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1 sheet material itself. This can result in excessive wear, maintenance problems,
2 and failure of the joint. It also limits the sheet material and its surface condition.
3 Joint assemblies which solve this problem are more complicated, three-component
4 systems.

5 There is therefore a need in the art to join two sheets of relatively thin
6 sheet metal while allowing rotation between them in a manner which is efficient
7 and economical and which also allows for axial deflection and resilient separation
8 between the sheets. There is also a need in the art for a simplified rotatable joint
9 assembly for thin metal sheets in which neither of the sheets is required to be a
10 frictional bearing surface.

11 SUMMARY OF THE INVENTION

12 In order to meet the needs in the art described above, the present invention
13 permits rotatable joinder of two sheets by providing a two-piece interfitting
14 bearing assembly with the individual elements rigidly attached to each sheet so
15 that the sheets are joined but rotation is controlled by the interfitting bearing
16 surfaces. The two interfitting parts comprise an inner and outer race which may
17 be placed together in superposition with aligned apertures in the sheets to be
18 joined before the race pair is pressed into the sheets in a single pressing operation.
19 Material for the bearing components may be selected for the friction and load
20 characteristics of the specific application. Alternate embodiments include adding
21 ball bearings between the races or in another case utilizing a biasing spring
22 between the sheets with arcuate bearing surfaces which permits the sheets to
23 rotate and/or deflect angularly.

24 More specifically, the present invention comprises a bearing assembly for

1 rotatably joining two sheets, a top sheet having a first aperture aligned with a
2 bottom sheet in face-to-face relation with the bottom sheet having a second
3 aperture in alignment with the first aperture about an axis. An outer race resides
4 within the aperture of the top sheet and has a bore in the center and means around
5 its circumference for receiving a cold flow of metal from the top sheet to rigidly
6 attach it. An inner race lies partially within the outer race and partially within the
7 second sheet, secured thereto by circumferential clinch attachment means. The
8 inner race further includes a head of increased diameter greater than the diameter
9 of the outer race bore thereby captivating the top sheet to the bottom sheet after
10 assembly. The inner race and the outer race are closely dimensioned to provide
11 the joinder and rotatability of one sheet relative to the other about the axis.

12 In this respect, before explaining at least one embodiment of the invention
13 in detail, it is to be understood that the invention is not limited in its application to
14 the details of construction and to the arrangements of the components set forth in
15 the following description or illustrated in the drawings. The invention is capable
16 of other embodiments and of being practiced and carried out in various ways.
17 Also, it is to be understood that the phraseology and terminology employed herein
18 are for the purpose of description and should not be regarded as limiting.

19 As such, those skilled in the art will appreciate that the conception, upon
20 which this disclosure is based, may readily be utilized as a basis for the designing
21 of other structures, methods, and systems for carrying out the several purposes of
22 the present invention. It is important, therefore, that the claims be regarded as
23 including such equivalent constructions insofar as they do not depart from the
24 spirit and scope of the present invention.

1 BRIEF DESCRIPTION OF THE DRAWINGS

2 Figure 1 is a bottom right isometric assembly view of the invention.

3 Figures 2A and 2B are sequential side sectional views showing the
4 assembly of the invention.

5 Figure 3 is a side sectional view of an alternate embodiment thereof using
6 a spring separator and arcuate bearing surfaces.

7 Figure 4 is a side sectional view of an alternate embodiment showing the
8 use of ball bearings.

9 DESCRIPTION OF THE PREFERRED EMBODIMENT

10 Referring now to Figure 1, the basic four elements of the present invention
11 are shown. Inner race **11** and outer race **13** are assembled into sheets **15** and **17**
12 such that they become joined yet freely rotatable upon bearing elements **11** and
13 **13**. Element **11** is an inner race which is interfitted within outer race **13**. In a
14 single pressing operation as depicted in Figures 2A and 2B, inner race **11** is
15 installed into the bottom sheet **17** as outer race **13** is clinched into top sheet **15**.
16 Installation of the races is achieved through aligned apertures **16** and **18** in the top
17 and bottom sheets respectively.

18 Referring now to Figures 2A and 2B, assemblage of the components of the
19 invention is illustrated by a pressing operation carried out between punch **21** and
20 anvil **23**. Top and bottom sheets **15** and **17** are placed in the press with their
21 apertures aligned. Inner race **11** and outer race **13** are placed together and set onto
22 the sheets in axial alignment with the sheet apertures as shown in Figure 2A.
23 Pressing is then performed which results in the joinder of the sheets and the
24 clinging of parts as depicted in Figure 2B. A circumferential undercut **31** around

1 the perimeter of the outer race receives the cold flow of metal from the top sheet
2 while a similar circumferential undercut **33** on the inner race receives the cold
3 flow of metal from the bottom sheet due to the pressure of these parts into the
4 sheet material. This achieves the rigid affixation of the outer race to the top sheet
5 and the inner race to the bottom sheet. The parts are sized to create a gap or
6 clearance **35** to control the relative movement between the parts and to permit
7 their free rotation.

8 Referring now to Figure 3, an embodiment of the invention utilizes an
9 inner race **11** having an elongated shank portion **41** which permits a substantial
10 standoff distance between sheets **15** and **17**. The inner race **11** and outer race **13**
11 are clinched into the top and bottom sheets in the same manner as shown in the
12 embodiment of Figures 2A and 2B but a spring **43** is employed around the shank
13 **41** of the inner race. The spring resiliently biases the sheets apart while
14 permitting their angular deflection as shown in this figure. This embodiment
15 permits a rocking motion as well as a rotary motion between the parts. To
16 facilitate the angular deflection, compatible arcuate surfaces **44** and **45** on the
17 inner and outer races respectively are employed. This embodiment provides a
18 ball-and-socket style flush clinch bearing but requires a two-step pressing
19 operation for installation. The outer race is pressed into the sheet first and then
20 the inner race is installed through the top sheet and spring, being clinched into the
21 second sheet with a second pressing operation.

22 Referring now to Figure 4, yet another embodiment rotatably joins sheets
23 **15** and **17** in which the inner and outer races **11** and **13** employ ball bearings **46** to
24 reduce friction. A further reduction of friction may be obtained by utilizing a

1 shim (not shown) between the sheets during installation which when later
2 removed ensures that the sheets will be maintained in a non-contacting
3 relationship as they rotate.

4 Therefore, the foregoing is considered as illustrative only of the principles
5 of the invention. Further, since numerous modifications and changes will readily
6 occur to those skilled in the art, it is not desired to limit the invention to the exact
7 construction and operation shown and described, and accordingly, all suitable
8 modifications and equivalents may be resorted to, falling within the scope of the
9 invention.

1 CLAIMS

2 What is claimed as being new and desired to be protected by Letters
3 Patent of the United States is as follows:

4 1. A bearing assembly for rotatably joining two sheets, comprising:
5 a planar top sheet having a first aperture;
6 an outer race located within said first aperture and having an axial
7 bore and means receiving a cold flow of metal from the top sheet rigidly
8 attaching it thereto;

9 a bottom sheet in face-to-face relation with said top sheet and
10 having a second aperture in axial alignment with said first aperture about an axis;
11 an unitary inner race partly located within said axial bore of said
12 outer race and extending axially at least to a point partially within said second
13 aperture, said inner race having circumferential clinch attachment means
14 receiving a cold flow of metal from said bottom sheet rigidly securing it to said
15 bottom sheet; and

16 wherein said inner race has a head of increased diameter greater
17 than the diameter of said outer race bore thereby captivating the top sheet to the
18 bottom sheet, said inner race and outer race being closely dimensioned to
19 rotatably join the top sheet to said bottom sheet about said axis.

20 2. The bearing assembly of claim 1 wherein the head of said inner
21 race includes an angled outer sidewall.

22 3. The bearing assembly of claim 2 wherein said outer race includes
23 an angled inner sidewall for closely receiving the outer sidewall of said head.

24 4. The bearing assembly of claim 3 further including a spring

1 encircling a shank portion of said inner race between said top and bottom sheets
2 and being in abutment with said sheets at each end of said spring resiliently
3 biasing said sheets apart.

4 5. The bearing assembly of claim 1 wherein the head of the inner
5 race is flush with a top surface of the top sheet and opposite end of the inner race
6 is flush with a bottom surface of the bottom sheet.