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METHOD AND TOOL FOR FORMING ROOF DECK

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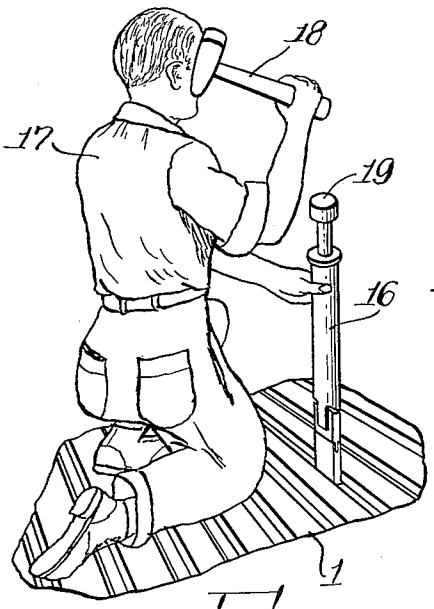
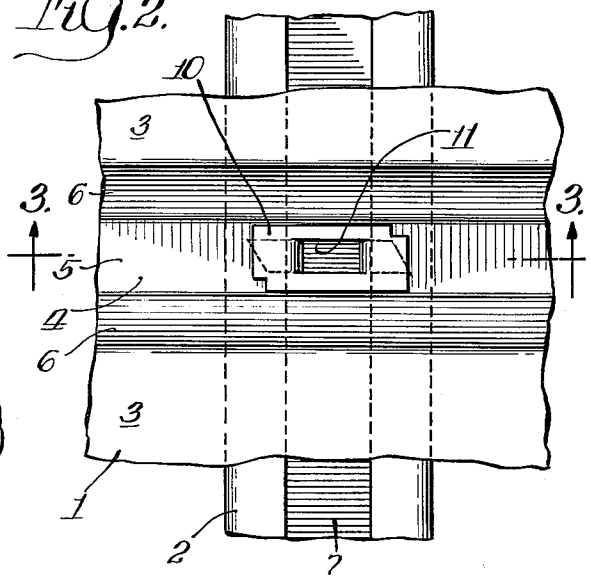


Fig. 1.

Fig. 2.



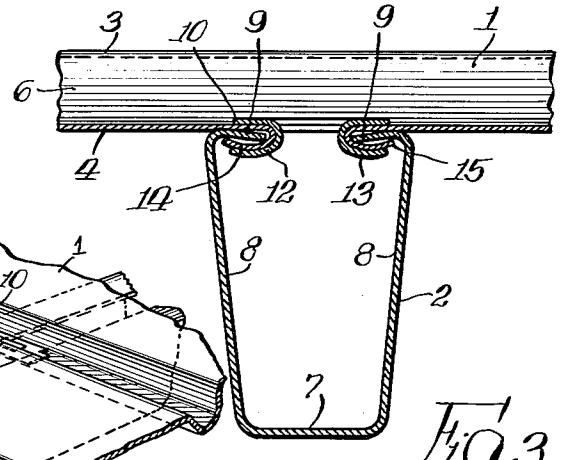


Fig. 3.

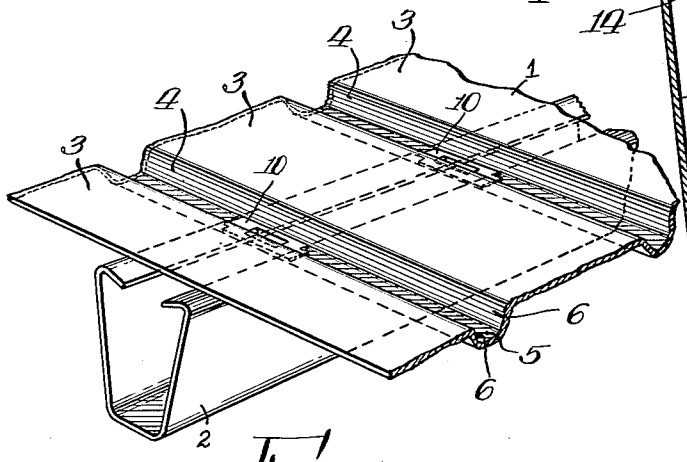


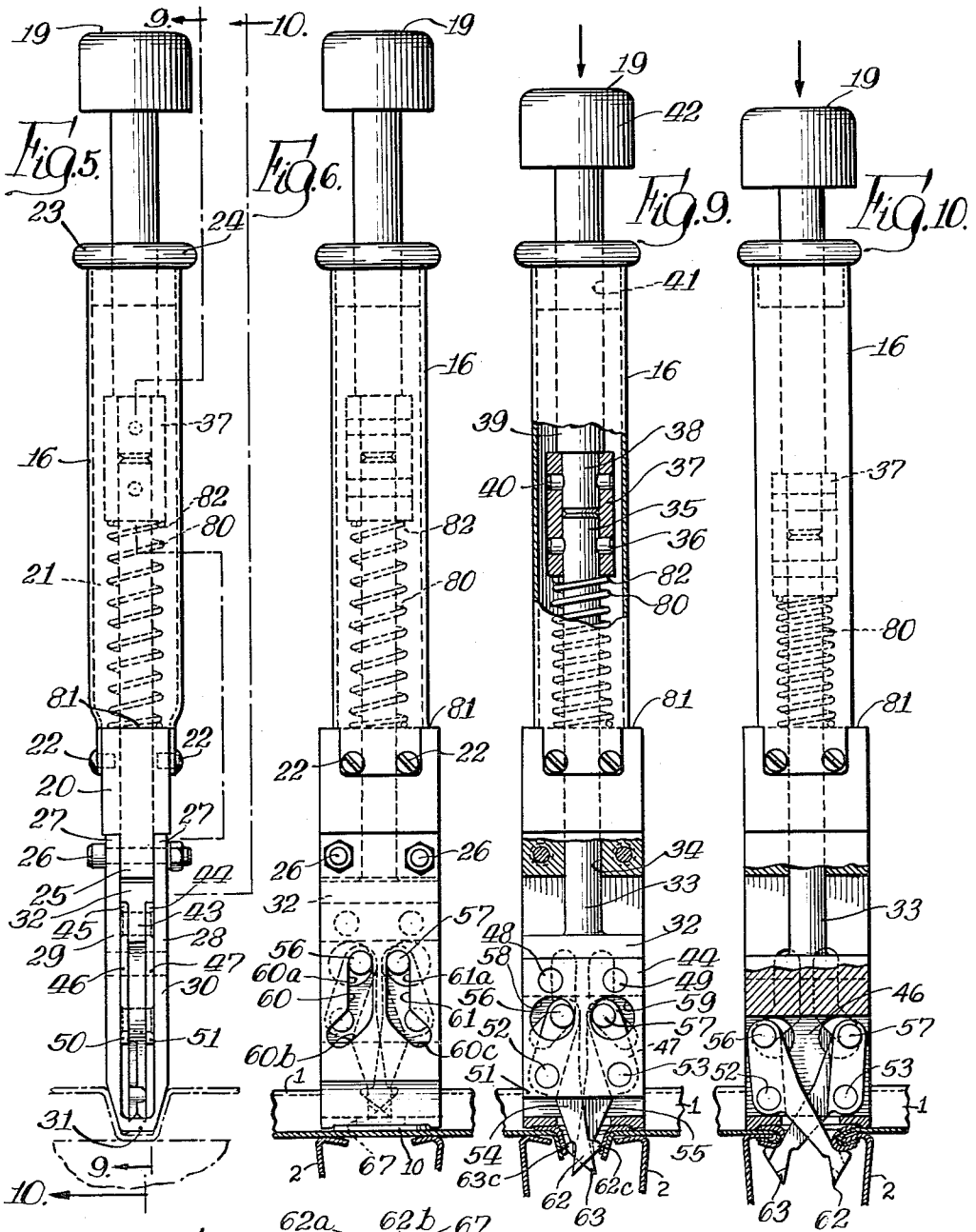
Fig. 4.

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METHOD AND TOOL FOR FORMING ROOF DECK

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METHOD AND TOOL FOR FORMING ROOF DECK

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This invention relates generally to the art of fastening together metal members and is particularly directed toward means for 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 whereby an improved fastening clip is employed which is provided with portions used to shear openings through the roof deck members as the clip is deformed into interlocking engagement with them.

It is still another object to provide an improved tool which can be used to effect the fastening between the sheet metal panels and the beams either with or without the use of the improved fastening clip, although an extra advantage is obtained when using the improved fastening clip because the clip portions themselves, which are used to shear openings through the roof deck members while effecting the fastening, preclude the requirement of having sharp shear edges on the tool which would ordinarily require frequent sharpening as the tool would be worn through use.

It is another object of the invention 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 still another object of the invention to provide an improved tool having an axial driver which can be operated by the simple blow of a hammer for effecting the fastening between the roof members.

It is another object of the invention to provide an improved tool having magnetic means for holding a clip in alignment on the tool preparatory to fastening the clip to the roof members.

It is another object of the invention to provide an improved tool having special linkages which cause the tool to first penetrate and form an opening and tabs in the roof members, and then react against the tabs to cause their interlocking engagement with portions of the roof, the special linkages including two spear like members which act integrally to penetrate the roof members

to cut and bend the tabs and then spread apart to effect the interlocking of the tabs.

Other objects and advantages of the invention will become apparent by referring to the accompanying drawings in which;

FIG. 1 shows a perspective view of a worker employing the improved roof deck fastening tool of this invention in a typical manner of operation;

FIG. 2 shows a partial top plan view of a portion of sheet metal roof deck and beam or purlin supporting it and a typical improved fastened connection between the roof members as effected by the improved tool of this invention;

FIG. 3 is a sectional view as viewed along the line 3—3 of FIG. 2 and particularly shows the improved fastened connection of this invention;

FIG. 4 shows a perspective view of a portion of a sheet metal roof deck positioned on a length of beam which supports it and is fastened to it by means of the improved fastened connection of this invention;

FIG. 5 shows a side view of an improved hand tool embodying the features of the invention;

FIG. 6 shows a front view of the tool shown in FIG. 5, but also shows the tool positioned on a sheet metal roof deck portion as it would be immediately prior to formation of a fastened connection between the roof deck and one of its support beams;

FIG. 7 shows a bottom end view of the tool as shown in FIG. 6, except that the fastening clip is not in place;

FIG. 8 shows a view of the flat sheet metal fastening clip in solid lines and its ordinary location on the tool is indicated by dotted phantom lines;

FIG. 9 shows a cut away and partial sectional view along the line 9—9 of FIG. 5, except with the driven members of the tool extended to positions they occupy at the completion of the shearing stroke of the tool, at which time holes or openings have been cut through and tabs formed on the fastener clip and adjacent roof members; and

FIG. 10 shows another cut away and partial sectional view along the line 10—10 of FIG. 5, except that all parts of the tool are positioned as they would appear after the fastened connection between the fastener clip and the roof members has been completed.

A portion of the roof construction in which the improved fastened connection of this invention can be embodied 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 but nevertheless coplanar, 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 consists of a fastener clip 10 in contact with the upper surface of the bottom wall 5 of one of the troughs 4 of the sheet metal roof deck. The clip 10 is provided with an opening 11 created after the bending in of two sheared tabs 12 and 13 which are formed of the sheet metal of the clip. These tabs 12 and 13 are deformed into interlocking engagement with two other tabs 14 and 15 sheared from the sheet metal roof deck immediately in alignment with the tabs 12 and 13 of the clip. The location of these tabs and their spacing from each other is such that the tabs 12 and 14 are interlocked with one of the flanges 9 while the tabs 13 and 15 are interlocked with the other flange 9 of the support beam 2.

As particularly shown in FIG. 1, the tool 16 used to form the interlocking joint between the clip 10 and the roof members is held in one hand by a worker 17 who actuates the tool by imparting a sharp blow by means of a hammer 18 to the upper end 19 of the tool. This actuation by the operator causes the tool to bend the tabs 12 and 13 from the clip and simultaneously shear through the sheet metal roof deck to create the additional tabs 14 and 15. As the stroke of the tool continues, these tabs 12, 13, 14 and 15 are forced into interlocking engagement with each other and the flanges 9 of the support beam 2 as best shown in FIG. 3.

The tool 16 used to form the fastened connection comprises a frame 20 which is provided at its upper end with a tubular member 21 by means of four screws 22. The tubular member 21 is provided at its upper end with a flanged end cap 23 fitted down into its base, the flange 24 on it maintaining its position properly at the end of the tubular member.

The lower end of the frame member 20 is provided with a portion 25 of reduced thickness which is fastened by means of two bolts 26 to the upper ends 27 of a U-shaped plate 28 having two side walls 29 and 30 connected between a bottom wall 31. Mounted between the side walls 29 and 30 is a head or driver 32 having its upper end connected to a shaft 33 which is guided in a bore 34 through the frame member 20 and connected at its upper end 35 by means of a pin 36 to a coupling sleeve 37 which couples the shaft 33 to the lower end 38 of a driving plunger 39 by means of another pin 40. The plunger 39 is guided through a bore 41 in the flanged end cap 23 and extends out of the end cap 23 above it where it is connected to an enlarged head 42, the upper surface 19 of which is struck with a hammer 18, as already described, in order to actuate the tool.

The lower end 43 of the driver 32 is of reduced thickness and is positioned between the upper ends 44 and 45 of two auxiliary plates 46 and 47 and fastened thereto by means of two pins 48 and 49. The lower ends 50 and 51 of these two auxiliary plates 46 and 47 are provided with two pins 52 and 53 on which are pivoted two punches or shearing dies 54 and 55. The upper ends of these punches 54 and 55 are provided with two pins 56 and 57 which extend through larger circular openings 58 and 59 provided in the auxiliary plates 46 and 47 as clearance for these pins 56 and 57 when they are actuated. The pins 56 and 57 also extend at their ends into slots 60 and 61 provided in both side plates 29 and 30 of the U-shaped plate 28. These slots 60 and 61 are used to guide the pins 56 and 57 when the tool is actuated to in turn cause the proper movement of the punches 54 and 55.

The lower ends 62 and 63 of the punches or shearing dies 54 and 55 are sharpened and provided with sharp points 62*a* and 63*a*, respectively. They also are provided with sharp edges 62*b* and 63*b* which, when in the positions as shown in FIG. 6 and FIG. 9 extend along a diagonal line as shown best in FIG. 7. This diagonal line formed by edges 62*b* and 63*b* coincides with the diagonal shear line 64 which is precut in the fastener clip 10 as shown in FIG. 8. The sum total width of both of the ends 62 and 63 when they are positioned together is equal to the width of the tabs 12 and 13 also precut in the clip 10. In addition, the ends 62 and 63 are provided with laterally extending lugs 63*c* and 62*c* which determine the size of the opening cut through the roof members when a clip is fastened in place.

In order to properly locate the clip 10 in the end of the tool 16 a recessed area 65 is provided at the immediate lower end of the tool. This recessed area 65 is of sufficient length to accommodate the clip flatly against it. The clip 10 has two cut out corner recesses 10*a* and 10*b*, either of which is used to engage a locating pin 66 projecting from the lower end of the tool at one corner of the recessed area 65. This locating means which includes the recessed area 65 for positioning of the clip 10 and the locating pin 66 against which recess 10*a* or 10*b* engages always insures that the clip is properly positioned with the diagonal cutting line 64 in alignment with the diagonal positioning of the punch edges 62*b* and 63*b* to insure the proper functioning of the tool in relationship to the tab formation of the clip.

An opening 67 is provided through the bottom 31 of the U-shaped plate 28 through which the punches 62 and 63 are moved as the tool is operated.

In order to operate the tool, a clip 10 is positioned at the lower end of the tool 16 as shown in FIG. 8 with a recess 10*b* lodged against the locating pin 66. Circular magnets 68 and 69 are embedded in the bottom wall 31 of the plate 28 and magnetically insulated from the plate 28 by rings 70 and 71 of non-magnetic material, such as copper. These magnets 69 and 68 have sufficient magnetism to hold the clip 10 positioned at the bottom end of the tool. The tool is then stood in a vertical position with the clip resting against the bottom wall 5 of a trough 4 provided in the sheet metal roof deck 1. The tool is aligned so that it is directly above support beam 2 and centered laterally of it. To assist in alignment of the tool in a trough, the lower end of the tool is preferably as wide as the trough and provided with a shape corresponding to that of the trough. This initial positioning is indicated in FIGS. 1, 5 and 6.

The head 42 of the tool 16 is then struck a hammer blow to cause the plunger 39 and the shaft 33 to be lowered to in turn cause the driver or head 32 to be lowered. This in turn causes the lowering of the punches 54 and 55 and the auxiliary side plates 46 and 47 on the head 32. For the first portion of movement which is represented by the change of positions of the parts from their positions as shown in FIG. 6 to their positions as shown in FIG. 9, the driver 32, the auxiliary side plates 46 and 47 and the punches 54 and 55 move together integrally without relative movement between each other. During this movement, the pins 56 and 57 at the upper ends of the punches 54 and 55 are guided along the vertical portions 60*a* and 61*a* of the slots 60 and 61 provided in the side plates 29 and 30. Also, during this movement, the ends 62 and 63 of the punches 54 and 55 penetrate the clip 10 and the bottom wall 5 of the roof deck 1. In so doing, the precut tabs 12 and 13 of the clip cause the two tabs 14 and 15 to be cut from the roof deck 1, leaving the tabs extending downwardly as shown in FIG. 9. As the driving stroke continues as a result of the hammer blow, the pins 56 and 57 are guided into the outwardly directed portions 60*b* and 60*c* of the slots 60 and 61. This results in the punches 54 and 55 pivoting from their positions as shown in FIG. 9 to positions as shown in FIG. 10 whereby their ends 62 and 63 are moved away from each other, although the punches 54 and 55 remain intersecting each other. This movement causes the tabs 12, 14 and 13, 15 to be interlocked around the flanges 9 of the support beam 2 into positions as show in FIG. 10 which are the final interlocked and fastened positions. During this final movement, it is the projections 62*c* and 63*c* of the punch ends which

perform the final bending and interlocking operation. Also, during this movement, it should be noted that the circular holes 58 and 59 provide sufficient clearance to permit the pins 56 and 57 to move laterally as they are guided in slots 60 and 61.

Although it has been shown that the tool 16 can be used in its preferred manner to deform a clip and provide it as a fastener for the roof members, it is apparent that the clip need not be used. The tool, without the use of a clip, can be used to deform only the tabs 14 and 15 around the flanges 9 of the support beam 2. If this is done, the resulting connection between the roof deck 1 and the support beam 2 is not nearly as strong as when the clip is used. However, for certain roof construction jobs it may be adequate.

When using the clip, however, it should be emphasized that the advantage is two-fold. Extra fastener strength is provided, as mentioned, and, in addition, the fastener is used as the shear for shearing out the tabs 14 and 15 from the sheet metal roof deck 1. The latter is of great significance since the sharpened edges of the punches 54 and 55 need never be sharpened when the clips are used. However, if no clips are used, there is sufficient wear on the ends 62 and 63 of the punches 54 and 55 that frequent sharpening is required. Frequent sharpening naturally provides short life for the punches and frequent replacement. The use of the clips completely obviates this condition and thereby prolongs the life of the tool considerably.

After the driving stroke is completed and all parts of the tool are in the positions shown in FIG. 10, the parts must be returned to the positions of FIGS. 5 and 6 in order to prepare the tool for a new driving stroke and to provide removal of the tool from its interlocked position with the roof portions. A coil spring 80 is provided for this purpose. It is mounted to react between the upper surface 81 of the frame 20 and the lower surface 82 of the coupling sleeve 37. Obviously, the force on the head 42 must be sufficient to overcome the resistance of this spring on the driving stroke and the spring must provide sufficient force to insure complete return of the parts after the driving stroke.

Although only one preferred form of the invention has been shown and described it should be understood that the invention can be manufactured in many different ways without departing from the true scope of the invention as defined by the appended claims:

We claim:

1. A tool for interlocking a sheet metal clip, a sheet metal panel and a supporting beam having a flange comprising, a frame, a shearing die carried by said frame, one end of the frame having a recess for receiving the sheet metal clip and a projection for engaging a notch in the sheet metal clip for properly locating the clip in said recess in the path of said shearing die and magnetic means for releasably holding said clip after it is properly located, and driving means for driving said shearing die to bend a tab from said sheet metal clip and cut a tab from said panel and bend said tabs together about said flange.

2. A tool for interlocking a sheet metal panel and a supporting beam having a flange comprising, a frame, a head guided for longitudinal movement in said frame, a shearing die pivoted on said head, driving means for moving said head longitudinally of said frame to cause said shearing die to cut a tab from said panel and bend said tab about said flange, guide means in said frame engaging said shearing die to maintain the shearing die fixed relative to the head during the first portion of the driving stroke when the shearing die cuts a tab from the panel and to cause said shearing die to pivot on said head during the second portion of the driving stroke when the shearing die bends said tab about said flange.

3. A tool for interlocking a sheet metal panel and a supporting beam having a flange comprising, a frame, a head guided for longitudinal movement in said frame, a shearing die pivoted on said head, driving means for moving said head longitudinally of said frame to cause said shearing die to cut a tab from said panel and bend said tab about said flange, guide means in the form of a groove in said frame engaging a projection on said shearing die to maintain the shearing die fixed relative to the head during the first portion of the driving stroke when the shearing die cuts a tab from the panel and to cause said shearing die to pivot on said head during the second portion of the driving stroke when the shearing die bends said tab about said flange.

4. A tool for interlocking a sheet metal panel and a supporting beam having two spaced flanges extending toward each other, comprising a frame, a head guided for longitudinal movement in said frame, a pair of shearing dies pivoted on said head, driving means for moving said head longitudinally of said frame to cause said shearing dies to cut oppositely disposed tabs from said panel and bend said tabs about said flanges, guide means in said frame engaging said shearing dies to maintain the shearing dies overlappingly fixed relative to the head during the first portion of the driving stroke when the shearing dies cut said tabs from the panel and to cause said shearing dies to pivot on said head during the second portion of the driving stroke when the shearing dies bend said tabs about said flanges.

5. A tool for interlocking a sheet metal panel and a supporting beam having two spaced flanges extending toward each other, comprising a frame, a head guided for longitudinal movement in said frame, a pair of shearing dies pivoted on said head, driving means for moving said head longitudinally of said frame to cause said shearing dies to cut oppositely disposed tabs from said panel and bend said tabs about said flanges, guide means in the form of grooves in said frame engaging projections on said shearing dies to maintain the shearing dies overlappingly fixed relative to the head during the first portion of the driving stroke when the shearing dies cut said tabs from the panel and to cause said shearing dies to pivot on said head during the second portion of the driving stroke when the shearing dies bend said tabs about said flanges.

6. A tool for interlocking a sheet metal panel and a supporting beam having two spaced flanges extending toward each other, comprising a frame, a head provided with a plunger for guiding said head longitudinally in said frame, said plunger having a free end positioned to be struck a hammer blow for causing longitudinal movement of said head in said frame, a pair of shear members pivoted one on either side of said head and having pins projecting into grooves provided in a wall of said frame, said shear members moving longitudinally with said head when the head is caused to move, the initial lengths of said grooves extending longitudinally of the frame to prevent movement of the shear members relative to each other upon the initial portion of the driving stroke of said head and shear members, the remaining lengths of said grooves being divergent to cause pivotal movement of the shear members across each other during the final portion of the driving stroke of said head and shear members, the initial portion of the driving stroke causing the shear members to cut tabs from the sheet metal panel and extend the tabs between the two spaced flanges of the supporting beam, and the final portion of the driving stroke of said head and shear members causing the shear members to bend the tabs about the spaced flanges.

7. A tool for fastening together a support beam having two spaced flanges extending toward each other and a corrugated sheet metal panel of a type having top surfaces connected between troughs each formed with two upright walls connected together by a bottom wall at a level below the top surfaces, the bottom walls resting in contact with the support beam, comprising a frame, a head provided with a plunger for guiding said head longi-

tudinally in said frame, said plunger having a free end positioned to be struck a hammer blow for causing longitudinal movement of said head in said frame, a pair of shear members pivoted on said head and having pins projecting into grooves provided in a wall of said frame, said shear members moving longitudinally with said head when the head is caused to move, the initial lengths of said grooves extending longitudinally of the frame to prevent movement of the shear members relative to each other upon the initial portion of the driving stroke of said head and shear members, the remaining lengths of said grooves being divergent to cause pivotal movement of the shear members across each other during the final portion of the driving stroke of said head and shear members, the initial portion of the driving stroke causing the shear members to cut tabs from the sheet metal panel and extend the tabs between the two spaced flanges of the supporting beam, and the final portion of the driving stroke

of said head and shear members causing the shear members to bend the tabs about the spaced flanges, the bottom end of said frame being provided with side walls which are spaced from each other by an amount equal to the width of one of said troughs to provide proper alignment of the tool when it is positioned in fastening position in a trough.

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