forth in claim 21 in which said supporting structure is in the form of a supporting structure for a roof which includes purlins and rafters and said attaching step comprises attaching certain ones of said plurality of clips to associated purlins and others of said plurality of clips to associated rafters.

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U.S. Cl. X.R.

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