PATENT SPECIFICATION

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(54) PRESS CONNECTION

(71) We, MESSERSCHMITT-BÖLKOW-BLOHM GESELLSCHAFT MIT BESCHRANKTER HAFTUNG, of 8000 Munchen, German Federal Republic, a Company organised and exising under the laws of the German Federal Republic, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an improved method of making a force-fit connecion, and preferably a cold-welded connection, between components preformed respectively with a rib and a channel dimensioned so that the rib is a force-fit in the channel.

In accordance with the present invention there is provided a method of making a force-fit connection beween components preformed respectively with at least one rib and at least one channel dimensioned so that the rib is a force-fit in the channel, at least one of said components being additionally formed or provided at a position spaced from its said rib or channel with a strengthened (as herein defined) bearing area, the method comprising introducing a wedge or other pressure-applying tool to exert an expansion force between the components such that the rib is forced relatively into the channel, said bearing area serving to resist, or assisting in resisting, the reaction force generated by the tool.

The expression "strengthened" used above and in the appended claims refers to an inherent strengthening of the component in the region of the bearing area either by the local thickness of the material of the component or by virtue of the structure of the component, a junction of two walls of the component occurring in the region of the bearing area. Although in some embodiments of the invention it is contemplated that extraneous means, such as a clamp, may be utilised to supplement the resistance of each bearing area to the expansion force such extraneous means is not regarded as providing *per se* the inherent strengthening called for by claim 1.

A wedging tool may be forced through a gap between a rear surface of the said channel or rib of said other component and a bearing surface of said bearing area of said one component, said wedging tool having transversely opposed pairs of lateral rollers, successive pairs of rollers, in the front-to-rear direction of the tool, extending further from the axis of the tool than the preceding pair.

The method of the invention may be used for the cold-welded connection of two pallet components one of which has a rib along one edge thereof and the other of which is formed with a channel in one side wall of a recess therein, the rib being a force fit in the channel and the channel opening toward an opposite side wall of the recess flanking said bearing area, the method comprising exerting an expansion force between a surface of said one component to the rear of the rib and said opposite side wall of the recess to force the rib into the channel.

Alternatively, the method of the invention may be used for the cold-welded connection in end-to-end relation of two hollow, metal components each comprising lateral walls joined by cross walls, free end portions of the lateral walls of each component extending beyond the nearest cross wall at the ends of the components to be connected, the free end portions of the lateral walls of one component being locally thickened and formed with mutually opposed channels in the regions of the adjacent cross wall and the free end portions of the lateral walls of the other component being elastically deformable toward directed ribs which are each a force fit in one another and formed with outwardly one of said channels, the method comprising telescopically forcing said end of said other component into said end of said one component until said ribs come into alignment with said channels transversely of the components and then applying an expansion force to said free end portions of the lateral walls of said other component by means of a tool inserted between them to force the ribs into the channels.

In yet another embodiment, the method of the inventionis used for the cold-welded connection in end-to-end relation of two hollow, metal components each having lateral walls joined by cross walls, the lateral walls of each component extending beyond the nearest cross wall at the end of said component to be connected and defining with said cross wall a pair of channels mutually opposed across said component, the method comprising locating said components in end-abutting relation, locating in the space bounded by the abutted lateral walls and said nearest cross walls a pair of mutually inverted components each of which has a pair of ribs which are force fits in the channels of abutted lateral walls and inserting between said mutually inverted components a tool capable of exerting an expansion force between them which is resisted by the reinforcements represented by the abutted lateral walls so that the ribs are forced into the channels to effect a cold-welded connection between said end-abutted components.

In the method according to either of the immediately preceding two paragraphs, during the application of the expansion force the channel-formed member or members may be protected against outward deformation in the bearing areas thereof by retention means removably positioned on opposite sides of said member or members.

In yet another embodiment of the invention a jacking tool is used relatively angularly to move the components in such a way that a projection on said other component slidably abuts a curved bearing surface of the bearing area of said one component which is spaced from the said rib or channel thereof so that the bearing surface guides said other component to insert the rib in the channel.

Preferred embodiments of the invention will now be described with reference to the accompanying diagrammatic drawings, in which:—

Figure 1 shows a first example of a connection made in accordance with the method of the invention,

Figures 2 and 3 show two examples of the inter-connection of two hollow components,

Figure 4 is a side view of a wedge-like rolling tool for the production of a cold-weld connection according to Figures 1 to 3,

Figure 5 is a cross-section through a corner connection between two hollow components,

Figure 6 shows a connection similar to that of Figure 2, but in which a support device is used, and

Figure 7 shows a similar arrangement to Figure 6 with a support device of modified construction.

Referring to Figure 1 a cold-welded pressed connection 2 is shown for two pallet components 4 and 6. The cold-weld connection is achieved by connecting a channel 8 formed in component 4 and a rib 10 which is formed along an edge of the component 6. The rib 10 has a width greater than the channel sufficient to obtain a cold-weld when the rib 10 is forced into the channel 8. The channel 8 is defined by a side wall 12 longer than an opposed side wall 14. These walls correspond to the longer and shorter side walls 16 and 18 respectively of the rib 10.

The channel 8 opens towards the surface 20 of a bearing area of the component 4 separated from the channel 8 by a recess 22. The bearing area behind the surface 20 is of high strength because of the local thickness of the material of the component 4. To produce the cold-weld connection 2 the component 6 is inserted into the recess 22 and the rib 10 brought into alignment with the opening of the channel 8. The rib 10 is then forced into the channel 8 to make a cold-welded connection. The force S which is effective in the direction in which the rib 8 is moved is an expansion force resisted by the wall 20 of the component 4. Equal and opposite forces are thus applied to the opposite sides of the recess 22 of component 4 as the rib 10 is forced into the channel 8, and the strength of the wall section 24 is sufficient to withstand these forces without exraneous support.

The force S is produced by a wedging tool 26 which, as shown in Figure 4, consists of a wedge-shaped body on which rollers are mounted. The rollers are arranged in laterally opposed pairs 28, 30 and 32 in the longitudinal direction of the body.

The peripheries of the individual pairs aif rollers 28, 30 and 32 extend successively further from the axis of the body toward the rear end of the tool 26. When the tool is drawn through the recess 22 in the direction of traction Z, the pairs of rollers 28, 30 and 32 roll against the bearing surface formed by the wall 20 and the rear surface of the rib 10 causing the latter to be forced into the channel 8 to an increasing extent by the succesive pairs of rollers 28, 30 and 32. By adjusting the distance between the rollers in the longitudinal direction of the tool the included angle between two planes tangential to the outer peripheries of the rollers can be altered and thus the shape of the wedging tool can be altered for different uses.

In the example shown in Figure 2 the two components 34 and 36 are each hollow and for example are of aluminium and formed by an extrusion process. The components have upper lateral walls 38 and 40 and lower lateral walls 42 and 44 respectively, the lateral walls of each component being connected by longitudinally spaced-apart cross walls. The cross walls 46 and 48 shown in Figure 2 are the outermost ones of each component 34 and 36. Adjacent the upper and lower edges of the cross wall 46 the lateral walls 38 and 42 are thickened to form reinforced wall sections 50 and 52 in which channels 54 and 56 are formed. These open toward one another across the interior of the component 34 and are positioned immediately adjacent the cross wall 46. The wall sections 50 and 52 taper at 58 and 60 to define guide surfaces 62 and 64 whereby the interior of the component 34 widens toward its open end.

On the other component 36 male parts 66 and 68 are provided in the form of ribs projecting from elastically deformable wall sections 70 and 72 which are extensions of the upper and lower lateral walls 40 and 44 respectively of the component 36. The ribs 66 and 68 have parallel projections extending from opposite sides thereof to a width greater than the channels 54 and 56 so as to achieve the required cold-welded connection.

To produce the connection the component 36 is forced telescopically into the component 34, the ribs 66 and 68 sliding over the inclined surfaces 62 and 64, as a result of which the wall sections 70 and 72 are squeezed together until the ribs 66 and 68 encounter the cross-wall 46 of the component 34. The ribs 66 and 68 are then simultaneously forced into the channels 54 and 56 using a wedging tool 26 to produce an expansion force S generally as explained in connection with Figure 1. Their entry into the channels is accompanied by the production of a cold weld. The equal and opposite components of the expansion force S are withstood by the component 34 and directly applied to the reinforced wall sections 50 and 52, the cross wall 46 taking up stresses in the process. In this way the inner surface of the wall section 50 acts as a bearing surface as the male part or rib 68 is forced into the channel 56 in the component 34, and conversely the inner surface of the wall section 52 acts as a bearing surface as the male part or rib 66 is forced into the cannel 54 in the component 34.

The cold-welded connection shown in Figure 3 provides for the permanent interconnection of two hollow components 74 and 76 each having channels 78, 80 and 82, 84, which are formed adjacent the upper and lower edges of cross walls 86 and 88 of the components in high strength wall regions 90, 92 and 94, 96. The channels in each component are in mutual opposition and are formed in upper and lower lateral walls 98, 100, 102, 104, of the components. For the production of a double connection upper and lower components 106 and 108 are provided, with male parts in the form of ribs 110, 112 and 114, 116, respectively, formed on the edges of the components and being of greater width than the channels to an extent required to obtain a cold-welded connection. The ribs have lateral projections. Under the influence of an expansion force S, provided by a wedge-type tool, e.g. the tool 26 shown in Figure 4, the components 106 and 108 are forced apart to connect the components 74 and 76. In this process the inner surface of the wall region 90 of the component 74 acts as a bearing surface as the male part 114 is forced into its channel 80, that of the wall region 94 acts as a bearing surface as the male part 116 is forced into the channel 84 of the component 76, the inner surface of the wall region 92 of the component 74 acts as a bearing surface as the male part 110 is forced into its channel 78 and that of the wall region 96 acts as a bearing surface as the male part 112 is forced into the channel 82 of the component 76. By this arrangement the equal and opposite components of the expansion force cancel each other in acting against the wall sections 90 to 96 reinforced by the cross walls 86 and 88. By making the sides of the channels slightly tapered it is posible to obtain at the abutting end faces 118, 120 and 122, 124, of the components 74 and 76, a further cold weld connection as the components 106 and 108 are moved apart.

Figure 5 shows a corner joint 126 for two hollow components 128, 130. The component 128 is formed with a cross wall 132 in which a channel 134 with a curved entrance 136 is formed, the channel 134 widening toward its mouth. Another thickened, reinforced wall section 138 is connected through wall sections 140 and 142 with the uper and lower edges of the cross wall 132. The wall part 138 has a surface 144 remote from the channel 134 which is curved to extend first inwardly of the component 128 and then toward the channel 134. The surface 144 defines one side of a second channel 146 formed in the thickened end reinforced wall section 138.

The end cross wall 148 of the component 130 has curved ribs 154 and 156 projecting beyond it which form extensions of the lateral walls 150 and 152. The ribs 154 and 156 conform to the curves of the channels

134 and 136 and are of greater width than the channels to an etxent necessary to obtain cold-welded connections. The ribs 154 and 156 are rigidly interconnected by the cross wall 148, the outerside surface of the rib 156 forming an abutment 158.

When the components 128 and 130 are brought together the rib 154 of the component 130 is first of all inserted in the opening 136 of the channel 134 and the component 130 is rotated in relation to the component 128 about this contact point forming a fulcrum until the apartment 158 formed by the rib 156 contacts the bearing surface 144. As the component 130 is pivoted further the abutment 158 slides over the bearing surface 144, so that the component 130 is displaced transversely with respect to component 128 and the rib 154 is forced into the channel 134, a cold-weld being formed in this process. At the same time the rib 156 is pressed into the channel 146, a further cold-weld point being formed. As a result of the sliding movement between the surface 144 and the abutment 158 an internal expansion force is again generated, which is absorbed by the component 128 not only through the reinforced wall portion 138 but also by the reinforced wall portion surrounding the channel 134 and the wall section 140. For the cold-welding operation use can be made of a jack acting between the components 128 and 130 along the line A-A. In this process due to the lever action of the jack the force applied is increased and outwardly-directed forces which would have to be withstood by supports or the like are not generated.

In the connection shown in Figure 6, the construction of the components and the method of connecting the components corresponds to that of Figure 2. The same reference numbers are used and the cold-welded connection is again produced by forcing the component 36 telescopically into the component 34 in such a way that the wall parts 70 and 72 are deformed toward one another until the ribs 66 and 68 encounter the cross wall 46 of the component 34, whereupon both ribs 66 and 68 are subjected to an expansion force S so that they are forced into the respective channels 54 and 56 to produce cold-welds. In order, however, to compensate for the stresses caused by the expanding force S, particularly in the cross wall 46, the component 34 is located on a support surface 162, which may be the floor or ground, and a T-girder 160 is positioned on the top wall 38 in the region of the channel 54 so that the component 34 is subject to compressive force produced by the weight of the girder 160. Stresses occurring in the cross wall 46 during the production of the cold-welds are thus reduced and the bearing surfaces defined by the inner surfaces of the wall parts 50 and 52 are supported and prevented from distortion under the effect of the expansion force S.

The arrangement shown in Figure 7 corresponds to that of Figure 6. In this case, however, the support device comprises upper and lower plates 164 and 166, which in the region of the cross wall 46 and the channels 54 and 56 are located against the lateral walls 38 and 42 of the component 34. The sides of the plates, which extend beyond the component 34, are held together by screw-threaded tie rods 168. When the tie rods 168 are tightened the component 34 is firmly clamped between the plates 164 and 166, if desired with a given precompression, the plates 164 and 166 being so designed as to ensure that the component 34 will not be deformed by the precompression and in particular that the cross wall 46 will not buckle. When the ribs 66 and 68 are forced into the channels 54 and 56 this precompression acts in opposition to the expansion force S and prevents deformation of the wall portions 50 and 52 providing the bearing surfaces and buckling of the components. After the cold-welded connections have been produced the tie rods 168 are released and the plates 164 and 166 removed.

WHAT WE CLAIM IS: —

1. A method of making a force-fit connection between components preformed respectively with at least one rib and at least one channel dimensioned so that the rib is a force-fit in the channel, at least one of said components being additionally formed or provided at a position spaced from its said rib or channel with a strengthened (as herein defined) bearing area, the method comprising introducing a wedge or other pressure-applying tool to exert an expansion force between the components such that the rib is forced relatively into the channel, said bearing area serving to resist, or assisting in resisting, the reaction force generated by the tool.

2. A method as claimed in claim 1, wherein a wedging tool is forced through a gap between a rear surface of the said channel or rib of said other component and a bearing surface of said bearing area of said one component, said wedging tool having transversely opposed pairs of lateral rollers, successive pairs of rollers, in the front-to-rear direction of the tool, extending further from the axis of the tool than the preceding pair.

3. A method as claimed in claim 1 or claim 2 for the cold-welded connection of two pallet components one of which has a rib along one edge thereof and the other of which is formed with a channel in one

side wall of a recess therein, the rib being a force fit in the channel and the channel opening toward an opposite side wall of the recess flanking said bearing area, the method comprising exerting an expansion force between a surface of said one component to the rear of the rib and said opposite side wall of the recess to force the rib into the channel.

4. A method as claimed in claim 1 or claim 2 for the cold-welded connection in end-to-end relation of two hollow, metal components each comprising lateral walls joined by cross walls, free end portions of the lateral walls of each component extending beyond the nearest cross wall at the ends of the components to be connected, the free end portions of the lateral walls of one component being locally thickened and formed with mutually opposed channels in the regions of the adjacent cross wall and the free end portions of the lateral walls of the other component being elastically deformable toward one another and formed with outwardly directed ribs which are each a force fit in one of said channels, the method comprising telescopically forcing said end of said other component into said end of said one component until said ribs come into alignment with said channels transversely of the components and then applying the expansion force to said free end portions of the lateral walls of said other component by means of a tool inserted between them to force the ribs into the channels.

5. A method as claimed in claim 1 or claim 2 for the cold-welded connection in end-to-end relation of two hollow, metal components each having lateral walls joined by cross walls, the lateral walls of each component extending beyond the nearest cross wall at the end of said component to be connected and defining with said cross wall a pair of channels mutually opposed across said component, the method comprising locating said components in end-abutting relation, locating in the space bounded by the abutted lateral walls and said nearest cross walls a pair of mutually inverted components each of which has a pair of ribs which are force fits in the channels of abutted lateral walls and inserting between said mutually inverted components a tool capable of exerting an expansion force between them which is resisted by the reinforcements represented by the abutted lateral walls so that the ribs are forced into the channel to effect a cold-welded connection between said end-abutted components.

6. A method as claimed in claim 4 or claim 5, wherein during the application of the expansion force the channel-formed member or members is or are protected aginst outward deformaion in the bearing areas thereof by retention means removably positioned on opposite sides of said member or members.

7. A method as claimed in claim 1, wherein a jacking tool is used relatively angularly to move the components in such a way that a projection on said other component slidably abuts a curved bearing surface of the bearing area of said one component which is spaced from the said rib or channel thereof so that the bearing surface guides said other component to insert the rib in the channel.

8. A method of making a cold-welded connection between two components substantially as herein described, with reference to Figure 1, Figure 2, Figure 3, Figure 5, Figure 6 or Figure 7 of the accompanying diagrammatic drawings.

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1594018 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig.1

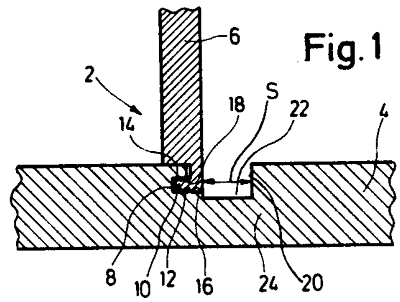


Fig.2

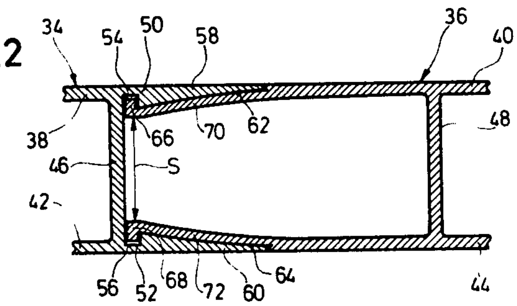
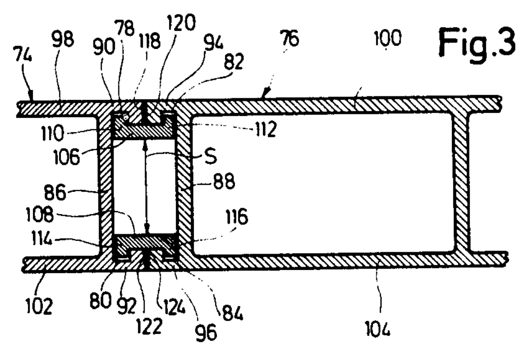


Fig.3



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Sheet 2

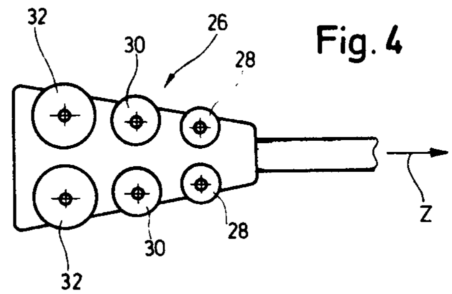

Fig. 4

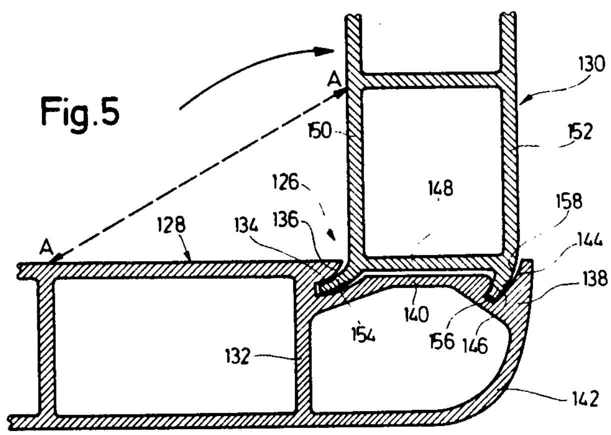

Fig.5

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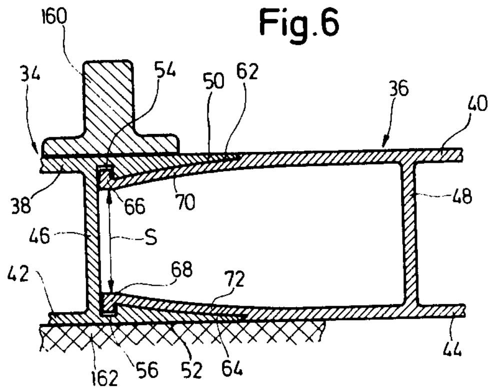
Sheet 3

Fig.6



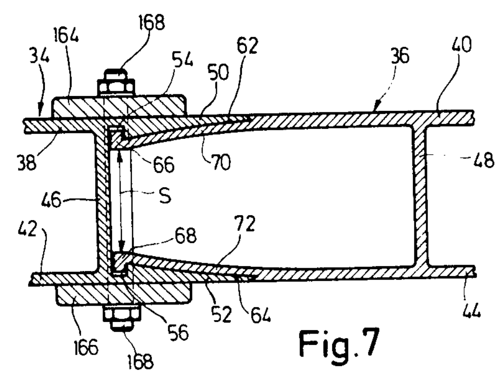


Fig.7