

1                                    CLINCH/BROACH CONNECTOR

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3                    RELATED APPLICATIONS

4                    The present patent application is related to U.S. Provisional Patent  
5                    Application Serial No. 60/650,519 filed February 8, 2005 entitled "Clinch/Broach  
6                    Connector," priority from which is hereby claimed.

7                    FIELD OF THE INVENTION

8                    The present invention relates to non-deformable fasteners which are  
9                    capable of affixing two sheets of material face-to-face. More specifically, it relates  
10                   to fasteners that pass through aligned apertures in two sheets of material in which  
11                   the joinder to the fastener is accomplished by the deformation of the sheets.

12                   BACKGROUND OF THE INVENTION

13                   It is known to fasten two sheets together using rivets, however these  
14                   fasteners have their drawbacks in that they leave an unacceptable aesthetic  
15                   appearance since they do not leave a finish which is flush with the surface of the  
16                   sheets. It is known to attach two metal sheets with an insert that provides a flush  
17                   finish as shown in U.S. Patent 3,242,962 issued to Dupree, however the materials  
18                   with which the Dupree insert may be used are limited to those capable of cold flow  
19                   deformation when the insert is applied under high pressure. The Dupree fastener  
20                   can only be installed between the sheets being joined as well. The clinch/broach  
21                   fastener installs from the top sheet of the two from the outside, permitting the  
22                   installation of more than one in any array of parts. There is therefore a need in the  
23                   art for an insert that can join two sheets which are composed of a wide range of  
24                   different materials while providing joinder of the sheets with a flush final finish.

1     SUMMARY OF THE INVENTION

2             The present invention is a connector insert that can be installed into two  
3     panels, one non-metallic and one metal, effectively locking them together and  
4     finishing flush with the surfaces of each panel. It attaches the panels much like a  
5     rivet and may be utilized as a replacement for rivets which leave a protrusion on  
6     the surfaces of the panels where a flush attachment is desired. It also replaces  
7     bonding agents such as epoxies which are messy and costly. Thus, the present  
8     invention installs flush with the metal and non-metallic surfaces without epoxy  
9     mess or rivet protrusion. The present insert can also install into a blind hole in a  
10    metal sheet leaving the outsides of the metal sheet completely mar free. A knurl  
11    can be added to the metal displacer of the connector causing a non-rotatable  
12    connection. Rivets do not provide this anti-rotation feature.

13            More specifically, the applicant has devised a clinch-type fastener for  
14    joining parallel sheets face-to-face having aligned apertures comprising a shank  
15    having a displacer head at one end and an endface at the opposite end, the head  
16    being a displacer having a planar top surface and being the largest diameter of the  
17    fastener. An undercut groove is located on the shank immediately below the head,  
18    and a plurality of axially extending broaching teeth on a portion of the shank are  
19    located immediately below the undercut groove. The outside diameter of the  
20    broaching teeth is greater than the diameter of the undercut groove but less than  
21    the diameter of the head. The endface is adjacent to and immediately below the  
22    broaching portion of the shank and has a planar bottom surface. The top surface  
23    and the endface bottom surface are circular.

24            An assembly including the fastener joins two sheets in face-to-face

1 contacting relationship further comprising a first metal planar sheet having a first  
2 hole therein including sidewalls which occupy substantially all of the first undercut  
3 groove of the fastener. A second non-metallic planar sheet is joined in face-to-face  
4 relation with the first sheet, the second sheet having a second hole therein of lesser  
5 diameter than the first hole in the first sheet and being concentric therewith, the  
6 broaching teeth of the fastener being embedded into the sidewall of the second  
7 hole. The top surface of the fastener is flush with an outer surface of the first sheet  
8 and the bottom surface of the endface is flush with an outer surface of the second  
9 sheet.

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

## 20 BRIEF DESCRIPTION OF THE DRAWINGS

21 Figure 1 is a front elevation view of the connector of the present invention.

22 Figure 2 is a top right front exploded assembly view of the invention  
23 installed in two panels.

24 Figures 3 and 4 are front elevation sectional views showing a two-step

1 sequence of installation of the invention in one embodiment thereof.

2 Figure 5 is a front elevation view of an alternate embodiment.

3 Figure 6 is a top right front exploded assembly view of an alternate  
4 embodiment of the invention installed in two panels.

5 Figures 7 and 8 are front elevation sectional views showing a two-step  
6 sequence of installation of the invention in an alternate embodiment thereof.

7 DESCRIPTION OF THE PREFERRED EMBODIMENT

8 The following drawings depict one or more embodiments of the invention  
9 in which the various elements are labeled. In one embodiment, the invention is a  
10 short metal stud which includes a displacer and undercut at one end and a  
11 broaching portion at the other end. This is shown in the following Figures 1-8  
12 wherein the displacer and undercut clinch into the sheets being affixed to one  
13 another. Figures 1-4 depict the embodiment where the top sheet is metal and the  
14 bottom sheet is plastic and the embodiment shown in Figures 5-8 show the  
15 invention utilized in an application where the top sheet is plastic and the bottom  
16 sheet is metal.

17 Referring now to Figure 1, this embodiment may be utilized where the top  
18 sheet is metal and the bottom sheet is composed of a non-metal such as plastic.  
19 The insert includes a displacer head **11** at one end and an endface **13** at the  
20 opposite end. The displacer head **11** has a planar top surface **15** and is the largest  
21 diameter of the insert. An undercut groove **17** on a shank located immediately  
22 below the displacer head is of a first diameter. A portion of the shank immediately  
23 below the undercut groove **17** includes axially extending broaching teeth **19**, the  
24 outside diameter of which is greater than the undercut groove **17** but less than the

1 displacer head 11. The insert endface 13 is immediately adjacent the broaching  
2 portion of the insert shank and is planar.

3 Referring now to Figures 2, 3, and 4, the application of the insert 21 to  
4 assemble two sheets 23 and 25 is shown. As shown in Figure 2, the insert is  
5 applied to two sheets having aligned circular apertures 24 and 26, hole 24 being of  
6 larger diameter than hole 26. Then, as illustrated in Figures 3 and 4, the insert is  
7 pressed into the two sheets between a movable ram 31 and an anvil 33. As shown  
8 in Figure 4, the insert is forcibly applied and the material of the top sheet 34 flows  
9 into the undercut groove while the teeth of the broaching portion of the shank cut  
10 into the inner wall 35 of the hole in the second sheet, thus joining both sheets.

11 Referring now to Figures 5-8, an insert similar to that shown in Figures 1-4  
12 is employed except that the attachment features of the insert are reversed in order  
13 so that the insert may be used in cases where the top sheet is of a non-cold flow  
14 material such as plastic and the second sheet is metal. In this case, the fastener as  
15 shown in Figure 5 includes a topmost portion of the shank having a planar top  
16 surface 51 and axially extending broaching teeth 53. This top portion of the shank  
17 is the largest diameter of the insert. Immediately adjacent the broaching portion is  
18 a displacer 54 and an undercut groove 55 which is followed by an endcap 57 being  
19 the least diameter of the insert. Referring now to Figures 6, 7, and 8, it will be  
20 readily understood by those of the mechanical arts that the application of this  
21 embodiment of the insert 60 to sheets 61 and 63 by the high force pressing shown  
22 in Figures 7 and 8 will achieve the attachment of the two sheets face-to-face with  
23 flush final finish in the outer surfaces of the sheets as shown in Figure 8. This is  
24 similar to the assembly process of the first embodiment in Figures 3 and 4.

1           In both embodiments, the top sheet has a larger mounting hole than the  
2 lower sheet as shown in Figures 2 and 6 allowing the clinching feature of the lower  
3 sheet to pass through it. As depicted in Figures 3 and 7, both sheets are attached  
4 simultaneously with one pressing operation. As shown in Figures 4 and 8, the  
5 broaching section of one end locks into the non-metal sheet at the same time as the  
6 clinch section of the opposite end locks into the metal sheet.

7           Thus, the object of the invention has been achieved to create an insert that  
8 can be installed into two panels, one non-metallic and one metal, effectively locking  
9 them together face-to-face while finishing flush with the outside surfaces of each  
10 panel. Other advantages and variations on the device described and depicted in the  
11 drawings will be apparent to those of skill in the art without departing from the  
12 nature and spirit of the invention disclosed. It should be understood that there may  
13 be other modifications and changes to the present invention that will be obvious to  
14 those of skill in the art from the foregoing description, however, the present  
15 invention should be limited only by the following claims and their legal equivalents.

CLAIMS

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2           What is claimed is:

3           1.       A clinch-type fastener for joining parallel sheets face-to-face having  
4 aligned apertures, comprising:

5                   a shank having a displacer head at one end and an endface at the  
6 opposite end, the head being a displacer having a planar top surface and being the  
7 largest diameter of the fastener;

8                   an undercut groove located on said shank immediately below said  
9 head; and

10                  a plurality of axially extending broaching teeth on a portion of said  
11 shank located immediately below the undercut groove.

12           2.       The fastener of claim 1 wherein the outside diameter of the  
13 broaching teeth is greater than the diameter of the undercut groove but less than  
14 the diameter of the head.

15           3.       The fastener of claim 2 wherein the endface is adjacent to and  
16 immediately below the broaching portion of the shank and has a planar bottom  
17 surface.

18           4.       The fastener of claim 3 wherein the top surface and said endface  
19 bottom surface are circular.

20           5.       An assembly including the fastener of claim 1 joining two sheets in  
21 face-to-face contacting relationship further comprising a first planar sheet having a  
22 first hole therein including deformed sidewalls which occupy substantially all of  
23 said first undercut groove of said fastener; and

24                   a second planar sheet joined in face-to-face relation with 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 broaching teeth of  
3 said fastener being embedded into the sidewall of said second hole.

4 6. The assembly of claim 5 wherein said first sheet is metal and said  
5 second sheet is non-metallic.

6 7. The assembly of claim 6 wherein the top surface of said fastener is  
7 flush with an outer surface of said first sheet and the bottom surface of said  
8 endface is flush with an outer surface of said second sheet.