(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 February 2006 (23.02.2006)

PCT

(10) International Publication Number
WO 2006/018313 A1

(51) International Patent Classification[7]: B21D 53/20

(21) International Application Number:
PCT/EP2005/008998

(22) International Filing Date: 19 August 2005 (19.08.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10 2004 040 311.2 19 August 2004 (19.08.2004) DE

(71) Applicants *(for all designated States except US)*: **UMICORE AG & CO. KG** [DE/DE]; Rodenbacher Chaussee 4, 63457 Hanau (DE). **ABB CALOR EMAG MITTELSPANNUNG GMBH** [DE/DE]; Oberhausener Strasse 33, 40472 Ratingen (DE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **GENTSCH, Dietmar** [DE/DE]; Mülheimer Strasse 19, 40878 Ratingen (DE). **PTASCHEK, Georg** [DE/DE]; Friendensstrasse 5, 63694 Limeshain (DE).

(74) Agent: **VOSSIUS & PARTNER**; Siebertsrasse 4, 81675 Munich (DE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

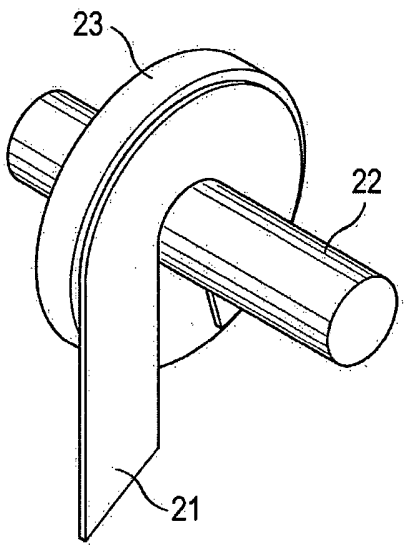
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designation US*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designation US*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ,*

[Continued on next page]

(54) Title: ANNULAR DISC OF BENT SHEET MATERIAL



(57) Abstract: The invention relates to an annular disc of bent sheet material (21) with at least one junction at which the annulus is closed. Furthermore, a method for producing an annular disc is disclosed, comprising the steps of: (a) providing a sheet material; (b) bending the sheet material into an annular disc; (c) severing the sheet material, so that an annular disc with a junction at which the annulus is open is provided; (d) closing the junction, so that an annular disc with a junction at which the annulus is closed is provided. A description is given of a method for producing an annular disc comprising the steps of: (i) providing a sheet material; (ii) bending the sheet material into a first part of an annular disc; (iii) severing the sheet material, so that a first part of an annular disc is provided; (iv) repeating steps (i), (ii) and (iii) at least once, so that at least one further part of the annular disc is provided; and (v) connecting the first part and the further parts of the annular disc, so that an annular disc with at least two junctions at which the annulus is closed is provided.

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— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designation US*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designation US*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Annular disc of bent sheet material

The present invention relates to an annular disc of bent sheet material and to a method for producing it.

It is known to produce annular discs by punching out the desired form from a wide sheet. With this punching method, however, only a small part of the sheet used is processed into annular discs. For instance, in industrially customary methods, generally only between 10% and 40% of the sheet used is actually processed into annular discs. The rest remains as scrap and must be reprocessed into sheet before possible reuse, with the great effort and costs that involves. Therefore, methods in which a greater part of the material used is processed into the annular discs are desired.

The present invention relates to an annular disc of bent sheet material with at least one junction at which the annulus is closed.

A further embodiment of the invention is a method for producing an annular disc, comprising the steps of:

(a) providing a sheet material;

(b) bending the sheet material into an annular disc;

(c) severing the sheet material, so that an annular disc with a junction at which the annulus is open is provided;

(d) closing the junction, so that an annular disc with a junction at which the annulus is closed is provided.

Furthermore, the invention relates to a method for producing an annular disc, comprising the steps of:

(i) providing a sheet material;

(ii) bending the sheet material into a first part of an annular disc;

(iii) severing the sheet material, so that a first part of an annular disc is provided;

(iv) repeating steps (i), (ii) and (iii) at least once, so that at least one further part of the annular disc is provided; and

(v) connecting the first part and the further parts of the annular disc, so that an annular disc with at least two junctions at which the annulus is closed is provided.

Figure 1 shows annular discs according to the invention with one, two and three junctions.

Figure 2 shows a possible device for bending the sheet material.

Figure 3 shows a further possible device for bending the sheet material.

Figure 4 shows another embodiment of a device for bending the sheet material.

Figure 5 shows yet a further possible device for bending the sheet material.

Figure 6 shows an annular disc according to the invention.

Annular discs according to the invention are shown in Figure 1. In Figure 1A, the annular disc 11 has one junction 12. The annular disc is characterized by an inside diameter 13, an outside diameter 14 and a web width 15. In Figure 1B, a further annular disc according to the invention with two junctions is shown. Although in Figure 1B the first part of the annular disc 16 and the second part of the annular disc 17 are represented as both being of the same size, this is merely preferred. It is likewise possible to assemble the annular disc from parts of different sizes. In Figure 1C, an annular disc according to the invention with three junctions is shown.

The annular discs according to the invention have at least one junction. The number of junctions is not particularly restricted and there are generally one to four junctions. Annular discs with two to four junctions are particularly preferred, more preferred with two junctions, since there is less of a tendency towards bulging and buckling during the bending of parts of annular discs that there is during the bending of complete annular discs which require only one junction.

In the case of both methods according to the invention, firstly a sheet material is provided. The sheet material is generally an elongated material in strip form, the width, thickness and length of which are not particularly restricted. The sheet material has a width which corresponds to the web width of the annular disc to be produced. Typical widths are from 0.5 mm to 15 mm, preferably 2 mm to 10 mm. The thickness of the sheet material likewise corresponds essentially to the desired thickness of the annular disc. It may vary for example from 0.005 mm to 0.30 mm, preferably from 0.15 mm to 0.20 mm. The minimum length of the sheet material is not restricted, provided that the sheet material is at least long enough for an annular disc or

part of an annular disc to be formed from it. The maximum length of the sheet material is not restricted, since pieces of the desired length can be obtained from a long strip by severing after bending. The sheet material is generally used as roll stock. However, it is likewise possible to use short strips.

The sheet material may consist of any desired material which can be formed into an annular disc by the method according to the invention. The sheet material preferably comprises a metal or a metal alloy, such as for example solder material, iron or grades of steel. With regard to the extensibility of the sheet material, sheet materials with a Vickers hardness of at most HV1 170 are preferably used, more preferably HV1 100 to HV1 150. The Vickers hardness can be measured as specified in DIN 50133.

In a particularly preferred embodiment of the invention, the sheet material consists of solder material, in particular of a hard solder material. Hard solder materials are, for example, solder materials which have a melting point of at least 450°C. They can be used to produce connections that are sealed with respect to a high vacuum, for example in the case of vacuum interrupters. These soldered connections can withstand high loading and can ensure sealing with respect to a high vacuum of 10^{-7} mbar over at least 20 years. Silver-copper based hard solder alloys (such as $Ag_{72}Cu_{28}$ and $Ag_{69.7}Cu_{28}Ge_2Co_{0.3}$) and silver-copper-palladium-based hard solder alloys (such as $Ag_{68.4}Cu_{26.6}Pd_5$, $Ag_{65}Cu_{20}Pd_{15}$ and $Ag_{54}Cu_{21}Pd_{25}$) may be mentioned as examples of a hard solder material.

The sheet material provided is bent into an annular disc or part of an annular disc. In a preferred embodiment, as shown in Figure 2, the sheet material 21 is wound on edge around a bar 22. The diameter of the bar should in this case correspond essentially to the

inside diameter of the desired annular disc. The diameter of the bar is not particularly restricted and is typically 25 mm to 290 mm, preferably 40 mm to 140 mm.

In order to prevent the annular disc or the part of the annular disc becoming non-planar during bending, since the sheet material 21 bulges or buckles for example, the sheet material 21 may for example lie on a plate 23 attached to the bar 22 during the bending operation. If required, the contact with the plate may be assisted in various ways. For example, it would be possible to feed the sheet material 21 in at a suitable angle, so that it lies in contact or, as shown in Figure 3, a pressing roller 34 or other corresponding device may be used. A further possible way of guiding the sheet is represented in Figure 4. Here, the sheet material 41 is guided between two circular discs 43 and 45, which are fastened to the bar 42. If appropriate, the guidance of the strip may also be provided by a plate which is not attached to the bar or a device which is separate from the bar. In this embodiment, too, the planarity of the annular disc can be assisted by corresponding further measures or devices.

Figure 5 shows a further device for bending the sheet material. The sheet material 51 is fed in by means of a guide 52 in such a way that it is guided in a depression 57 in a lower plate 56. An upper plate 53, which is mounted rotatably about a bar 54, also guides the sheet material.

It is possible that, with the method according to the invention, annular discs which have slight bulges transversely to the web width are obtained (Figure 6). These bulges do not adversely influence the use of the annular discs, in particular when they are used as solder material.

After the bending of the annular disc or the first part of the annular disc, the sheet material is severed. In the case of the second embodiment of the method according to the invention, in which the annular disc is made up of a number of parts, the steps (i), (ii) and (iii) described above are subsequently repeated, thereby providing one or more further parts of the annular disc, which can be joined together to form a complete annular disc.

In a final method step, the junction or junctions of the inner disc is or are connected, so that a complete annular disc is provided. The methods for connecting the junctions are not particularly restricted. Generally, the method for connecting the junctions is suitably selected on the basis of the sheet material used. Soldering and welding, in particular resistance welding and laser welding, can be mentioned as possible methods.

An annular disc which has been bent, but the junction of which is not connected, is disadvantageous. Since the junction is not connected, the two ends of the sheet material at the junction can move away from each other during production, mounting or use, so that the annular disc is no longer planar. Moreover, such annular discs are disadvantageous because the open junction can become hooked with other annular discs, the devices used, storage containers and the like, and the hooked annular disc subsequently has to be laboriously unhooked again manually.

Claims

1. Annular disc of bent sheet material with at least one junction at which the annulus is closed.

2. Annular disc according to Claim 1, the annular disc having two junctions at which the annulus is closed.

3. Annular disc according to Claim 1 or 2, the sheet material comprising a metal or a metal alloy.

4. Annular disc according to one of Claims 1 to 3, the sheet material having a Vickers hardness of up to HV1 170.

5. Annular disc according to one of Claims 1 to 4, the sheet material being a solder material.

6. Annular disc according to Claim 5, the solder material being a hard solder material.

7. Annular disc according to Claim 6, the hard solder material being selected from silver-copper-based and silver-copper-palladium-based hard solder alloys.

8. Annular disc according to Claim 7, the hard solder material being selected from $Ag_{72}Cu_{28}$, $Ag_{69.7}Cu_{28}Ge_2Co_{0.3}$, $Ag_{68.4}Cu_{26.6}Pd_5$, $Ag_{65}Cu_{20}Pd_{15}$ and $Ag_{54}Cu_{21}Pd_{25}$.

9. Method for producing an annular disc, comprising the steps of:
   (a) providing a sheet material;
   (b) bending the sheet material into an annular disc;
   (c) severing the sheet material, so that an annular disc with a junction at which the annulus is open is provided;
   (d) closing the junction, so that an annular disc with a junction at which the annulus is closed is provided.

10. Method for producing an annular disc, comprising the steps of:
   (i) providing a sheet material;
   (ii) bending the sheet material into a first part of an annular disc;
   (iii) severing the sheet material, so that a first part of an annular disc is provided;
   (iv) repeating steps (i), (ii) and (iii) at least once, so that at least one further part of the annular disc is provided; and
   (v) connecting the first part and the further parts of the annular disc, so that an annular disc with at least two junctions at which the annulus is closed is provided.

11. Method according to Claim 10, the first part of the annular disc and the at least one further part of the annular disc in each case being half annular discs.

12. Method according to Claim 9 or 10, the junction being connected by soldering or welding.

13. Method according to Claim 12, the welding being selected from resistance welding and laser welding.

14. Method according to one of Claims 9 to 13, the sheet material having a width of from 0.5 to 15 mm.

15. Method according to one of Claims 9 to 14, the bending of the sheet material into an annular disc or part of an annular disc being carried out by the sheet material being wound on edge around a bar.

16. Annular disc obtainable by a method according to one of Claims 9 to 15.

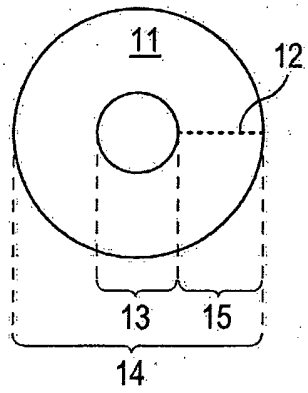

FIG. 1A

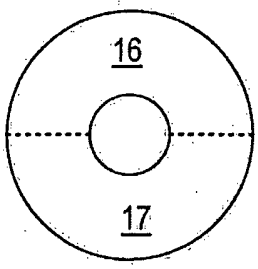

FIG. 1B

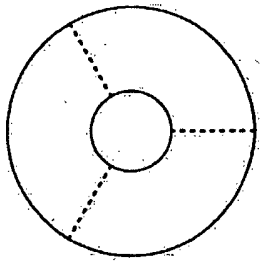

FIG. 1C

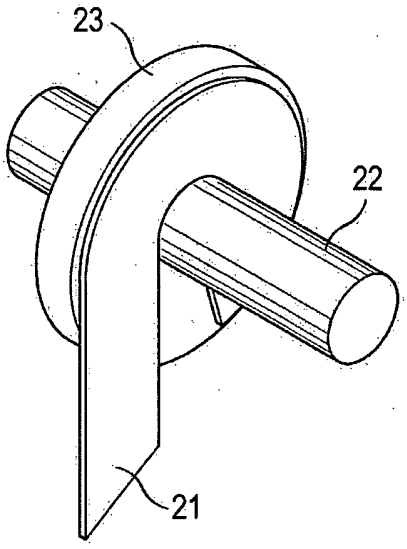

FIG. 2

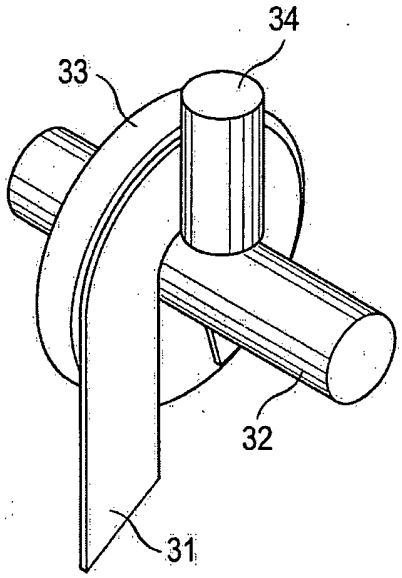

FIG. 3

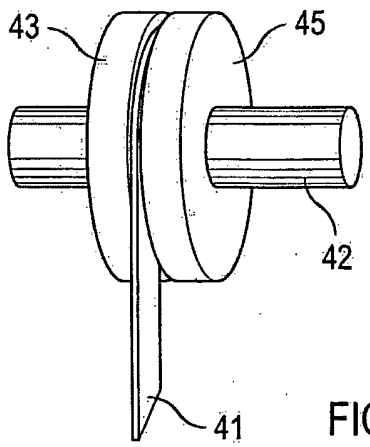

FIG. 4

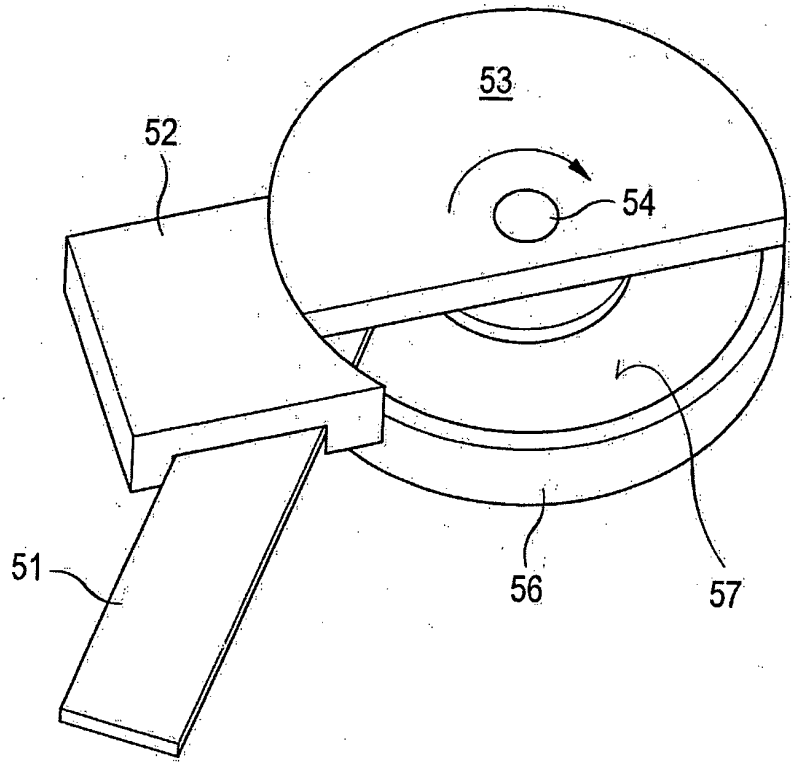

FIG. 5

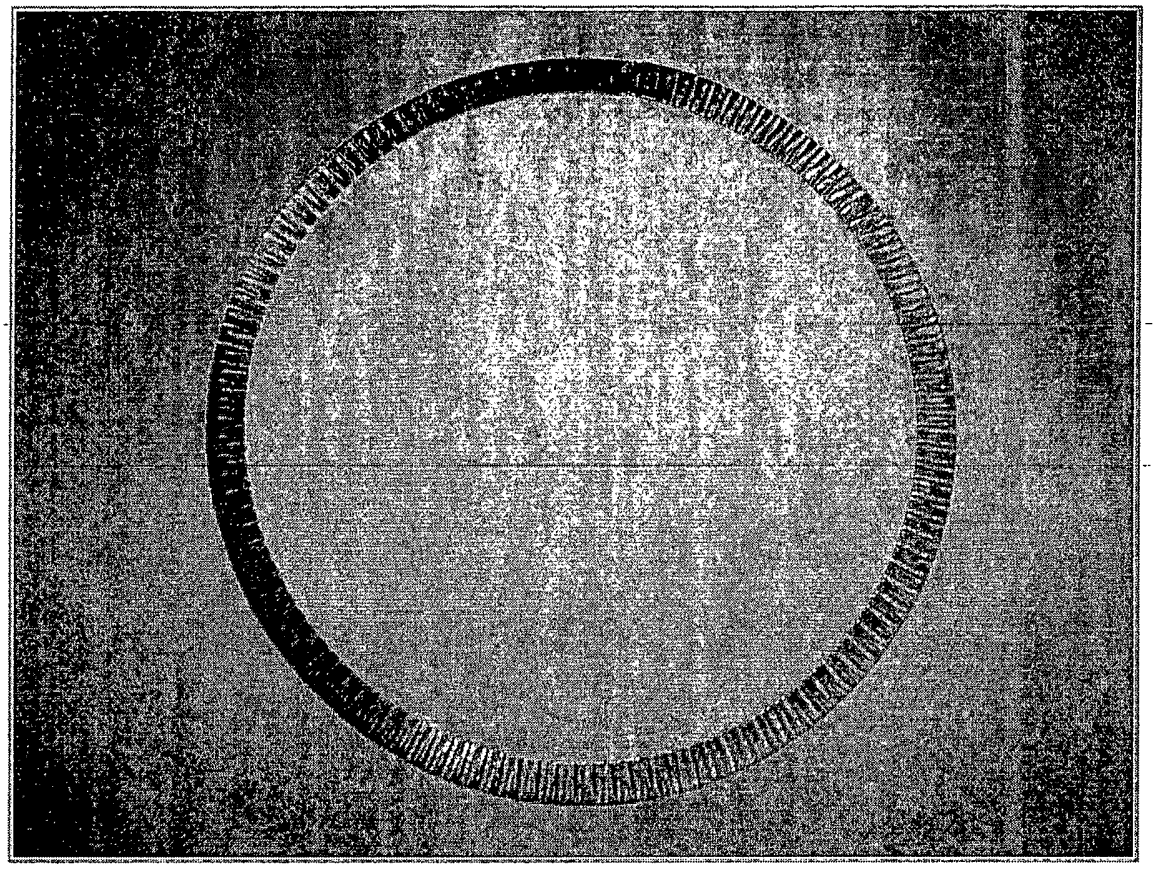

FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/008998

A. CLASSIFICATION OF SUBJECT MATTER
B21D53/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B21D B21H F16L F16B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 12, 5 December 2003 (2003-12-05) -& JP 2004 202499 A (JFE STEEL KK), 22 July 2004 (2004-07-22) abstract; figures 1,2	1,3,4,9, 12-15
X	EP 0 823 566 A (BARNES GROUP INC) 11 February 1998 (1998-02-11) the whole document column 8, line 14 - column 9, line 3; figures 4-8	1,3,4,9, 14,15
X	US 3 021 593 A (COUSINO WALTER F) 20 February 1962 (1962-02-20) figures 1,2	1,2
A	figures 19-22	9-11

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 December 2005	04/01/2006

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Meritano, L

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/008998

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 05, 31 May 1999 (1999-05-31) -& JP 11 047976 A (TOPY IND LTD), 23 February 1999 (1999-02-23) abstract	1,6-8
A	GB 1 585 733 A (DAIDO METAL CO LTD) 11 March 1981 (1981-03-11) figures	1,2,9-11

INTERNATIONAL SEARCH REPORT

national application No.
PCT/EP2005/008998

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 16
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

Continuation of Box II.2

Claims Nos.: 16

Claim 16 contains no features of the annular disc.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/008998

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