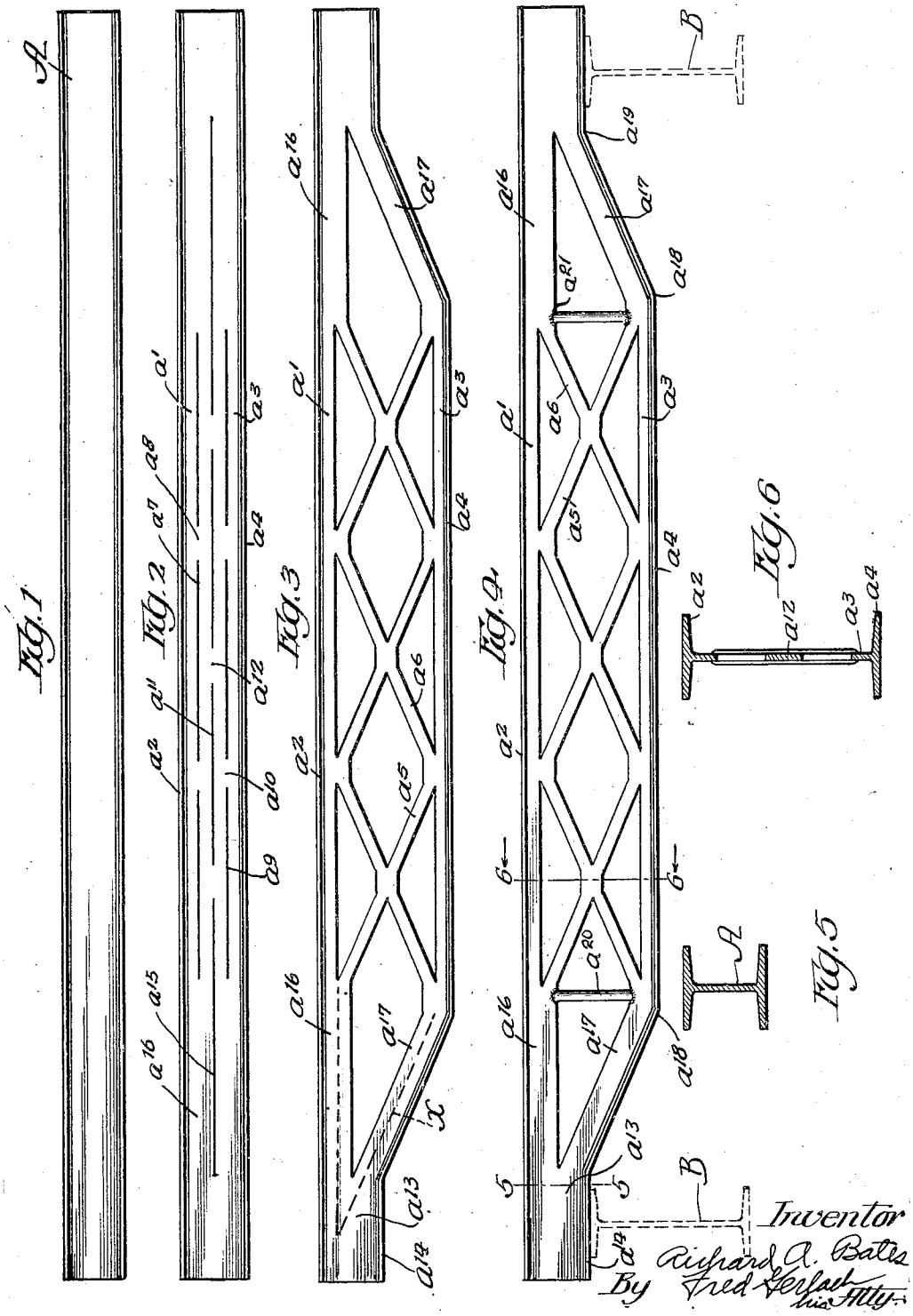
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JOIST AND THE MANUFACTURE THEREOF

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RICHARD A. BATES, OF EAST CHICAGO, INDIANA, ASSIGNOR TO BATES EXPANDED STEEL TRUSS COMPANY, OF EAST CHICAGO, INDIANA, A CORPORATION OF DELAWARE

JOIST AND THE MANUFACTURE THEREOF

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The present invention relates to expanded metal joists or beams and the manufacture thereof.

One object of the invention is to provide a joist or supporting beam of the type that is formed of a flanged metallic structural element such, for example, as an I-beam, and has the central portion of the web which connects the flanges slitted and expanded to form diagonal compression and tension members or trussing, in which the ends of the joist are not expanded or slit so that they are of maximum strength and the end portions of the lower flange form integral bearing members whereby the joist may be supported or held in its operative position.

Another object of the invention is to provide a joist or beam of this character in which the end truss members are formed by the lower flange and the lower portion of the web, and the metal of the intermediate portion of the web which would otherwise form the end trussing is utilized to reinforce these end members so that they are capable of withstanding the additional pressure and tension to which they are subjected and the joist is strengthened at the zones thereof adjacent and inwardly of the bearing members.

A further object of the invention is to provide a method of manufacturing joists or beams of the aforementioned construction by which the joists may be produced at a comparatively low cost and with a minimum number of operations.

A still further object of the invention is to provide a joist or beam of the expanded metal type which is generally of new and improved construction and may be readily and economically fabricated and utilized for building and other purposes.

Additionally it is contemplated as one of the objects of the invention to improve the joist construction illustrated in an application of Charles I. Bates for Letters Patent of the United States for improvements in "Expanded metal joists and the manufacture thereof", filed October 31, 1927, and serially numbered 229,835.

Other objects of the invention and the various advantages and characteristics of the present construction will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features hereinafter set forth and more particularly defined by the claims at the conclusion hereof.

In the drawing which accompanies and forms a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views: Fig. 1 is a side elevation of an I-beam from which the joist or supporting beam is formed. Fig. 2 is a similar view illustrating the manner of slitting the beam before it is expanded. Fig. 3 is a side elevation of the beam, after it has been expanded. Fig. 4 is a side elevation of the finished joist. Fig. 5 is a section taken on the line 5—5 of Fig. 4. Fig. 6 is a section taken on the line 6—6 of Fig. 4.

The invention is exemplified in a joist, beam, or structural supporting element comprising a longitudinal upper member which consists of a vertical web a' and a horizontal flange a^2 projecting laterally from both sides thereof and forming the top of the joist; a lower longitudinal member which consists of a vertical web a^3 and a horizontal flange a^4 projecting laterally from both sides thereof and forming the bottom of the joist; a series of substantially parallel diagonal truss members a^5 which extend between the vertical webs of the upper and lower members; and a series of oppositely extending diagonal truss members a^6 which extend between the webs of the upper and lower members and are medially united with the truss members a^5. All of the parts or members which together form the joist are integral and are formed of an I-beam or bar A, such, for example, as the one shown in Fig. 1. The upper and lower flanges of this bar correspond to the flanges a^2 and a^4 of the joist.

In the manufacture of the joist, the web of the beam is first sheared to form an upper series of longitudinally aligned slits a^7, with bonds or intact portions a^8 between them, a lower series of longitudinaly aligned slits a^9,

with bonds a^{10} between them, and a central or intermediate series of slits a^{11}, with bonds a^{12} between them. The slits of the lower series are parallel with the slits of the upper series and are aligned and coextensive therewith. The slits of the intermediate series are equal in length to the slits a^7 and a^9 and are staggered relatively thereto so that the bonds a^{12} are positioned midway between the bonds a^8 and a^{10}. The portions of the web between the slits form strands which, when expanded or spread apart, constitute the truss members a^5 and a^6. All three series of slits a^7, a^9 and a^{11} terminate inwardly of the ends of the beam, so as to form supporting portions a^{13}. These portions are left uncut and as a result are of a height equal to the entire width of the beam A that is the aggregate height of the web a', the strands between the slits a^7 and a^9 and the slits a^9 and a^{11}, the web a^3 and the flanges a^2 and a^4. The portions of the flanges a^4 which underlie the portions a^{13} form bearing plates a^{14} at the ends of the joist whereby the joist may be supported in its operative position upon a suitable support B, such, for example, as a wall or beam structure (see Fig. 4). In operation the plates a^{14} serve to hold the joist against transverse rocking and prevent the joist from cutting into the supporting structure B. A characteristic forming the joist-ends in this manner is that they are of a maximum strength due to the fact that they are uncut, and no additional or non-integral reinforcement is necessary. Additionally the bearing plates a^{14} are formed as an integral part of the portions a^{13}, thus dispensing with the use of separate members which heretofore have been employed and the incident welding operation.

The end slits of the intermediate series a^{11} are extended as at a^{15} toward the beam-ends. The extended parts of these slits terminate however inwardly of the end-edges of the beam a sufficient distance to give the supporting portions a^{13} the desired or necessary length. The upper slits a^7 are omitted from the portions of the beam which are disposed inwardly of the portions a^{13} so as to eliminate compression or downwardly and outwardly extending members adjacent the beam-ends and so that the upper member of the joist is additionally reinforced adjacent the ends thereof. The uncut metal of the web between the top flange a^2 and the extended parts a^{15} of the slits a^{11} forms portions a^{16}. These portions are of a height equal to the aggregate height of the vertical web a' and the strands between the slits a^7 and a^{11}, and operate to reinforce the joist at the places where most needed. A characteristic of terminating or omitting the slits a^7 at the ends of the beam as set forth is that there are only tension truss members adjacent the beam-ends and the metal which would otherwise form downwardly and outwardly extending compression members adjacent the ends of the joist, as in the criss-cross trussing of the central portion, is utilized to provide additional reinforcement against bending movement. The slitting arrangement so far described exemplifies a method of slitting the joist preparatory to expansion, by which the upper member is reinforced by an integral web portion adjacent the ends or supporting portions of the joist.

The lower series of slits is co-extensive with the upper series, as previously pointed out, and consequently the lower slits a^9 are omitted from the portions of the beam which are disposed inwardly of the portions a^{13}. The metal of the web between the lower flange a^4 and the extended parts a^{15} of the slits a^{11} is left uncut and forms portions a^{17}. The latter are of a height which corresponds to the aggregate height of the vertical web a^3 and the strands between the slits a^9 and a^{11}. These portions a^{17}, being connected at their outer ends to the portions a^{13} and at their inner ends to the outer bonds a^{10}, are deflected during the expansion of the beam, so that they extend upwardly and outwardly as shown in Fig. 3, thus forming tension members at the ends of the joist. A characteristic of slitting the beam as set forth and a result is that the end truss members are formed during the expansion operation and include the lower flange a^4 which operates to strengthen the lower member and the criss-cross diagonal members a^5 and a^6 at the center of the beam against transverse bending movement. Additionally, the metal between the slits a^9 and a^{11} is utilized to strengthen and reinforce the end truss members instead of being sheared away and scrapped as in the case of the joist illustrated in the aforementioned application of Charles I. Bates. Because the end truss members herein illustrated receive the major part of the tension, it is of great importance that they be reinforced and include more metal than the central truss members. By eliminating compression members at the ends of the joist and forming the end truss members as set forth, the intersection of the stress lines in the portions a^{16} of the upper member and the end tension members a^{17} are projected so as to reach or extend beyond the points of support, as indicated by dotted lines X in Fig. 3.

After the beam A has been slitted as described, it is heated and the upper and lower flanges a^2 and a^4 are spread apart in parallelism by suitable expanding mechanism into the position shown in Fig. 3. This expanding operation stretches and deflects the strands of the web formed by the slits, into the diagonal truss members a^5 and a^6, leaving their ends joined to the web of the upper and lower members of the beam and their

medial portions joined together. This forms a series of diamond shaped openings in the web and permits the extent of expansion necessary to form a joist of any desired height. The expanding operation also stretches and deflects the portions a^{17} into the end tension members, said portions bending at the points a^{18} which are disposed adjacent the end bonds a^{10} and at the points a^{19} which are located at the inner ends of the portions a^{13}. The metal at the ends of the beams which is included in the portions a^{13} being uncut is left in its original form. The slits a^{7} are spaced from the flange a^{2} a greater distance than the slits a^{9} are spaced from the flange a^{4}, to give greater strength to the upper member.

Struts a^{20} are placed between the upper and lower longitudinal members of the joist in the end openings, to act as vertical compression members between said longitudinal members. These struts have their upper ends welded as at a^{21} to the inner ends of the portion a^{16} and their lower ends welded to the end bonds a^{10}. By positioning the struts a^{20} as set forth, that is, a suitable distance from the ends of the beam, downward stresses are transmitted directly from the upper member to the lower member at the most suitable points or locations.

The invention exemplifies, a joist which is formed of a slitted expanded I-beam with diagonal truss members which serve as compression and tension members to increase the strength of the joist, and in which the ends of the joist are not expanded or slit so that they are of a maximum height and strength and the end portions of the lower flange form integral bearings or supporting surfaces; a joist of this character in which the end truss members are formed during the expansion operation and include the lower flange and the intermediate and lower portion of the web; and also a method of manufacturing the joist which includes only a minimum number of operations and permits the joist to be produced readily and at a low cost.

The slitting may be advantageously done in a machine of the character set forth in an application filed November 5, 1926 by Albert J. Bates, jr., and serially numbered 141,702. The expanding may be done in a machine of the type set forth in Letters Patent No. 1,260,857, dated March 26, 1918.

The invention is not to be understood as restricted to the details set forth, since these may be modified within the scope of the appended claims, without departing from the spirit and scope of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent, is:

1. That improvement in the manufacture of metal joists which consists in slitting the medial portion of a flanged beam on three longitudinal lines to form an upper and a lower longitudinal member and two intermediate and side by side series of expansible strands with bonds between themselves and the members, and slitting the ends of the beam from points adjacent the ends of the series of strands to points located inwardly of the extreme end parts of the beam to form single expansible strands in substantial alignment with and in the nature of continuations of the lower member; and then expanding the beam to space the lower longitudinal member from the upper member and to form of the two side by side series of expansible strands oppositely extending centrally united diagonal truss members adjacent the medial portion of the beam, and of the single expansible strands end truss members extending upwardly from the lower member and connected directly to and integral with the ends of the upper member.

2. That improvement in the manufacture of metal joists which consists in slitting the medial portion of an I-beam on three longitudinal lines to form an upper and a lower longitudinal member and two intermediate and side by side series of expansible strands with bonds between themselves and the members, and slitting the ends of the beam on the intermediate line to points located inwardly of the extreme ends of the beam to form single expansible strands in substantial alignment with and in the nature of continuations of the lower member; and then expanding the beam to space the lower longitudinal member from the upper member and to form of the two side by side series of expansible strands oppositely extending centrally united diagonal truss members adjacent the medial portion of the beam, and of the single expansible strands end truss members extending upwardly from the lower member and connected directly to and integral with the ends of the upper member.

3. An expanded metal joist formed of a flanged beam and comprising an upper and a lower longitudinal member, and oppositely extending centrally united diagonal truss members acting as tension and compression members in the medial portion of the beam and formed integrally with said upper and lower longitudinal members, the ends of the lower member extending upwardly and outwardly to form tension truss members at the ends of the joists and being connected directly to and formed integrally with the ends of the upper member.

4. An expanded metal joist formed of a flanged beam and comprising an upper and a lower longitudinal member, and oppositely extending diagonal truss members acting as tension and compression members in the

medial portion of the beam and formed integrally with the upper and lower members, the ends of the lower member being of greater height than either the central portion of said lower member or the diagonal truss members and extending upwardly and outwardly to form tension truss members at the ends of the beam.

5. An expanded metal joist formed of an I-beam and comprising an upper and a lower longitudinal member, and oppositely extending centrally united diagonal truss members acting as tension and compression members in the medial portion of the beam and formed integrally with the upper and lower members, the ends of the lower member being of greater height than either the central portion of said lower member or the centrally united diagonal truss members and extending upwardly and outwardly to form tension truss members at the ends of the beam, the upper portions of the ends of the lower member being connected directly to and formed integrally with the ends of the upper member.

Signed at East Chicago, Indiana, this 26th day of October, 1927.

RICHARD A. BATES.