United States Patent

[11] **3,571,909**

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[54] **METHOD OF JOINING STRUCTURAL MEMBERS OF A LADDER**
4 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **29/509,** 29/522, 29/243.53, 182/194, 182/228
[51] **Int. Cl.** **B21d 39/00,** B23p 11/00
[50] **Field of Search** 29/509, 513, 522, 243.53; 182/194, 228

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ABSTRACT: Exceptional rigidity is imparted to a metal ladder by roll forging tabs at the ends of the steps and which project through the side rails. The roots of the tabs are expanded to fit tightly in the side rail openings and an enlarged head is formed on each tab which bears against the side rail and securely locks the step in place. The enlarged heads are confined between ribs on the side rails, the ribs having mutually divergent opposed faces serving to wedge the parts together.

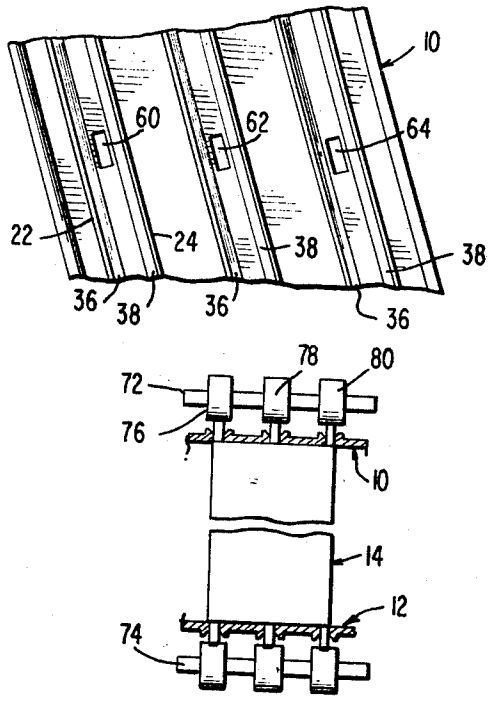


FIG. 1

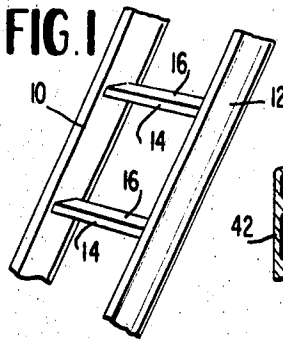


FIG. 2

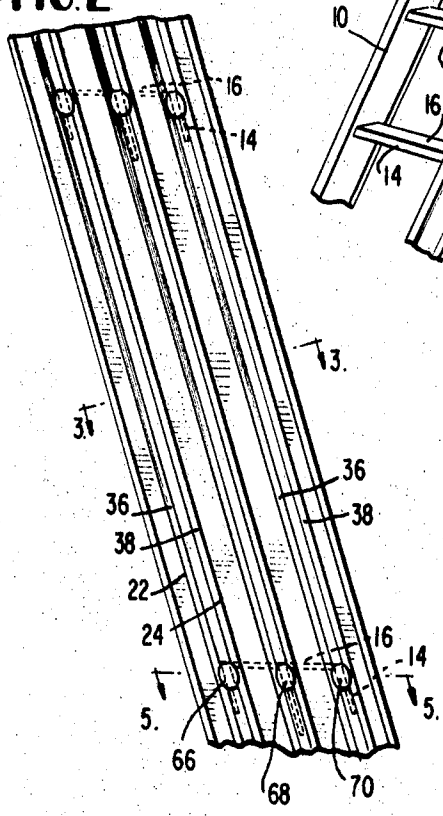


FIG. 3

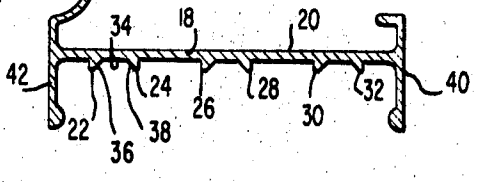
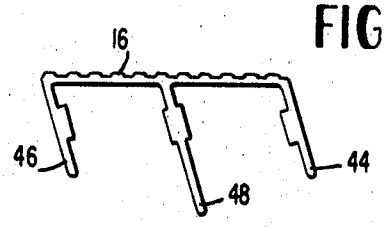


FIG. 4



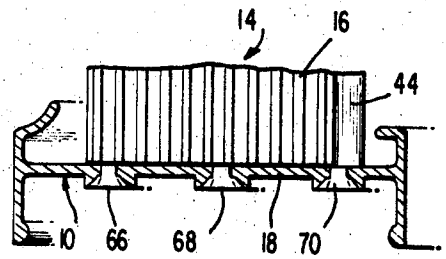


FIG. 5

FIG. 6

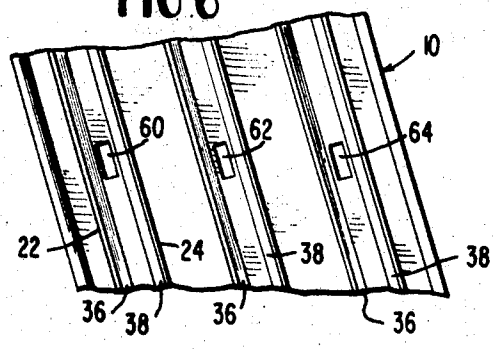
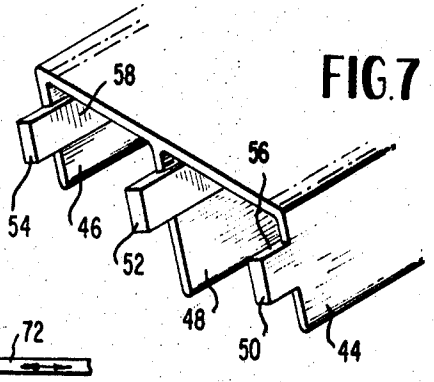


FIG. 7



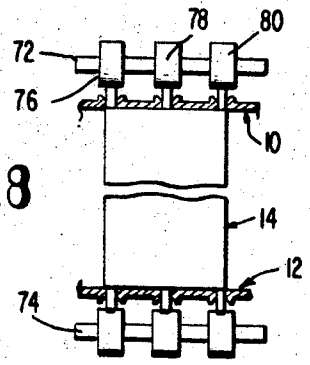


FIG. 8

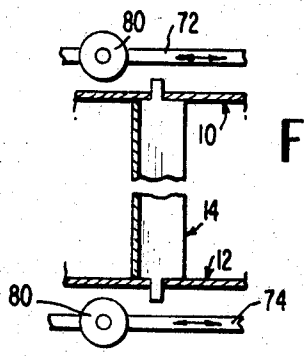


FIG. 9

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METHOD OF JOINING STRUCTURAL MEMBERS OF A LADDER

BACKGROUND OF THE INVENTION

Many methods have been used to fabricate metal ladders including the use of separate fasteners to secure the steps to the side rails, tabs on the steps which project through and are bent over upon the side rails, and the like.

In every instance, however, the construction is such that even though the initial assembly may be sufficiently rigid for the intended purpose, the ladder structure soon becomes loosened incidental to normal usage, displaying substantial free play between the side rails and the steps with concomitant loss of rigidity.

BRIEF SUMMARY OF THE INVENTION

The above disadvantage is overcome in the present instance by utilizing tabs on the steps which project through the side rails and are thereafter roll forged to expand the tabs so as to tightly fit and interlock the component parts. In the process, the tabs are expanded at their roots to fit tightly within the side rail openings receiving them and the enlarged heads formed on the tabs are forged into bearing relation against the side rails so as to effect residual tension-compression forces which defy subsequent loosening. To enhance this effect further, the heads are confined between ribs on the side rails having inclined faces mating with the heads and which effect a wedging action serving to force the parts together.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. 1 is a partial perspective view showing a ladder constructed according to the present invention;

FIG. 2 is a side elevation of the assembly shown in FIG. 1;

FIG. 3 is a sectional view taken through one of the side rails, as indicated by section line 3–3 in FIG. 2;

FIG. 4 is a cross-sectional view taken through one of the step members;

FIG. 5 is an enlarged section taken along the plane of section line 5–5 in FIG. 2 and illustrating the manner of interconnection between the side rails and the steps;

FIG. 6 is an enlarged side elevation of a portion of a side rail showing the tab-receiving openings therein;

FIG. 7 is an end perspective of a step member showing the tab formations thereon;

FIG. 8 is a diagrammatic view showing the roll forging operation; and

FIG. 9 is a side view of FIG. 7 showing further details of the roll forging operation.

DETAILED DESCRIPTION OF THE INVENTION

As shown in FIG. 1, a ladder according to this invention employs the side rails 10 and 12 which are joined and rigidly interconnected by a requisite number of steps 14 for the length of ladder involved. It is to be understood, of course, that the construction contemplates various types of ladders such as a stepladder as shown wherein the tread portion 16 are at an angle to the plane containing the rails, or the treads may be normal to this plane as in a straight ladder.

In any event, the side rails as well as the steps are constructed of metal such as aluminum and the side rails, as shown in FIG. 2, include web portions 18 having smooth inner faces 20 while their outer faces are provided with a plurality of longitudinally extending pairs of ribs. In the illustrative embodiment shown, there are three such pairs of ribs 22,24; 26,28; and 30,32, each of which pairs is spaced apart to expose a narrow strip 34 of the outer face of the side rail therebetween, and the opposing faces 36 and 38 of which are mutually divergent in the direction away from such outer face. In addition, the rails are provided with front and rear rigidifying flanges 40 and 42.

As shown in FIGS. 3 and 6, each step 14 includes the previously mentioned tread portion 16 and the front, rear and intermediate depending flanges 44,46 and 48 corresponding to the three pairs of ribs on the rails 10 and 12 and spaced apart so as to register therewith. The ends of the steps are cut off square except for the projecting tabs 50,52 and 54 as shown in FIG. 6, which tabs are formed as continuations of portions of the flanges 44,48 and 46. In the case of the front and rear flanges 44 and 46, these portions are thickened by the presence of beads 56 and 58 on the inner surfaces of the flanges whereas the intermediate flange 48 is provided with beads along both its sides to form the thickened tab 52. In any case, the tabs are of a thickness or width slightly less than the strips 34 between the pairs of ribs 22, 23; 26,28; and 30,32 so that the openings 60, 62 and 64 provided between these pairs of ribs, as is shown in FIG. 5, receive the step tabs to locate the steps 14 relative to the rails 10 and 12. The tabs are of a length to project beyond the outer edges of the ribs 22,24; 26,28; and 30,32 as is shown in FIG. 7, with the extend of such projection being such that when the tabs are roll forged down to the level of the ribs, the enlarged heads 66, 68 and 70 thus formed bear firmly against the opposed faces 36 and 38 of the ribs and assure a rigid and secure interconnection, without play, between each end of each step and the associated side rails.

As is shown in FIGS. 7 and 8, the roll forging is effected by means of reciprocable carriers 72 and 74 which rotatably carry sets of rollers 76, 78 and 80 and which carriers are urged, as for example by hydraulic mechanism, toward and into engagement with the edges of the ribs as the carrier is reciprocated back and forth to carry the rollers onto and over the projecting tabs. As the process proceeds, the roots of the tabs are expanded into tight filling engagement with the side rail openings and the heads 66, 68 and 70 are formed to function as described above. The carriers 72 and 74 are reciprocated longitudinally with respect to the side rails which, in the embodiment shown, effects a staggered or successive engagement of each set of rollers with the tabs roll forged thereby. If the tabs are aligned normal to the axis of the side rail, the rollers of each set may be staggered. In either case, the pressure loading on the carriers is reduced and spread over a greater length of their movement.

The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned as well as others inherent therein. While the presently illustrative embodiment of the invention is given for the purpose of disclosure, numerous changes in the details of construction and arrangement of parts may be made which will readily suggest themselves to those skilled in the art and which are encompassed within the spirit of the invention and the scope of the appended claims.

I claim:

1. The method of making a metal ladder which comprises: the steps of:

a. forming a plurality of metal steps each having a plurality of projecting tabs at its opposite ends,

b. forming a pair of side rails, each having tab-receiving openings at spaced points therealong, said rails being formed with outwardly diverging ribs adjoining opposite sides of said openings and extending in a direction longitudinal of said side rails,

c. assembling the side rails and steps with the ribs facing outwardly and with the tabs of the steps projecting through and beyond the tab-receiving openings, and

d. roll forging the tabs to such an extent that the portions of the tabs lying within the tab-receiving openings are expanded into tight filling engagement with said openings while the portions of the tabs projecting beyond said openings are rolled down to form enlarged heads bearing firmly against the divergent rib surfaces thus assuring a rigid and firm connection between the steps and the side rails.

2. The method of claim 1 wherein the steps are provided with depending flanges and the tabs are formed as projections on said flanges.

3. The method of claim 2 in which there are three such flanges, one centrally located and one along each edge of the steps and in which the tabs are formed on the inner surfaces of the edge flanges and on both surfaces of the central flange.

4. The method of claim 1 in which the ribs of the side members are continuous and extend along the entire length of such members.