March 19, 1963 A. F. NOVY ETAL 3,081,537

METHOD AND TOOL FOR FASTENING ROOF DECK

Filed July 14, 1959 3 Sheets-Sheet 1

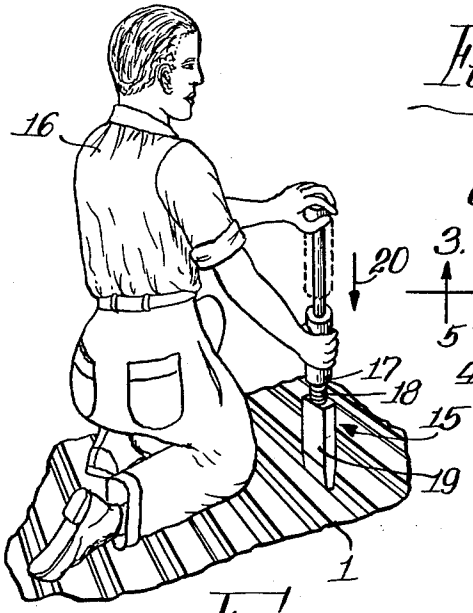
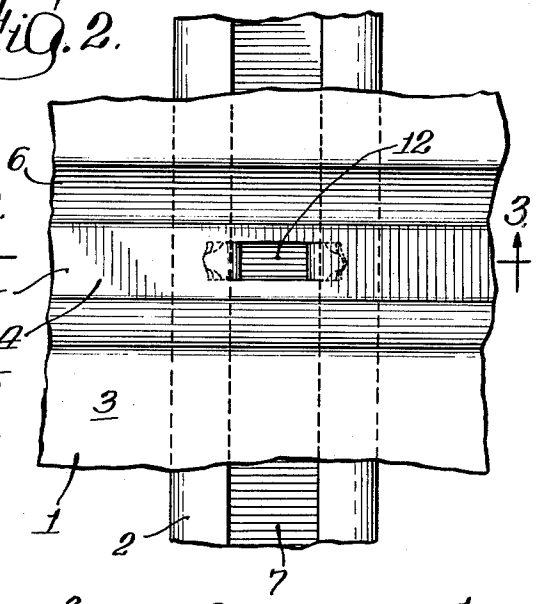


Fig. 1.

Fig. 2.



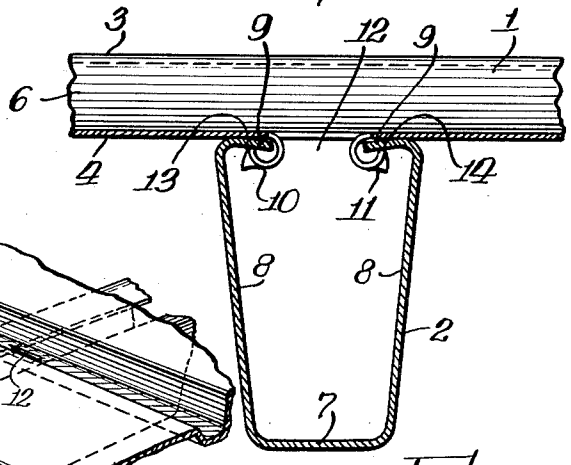


Fig. 3.

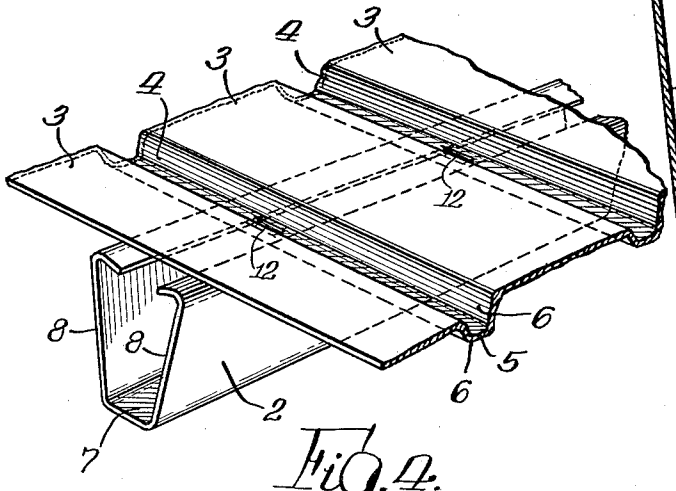


Fig. 4.

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METHOD AND TOOL FOR FASTENING ROOF DECK

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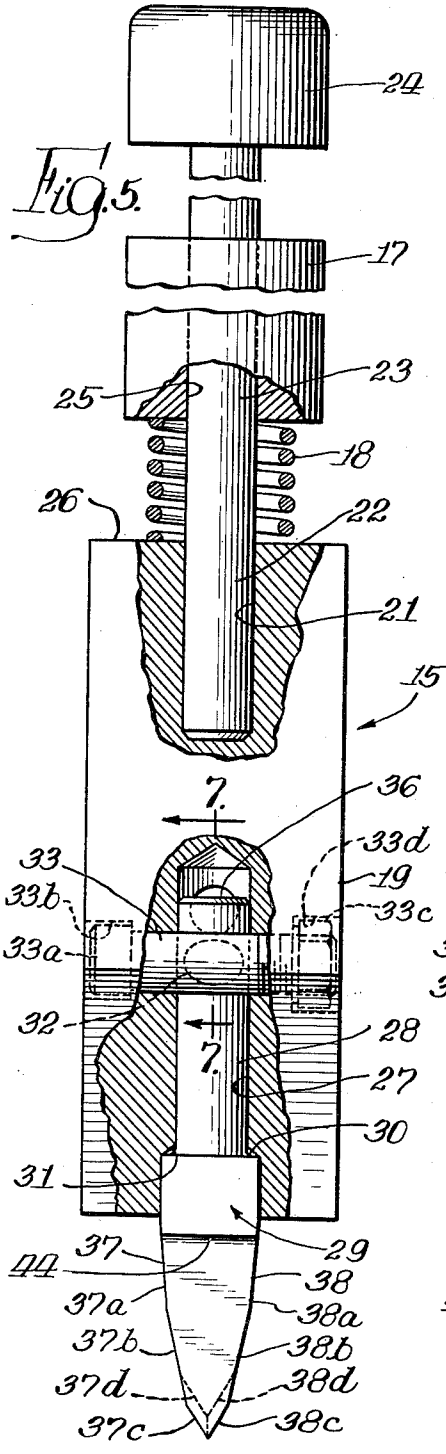


Fig. 5.

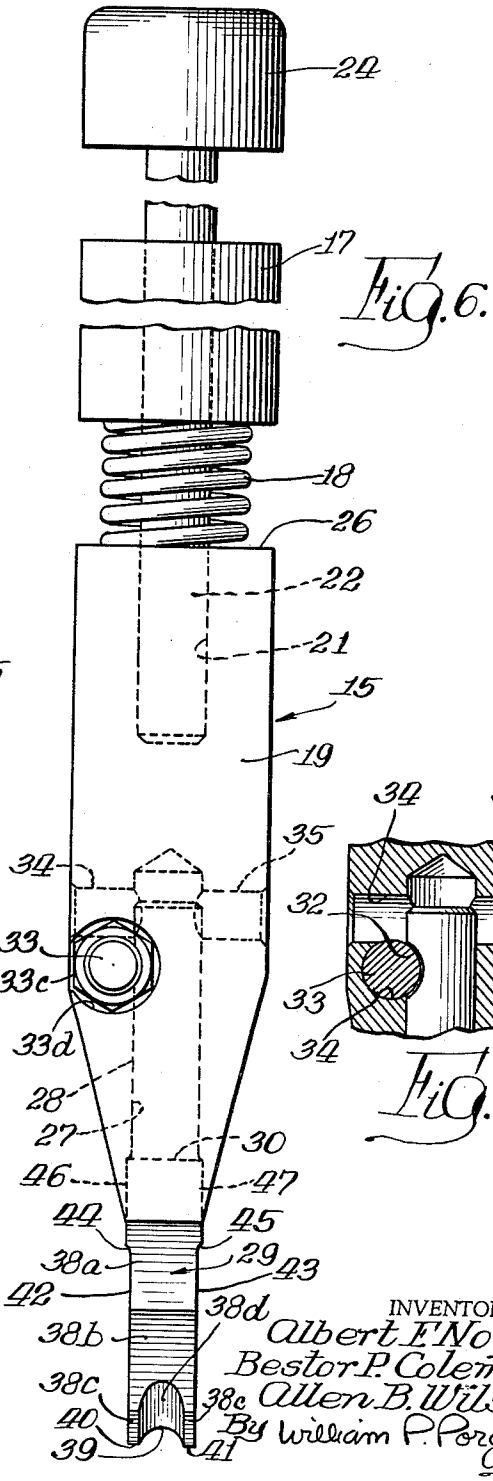


Fig. 6.

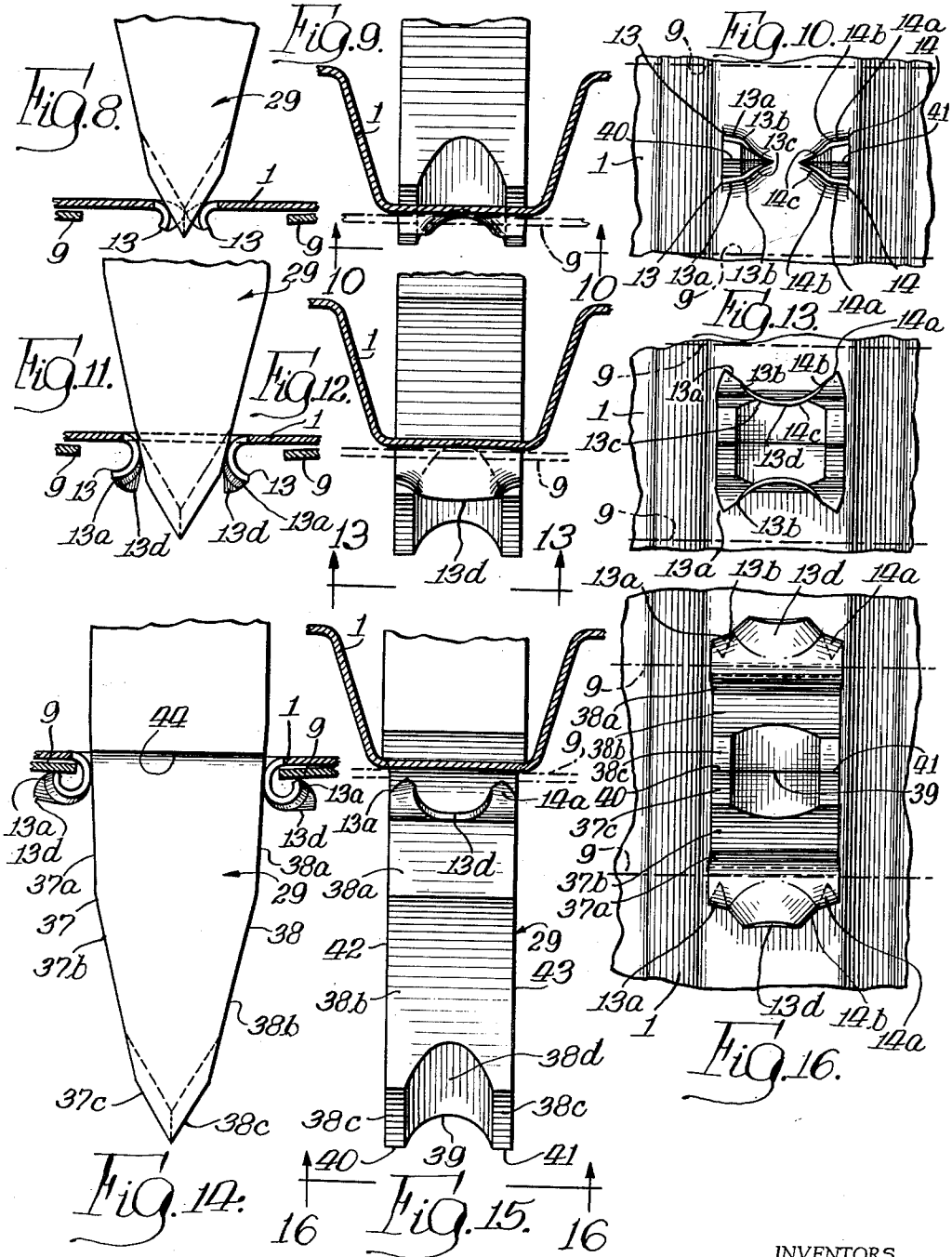
Fig. 7.

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METHOD AND TOOL FOR FASTENING ROOF DECK

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3,081,537 METHOD AND TOOL FOR FASTENING ROOF DECK

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5 Claims. (Cl. 29—509)

This invention relates generally to the art of fastening together metal members and is particularly directed toward joining together metal roof members.

It is customary in the construction of certain type roof structures, such as on factories and other similar type buildings, to provide a sheet metal roof deck supported directly upon beams or other supporting members of the roof, the roof deck ordinarily being covered with insulation, tar paper, asphalt or other materials to render the roof water and weather tight. The sheet metal roof deck is ordinarily made up of a plurality of either overlapping or abutting sheet metal panels in a sufficient number to extend for the entire roof area. These sheet metal panels and beams are often secured together by means of specially formed fasteners which have added considerably to the cost of the roof and to the cost of the labor required for its construction. Further, these fasteners have not been satisfactory because of their tendency to loosen after use and because they sometimes require that accurately positioned holes be punched through the panels and beams, and proper register of these holes has created a major assembly problem.

It is, therefore, an object of this invention to provide an improved roof deck fastening means whereby the sheet metal panels and beams are secured together without requiring pre-punching of the members with holes, so that hole registry is not a problem.

It is another object of the invention to provide an improved roof deck fastening means which does not require any separate fasteners but, instead, comprises only deformed and interlocked portions between the roof deck members themselves. The particular deformed and interlocked portions of the fastening means are in the form of tabs which are bent into a longitudinal curl around roof deck portions for purposes of interlocking, and are shaped with a non-rectilinear three way transverse curvature to impart rigidity to them and are provided with sharp pointed corners which tightly engage the adjacent metal to thereby provide a tightly holding fastening means.

It is still another object of the invention to provide an improved tool which can be used to effect the improved fastening between the metal roof members by providing means with specially shaped sharpened edges which pierces the metal members and cuts tabs out of them while simultaneously imparting the proper non-rectilinear shape to the tabs and curls the tabs around roof deck portions into interlocking engagement.

It is another object to provide an improved tool of the type mentioned which can be operated manually in a simple manner so as to minimize the skill required of the roof worker.

It is another object to provide an improved tool having a manually driven axial driver which permits its simple manual operation.

It is still another object of the invention to provide an improved tool which guides the tabs being cut and formed from the roof members in such a manner that the tabs are consistently cut into substantially even lengths to thereby insure proper fastening repeatedly.

Other objects and advantages of the invention should

become apparent by referring to the accompanying drawings in which:

FIG. 1 shows a perspective view of a worker operating a tool embodying the invention;

FIG. 2 shows a top plan view of a cutaway portion of two roof members joined together by means of a connection formed by actuation of the tool embodying the invention;

FIG. 3 shows a sectional view along the line 3—3 of FIG. 2;

FIG. 4 shows a cutaway and partial sectional view of a portion of the same roof members as shown in FIGS. 2 and 3;

FIG. 5 shows a partial sectional and cutaway view of a roof tool embodying the invention and of the same type as indicated in FIG. 1;

FIG. 6 shows a right side view of the tool as shown in FIG. 5;

FIG. 7 shows a sectional view along the line 7—7 of FIG. 5;

FIG. 8 shows a front view of the lower end of the tool of FIGS. 5 and 6 in its position after it has begun to pierce a roof deck member and start the formation of a connection between two roof members;

FIG. 9 shows a right side view of the same lower portion of the tool of FIG. 8 and also shows the relative position of the tool to the roof member through which it has begun to cut and form a connection;

FIG. 10 shows a bottom view of the roof portions shown in FIG. 9 as viewed along the line 10—10.

FIG. 11 shows a front view of the same members as shown in FIG. 8 except with the tool advanced to a different cutting and forming position;

FIGS. 12 and 13 are views in the same directions as views 9 and 10, respectively, except corresponding to the position of the parts as shown in FIG. 11; and

FIGS. 14, 15 and 16 are views corresponding to FIGS. 11, 12 and 13, respectively, except that all parts shown are advanced to their positions as they appear at the completion of the connection between the roof members.

A portion of the roof construction in which the improved connection can be formed by the tool of this invention is shown especially in FIGS. 1 through 4. The upper portion of the roof construction comprises a corrugated metal roof deck 1 supported on a support beam 2. The sheet metal roof deck 1 ordinarily consists of several sheets which are positioned in either overlapping or abutting positions in order to extend the roof deck surface for the entire area of the roof being installed. Also, it should be apparent that, although only one support beam 2 is shown, the ordinary roof construction requires the use of many identical support beams positioned parallel to each other at regular spaced intervals. And, even though no supports for the support beams 2 are shown, it should be understood that these support beams 2 are ordinarily connected by welding or other fastening means to the main supporting structure of the building on which the roof is being formed.

The typical corrugated sheet metal roof deck 1 as shown comprises a plurality of parallel spaced top surfaces 3 connected to each other by means of troughs 4 which impart the corrugated shape to the roof deck. The troughs 4 consist of bottom walls 5 connected between two downwardly convergent side walls 6.

The typical support beam 2 is of channel shape consisting of a bottom wall 7 connected between two slightly upwardly divergent side walls 8 which are provided at their upper edges with flanges 9 which extend inwardly toward each other and slightly downward.

A typical fastened connection made according to this invention and with the tool of this invention consists of

two sheared tabs 10 and 11 which are sheared from the corrugated sheet metal roof deck 1 and curled around and below the flanges 9 of the support beam 2. When these tabs 10 and 11 are sheared from the roof deck 1, they provide an opening 12 through the roof deck 1. When the tabs 10 and 11 are curled around and below the flanges 9, they are pressed against the flanges 9 and thereby provide an interlocking connection between the roof deck 1 and the support beam 2. By the unusual manner in which the tabs 10 and 11 are curled or formed, they are provided with sharp corners 13 and 14 which tend to dig into the flanges 9 and provide a more secure gripping type action for the connection. Also, the shapes of portions of the tabs 10 and 11 provide rigidity which inhibits their unbending and thereby also provides a better connection. More details of their shapes are explained hereinafter.

As particularly shown in FIG. 1 the tool 15 used to form the interlocking joint or connection between the roof members 1 and 2 is held in one hand by a worker 16 who actuates the tool by reciprocating motion of a sleeve 17 surrounding a portion of the tool. The tool 15 is driven downwardly when the worker quickly moves the sleeve 17 downwardly against a coil spring 18 in the direction of the arrow 20. The force created by movement of this sleeve drives the head 19 of the tool downwardly and pierces through the roof members 1 and 2 to provide a connection between them. The tool is removed from one position to another position on the roof members by merely raising the tool vertically and re-positioning it as desired.

The complete details of construction of the tool 15 are shown in FIGS. 5, 6 and 7. The head 19 of the tool is of generally rectangular shape and is provided at its upper end with a circular opening 21 into which is secured the lower end 22 of a rod 23. The lower end 22 can be press fit into the opening 21 as shown, or else threaded and then screwed into the opening 21 which would also have to be threaded. Also, this lower end 22 could just as well be welded or otherwise securely fastened in place. The upper end of this rod 23 is provided with an enlarged nob 24 which can be used as a gripper for the worker for steadying the tool while it is operated. Around the rod 23 is provided the sleeve 17 which has been mentioned. This sleeve is provided with a central opening 25 of large enough diameter to permit the sleeve 17 to slide easily along the rod 23. The spring 18 mounted between the sleeve 17 and the upper end 26 of the head 19 is a coil spring which can be compressed when the sleeve 17 is driven downwardly against it. The lower end of the head 19 is also provided with an opening 27 into which is passed a circular end 28 of the shear member 29. This shear member is provided with a shoulder 30 which contacts a shoulder 31 in the opening 27 which limits the inward movement of this shear member 29. On the circular end 28, as particularly shown in FIG. 7, is provided a circular curved cut out 32. This cut out 32 is engaged by a portion of the surface of a bolt 33 provided in an opening 34 through the head 19. The head 33*a* of the bolt 33 is recessed in a counter bore 33*b* in the head 19 and a nut 33*c* is secured to the free threaded end of the bolt 33 and it is also secured in a counter bore 33*d* of the head 19. When the bolt 33 is positioned as shown, it retains the shear member 29 and prevents it from being dislodged from the block 27. Two openings 34 and 35 are provided in the head 19 to give access to the extreme upper end 36 of the shear member 29 which can provide access for a screw driver or other wedging instrument for the removal of the shear member 29, if necessary.

The lower end of the shear member 29 is provided with a spear-like point having side walls 37 and 38 of increased convergence defined by surfaces 37*a* 37*b*, 37*c*, 38*a*, 38*b*, and 38*c*. The surfaces 37*a*, 37*b*, and 37*c* having progressively more angularity with the longitudinal center of the shear member 29 and so, likewise, the surfaces 38*a*, 38*b* and 38*c*. Intersecting the surfaces 37*b* and 37*c* is a concave recess 37*d* and intersecting the surfaces 38*b* and 38*c* is a concave recess 38*d*. These recesses 37*d* and 38*d* provide an arcuate shaped sharp edge 39 between two flat sharpened edges 40 and 41. The shear member 29 is provided with a front wall 42 and a back wall 43 parallel to it. The front wall 42 is provided with a curved shoulder 44 and the back wall 43 is provided with a curved shoulder 45. These shoulders connect to two walls 46 and 47 which are also parallel to each other but which are spaced further apart than the walls 42 and 43. The shoulders 44 and 45 have a definite function which is explained hereinafter.

When the tool is operated as indicated in FIG. 1, it is positioned vertically of the roof deck 1 with the cutting edges 40 and 41 resting on the bottom walls 5 of the roof deck 1. Then the sleeve 17 is raised and lowered quickly in the direction of the arrow 20 to provide a driving force tending to drive the shear member 29 into the roof deck 1 as the driving force is transmitted from the sleeve 17 through the spring 18 to the head 19 which carries the shear member 29. After the driving force is applied, the shear member 29 provides the opening 12 through the roof deck 1 in a progressive manner indicated by the parts as shown in FIGS. 8 through 16. The initial piercing or cutting through of the roof deck occurs as the sharp edges 40 and 41 penetrate along their lines of contact and this cutting action is immediately followed by the cutting action of the sharp arcuate edge 39. It should be noted that the edges 39, 40 and 41 impart a three-way curvature to each of the tabs 10 and 11 sheared and bent from the roof deck 1. This three-way curvature is indicated as it begins in FIG. 10 where the sharpened corners 13 and 14 are shown as they are initially formed. These corners 13 and 14 are at the end of flat regions 13*a* and 14*a* which are connected at corners 13*b* and 14*b* to arcuate portions 13*c* and 14*c*, respectively. At this point in the formation of the tabs 10 and 11 the initial basic shape is imparted to the tabs which provides them with the rigidity characteristics which subsequently cause them to provide a secure connection. As the shear member 29 moves further downward where the side walls 37*b* and 38*b* contact the roof deck 1, the tabs 10 and 11 are further cut and entirely separated from each other. At this point in their formation, the tabs have retained their initial flat surfaces 13*a* and 14*a*, their corners 13*b* and 14*b* and their arcuate portions 13*c* and 14*c*. However, because of the separation of the two tabs, the arcuate portions 13*c* and 14*c* are blended into a single arc designated as 13*d*. Because the angularity of the side walls 37*b* and 38*b* is less with respect to the longitudinal axis of the shear member 29, the tabs 10 and 11 are urged into a tighter curl than was their tendency when acted upon by the side walls 37*c* and 38*c*. But, even though the tendency is toward a tighter curl for the tabs 10 and 11, they still retain adjacent their ends the initial three-way curvature imparted to them by the cutting edges 39, 40 and 41.

As the shear member 29 continues further, it is driven until the shoulders 44 and 45 contact the top surface of the bottom walls 5 of the roof deck 1. During this travel, the tabs 10 and 11 are contacted by the side walls 38*a* and 37*a* of the shear member 29 and, since the angularlity of these side walls 37*a* and 38*a* is less with respect to the longitudinal axis of the shear member 29 then was the angularity of the side walls 37*b* and 38*b*, the tendency is to curl the tabs with a still tighter curl. As this occurs, the tabs are curled around and bent up against the lower surfaces of the flanges 9 of a support member 2. The action of the side walls 37*a* and 38*a* is of sufficient length to tend to cause the curling action to continue even after the sharp corners 13 and 14 of the tabs are in contact with the flanges 9. This action insures that tight contact remains between the sharpened corners 13 and 14 with the flanges 9 after the pressure of the shear member 29 is relieved when the tool is removed. It should be noted

that the tabs **10** and **11** have still retained their three-way curvature at this time even though they have been further curled.

The shear member **29** reaches its final position when the shoulders **44** and **45** are driven down against the top surface of the bottom wall **5** of the roof deck **1** sufficiently to widen the hole from which the tabs **10** and **11** are sheared beyond the width of the parallel side walls **42** and **43** of the shear member **29**. This widens the hole to permit easy removal of the shear member **29** after the connection is completed.

For purposes of illustration, the flanges **9** of the support members **2** have been shown in solid outline in FIGS. 8, 11 and 14, but in phantom outline in FIGS. 9, 10, 12, 13, 15 and 16.

By having formed a connection between the roof members **1** and **2** as shown in FIGS. 8 through 16, a connection is provided of far greater holding power than one wherein only a curled shape is imparted to the tabs without imparting a three-way curvature as shown. In fact, it has been shown that the connection of this invention holds better than one not having the three-way curvature and in which an additional third connector piece is used as reinforcement for the connection. Also, the connection has been used successfully on both steel and aluminum sheets.

Because of the manner in which the tabs are initially cut and subsequently formed, the tool of this invention consistently cuts tabs of substantially even lengths to thereby insure proper fastening time after time. It is believed that this occurs primarily because, as shown in FIGS. 8, 9 and 10, the tabs **10** and **11** are initially begun to be formed by piercing with the two spaced cutting edges **40** and **41** and the forming of the tabs continues equally as the piercing or cutting progresses from the regions of the edges **40** and **41** toward the middle between them along the curved cutting edge **39**. By the time the cutting is completed by the cutting edge **39**, the tabs **10** and **11** are substantially imparted with their longitudinal curvature as well as their non-rectilinear transverse shape, and resistance to further formation of the tabs **10** and **11** at that time is equal for both. Consequently, continued formation of the tabs **10** and **11** occurs equally for both and so, the final length of the tabs is always substantially equal.

In tools of the same type where a single chisel or wedge shaped cutting edge is used, it has been observed that often times one tab will form faster than the other to result in final uneven tab length. The tool of this invention overcomes this shortcoming.

For proper operation of the tool **15**, it is proper to center the line of the cutting edges **40** and **41** centrally between the location of the edges of the flanges **9** of the beam. The reason for this is to prevent a flange **9** on one side from being contacted before the flange **9** opposite it and thereby offer resistance to the curling of one tab to cause uneven tab length and improper tab formation. Proper curling of the tool can be insured by using a locating fixture with it.

Whereas the side portions **37***a*, **38***a*, **37***b*, **38***b*, **37***c* and **37***d* are angular with respect to each other, it should be apparent that each of the side walls **37** and **38** can be a smooth curve of varying curvature and the effect is substantially the same. The curve produces varying rates or amounts of curl in the tabs depending upon the portion of the curve in contact with the tabs at the time.

Although only one form of the invention has been shown and described, it should be understood that the invention can be made in many different ways without departing from the true scope of the appended claims.

We claim:

1. The method of providing an interlocking connection between a sheet metal panel and a member having two inwardly directed spaced flanges extending toward each other comprising, shearing two oppositely disposed tabs from the sheet metal panel in a region between the location of the two flanges when the panel is positioned against the flanged member to simultaneously impart a transverse cross sectional shape to each tab in the nature of a centrally concave curved portion connected at its edges between two spaced aligned rectilinear portions by two corners curved reversely of said curved portion, said curved portion and two corners providing longitudinal rigidity along three different longitudinal regions of each tab to thereby increase resistance to longitudinal bending of the tabs, and then further shearing and curling the tabs longitudinally about the flanges.

2. The method of providing an interlocking connection between a sheet metal panel and a member having two inwardly directed spaced flanges extending toward each other comprising, shearing two oppositely disposed tabs from the sheet metal panel in a region between the location of the two flanges when the panel is positioned against the flanged member to simultaneously impart a transverse cross sectional shape to each tab in the nature of a centrally concave curved portion connected at its edges between two spaced aligned rectilinear portions by two corners curved reversely of said curved portion, said curved portion and two corners providing longitudinal rigidity along three different longitudinal regions of each tab to thereby increase resistance to longitudinal bending of the tabs, and then further shearing the curling the tabs longitudinally about the flanges by first curling the free ends of the tabs with one radius of curvature and then curling the remaining tab portions with a curvature having a radius of curvature longer than said one radius.

3. A tool for interlocking metal members together comprising, a shear member having means against which a driving force can be applied for driving the shear member longitudinally, said shear member being provided with two opposite side walls converging longitudinally toward the free end of said shear member where they intersect at a shear edge, said side walls each having a transverse shape of a central concave curved portion connected at its edges between two spaced aligned rectilinear portions by two corners curved reversely of said curved portion, said shape extending to said free end to thus impart to the shear edge at the intersection of said side walls a shape having a central concave portion connected between two spaced rectilinear aligned portions.

4. A tool for interlocking a sheet metal panel and a beam having two inwardly directed spaced flanges extending toward each other comprising, a frame, a shear member secured at its inner end to the frame, said shear member having four side walls imparting to it a transverse quadrilateral cross sectional shape, two of said walls being opposite and parallel and the other two side walls being opposite and tapered to a shear edge at its outer end which is unsupported, said unsupported outer end being adapted to be driven by longitudinal movement of the frame to cause the shear member to shear a quadrilaterally shaped hole in said sheet metal, said other two side walls which are tapered each having a transverse shape of a central concave curved portion connected at its edges between two spaced aligned rectilinear portions by two corners curved reversely of said curved portion, said shape extending to said shear end to thus impart to said shear edge at the intersection of said other two side walls a shape having a central concave portion connected between two spaced rectilinear aligned portions, said parallel side walls of the shear member having laterally extending shoulder divergent away from the unsupported end of the shear member, said shoulders causing said hole to be widened beyond the width of the spacing of said parallel side walls as the shear member is driven and thereby permit easy removal of the shear member from said hole.

5. A tool for interlocking metal members together comprising, a shear member having means against which a driving force can be applied for driving the shear mem-

ber longitudinally, said shear member being provided with two opposite sloped side walls converging longitudinally toward the free end of said shear member where they intersect at a shear edge, the slope of the side walls changing in a longitudinal direction with respect to the longitudial axis of the shear member to provide a steeper slope of the side walls relative to said longitudinal axis in a region adjacent to said shear edge than behind said region, said side walls each having a transverse shape of a central concave curved portion connected at its edges between two spaced aligned rectilinear portions by two corners curved reversely of said curved portion, said shape extending to said free end to thus impart to the shear edge at the intersection of said side walls a shape having a central concave portion connected between two spaced rectilinear aligned portions.

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