

1 DOUBLE FLUSH CLINCH STUD

2

3 RELATED APPLICATIONS

4 The present application is related to provisional patent application serial
5 number 60/620,345 entitled "Double Flush Clinch Stud" filed on October 21, 2004,
6 priority from which is hereby claimed.

7 FIELD OF THE INVENTION

8 The present invention relates to fasteners for securing two sheets of metal
9 face-to-face. It further relates to fasteners that provide a flush attachment to the
10 sheets by deformation of the sheet material.

11 BACKGROUND OF THE INVENTION AND PRIOR ART

12 Most commonly, metal sheets are fastened together using rivets or spot
13 welds. These methods of fastening, however, have their drawbacks inasmuch as
14 the spot welds leave a weld scale and burn the surface of the sheets. Spot welding
15 is also not effective in sheet materials which are not easily welded, such as is the
16 case with very thin or dissimilar materials. Furthermore, the burned sheets may
17 leave an unacceptable aesthetic appearance. Rivets can perform a similar function
18 but they do not leave a finish flush with the surface of the sheets which may be a
19 requirement in some applications. As yet another alternative, adhesives or other
20 bonding agents such as epoxies can be used, however these are often very messy
21 and very costly. Additional methods such as Tog-L-Loc® which forms sheets
22 together and Henrob style fasteners deform the sheets being attached. Allowing
23 for rotation is also possible. Of the technologies discussed above, the additional
24 feature of rotation can only be accomplished by a rivet which does not install flush.

1 U.S. Patent 3,242,962 to Dupree discloses a double-sided clinch type insert
2 which installs between the sheets being joined. However, there are many problems
3 and disadvantages of the Dupree fastener. For example, it allows for installation of
4 only one fastener, due to the fact that once the sheets are joined nothing additional
5 can be inserted between them. This also negates the advantage of autofeeding and
6 installing the Dupree fastener using more efficient, modern techniques. In addition,
7 the Dupree fastener must be the same thickness as the width of the combined
8 sheets. And finally, while the Dupree fastener may be modified to permit rotation
9 by removing a knurl in one of the undercuts, the rotating clinch would significantly
10 weaken and fail after numerous cycles.

11 There is therefore a need in the art for means for securing two metal sheets
12 together which provides flush finish on both metal sheets, with the additional
13 feature of providing a pivot for rotation, and avoids the weld scale or epoxy mess
14 of the aforementioned fastening methods.

15 SUMMARY OF THE INVENTION

16 The present invention provides an extremely simple solution to the above-
17 stated need in the art for a fastening method which secures two metal sheets face-
18 to-face. The device is a clinching stud having adjacent fastening means of differing
19 diameter so that the stud may be pressed into suitably dimensioned holes of aligned
20 sheets in a single pressing operation. As will be more fully described herein,
21 double flush attachment is provided without the need for the heat of welding or the
22 mess and expense of bonding adhesives, or deformation of the surface of the sheets
23 being bonded.

24 More specifically, the applicant has devised a clinch-type fastener for

1 joining parallel sheets having aligned apertures comprising a shank having a head at
2 one end and an endcap at the opposite end, the head being a first displacer, a top
3 surface, and being of the largest diameter of the fastener. A first undercut groove
4 on the shank is located immediately below the first displacer having a first diameter
5 and a second displacer on the shank located immediately below the first undercut
6 groove having a second diameter less than the first diameter. A second undercut
7 groove on the shank is located immediately below the second displacer, and the
8 endcap is located immediately below the undercut groove and is of lesser diameter
9 than the second displacer. The fastener preferably includes opposing planar
10 circular top and bottom surfaces.

11 The inventive fastener is advantageously employed in forming an assembly
12 wherein two metal sheets are joined in face-to-face contacting relationship, the first
13 sheet having a first hole therein including sidewalls which occupy substantially all
14 of the first undercut groove of the fastener and wherein the second planar sheet is
15 joined in face-to-face relationship with the first sheet. The second sheet has a
16 second hole therein of lesser diameter than the first hole in the first sheet and is
17 concentric therewith. The second hole is of lesser diameter than the first hole and
18 includes sidewalls which occupy substantially all of the second undercut groove of
19 the fastener. This assembly provides flush attachment with a top surface of the
20 first sheet being coplanar with a top surface of the head of the fastener and the
21 endface of the endcap of the fastener being flush or sub-flush with the bottom
22 surface of the second sheet. This results in an assembly whereby the top undercut
23 groove can alternatively be underfilled with the material of the top sheet
24 respectively, while maintaining a high pushout strength. With this alternative, the

1 top sheet is effectively constrained between the head of the fastener and the second
2 sheet while permitting a strong pivot joint. Pushout performance remains high due
3 to the larger diameter, and hence, displaced volume, of the top displacer and
4 undercut.

5 Compared with some of the prior art described above such as the Dupree
6 fastener, the present invention provides the advantage of installing from the top of
7 the sheets and therefore can be installed in any pattern on multiple fasteners as
8 desired. Additionally, the present invention only requires a minimum thickness of
9 the second sheet and the second sheet can be thicker than the lower shank of the
10 fastener if the fastener is installed blind in the second sheet. Also, according to the
11 invention as will be more fully described below, the top sheet is contained between
12 the head of the fastener and the second sheet. This permits the top sheet to rotate
13 freely by underfilling the undercut while maintaining a high push-out force and
14 flush installation.

15 From the following drawings and description of the preferred embodiment,
16 it will be appreciated by those of skill in the art that the objects of the invention
17 have been achieved. While the present invention will be described with the
18 reference to a specific embodiment, the following description is illustrative of the
19 invention and is not to be construed as limiting the invention. Various
20 modifications to the present invention can be made to the preferred embodiment by
21 those skilled in the art without departing from the true spirit and scope of the
22 invention. It will be noted here that for better understanding like components are
23 designated by the reference numerals throughout the various figures of drawing
24 which follow.

1 DESCRIPTION OF THE DRAWINGS

2 Figure 1 is a side view of the clinch stud of the invention with the displacers
3 and undercuts indicated.

4 Figure 2 is a right front top exploded assembly view of the clinch connector
5 in alignment with the receiving apertures of two sheets to be fastened.

6 Figure 3 is a partial side sectional view of the installation of the invention
7 by pressing.

8 Figure 4 is a side sectional view showing the resulting completed
9 installation of the invention.

10 Figure 5 is a side sectional view of an alternate embodiment of the
11 invention in which the clinch stud is installed into a blind hole in the second sheet.

12 DESCRIPTION OF THE PREFERRED EMBODIMENT

13 Referring now to Figure 1, the present invention is a clinch-type fastener
14 which has two pairs of displacers 13 and 15 and related undercuts 14 and 16
15 coaxially adjacent one another, the first pair 13 and 14 being larger in diameter
16 than the other pair. The fastener is terminated at the bottom by endcap 17. These
17 structures lie along a shank of the fastener between a top surface 18 and a bottom
18 surface 19 of endcap 17.

19 As shown in Figure 2, two sheets 1 and 2 are held in alignment with the
20 clinch connector of the invention being forcibly applied from above. Sheets 1 and
21 2 are shown separated in this figure for illustration only. The top sheet and second
22 sheet include aligned holes 3 and 4 of different diameter which correspond to the
23 diameters of the respective displacers and undercuts of the connector. The
24 diameter of hole 3 in the top sheet is greater than the diameter of hole 4 in the

1 second sheet, allowing the first advancing clinching feature of the connector to
2 pass through it.

3 As depicted in Figure 3, an installation force is applied to punch **21** which
4 forces the clinch connector of the invention **11** into sheets **1** and **2** against
5 installation anvil **23**. The arrow shows the direction of application of force to the
6 clinch connector which is applied to the first and second sheets. The connector **11**
7 is applied by a single application of force during a pressing operation against anvil
8 **23** which achieves the resulting installation as shown in Figure 4 wherein the top
9 displacer and undercut clinch into the top of the two sheets **1** being bonded and the
10 lower displacer and undercut simultaneously clinch into the second sheet **2**.

11 Referring now to Figure 4, after the pressing operation is complete, the
12 sheets become locked together by the cold flow of metal by the top head/displacer
13 **13** forcing the cold flow of metal **25** of the top sheet into the top undercut and
14 similarly the cold flow of metal **26** is displaced by displacer **15** into the bottom
15 undercut within the second sheet locking the clinch stud of the invention into both
16 sheets, thus joining them together. As depicted in Figure 5, the second sheet **2** can
17 have a blind hole. As a significant advantage of the invention, if the first and or
18 second undercut grooves are of sufficient diameter such that they are underfilled by
19 the material of their respective sheets, the present invention provides a locking
20 pivot whereby the sheets may be attached flush in a controlled manner while
21 providing for relative rotation between the sheets.

22 It should be understood that there may be other modifications and changes
23 to the present invention that will be obvious to those of skill in the art from the
24 foregoing description, however, the present invention should be limited only by the

- 1 following claims and their legal equivalents.

CLAIMS

What is claimed is:

1. A clinch-type fastener for joining parallel sheets having aligned apertures, comprising:
 - a shank having a head at one end and an endcap at the opposite end;
 - the head being a first displacer having a top surface and being the largest diameter of said fastener;
 - a first undercut groove on said shank located immediately below said first displacer having a first diameter;
 - a second displacer on said shank located immediately below said first undercut groove having a second diameter less than said first diameter;
 - a second undercut groove on said shank located immediately below said second displacer; and
 - the endcap located immediately below said second undercut groove and being of lesser diameter than said second displacer.
2. The fastener of claim 1 wherein said fastener further includes opposing, planar top and bottom surfaces.
3. The fastener of claim 2 wherein said surfaces are circular.
4. An assembly, comprising:
 - the fastener of claim 1 joining two metal sheets in face-to-face contacting relationship;
 - a first planar sheet having a first hole therein including sidewalls which occupy substantially all of said first undercut groove of said fastener; and
 - a second planar sheet joined in face-to-face relation to said first

1 sheet, said second sheet having a second hole therein of lesser diameter than said
2 first hole in said first sheet and being concentric therewith, said second hole being
3 of lesser diameter than said first hole and having sidewalls which occupy
4 substantially all of said second undercut groove of said fastener.

5 5. The assembly of claim 4 wherein the top surface of said fastener is
6 flush with a top surface of said first sheet and an endface of said endcap of said
7 fastener is flush with a bottom surface of said second sheet.

8 6. The assembly of claim 5 wherein said first and second holes are
9 circular.

10 7. The assembly of claim 4 wherein the second hole is a blind hole in
11 the second sheet.

12 8. The assembly of claim 4 wherein the first undercut groove of said
13 fastener is of sufficient diameter such that it is underfilled by the material of the
14 first sheet thereby providing relative rotary motion between said fastener and said
15 sheet.

16 9. The assembly of claim 8 wherein both said first and second undercut
17 grooves are of sufficient diameter such that they are underfilled with the material of
18 said first and second sheets respectively.