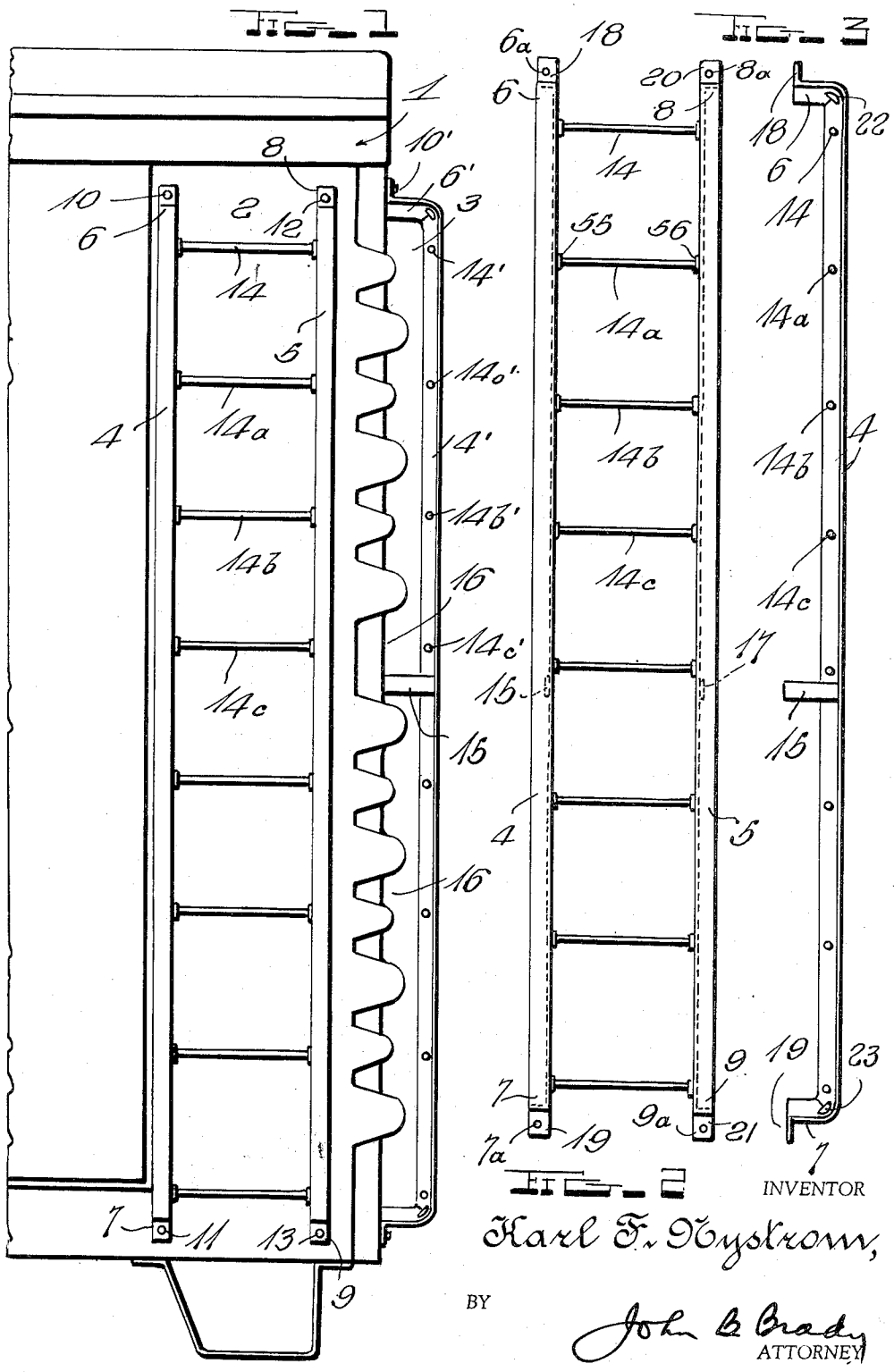
Jan. 8, 1957 K. F. NYSTROM 2,776,793

LADDER CONSTRUCTION

Filed Feb. 1, 1952 4 Sheets-Sheet 1



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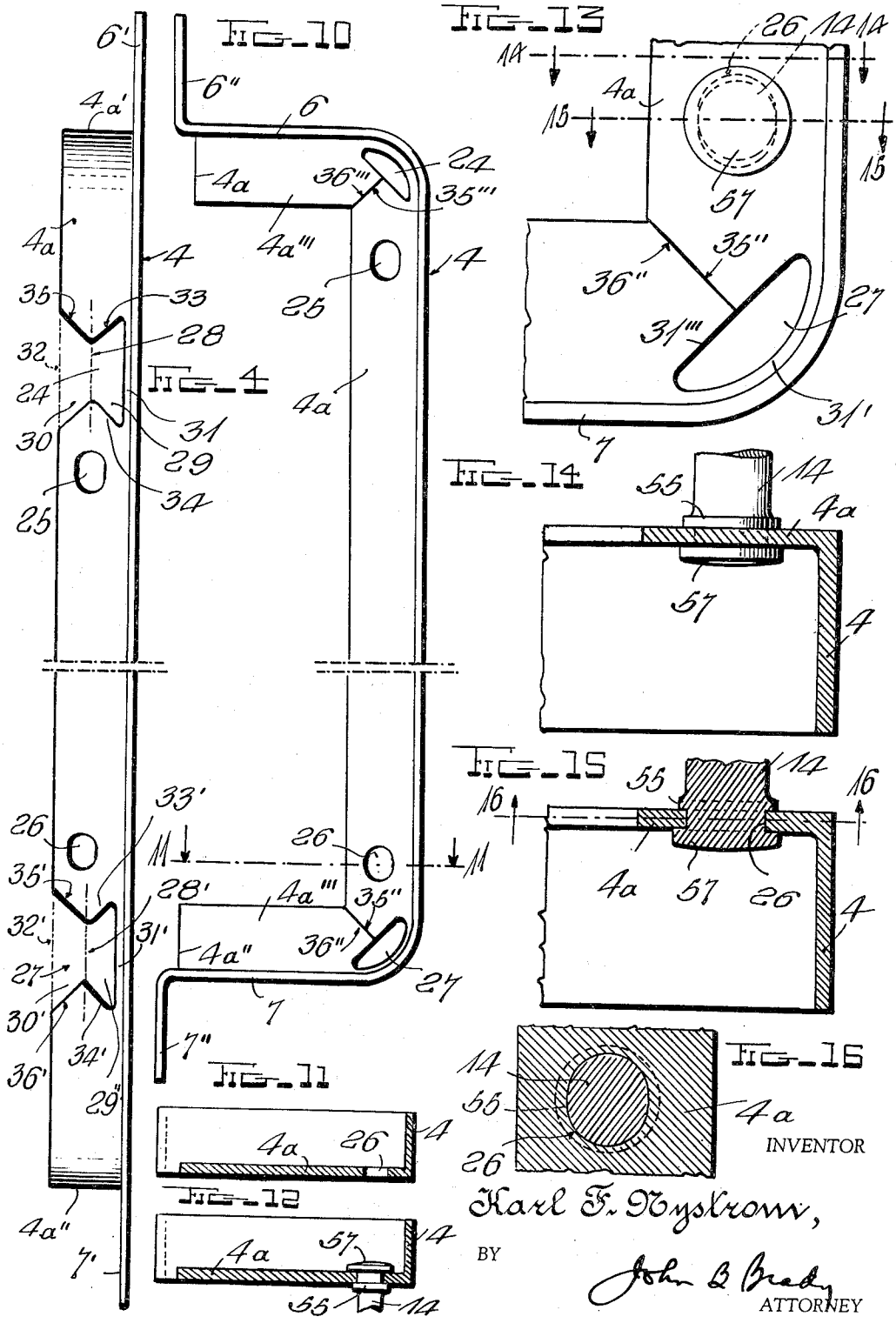
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LADDER CONSTRUCTION

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LADDER CONSTRUCTION

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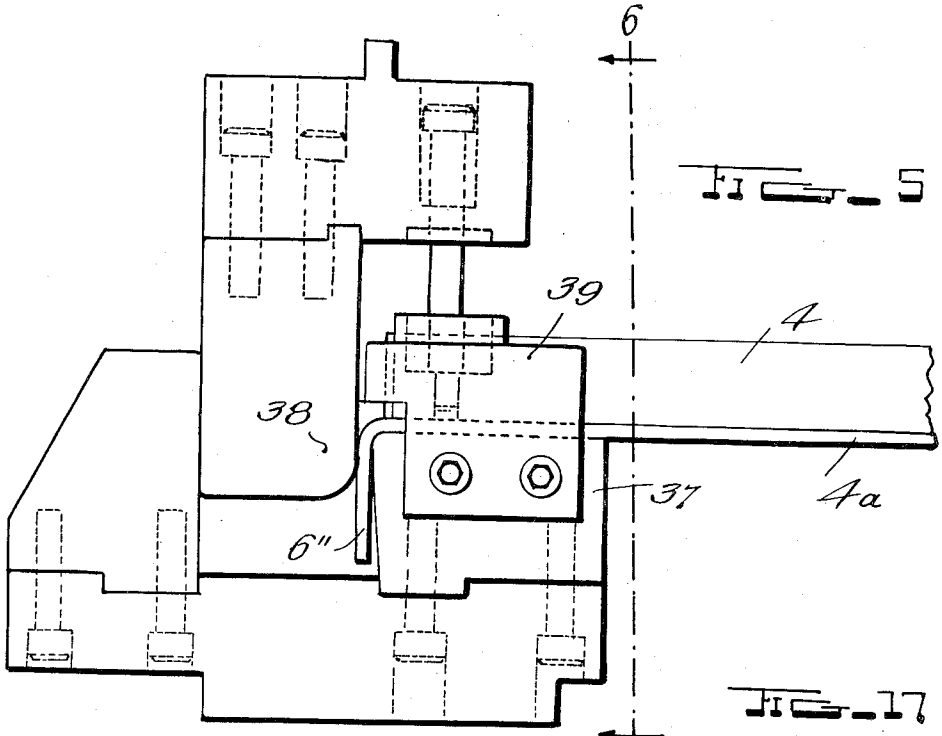


FIG. 5

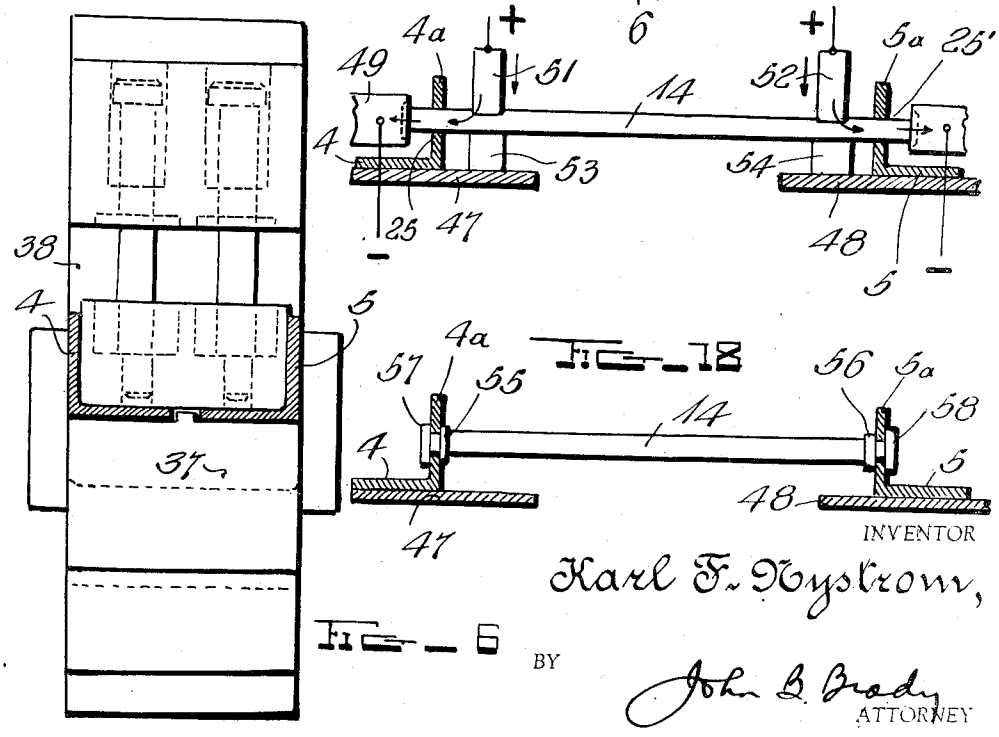


FIG. 17

FIG. 18

FIG. 6

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LADDER CONSTRUCTION

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FIG. 7

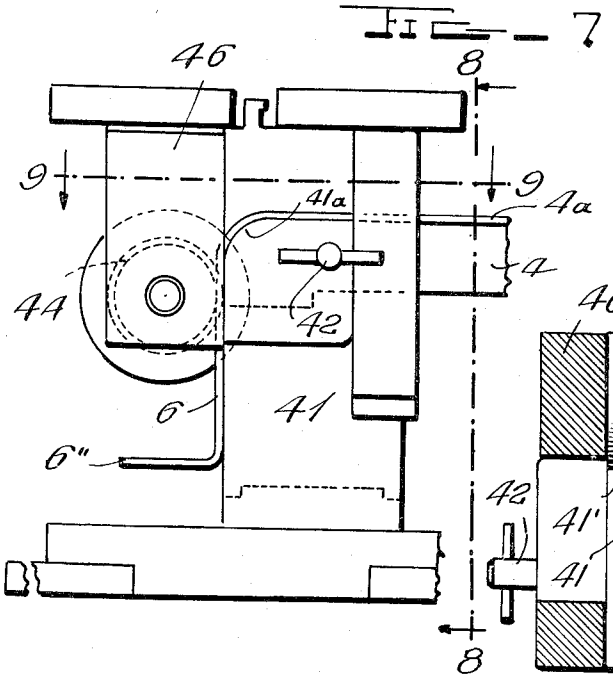


FIG. 9

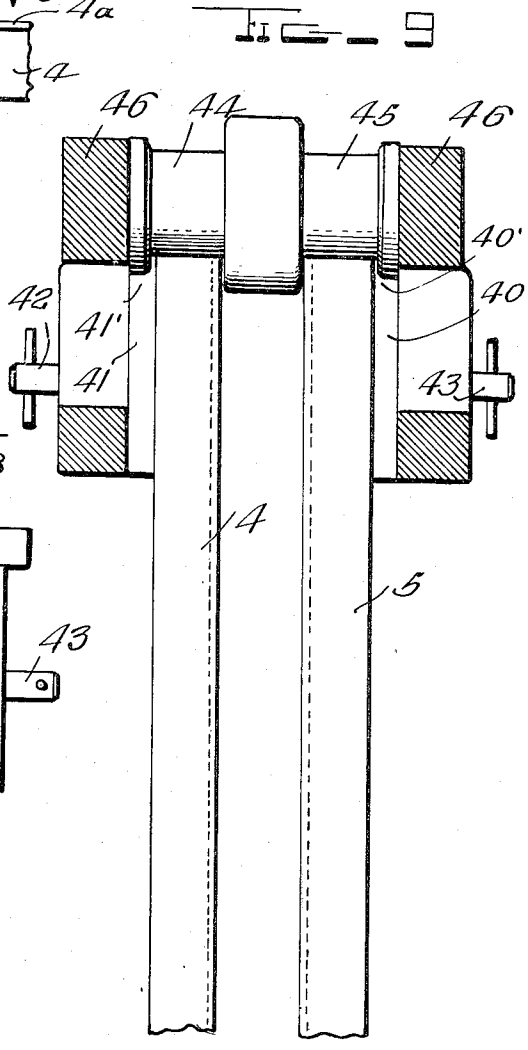
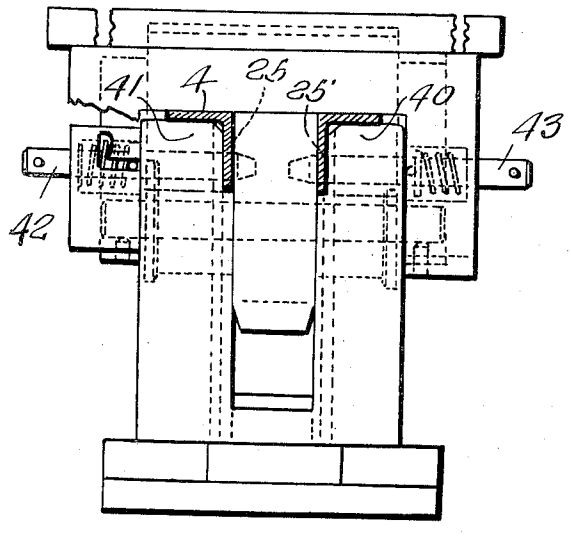


FIG. 8



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2,776,793

LADDER CONSTRUCTION

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Application February 1, 1952, Serial No. 269,384

3 Claims. (Cl. 228—58)

My invention relates broadly to an improved construction of ladder and more particularly to a construction of railway car ladder.

This application is a continuation-in-part of my application Serial No. 99,471, filed June 16, 1949, now Patent 2,630,261, dated March 3, 1953, for Railway Car Ladder.

One of the objects of my invention is to provide a construction of railway car ladder having attachment brackets integral with the rung-supporting portion of the ladder.

Another object of my invention is to provide a construction of railway car ladder with integrally connected attachment brackets at each end thereof and an intermediate rung-supporting portion in which the rungs are so connected with the intermediate portions of the ladder that the rungs are permanently fixed against individual rotation over the life of the ladder.

Other and further objects of my invention reside in the construction of railway car ladders formed from rolled steel sections with integrally connected end supporting brackets as set forth more fully in the specification hereinafter following by reference to the accompanying drawings, in which:

Figure 1 is an elevational view showing the application of the ladder of my invention to the side and end of a conventional freight car; Fig. 2 is a front elevational view of the railway car ladder prior to the application thereof to a railway car; Fig. 3 is a side elevational view of the ladder shown in Fig. 2; Fig. 4 is an elevational view of the rolled steel angle members showing the arrangement of die-punched recesses therein prior to the forming operation, the view being foreshortened in order to show the parts of the angle member in proper proportion on an enlarged scale; Fig. 5 shows the first step in the forming operation utilizing the die-punched blank of Fig. 4 and showing the manner of forming the terminating ends of the brackets; Fig. 6 is a view taken substantially on line 6—6 of Fig. 5; Fig. 7 is a view showing the next succeeding operational step in forming the bracket at each end of the ladder after the terminating ends have been formed as in Figs. 5 and 6; Fig. 8 is a view taken substantially on line 8—8 of Fig. 7 and illustrating the die-punched angle members in position for forming the brackets thereon; Fig. 9 is a view taken substantially on line 9—9 of Fig. 7 and showing more clearly the forming of the brackets on the ends of the die-cut blank of Fig. 4; Fig. 10 is a side elevational view of the completed angle member prepared for receiving the ladder rungs, the view being foreshortened in order to illustrate the structure on an enlarged scale in proper proportions; Fig. 11 is a transverse sectional view taken on line 11—11 of Fig. 10; Fig. 12 is a view similar to the view shown in Fig. 11, but illustrating a rung secured in position; Fig. 13 is an enlarged view of the corner portion of the ladder and integrally connected bracket and showing one of the rungs in position in the ladder; Fig. 14 is a transverse sectional view taken on line 14—14 of Fig. 13; Fig 15 is a transverse sectional

view taken on line 15—15 of Fig. 13; Fig. 16 is a cross-sectional view taken on line 16—16 of Fig. 15 and illustrating particularly the manner of mounting the rungs in the angle members so that the rungs are maintained rigid with respect to the angle members and will not rotate; Fig. 17 is a theoretical view illustrating the manner of electrically heating and processing the ends of each rung into rigid connection with the angle members in forming the ladders; and Fig. 18 is a theoretical transverse sectional view of the completed ladder illustrating one of the rungs secured in position by the angle members according to the process shown in Fig. 17.

My invention is directed to a construction of steel ladders for freight cars wherein rolled steel angle members may be punched and die-pressed to shape for forming brackets on opposite ends of the angle members and prepared to receive the ladder rungs. Perforations of distorted circular shape approximating an ellipse are formed in the angle members for receiving the ladder rungs. The ladder rungs when placed in position through the perforations in the angle members are electrically heated and the metal of the rungs upset on both sides of the perforations in the angle members to secure the rungs in position in the angle members. The rungs are thus fastened as ladder treads in such manner that they remain permanently fixed and cannot rotate during the life of the ladder.

Referring to the drawings in more detail, reference character 1 designates a freight car on the side and end of which I have shown a steel ladder constructed in accordance with my invention installed in the positions 2 and 3. The front elevational view of the ladder shown at position 2 illustrates the manner in which the angle members 4 and 5 are contiguous with the mounting brackets 6, 7, 8 and 9 which are secured by fastening screws or bolts indicated at 10, 11, 12 and 13. The treads of the ladder are formed from rungs illustrated at 14, 14*a*, 14*b*, 14*c*, etc. The side elevational view of the installed ladder shown at position 3 in Fig. 1 illustrates angle member 4′ corresponding to angle member 4 of the ladder shown in position 2. Angle member 4′ is shown contiguous with mounting brackets 6′ and 7′ secured in position by fastening means 10′ and 11′. The angle members 4 and 5 are initially formed with the flanges 4*a* terminating short of the webs to provide adequate extensions of the web at each end of the angle member to provide terminating supporting ends 6′ and 7′ as shown in Fig. 4. After the processing of the angle members according to the method of my invention, these terminating ends 6′ and 7′ are displaced approximately 90 degrees to the positions shown at 6″ and 7″ in Fig. 10 beyond the terminating extremities 4*a*′ and 4*a*″ of the flange 4*a*. Thus the integral brackets at each end of the intermediate portion of the angle member serve to space the plane of the ladder treads from the wall surface to which the terminating ends 6″ and 7″ are attached. The horizontal projection of the ladder is strengthened by the short portions of the flange represented at 4*a*‴ and 4*a*⁗, each of which terminate in angularly disposed ends shown at 36″ and 36‴ as shown in Fig. 10. The edges 35″ and 36‴ form end abutments against which the abutting edges 35″ and 35‴ of intermediate flange 4*a* extend in aligned abutment on lines which extend approximately 45 degrees with respect to the horizontal axis of the flange of the angle member.

The upset ends of the rungs forming treads 14, 14*a*, 14*b*, 14*c*, etc. are indicated at 14′, 14*a*′, 14*b*′, 14*c*′, etc. The angle member 14′ is illustrated as being provided with an intermediate support constituted by spacer member 15 forming a foot attached to angle member 4′ and bearing against the end wall 16 of the freight car for stabilizing the ladder and positively spacing the ladder

from the wall of the car intermediate the ends secured by attachment brackets 6' and 7'.

In Fig. 2 I have shown the ladder of my invention prior to installation against the side or end of a freight car wherein a pair of spacer members 15 and 17 are represented as associated with the angle members 4 and 5. The flattened ends of the bracket members 6, 7, 8 and 9 are shown at 18, 19, 20 and 21, each perforated at 6*a*, 7*a*, 8*a* and 9*a* to receive the fastening means 10, 11, 12 and 13 heretofore explained.

In Fig. 3 I have shown the finished ladder of my invention in side elevational view and showing particularly the flattened ends of bracket members 6 and 7 at 18 and 19 preparatory to the fastening of the ladder with respect to the railway car. The perforation at 22 and 23 facilitates the forming of the mounting brackets integral with opposite ends of the angle member 4 as will be hereinafter described in more detail.

In Fig. 4 I have shown one of the rolled angle members which extends the full height of the freight car and which is prepared on a punch press having cut-out portions and perforations in flanges 4*a* as represented at 24, 25, 26 and 27. The cut-out portions are shown at 24 and 27 adjacent opposite ends of flange 4*a* of angle member 4, while the perforations for the first and last rungs of the ladder are represented at 25 and 26. The shape of the cut-out portions 24 and 27 and the perforations 25 and 26 are important features in carrying out the method of my invention, and it will be observed that these cut-out portions are each formed by a pair of adjacent trapezoids having a common intermediate boundary with the sides of the trapezoids extending outwardly in opposite directions from said common intermediate boundary. The intermediate boundary for the pair of adjacent trapezoids extends on the theoretical axis designated by dotted line 28 forming the two adjacent trapezoids, one of which is designated at 29 and the other of which is designated at 30. The trapezoidal figure 29 in the original cut-out portion 24 includes the parallel extending sides 28 and 31, while the adjacent trapezoidal figure 30 includes parallel extending sides 28 and 32. The other two sides of the trapezoidal figure 29 taper toward each other as represented at 33 and 34. The two nonparallel sides of trapezoidal figure 30 taper toward each other as represented at 35 and 36. The cut-out portion 27 is identical in shape with the cut-out portion 24, and for purposes of showing the symmetry of the figures, I have illustrated the elements by corresponding primed reference characters 28'–36'. The perforations for the ladder rungs are formed on distorted curves which are elongated in the direction of the axis of the flange 4*a* approximating the elliptical shapes as shown at 25 and 26. The angle member 4 thus punched out and perforated is fitted into the press brake shown in Fig. 5. The press brake is shown as including a bottom die section 37 and an upper die section 38 with a clamp 39 extending therebetween for solidly gripping each angle member as represented by angle member 4 and pressing the mounting bracket terminating end 6'' thereon as pressure is applied to the upper die section 38 forcing it to move downwardly across the projecting end of the angle member 4, causing the terminating end 6'' to be formed in a plane normal to the plane of the flange 4*a* as shown. Two angle members 4 and 5 are pressed simultaneously as shown more clearly in Fig. 6, from which it will be observed that the upper die section 38 forces the terminating ends of both angle members 4 and 5 over the forming edge of the bottom die section 37. The terminating end for the opposite end of each angle member 4 and 5 is similarly formed by reversing the position of the angle members 4 and 5 in the press brake illustrated in Figs. 4 and 6.

The terminating ends on the angle members having been formed, the integral brackets are next formed by insertion of the angle members 4 and 5 in another press brake of the construction illustrated in Figs. 7–9 in an

inversed direction thus forming brackets on the angle members. In this operation the two angle members 4 and 5 are inserted, inversely with respect to the positions in which they were processed in the press brake shown in Figs. 5 and 6, over bottom die sections illustrated at 40 and 41 and clamped thereto by retractable and projectible spring actuated pins 42 and 43 which secure the angle members 4 and 5 in position by extension through perforations 25 and 25' respectively. The bottom die sections 40 and 41 have curved corner faces represented, for example, at 40' and 41' in Fig. 9 with which the rollers 44 and 45 carried by the upper die 46 co-act. The forced downward movement of upper die 46 rolls the bracket 6 on the end of the angle member 4 as represented in Fig. 7. Simultaneously, a similar bracket 8 is rolled on angle member 5 under the action of roller 45 operating over the curved face 40' of bottom die section 40. Upon reversal of the ends of angle members 4 and 5, the brackets 7 and 9 are rolled onto the opposite ends of the angle members.

The deformation of the metal at each end of the angle members 4 and 5 which takes place is shown more clearly in Fig. 13 where it will be observed that the trapezoidal figure 29' of cut-out 27 is distorted so that the original linear side 31' and the nonparallel sides 33' and 34' become compositely the curved edge 31'' and the linear boundary edge 31''' in Fig. 13, while the nonparallel sides 35' and 36' of the original trapezoidal figure 30' abut edge-to-edge as represented at 35'' and 36'' along a substantially radially extending line passing through the segment bounded by arc 31'' and chord 31'''. A similar deformation occurs at each end of the angle members.

Fig. 17 illustrates the manner of applying the rungs which form the treads of the steel ladder. The angle members 4 and 5 are positioned longitudinally on spaced supports 47 and 48 with the steel rungs in the form of rods illustrated at 14 extending loosely through the aligned perforations of distorted shape represented at 25 and 25' in the flanges 4*a* and 5*a* of the angle members 4 and 5 and projecting substantially beyond the interface of the flanges 4*a* and 5*a* as shown. The angle members 4 and 5 are moved to a position in a press where the projecting ends of rung 14 are clamped between the transversely aligned pressure heads 49 and 50. Simultaneous with the application of pressure in an axial direction along rung 14, the rung 14 is gripped by clamping electrodes 51 and 52 which move downwardly against the steel rung 14 immediately adjacent the sides of flanges 4*a* and 5*a* in alignment with the anvil supports 53 and 54. The electrodes 51 and 52 are connected to one side of a heavy current source, so that current of the same polarity is fed to each end of a rung 14. The other side of the heavy current source connects to the pressure heads 49 and 50. For purposes of explanation I have shown the positive side of the heavy current source connected with electrodes 51 and 52, and the negative side of the heavy current source connected with pressure heads 49 and 50. Under conditions of application of heavy current to the ends of the rung and application of pressure axially of the rung, the two ends of the rung are raised to a red heat and the metal of the rung softened sufficiently to upset the ring, so that the metal of the rung is pliable and flows to produce a swaging of the metal between the electrode 51, and aligned anvil 53 and the inside surface of the perforated flange 4*a* as represented at 55, and a similar swaging of the metal at 56 between the inside surface of the perforated flange 5*a* and the electrode 52 an aligned anvil 54. The upset ends of the rung 14 are pressed into the flattened heads represented at 57 and 58 thereby permanently securing the rung 14 in position against rotation. The angle members 4 and 5, after being released from the clamping engagement by heads 49 and 50, which are withdrawn therefrom in an axial direction, and after raising of electrodes 51 and 52, which are withdrawn in a vertical direction, are moved to the next tread position in the ladder and the

process heretofore explained repeated for securing the next succeeding rung in position. This same process is repeated until all of the rungs of the ladder are permanently secured in position.

In Figs. 14–16 I have shown more clearly the manner in which the rung is permanently secured in position by the upset metal extending over each of the opposite parallel surfaces of the flange 4*a* of angle member 4. In Figs. 13 and 16 the manner in which the metal of the rung flows into the elongated perforation 26 has been brought out which clearly illustrates the means provided for preventing rotation of the rungs. That is to say, the hot metal of the rungs flows into the distorted perforations in the flanges of the angle members and by virtue of the approximately elliptical or elongated shape of the metal section within the perforation, rotation is obstructed.

Right and left angle members are provided in the fabrication of each ladder. When viewed from the front of the ladder, the webs of the right and left hand angle members are directed away from each other with the flanges adjacent each other. By virtue of this construction, the upset ends 57 of the treads are substantially hidden from view when looking at the front of the ladder and cannot become obstructive as a source of ensnarement during use of the ladder.

I have found the method of manufacturing railway car ladders as set forth herein highly practical and the construction of such ladders efficient and useful. I realize, however, that modifications may be made, and I desire that it be understood that no limitations upon my invention are intended other than may be imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A ladder stile comprising an angle member having its sides disposed in planes substantially at 90° to each other and one side extending beyond the limits of the other side, the shorter side having spaced cut-out portions therein adjacent opposite ends of the stile, said cut-out portions each being constituted by pairs of substantially coplanar trapezoidal shaped openings with the shorter sides thereof extending in alignment with the central axis of the shorter side of said angle member and the longer side of one opening extending in alignment with the edge of the shorter side of said stile and the longer side of the other of said openings being displaced from the plane of the longer side of said stile whereby opposite ends of said stile may be displaced to form integral supporting brackets with the opposite ends of one of said last mentioned trapezoidal shaped openings being displaceable to form a chord subtending a segmental opening constituted by the curvature of said last mentioned longer side of said last mentioned trapezoidal opening and the sides of the first mentioned trapezoidal shaped opening adjacent the shorter side of the stile being displaceable toward each other to form abutting edge-to-edge limit stops extending on a line normal to the direction of the chord formed by the opposite sides of said other trapezoidal shaped opening, said segmental shaped opening extending in a curved path spaced from the plane of the longer side of said stile to maintain an open segmental aperture through said stile adjacent each of the brackets thereon.

2. A ladder stile comprising an angle member having its sides disposed in planes substantially at 90° to each other and one side extending beyond the limits of the other side, the shorter side having spaced cut-out portions therein adjacent opposite ends of the stile, said cut-out portions each being constituted by pairs of coplanar polygonal openings each having a short side and a long side with the short sides of the respective openings extending end-to-end and the long side of one opening extending in alignment with the edge of the shorter side of said stile and the long side of the other of said openings being displaced from the plane of the longer side of said stile whereby opposite ends of said stile may be displaced to form integral supporting brackets with the boundaries of said polygonal openings forming a segmental aperture and a pair of lineal portions extending from the edge of the shorter side of the stile to the first mentioned segmental opening therein and the sides of the first mentioned polygonal opening adjacent the longer side thereof abutting edge-to-edge to form limit stops extending on a line normal to the direction of the displaced position of the sides of said first mentioned opening, the aperture formed by said second mentioned opening extending in a path spaced from the plane of the longer side of said stile to provide said segmental aperture through said stile adjacent each of the brackets thereon.

3. A ladder stile and integral end support bracket comprising an angle member having the sides thereof disposed in planes substantially at 90° to each other with one side of the angle extending beyond the ends of the other side of the angle, the shorter side thereof having cut-outs formed therein adjacent each end thereof, each of said cut-outs having a lineal side spaced from the longer side of said angle and being tapered inwardly toward each other in converging relation to a position substantially coincident with the central axis of said shorter side of the stile and then tapered outwardly in diverging relation to each other and opening into alignment with the edge of the shorter side of said stile, whereby the opposite ends of said stile may be displaced to form integral supporting brackets for said stile with the converging portions of each cut-out aligned to form a chord with respect to a segmental curve formed by the aforesaid lineal side of the said cut-out and with the diverging portions of each cut-out abutting edge-to-edge in a direction normal to the direction of said chord for reinforcing said bracket with respect to said stile.

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