Sept. 20, 1949. S. KORMAN ET AL 2,482,624

METAL BUILDING

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Fig. 1.

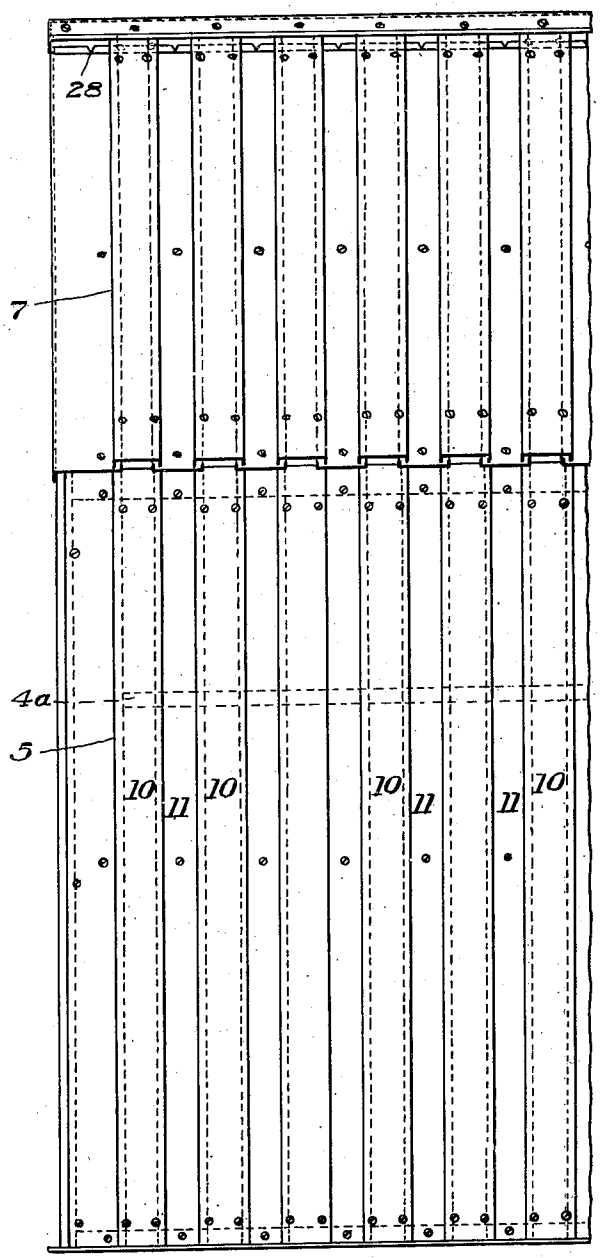


Fig. 2.

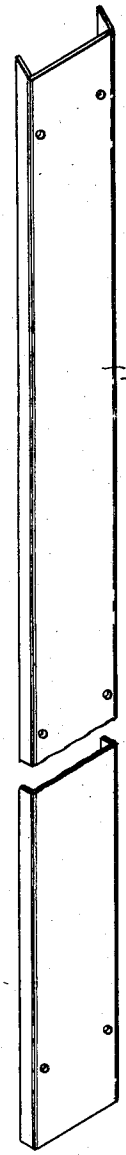
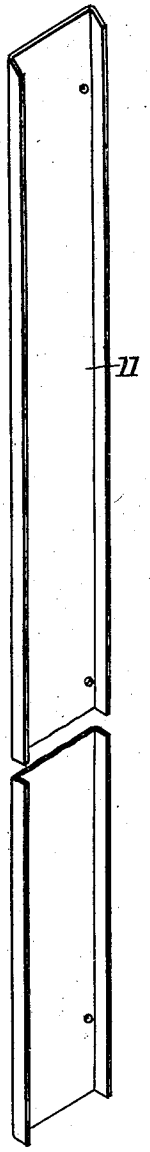


Fig. 3.



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METAL BUILDING

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Fig. 4.

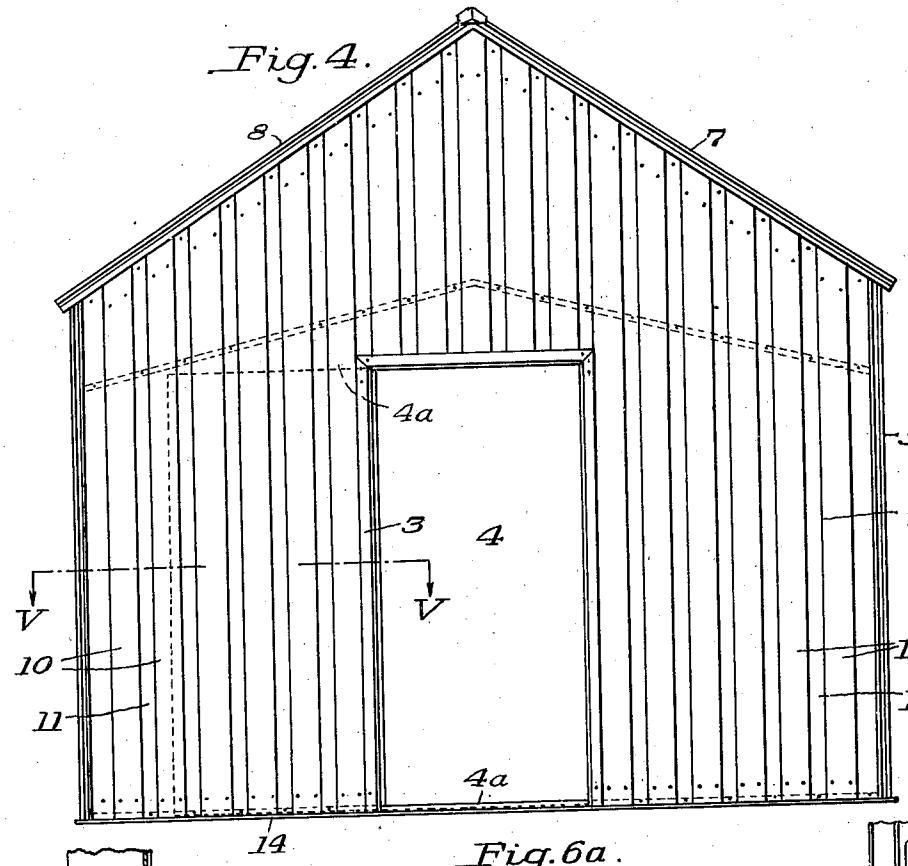


Fig. 6a.

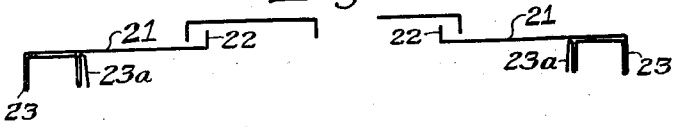
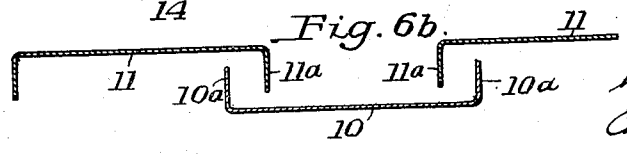


Fig. 6.

Fig. 5.

Fig. 6b.



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METAL BUILDING

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Fig. 9.

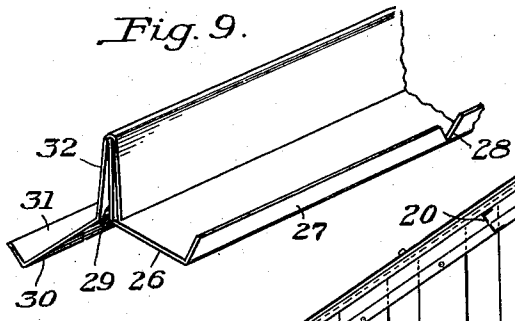

Fig. 7.

Fig. 8a.

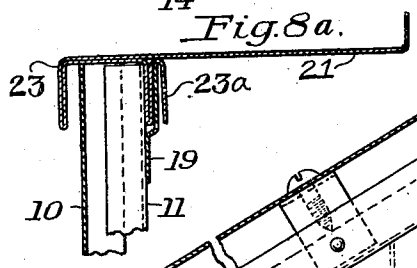

Fig. 8.

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METAL BUILDING

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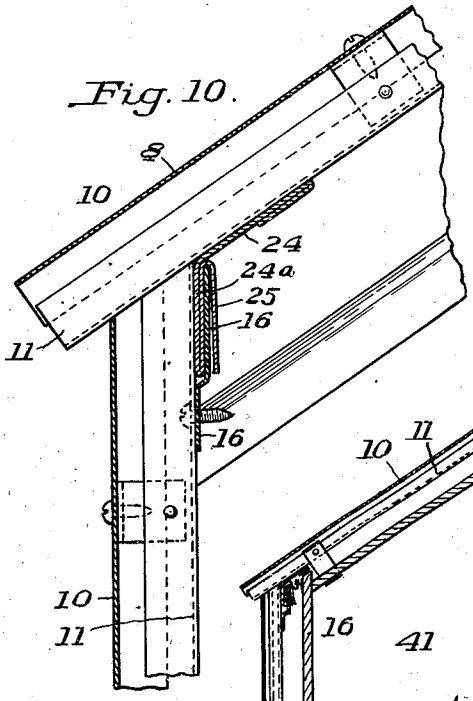

Fig. 10.

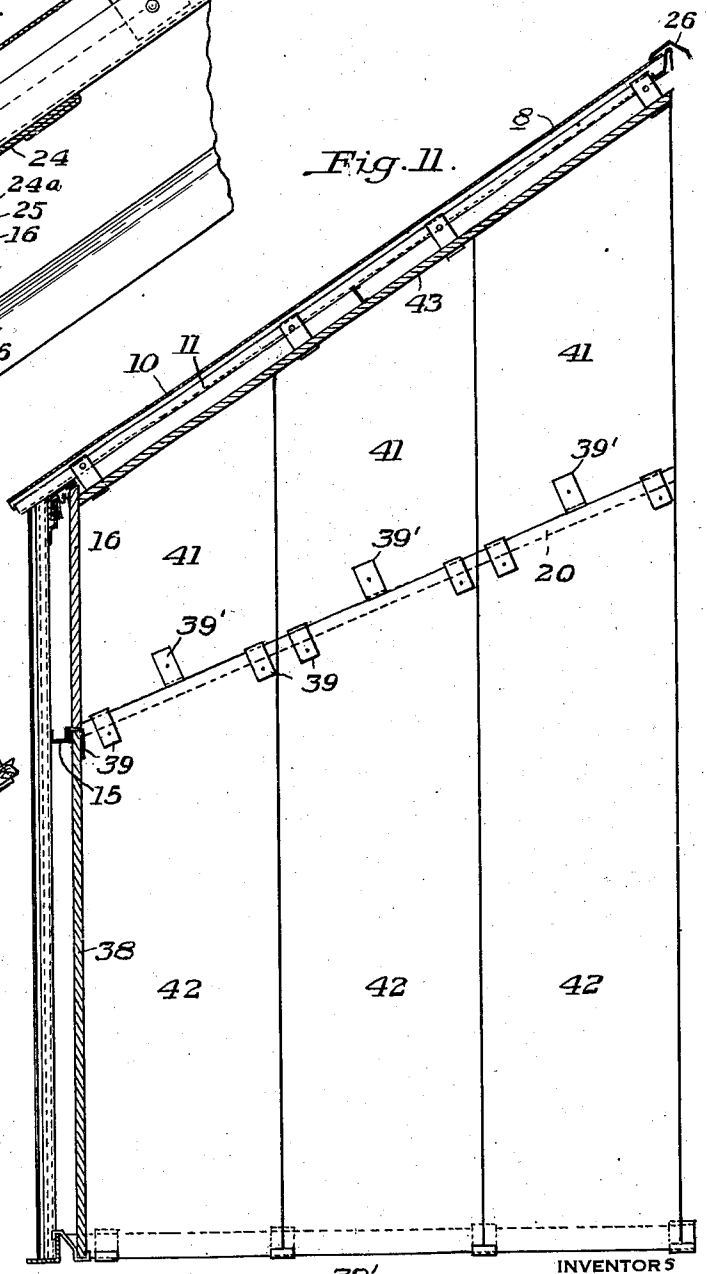

Fig. 11.

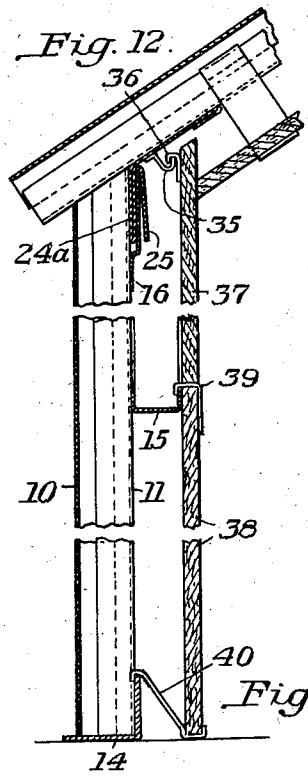

Fig. 12.

Fig. 13.

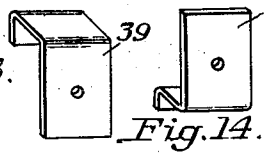

Fig. 14.

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UNITED STATES PATENT OFFICE

2,482,624

METAL BUILDING

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Application March 10, 1945, Serial No. 582,024

3 Claims. (Cl. 189—1)

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This invention relates to metal buildings and is for an improved building which may be economically and rapidly erected in the field from prefabricated parts. The invention is especially applicable to ventilated buildings, although it is not restricted to a ventilated construction.

Various forms of metal buildings have heretofore been commercially available, but for the most part, all such buildings require metal or wooden framing to which sheets of sheathing or covering material are applied. Because of the need of framing, such buildings require skilled labor for their erection, and frequently considerable time is required for their construction in the field, even with the use of pre-cut material. Moreover such structures are hot when they are exposed to the rays of the sun, and provide no ventilation except as can be obtained through doors or windows.

According to the present invention there is provided a building construction in which all of the walls and the roof are formed of basically similar panels. These panels are comprised of alternately reversed overlapping sheet metal channels, one series of channels having the flanges turned inwardly and the other outwardly. While the sides or flanges of the alternately reversed channels preferably overlap, they preferably leave a space for the circulation of air around the overlapped channel portions, forming a covering which will not permit the direct rays of the sun to pass therethrough, and which is entirely watertight, even when exposed to rain driven by relatively high velocity wind. At the same time, the structure may be very airy and sufficient light diffuses through the wall to give satisfactory daytime illumination to the interior of the building. Moreover, the covering for the building will not allow light on the interior to pass directly to the exterior.

The panels formed in this way from alternately turned channel members, even though made of light sheet metal, have very great transverse rigidity to effectively resist bowing or sagging. By reason of this fact, the side walls made in this manner are inherently stable and require no framing, and the roof panels do not require any rafters. One or two very light purlines running transversely of the channels which form the panels are desirable to support the panels against deflection in a direction perpendicular to the plane of the panel, but otherwise reinforcements other than those provided by the mutual interconnection of the several panels are not required.

Because of the ventilation provided by the panels as preferably constructed, a building of

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this character is ideal for use for either temporary or permanent housing in tropical climates, or for summer purposes. It has been found for example that temperatures under a roof construction made with panels of this kind when exposed to the direct heat of the sun, will be very substantially lower than temperatures under a canvas roofing exposed to the same conditions. The building is also desirable for use in warm climates and for summer purposes because due to ventilation the interior can quickly dry out after periods of dampness. In addition to providing ideal living quarters for warm climates or for summer purposes, this type of building is also well adapted for temporary or permanent storing of various commodities which may not be safely stored in air-tight enclosures. In this connection the building is well adapted for the storage of hay or cereals, especially field corn, and various food substances which require storage in dry but ventilated enclosures.

While the buildings embodying the present invention are highly desirable for use in warm weather or warm climates, they can be quickly and easily converted to comfortable, cold-weather quarters by the use of panels of insulating board attached to the interior thereof. These panels of insulating board being open on one side to the air in the room, and being against a ventilated surface on the outside, cannot absorb and maintain dampness so that a warm, dry, fireproof building may be provided.

Structures of this character, because of the speed with which they can be erected without any framing and the compact manner in which they can be crated for shipment, and because of the lightness of the structure itself, in addition to the fact that they are dry, well ventilated, illuminated in daytime by diffused light, and incapable of emitting exposed direct interior illumination except through doorways, and hence being easily blacked out, are extremely well adapted for use for the quartering of troops in hot climates, for army field and evacuation hospitals in such climates, and for the protection of food and military supplies. It may also be well adapted for sheltering animals as well as equipment.

The invention may be more fully understood by reference to the accompanying drawings, in which:

Fig. 1 is a side elevation of a portion of a building constructed in accordance with our invention;

Fig. 2 is a perspective view showing one of the

channels of which the various panels are comprised;

Fig. 3 is a similar view showing a like channel turned in the other direction;

Fig. 4 is an end elevation of a building constructed in accordance with our invention;

Fig. 5 is a fragmentary section in the plane of line V—V of Fig. 4, and on a somewhat larger scale;

Fig. 6 is a fragmentary top plan view of the structure with the roof panel removed;

Fig. 6*a* is an end elevation of the two end members of the roofing panels;

Fig. 6*b* is a transverse section through one of the panels, the view being on a larger scale than Figs. 5 and 6;

Fig. 7 is a fragmentary transverse section through the building looking toward the end wall;

Fig. 8 is a transverse section through the ridge of the roof;

Fig. 8*a* is a transverse section in the plane of line 8*a* of Fig. 8;

Fig. 9 is a perspective view showing the interlocking pieces that form the roof seam;

Fig. 10 is a transverse fragmentary section on a larger scale than Fig. 7, showing the construction at the eaves of the building;

Fig. 11 is a view similar to Fig. 7 showing the interior of the building with insulating panels applied to the interior thereof;

Fig. 12 is a detail view showing a transverse section through a portion of the side and end wall of the building with insulating panels secured in place;

Fig. 13 is a perspective view over one of the clips used in the insulation of the insulating panels; and

Fig. 14 is a similar view of another metal clip.

Referring first to Figures 1 to 10 inclusive, the building illustrated is formed of six panels, these being a front end panel 2 having a framing 3 therein for the sliding door 4, two longitudinal side panels, each designated generally as 5, a rear end panel 6, and two roofing panels 7 and 8.

For smaller buildings, these six panels are completely prefabricated, whereas in larger buildings the panels may be divided into subpanels which can be easily joined in the field, as is readily apparent from a detailed consideration of the construction of the panels.

While all of the several panels are basically of the same construction, the vertical side walls 5 will be first described in detail. These side panels are comprised of two series of identically formed sheet metal channels 10 and 11 which are shown in detail in Figure 2 and Figure 3. The channels 11 are arranged vertically in spaced relation, as clearly shown in Figure 5, and the channels 10 are reversed with respect to the channels 11 and are alternated so that the channels 10 overlie the spaces 12 between each two of the channels 11. The side edges of the channels 11 have small sheet metal brackets 13 secured thereto at intervals and the channels 10 are supported by these brackets 13 with the sides 10*a* of the channels 10 overlapping the sides 11*a* of the channels 11, but with the edges of the channels out of contact with the web of the opposite channel as well as with the edge or flange of the opposite channel so as to provide a free air circulating space around these flanges or edges. This is clearly shown in Figure 6*b*. The channels 10 may be secured to the brackets 13 by means of bolts or sheet metal screws as illustrated. At the bottom of the side wall panel is a sheet metal angle 14 on which the lower ends of both series of channels rest, the angle preferably being turned outwardly as clearly shown in Figures 7 and 12. Intermediate the top and bottom, each side panel has a longitudinally extending purline formed from a piece of light gauge metal turned to an angle shape, this purline being designated 15. It is secured against the inner faces of the channels 11. It may be fastened in place by means of sheet metal screws as illustrated, or by other suitable fasteners. The purpose of this strip is primarily to hold the wall against deflection from end to end in a direction perpendicular or normal to the plane of the wall. Because of the fact that the side wall panels are formed of light gauge metal shaped into channel form, the wall is extremely stiff in a vertical direction and will not buckle under normal vertical loads. Because the vertical loads can be carried by these channels, no framing or vertical studding for the building is necessary.

Extending along the top of each side wall panel and secured to the inner faces of the channels 11 is a sheet metal strip 16 which is most clearly shown in Figure 10, and which has its upper edge portion spaced inwardly from the plane of the webs of the channels 11 so as to provide a recess between the inner faces of the channels 11 and the strip 16. This provides in effect a groove for a tongue and groove joint between the side panels and the roof, which joint will be hereinafter more fully described.

Each of the end strips of the side wall panels is designated 17. Instead of being a complete channel it has the outer edge which comes at the corner of the building flat so that it may be subsequently turned over in putting the building together. This arrangement of the slats or strips constituting the panels is most clearly shown in Figure 5.

The rear end panel 6 is likewise made out of alternately arranged vertical channels 10 and 11, the construction being essentially the same as the construction of the side walls, except that in the end panels the strips or channels are of increasing height toward the center to provide the slope or gable. The channels in the end panel 6 also set on an angle strip 14 similar to that previously described. The inside of the rear end wall may also be provided with one or more purlines 18 which may be inclined toward the center as shown in Figure 7, and which reinforces the end wall channel against deflection in a direction normal to the plane of the panel. Also as clearly shown in Figure 8*a* there is a strip 19 extending along the upper edge of the inside face of the end wall panel, this strip being similar to the strip 16 to provide a tongue to form a tongue and groove connection with the roof panel as hereinafter more fully described.

The front panel 2 is likewise formed essentially of alternately reversed vertically extending channels 10 and 11. These channels, however, are cut away to provide a door opening which is surrounded by a sheet metal framing strip 3, a section of which is shown in Figure 5. There may be a sliding sheet metal door 4 guided along its edges in upper and lower angles 4*a* secured to the inner face of the panel 2 to receive and guide the edges of this door.

As shown in Figure 5 the edges of the strip 17 constituting the ends of the side panels, lap against the edges of the channels 11 forming the end panels, and they may be bent over in the field to form a lap joint having a considerable

rigidity and be secured by a sheet metal screw or bolt and nut which is applied in the field. The lapping of the joints in this manner not only provides a water-tight seal, but aids in holding the walls against weaving, once the building is erected.

The roof panels 7 and 8 are of practically identical construction. They again are formed of alternately arranged channels 10 and 11, the length of the channels extending in the direction of the slope of the roofing so that they are rigid and self-supporting without requiring any rafters. A single purline strip 20 may be secured to each panel extending crosswise of the channels. The roof channels are connected the same way as the side panels so that while the flanges of the channels are overlapped, they are in spaced relation to one another, and the hot air that forms under the roof when the sun beats upon it will readily escape by passing through the openings provided between the overlapping channels. At the same time, direct sunlight, even when the sun is at an angle to the building, cannot pass through the roof and the roof will shed water. The overlapping channels prevent the rain from beating in and the flanges on the channels 11 of course form gutters down which the rain can run. The end strip of each roof panel, however, instead of being formed as a complete channel, is formed as shown in Figure 6a. These end strips designated 21 have one upwardly turned flange along their inner edge, this flange being designated 22, and a downwardly turned and depending flange 23 along its outer edge. The metal is then turned upwardly and inwardly along the inner face of the strip, and again turned to form a narrow U-shaped rib 23a providing a depending flange which is spaced inwardly from the downwardly turned outer edge flange. The U-shaped rib 23a provides spaced outer and inner flanges which together define a vertical narrow groove (see Fig. 8a), in which the tongue formed by the strip 19 is received so as to form a weather tight tongue and groove joint along each sloping edge of the roof panel. Also the space between the flanges 23 and 23a provides a recess to receive the top edge of the end wall panel. Also as shown in Figure 10 the roof, near the eaves thereof, may have a longitudinally extending strip 24 secured thereto, which strip is folded and flattened upon itself to form a shield 25 and a tongue 24a. The tongue 24a fits into the groove formed back of the strip 16 on the side wall panels making a weather-tight lapped joint between the side walls and the roof on the inside of the building at the eaves. The tongue 24a and shield 25 are in effect spaced apart downwardly extending flanges which define a space or vertical groove therebetween in which the upper part of the strip 16 is received.

The roof panel 8 along its top ridge forming edge has a longitudinally extending strip 26 secured thereto, this strip having an upturned flange 27 thereon forming a support for the upper channels 10, the strip resting on the webs of the lower series of channels 11. Notches 28 formed at intervals in the flange 27 allow for the escape of water onto the channels 11. The strip 26 has an upwardly extending flange or tongue 29 thereon which is at the parting line of the roof.

The roof panel 7 has a somewhat similar strip 30 along its upper edge, the strip having a flange 31 on its lower edge similar to the flange 27, and the upper channels 10 rest on this flange while the strip 30 rests on the webs of the lower channels 11. The strip 30 at its inner edge has an upwardly extending fold 32 extending therealong, which laps over the flange 29 on the strip 26. This forms a tongue and groove overlap at the ridge of the roof which is water-tight. To give the roof a more finished appearance, there may be a cover strip 33 secured to the top of the roof and lapped over the ends of the ridge at each end of the building, the strip 33 forming a ridge or cap strip. This cover strip is permanently bolted or fastened to the roof panel 7, which is the last panel of the assembly to be put into place.

As previously indicated, the metal strips may be made of fairly light gauge metal and still have the requisite strength. The strength is increased because of the series of strips 10 and 11 being in different planes so that the neutral plane of the two sheets of strips 10 and 11. In other words, the two sheets of strips form complementary trusses to impart rigidity to the panel in the direction of the length of the channels. The panels can be prefabricated into units of a standard size and a set of six complete panels can be placed in a crate, the panels being in face-to-face relation so that the thickness of the crate required to receive them is less than 24 inches. The crates are thus of a size that can be handled conveniently either on freight cars or on trucks, and can be compactly stored in the hold of a ship. Once the site for the building has been graded, the end panels are set up and bolted or screwed together at the corners. The roof panel 8 is then put on after which the roof panel 7 is put into position, whereupon the building is complete. Not more than four men should be required to erect a building, and the erection is a matter of a few minutes.

As heretofore indicated, the building is cool and comfortable as a hot weather shelter, and is well ventilated. In bright daylight, sufficient light diffuses into the building around the overlapping flanges of the channels to give a soft, pleasant illumination and keep the interior of the building cool and shady. While it has not been illustrated, insects may be excluded by securing screening to the interior thereof, or simply by putting strips of netting over the exterior. A tent or canopy-like insect netting (not shown) is preferably hung on the inside. At night the building can be illuminated from within, but the light which can escape is almost unnoticeable, providing security for military purposes, and avoiding the attraction of insects for summer shelters or living quarters. Since ventilation is uniform, the building is airy, but not drafty. It can be erected with the same facility as a tent, but provides substantially greater comfort than a tent.

Where the building is to be used in temperate or cold climates, sectional insulating panels may be provided as shown in Figures 11 and 12. These panels may consist of sheets of insulating fiberboard of appropriate thickness. Such fiberboard is well known and extensively used in the building trades. Along the side walls, cleats 35 may be secured to the interior of the roof, and sheet metal hooks 36 secured to the side wall insulating panels 37. These panels may reach down to the purline strip 15. Other insulating panels 38, having hooks 39 at their upper edges, can be hung to the purline strip 15 and sheet metal cleats 40 may be hooked to the angle strip 14 to secure the base of the insulating panels 38 in place. Substantially the same construction is followed along the

end walls of the building where the upper panels are designated 41 and the lower panels are designated 42. It may be mentioned that in addition to hooks 39 at the tops of the strips 38 there may be similar hooks 39' on the bottoms of the upper insulating panels that extend upwardly to hook the lower ends of panels 37 or 41 to the purline strips so as to firmly anchor the lower edges of the upper panels 37 and 41 in place. The insulating roof panels, designated 43, are co-extensive with the interior of the metal roof panels and are held in place by hooks similar to the hooks 39, these hooks being engaged over the edge flanges of the upwardly turned roof channels 11. If desired tape may be adhesively secured over all joints. Thus the ventilated building may be quickly converted into a weather-tight warm building, and because of the ventilation provided through the metal sheathing, the insulating material will not absorb and retain dampness.

It will be noted that the strips 14 at the bottom of side and end wall panels serve to tie all of the channels 11 together in proper spaced relation, and because the channels 10 are supported by the channels 11, these channels also are thus held in proper spaced relation while the horizontal flange of the angle which extends under the ends of all of the channels provides a footing for the panel and means by which it may be spiked on. The angle 14 of course gives rigidity to the wall at the bottom in a direction crosswise of its span. Likewise the strip 16 at the tops of the side wall panels and the strips 19 at the tops of the end wall panels serve to similarly tie the channels together in proper spaced relation at the top and likewise provide a brace to hold the wall against distortion in a direction transversely of its length. The joining of the side and end panels along the interfitting tongue and groove connections between the strip 16 and the roof panels and the strips 19 and the roof panels tie the side walls and end walls respectively together through the roof panels as a connecting means and to hold the side and end wall panels from weaving or shifting relatively to the roof panels or to each other.

While we have illustrated and described certain specific embodiments of our invention, it will be understood that this is merely by way of illustration and that various changes and modifications may be made in the construction and arrangement of parts within the contemplation of our invention and under the scope of the following claims.

We claim:

1. A metal building construction comprising end walls formed of overlapping alternately turned vertical channel members, the upper ends of the end walls being sloped to define the slope of a roof, a strip on the inner face of each wall near its top edge providing a vertically extending tongue spaced inwardly from the plane of the wall, a roof comprising similarly arranged channel elements, the endmost elements of the roof each having on the under side of the edge thereof an inverted channel with two depending flanges, the outer of said flanges extending down over the outside of one of the end walls, and the inner depending flange of said elements being interfitted with one of said tongues of an inner face of an end wall to thereby connect the roof and end walls against relative movement and provide a tight connection between them.

2. A metal building construction including a wall formed of overlapping alternately turned vertical channel members, a strip on the inner face of the wall near its top portion providing a vertically extending tongue spaced inwardly from the plane of the wall, a roof comprising similarly arranged channel elements, the endmost element of the roof having on the under side of the outer edge a depending outer flange and a depending inner flange spaced inwardly from the outer flange and formed so as to include a vertical groove, the outer flange extending over the outer side of the wall, a portion of the inner flange being received in the space between the tongue on the strip and the inside wall and the tongue being received in the groove of the inner flange.

3. In a metal building construction, a vertical wall panel comprised of vertically extending sheet metal channel members alternately faced in opposite directions and in overlapping relation, means securing the channels to each other, means extending along the upper edge of the panel providing an upwardly extending flange, a roof panel having an end member provided with two spaced apart downwardly extending flanges defining a space into which the said upwardly extending flange is received, and an angular bottom strip secured to some of the channels and having a flange against which all of the channels abut for tying the channels together and forming a footing therefor.

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