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TITLE OF THE INVENTION

Joint Structure for Metal Plates

BACKGROUND OF THE INVENTION

Field of the Invention

5 The present invention relates to a structure of joining two metal plates with each other, by shape changes of these metal plates to be joined with each other.

Description of the Background Art

10 In relation to joining of metal plates, there have generally been proposed various joint structures employing welding, riveting, caulking, curling and the like.

15 In portions which are exposed on a merchandise, however, a painting operation is preferably omitted by employing painted steel plates. In this case, employment of the joint structure by welding is inefficient since the joint portions must be again painted after the welding.

20 In the joint structure employing riveting, on the other hand, rivets are required in addition to the metal plates to be joined with each other, while complicated operations such as formation of holes for receiving the rivets, and insertion and caulking of the rivets, with requirement for specific apparatuses.

25 In the joint structure utilizing plastic deformation such as caulking or curling, painted steel plates can be employed to omit the painting operation. However, this

structure requires a specific mold, a specific apparatus etc. in joining.

Japanese Patent Publication No. 5-62241 (1993) discloses a joint structure for metal plates, which can solve the aforementioned problems. According to the joint structure which is disclosed in this gazette, metal plates can be readily joined with each other with no requirement for a specific apparatus.

Figs. 17 to 22 are adapted to illustrate the joint structure which is disclosed in Japanese Patent Publication No. 5-62241.

Referring to Fig. 17, a plurality of joint portions 3 are formed in relation to joining of first and second metal plates 1 and 2. In the respective joint portions 3, lugs 4 which are formed on the first metal plate 1 extend toward the second metal plate 2 and downwardly press parts of an end portion of the second metal plate 2, as if the second metal plate 2 is stitched into the first metal plate 1.

The joint structure shown in Fig. 17 is obtained in the following manner: Referring to Fig. 18, the first and second metal plates 1 and 2 are first prepared. The second metal plate 2 is subjected to no preliminary working. On the other hand, the first metal plate 1 is provided with the lugs 4 to have openings 5.

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Fig. 19 is a plan view showing a lug 4 which is still in an unraised state. As shown in Fig. 19, a clearance 6 is formed between opening edges 5a defining the size of each opening 5 of the first metal plate 1 and each lug 4.

5 The clearance 6 is rendered larger than the thickness of the second metal plate 2.

Fig. 20 is a plan view showing the first and second metal plates 1 and 2 which are joined with each other.

10 Figs. 21 and 22 are sectional views taken along the lines A - A and B - B in Fig. 20 respectively.

As shown in Figs. 21 and 22, a part 2a of the end portion of the second metal plate 2 which is superposed with the first metal plate 1 is press-molded with the lug 4 to be press-fitted into the opening 5 without being cut
15 off from the remaining portion 2b, in a state held between the opening 5 and the lug 4 of the first metal plate 1.

In the joined state, the press-fitted portion 2a of the second metal plate 2 is in contact with the opening edges 5a of the first metal plate 1, as shown in Figs. 21
20 and 22.

According to the joint structure shown in Figs. 17 to 22, it is possible to readily join metal plates to be joined with each other with no requirement for a specific working apparatus. However, this joint structure still
25 has a point to be improved.

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As described with reference to Fig. 19, the clearance 6 which is larger than the thickness of the second metal plate 2 is present between each lug 4 and the opening edges 5a of the first metal plate 1. As shown in Figs. 21 and 22, therefore, a portion 2c connecting each press-fitted portion 2a and the remaining portion 2b of the second metal plate 2 extends in a direction not perpendicular to but inclined with respect to the surface direction. Therefore, the contact force between the press-fitted portion 2a of the second metal plate 2 and the opening edges 5a of the first metal plate 1 is so weak that misregistration may be caused between the metal plates 1 and 2.

SUMMARY OF THE INVENTION

An object of the present invention is to improve the joint structure for metal plates which is disclosed in Japanese Patent Publication No. 5-62241. In more concrete terms, the object of the present invention is to provide a joint structure which can provide stronger contact force.

The joint structure for metal plates according to the present invention is characterized in the following points: A first metal plate is provided with a lug to have an opening. An end portion of a second metal plate which is superposed with the first metal plate is partially press-molded with the lug, to be press-fitted

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into the opening in a state held between the opening and the lug. The press-fitted portion of the second metal plate has a cutoff portion which is cut off from the remaining portion, and a connected portion which is not
5 cut off from but connected with the remaining portion.

The press-fitted portion of the second metal plate is firmly connected with the remaining portion through the connected portion, not to be cut off from the remaining portion. On the other hand, the cutoff portion of the
10 second metal plate has large contact force since the same strikes and comes into contact with opening edges of the first metal plate. According to the present invention, therefore, a joint structure providing stronger contact force is attained.

15 In an embodiment of the present invention, a clearance between the opening edges defining the size of the opening of the first metal plate and the lug is smaller in a portion corresponding to the cutoff portion of the press-fitted portion, and larger in a portion
20 corresponding to the connected portion. Preferably, the clearance is rendered smaller than 30 % of the thickness of the second metal plate in the portion corresponding to the cutoff portion of the press-fitted portion, and larger than the thickness of the second metal plate in the
25 portion corresponding to the connected portion.

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In another embodiment of the present invention, the lug of the first metal plate is provided along its outer edges with an embedded portion which is flush with the remaining portion of the second metal plate and a mount
5 portion mounting the remaining portion of the second metal plate. The cutoff portion is positioned under the embedded portion, while the connected portion is positioned under the mount portion.

The foregoing and other objects, features, aspects
10 and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

15 Fig. 1 is a perspective view showing an embodiment of the present invention;

Fig. 2 is a plan view showing a lug which is still in an unraised state;

20 Fig. 3 is a perspective view showing the lug which is in a raised state;

Fig. 4 is a plan view showing the embodiment of the present invention;

Fig. 5 is a plan view showing a press-fitted portion of a second metal plate;

25 Fig. 6 is a sectional view taken along the line C - C

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in Fig. 4;

Fig. 7 is a sectional view taken along the line D - D
in Fig. 4;

Fig. 8 is a sectional view taken along the line E - E
5 in Fig. 4;

Fig. 9 is a sectional view taken along the line F - F
in Fig. 4;

Fig. 10 is a plan view showing a lug of a first metal
plate employed in another embodiment of the present
10 invention;

Fig. 11 is a perspective view showing the lug which
is in a raised state;

Fig. 12 is a plan view showing a lug of a first metal
plate employed in still another embodiment of the present
15 invention;

Fig. 13 is a perspective view showing the lug which
is in a raised state;

Fig. 14 illustrates the bottom surface of a punch;

Fig. 15 is a sectional view showing a state of press
20 molding with the punch;

Fig. 16 is a sectional view showing a state of press
molding with the punch in a position different from that
shown in Fig. 15;

Fig. 17 is a perspective view showing a joint
25 structure which is disclosed in Japanese Patent

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Publication No. 5-62241;

Fig. 18 is a perspective view showing first and second metal plates;

Fig. 19 is a plan view showing a lug which is still
5 in an unraised state;

Fig. 20 is a plan view showing the joint structure which is disclosed in Japanese Patent Publication No. 5-62241;

Fig. 21 is a sectional view taken along the line A -
10 A in Fig. 20; and

Fig. 22 is a sectional view taken along the line B - B in Fig. 20.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 is a perspective view showing the appearance
15 of a joint structure according to an embodiment of the present invention. A plurality of joint portions 13 are formed in joining of first and second metal plates 11 and 12. The first metal plate 11 is provided with lugs 14, to have openings 15 (Fig. 3). The second metal plate 12 is
20 subjected to no preliminary working. Parts of an edge of the second metal plate 12 are press-molded with the lugs 14, to be press-fitted into the openings 15 in a state held between the openings 15 and the lugs 14 of the first metal plate 11.

25 Fig. 2 is a plan view showing each lug 14 which is in

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a still unraised state, and Fig. 3 is a perspective view showing the lug 14 which is in a raised state.

As shown in Figs. 2 and 3, each lug 14 of the first metal plate 11 is provided along its outer edges with
5 recesses 14a and linear portions 14b. Similarly, recesses 15a and linear portions 15b are provided along opening edges defining the size of each opening 15.

Each lug 14 shown in Figs. 2 and 3 is formed in the following manner, for example: First, elliptic holes are
10 formed in the first metal plate 11, thereby providing the recesses 14a and 15a. Then, the linear portions 14b and 15b are formed by shearing.

The maximum clearance between each recess 14a of each lug 14 and each recess 15a of each opening 15 is
15 preferably rendered larger than the thickness of the second metal plate 12. On the other hand, the clearance between each linear portion 14b of each lug 14 and each linear portion 15b of each opening 15 is rendered smaller than 30 % of the thickness of the second metal plate 12.

20 Fig. 4 is a plan view showing the first and second metal plates 11 and 12 which are joined with each other, and Figs. 6, 7, 8 and 9 are sectional views taken along the lines C - C, D - D, E - E and F - F in Fig. 4 respectively. Fig. 5 is an illustrative plan view showing
25 each press-fitted portion 16 of the second metal plate 12.

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Referring to Figs. 4 and 5, parts of an end portion of the second metal plate 12 are press-molded with the lugs 14, to be press-fitted into the openings 15 in a state held between the openings 15 and the lugs 14 of the first metal plate 11. Each press-fitted portion 16 of the second metal plate 12 has cutoff portions 16a which are cut off from the remaining portion 17, and connected portions 16b which are not cut off from but connected with the remaining portion 17. The cutoff portions 16a are formed by shearing of the second metal plate 12 in press molding, since the clearances between the linear portions 14b and 15b of each lug 14 and each opening 15 of the first metal plate 11 are smaller than the thickness of the second metal plate 12. On the other hand, the second metal plate 12 is not shorn in the parts of its end portion which are press-fitted through the lugs 14 but these parts remain as the connected portions 16b since the maximum clearances between the recesses 14a and 15a of each lug 14 and each opening 15 of the first metal plate 11 are larger than the thickness of the second metal plate 12.

In the position shown in Fig. 6, the press-fitted portion 16 of the second metal plate 12 is connected to the remaining portion 17 through the connected portion 16b. The connected portion 16b, which extends obliquely

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with respect to the surface direction, has relatively weak contact force against the first metal plate 11.

In the position shown in Fig. 7, the press-fitted portion 16 of the second metal plate 12 is cut off from the remaining portion 17 by shearing. Therefore, the cutoff portion 16a of the press-fitted portion 16 strikes and comes into contact with the linear portion 15b of the first metal plate 11. This contact force is so strong that no misregistration is caused along arrow X.

In the position shown in Fig. 8, the press-fitted portion 16 of the second metal plate 12 is connected with the remaining portion 17 through the connected portion 16b.

In the position shown in Fig. 9, the press-fitted portion 16 of the second metal plate 12 is cut off from the remaining portion 17 by shearing. Therefore, the cutoff portion 16a of the press-fitted portion 16 strikes and comes into contact with the linear portion 15b of the opening 15 of the first metal plate 11. This contact force is so strong that no misregistration is caused along arrow Y.

As clearly understood from the above description, the press-fitted portions 16 of the second metal plate 12 have the cutoff portions 16a which are cut off from the remaining portions 17 and the connected portions 16b which

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are not cut off from but connected with the remaining portions 17, whereby a strong joint structure is obtained with no misregistration.

5 Figs. 10 and 11 illustrate another example of each lug 24 of a first metal plate 21. In the structure shown. in these figures, the lug 24 of the first metal plate 21 includes recesses 24a and linear portions 24b. On the other hand, an opening 25 has only linear opening edges. Also in this embodiment, the maximum clearances between
10 the recesses 24a of the lug 24 and the opening edges of the opening 25 are rendered larger than the thickness of a second metal plate to be joined with the first metal plate 21. On the other hand, the clearances between the linear portions 24b of the lug 24 and the opening edges of the
15 opening 25 are rendered smaller than 30 % of the thickness of the second metal plate. When press molding is carried out with such a lug 24, each press-fitted portion of the second metal plate has cutoff portions and connected portions, similarly to the aforementioned embodiment.

20 Figs. 12 to 16 illustrate still another embodiment of the joint structure according to the present invention. Referring to Figs. 12 and 13, each lug 34 of a first metal plate 31 has no recesses, dissimilarly to the aforementioned embodiments. Further, each opening 35 has
25 no recesses either. A clearance between the lug 34 and

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the opening 35 is rendered smaller than 30 % of the thickness of a second metal plate to be joined with the first metal plate 31. If a pressure is uniformly applied to the overall region of each lug 34 to partially press-
5 fit an end portion of the second metal plate, therefore, the press-fitted portion of the second metal plate is completely cut off and separated from the remaining portion.

In the embodiment shown in Figs. 12 to 16, therefore,
10 the shape of a punch 40 for pressing each lug 34 is improved. Fig. 14 illustrates the bottom surface of the punch 40. This punch 40 has a plurality of cavities 41 in portions corresponding to outer edges of the lugs 34.

Figs. 15 and 16 show the punch 40 pressing each lug
15 34. As shown in Fig. 15, each press-fitted portion 36 of a second metal plate 32 is not cut off and separated from the remaining portion 37 but still connected with the same. In the position shown in Fig. 15, each lug 34 of the first metal plate 31 is provided along its outer edges
20 with a mount portion mounting the remaining portion 37 of the second metal plate 32.

In the position shown in Fig. 16, each press-fitted portion 36 of the second metal plate 32 is pressed by the lug 34 of the first metal plate 31 and cut off/separated
25 from the remaining portion 37. In this state, the press-

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fitted portion 36 is strongly in contact with opening edges of each opening 35 of the first metal plate 31, whereby no misregistration is caused between the first and second metal plates 31 and 32. In the position shown in
5 Fig. 15, the lug 34 of the first metal plate 31 is provided along its outer edges with an embedded portion which is flush with the remaining portion 37 of the second metal plate 32.

As clearly understood from Figs. 15 and 16, the lug
10 34 of the first metal plate 31 is provided along its outer edges with the embedded portion which is flush with the remaining portion 37 of the second metal plate 32 and the mount portion which mounts this remaining portion 37. A cutoff portion and a connected portion of the press-fitted
15 portion are positioned under the embedded portion and the mount portion respectively.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not
20 to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.



WHAT IS CLAIMED IS:

1. A joint structure for metal plates, for joining a first metal plate (11) and a second metal plate (12) with each other, wherein

5 said first metal plate (11) is provided with a lug (14) to have an opening (15),

an end portion of said second metal plate (12) being partially superposed with said first metal plate (11) is press-molded with said lug (14), to be press-fitted into said opening (15) in a state held between said opening
10 (15) and said lug (14), and

said press-fitted portion of said second metal plate (12) has a cutoff portion (16a) being cut off from a remaining portion (17) and a connected portion (16b) being not cut off from but connected with said remaining portion
15 (17).

2. The joint structure for metal plates in accordance with claim 1, wherein a clearance between opening edges defining the size of said opening (15) of said first metal plate (11) and said lug (14) is smaller
5 in a portion corresponding to said cutoff portion (16a) of said press-fitted portion and larger in a portion corresponding to said connected portion (16b).



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3. The joint structure for metal plates in
accordance with claim 2, wherein said clearance is smaller
than 30 % of the thickness of said second metal plate (12)
in said portion corresponding to said cutoff portion (16a)
5 of said press-fitted portion, and larger than the
thickness of said second metal plate (12) in said portion
corresponding to said connected portion (16b).

4. The joint structure for metal plates in
accordance with claim 1, wherein said lug (14) is provided
along its outer edges with an embedded portion being flush
with said remaining portion of said second metal plate
5 (12) and a mount portion mounting said remaining portion
of said second metal plate,

said cutoff portion and said connected portion being
positioned under said embedded portion and said mount
portion respectively.