(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 873 485 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.05.2015 Bulletin 2015/21

(21) Application number: **14193188.1**

(22) Date of filing: **14.11.2014**

(51) Int Cl.:
B24D 5/12 *(2006.01)* ***B24D 5/04*** *(2006.01)*
B24D 7/04 *(2006.01)* ***B24D 5/16*** *(2006.01)*
B24D 7/16 *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **15.11.2013 IT RE20130086**

(71) Applicant: **Ficai, Giovanni**
43044 Fraz. Ozzano Taro, Collecchio (PR) (IT)

(72) Inventor: **Ficai, Giovanni**
43044 Fraz. Ozzano Taro, Collecchio (PR) (IT)

(74) Representative: **Corradini, Corrado et al**
Ing. C. Corradini & C. S.r.l.
Via Dante Alighieri 4
42121 Reggio Emilia (IT)

(54) A depressed-centre grinding wheel

(57) A depressed-centre grinding wheel (10) comprising at least a circular cutting annulus (15) made of a substantially planar compacted abrasive material lying on a plane that is perpendicular to the rotation axis of the grinding wheel (10) and a concave central portion (16) provided with a central through-hole (12) for attachment, in which the internal diameter (Di) of the circular annulus (15) coincides with the external diameter of the concave portion (16), is not greater than 60 mm.

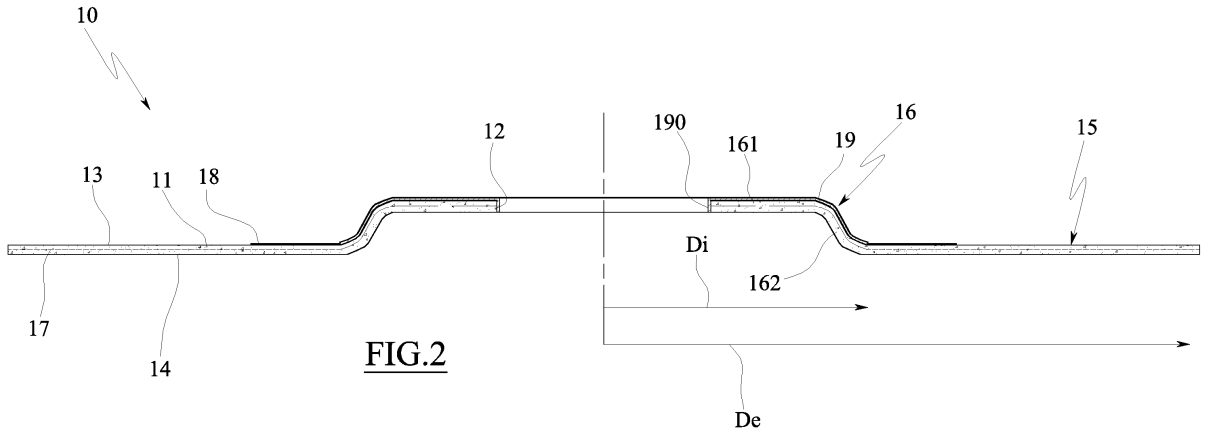


FIG.2

EP 2 873 485 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a grinding wheel, in particular a depressed-centre grinding wheel made of at least a compacted abrasive material.

PRIOR ART

[0002] As is known, grinding wheels exist of a disc-shaped type having a depressed centre, or centres that are flat, conical, semi-flexible, dimpled or not dimpled, exhibiting an external diameter that is substantially comprised between 20 and 230 mm, especially used on electric portable grinding machines, or highspeed compressed air grinding machines (60-100 m/s peripheral velocity), also known as sanders, able to perform burring and/or cutting operations, which are essentially constituted by an abrasive mixture reinforced with armatures constituted by one or more textile meshes, one or more annular metal elements, commonly known as washers or sleeves, which delimit the fixing hole of the grinding wheel to the shaft of the grinding machine, and possibly bear a paper label, or commonly used adherent rating plate stuck on one of the two faces of the grinding wheel (in depressed-centre grinding wheels usually the convex face).

[0003] The abrasive mixture is generally constituted by grains of abrasive material (silicon carbide, light green, dark green, black, corundum, modified corundums with zirconium, semi-friable, dark brown, white, pink, ruby, with ceramic, mono-crystalline, sol-gel abrasives or sintered ceramics, or other like materials) having a predefined granulometry (normally measured in meshes) which are mixed with resins, for example phenolic, liquid and/or powder and possibly modified with epoxy resins, and/or others, possibly modified with organic compounds and/or vegetal or synthetic compounds, and other types of polyamide resins, etc., with the use of additives and fillers. The reinforcing meshes are normally textiles with fibreglass threads, but might also be other types of fibre such as carbon, Kevlar or another; the meshes have a height of about 1.5 m, are first immersed in a solution of liquid resins and solvents, squeezed between pairs of rollers and dried in special ovens internally of which the resin dries without polymerizing (polymerization is completed later in the firing oven together with the firing of the grinding wheel).

[0004] The meshes, thus-impregnated with resin and dried, are used for the blanking (or other method) of the mesh discs required for reinforcing the grinding wheels.

[0005] The meshes can be pre-glued to a paper sheet or a slim polymer material sheet, or to labels.

[0006] The annular defining elements delimiting the attaching hole of the grinding wheel are constituted by a circular annulus plate, or another shape such as square or polygonal, from an internal hole of which a cylindrical or non-cylindrical appendage emerges; the plate adheres to one of the two faces of the grinding wheel, while the hollow appendage inserts in the hole of the grinding wheel, delimiting the internal wall thereof.

[0007] The labels are made of paper or foil or another synthetic material and normally are circular-annulus shaped (though they could be of any other shape), and can occupy either the whole face of the grinding wheel or a limited area of the face on which the identifying and information data of the grinding wheel are reported.

[0008] Flat grinding wheels (in particular reference is made to a cutting disc and not a burring disc) exhibit the whole circular annulus projecting externally of the annular elements which delimit the attaching hole potentially active in the cutting operations, and which can therefore exhibit a depth that is substantially equal to the radial thickness of the circular annulus (except the part of the blocking flanges which block the grinding wheel on the rotary shaft of the grinding machine, which normally have an external diameter of 42 mm), and/or the grinding wheel can be used for a large number of cutting operations.

[0009] Flat grinding wheels, however, exhibit a high flexibility and therefore low precision in the cutting operations and a low resistance to inappropriate uses and stresses. Further, as they are not very rigid, they can be subject to flutter during rotation, which makes precision cuts difficult to carry out.

[0010] To obviate this drawback, grinding wheels with a central depression have been realised, in which at the central zone proximal to the attaching hole a cupola is formed, as shown in figure 1, which illustrates a depressed-centre cutting grinding wheel of known type.

[0011] Depressed-centre grinding wheels have the advantage, with respect to flat grinding wheels, of having a three-dimensional shape and therefore of providing a greater rigidity, stability and precision.

[0012] The main disadvantage of the depressed-centre grinding wheels is that the cupola, or cap, which generally extends over a conspicuous radial tract of the grinding wheel (in practice, it normally exhibits an external diameter of about 65 mm, so that the attaching flange, which has a standard external diameter of 42 mm, of the grinding machine can be accommodated in the concave part of the cupola) and therefore does not enable the cut to be as deep as with a flat grinding wheel and/or does not enable making a same number of total cuts as with a flat grinding wheel.

[0013] This forces the user to replace depressed-centre grinding wheels frequently as they are no longer fit for use, with a subsequent effect on costs for the users. Flat discs on the other hand can be used for a longer time as they do not have the cupola interfering with pushing the cut more deeply.

[0014] This drawback is more severely felt in cutting grinding wheels which exhibit relatively small external diameters, as all depressed-centre grinding wheels have a cupola with an external diameter that is greater than 60 mm and therefore this cupola is more "unwieldy" in

discs having a smaller diameter. An aim of the present invention is to obviate the above-mentioned drawbacks in the prior art, with a solution that is simple, rational and relatively inexpensive.

[0015] The aims are attained by the characteristics of the invention reported in the independent claim. The dependent claims delineate preferred and/or particularly advantageous aspects of the invention.

DESCRIPTION OF THE INVENTION

[0016] The invention relates in particular to a depressed-centre grinding wheel comprising at least a circular cutting annulus made of a substantially planar compacted abrasive material lying on a plane that is perpendicular to the rotation axis of the grinding wheel and a concave central portion provided with a central through-hole for attachment.

[0017] In the invention, the internal diameter of the circular annulus coinciding with the external diameter of the concave portion is not greater than 55 mm.

[0018] With this solution, given a same external radius of the grinding wheel, the wheel exhibits a larger active cutting portion and therefore a greater depth of cut and/or it can be used to perform a greater number of cuts.

[0019] In an aspect of the invention, the external diameter of the circular annulus is substantially comprised between 100 and 230 mm, preferably between 100 and 125 mm.

[0020] In these grinding wheel formats, the increase in radial thickness of the circular annulus, with a subsequent reduction of the external diameter of the circular cap part, enables a significant increase in the active cutting portion of small-dimension grinding wheels, which among other things are the most widely-used because they are easier to handle and cost less.

[0021] The concave portion advantageously comprises a first central section that is substantially planar and a concave cap, in which the inclination of the cap wall is substantially comprised between 40° e 70°.

[0022] A further aspect of the invention relates to a method for realizing a depressed-centre grinding wheel, according to any one of the preceding claims, which comprises steps of:

- raw-moulding a substantially planar semi-finished grinding wheel;
- deforming the central portion of the semi-finished grinding wheel, so as to define a depressed concave portion having an external diameter that is substantially identical to an internal diameter of the external planar circular annulus of the undeformed semi-finished grinding wheel, where the external diameter of the concave portion is not greater than 55 mm.

[0023] Furthermore, following the deformation, the deformed semi-finished grinding wheel is subjected to a firing step, for example at appropriate firing temperatures which enable polymerization of the binding resin that binds the abrasive mixture together.

[0024] A further aspect of the invention relates to a grinding system which comprises a grinding machine having a rotary shaft which can be inserted into the grinding wheel, as described above, (i.e. into the through-hole) and a coupling flange suitable to be inserted into the concave portion of the grinding wheel and having an external diameter substantially equal to 42 mm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] Further characteristics and advantages of the invention will emerge from a reading of the description that follows, provided by way of non-limiting example, with the aid of the figures of the accompanying tables.

Figure 1 is a section view of a depressed-centre grinding wheel of the prior art.

Figure 2 is a section view of a depressed-centre grinding wheel according to the present invention.

BEST WAY OF CARRYING OUT THE INVENTION

[0026] With particular reference to the figures, reference numeral 10 denotes in its entirety a depressed-centre cutting wheel.

[0027] The grinding wheel 10 comprises an abrasive disc-shaped element 11 which is attachable, substantially coaxially, to the free end of a rotating shaft of a grinding machine.

[0028] The disc-shaped element 11 comprises at least a substantially central through-hole 12 and a first convex face 13 defining the back of the disc-shaped element.

[0029] The disc-shaped element 11 further comprises a second face 14 opposite the first face 13.

[0030] In particular, the disc-shaped element 11 is realized by at least a layer of an abrasive mixture that is compacted and stably bound by a binder resin.

[0031] In practice, the disc-shaped element 11 is obtained by pressing a mixture of a loose powder of abrasive material, for example abrasive material such as natural corundum, sand, recycled artificial corundum or the like, abrasive sol-gel or sintered ceramic, corundum at zirconium, or other, and mixed with a suitable binder, for example resin-based, such as phenolic, liquid and/or powder resins possibly modified with phenoxy epoxy resins and/or others, modified with organic and/or vegetal or synthetic compounds, and other types of poly-imide resins, etc...., and/or with additives and fillers.

[0032] The disc-shaped element 11 is constituted by an external peripheral circular annulus 15 and a disc-shaped internal cap 16 (or hub), both coaxial to the through-hole 12.

[0033] In practice, the disc-shaped cap 16, which comprises the through-hole 12, extends radially externally from the circular annulus 15.

[0034] The circular annulus 15 lies substantially in a

perpendicular plane to the axis of the grinding wheel 10 (axis of the through-hole 12).

[0035] The circular annulus 15 of the abrasive mixture is the active portion of the grinding wheel 10, i.e. the portion thereof that is generally used for cutting.

[0036] The circular annulus 15 has an external diameter De, variable during use, which defines the external diameter of the grinding wheel 10 and an internal diameter Di, fixed, which defines the external diameter of the circular cap 16. The circular cap 16 has an external diameter substantially equal to the internal diameter Di of the circular annulus 15 and an internal diameter substantially equal to the diameter of the through-hole 12.

[0037] In particular, for the purposes of the present invention, the external diameter of the circular cap 16, which substantially coincides with the internal diameter Di of the circular annulus 15, is substantially not greater than 60 mm (for example, less than 57.5 mm).

[0038] The external diameter of the circular cap 16 is preferably substantially between 45 and 55 mm, so as to allow insertion of a coupling flange in its concavity, able to fasten the grinding wheel 10 to the rotary shaft of the grinding machine, which generally exhibits a diameter of about 42 mm and, at the same time, does not adversely affect either the radial thickness of the active portion in the cutting action (circular annulus 15) of the grinding wheel 10 or the stability and resistance of the grinding wheel.

[0039] Advantageously, the external diameter of the circular cap 16 is substantially 55 mm.

[0040] This dimension has been found to be optimal for the aims set out above. The external diameter (De) of the circular annulus 15 is between 100 and 230 mm.

[0041] In particular, the wheels 10 have standardized dimensions and are classified according to the external diameter (De) of the grinding wheel 10, which exhibit the following rated dimensions:

[0042] De = 115 mm, 125 mm, 150 mm, 180 mm, 200 mm and 230 mm.

[0043] The external diameter (De) of the circular annulus 15 is preferably between 100 and 155 mm and preferably between 115 and 150 mm.

[0044] In these formats (where the external diameter of the grinding wheel 10 is between 100-155 mm, and in particular the standard formats have external diameters of 115 mm and 125 mm) of grinding wheels 10, where the external diameter is smaller, the peculiarity of the invention (i.e. the fact that the external diameter of the circular cap 16 does not exceed 60 mm) is decidedly more advantageous, as it provides a percentage active portion greater than the grinders (of the same diameter) of the traditional type (as shown in figure 1), given an identical sturdiness of the grinding wheel 10.

[0045] In practice, even in these formats, in which the external diameter De is 115, 125 and 150 mm) the ratio between the internal diameter Di and the external diameter De of the circular annulus 15 is substantially less than ½.

[0046] The circular cap 16 includes a first internal portion 161 that is substantially planar, parallel and coaxial to the circular annulus 15, and a cap wall 162 (coaxial with the circular annulus 15), connecting the first internal portion 161 and the circular annulus 15.

[0047] Advantageously, the cap wall 162 of the concave circular cap 16 has an inclination substantially comprised between 40 and 70°, preferably 60°.

[0048] In practice, the cap wall 162 radially occupies a radial portion substantially identical to the distance of the rise that it defines (i.e. the axial distance between the first internal portion 161 and the circular annulus 15, which are substantially parallel).

[0049] The abrasive mixture has a granulometry of substantially between 120 and 12 mesh (however abrasive mixtures of a greater or smaller particle size than the above-described range recorded can be used, according to requirements).

[0050] The layer of abrasive mixture can have a thickness of around 3 mm or less, though this could be greater or smaller than 3 mm, depending on requirements.

[0051] The grinding wheel 10 comprises, for example, at least a reinforcement mesh 17, schematically illustrated in figure 2, incorporated in the layer of abrasive mixture.

[0052] The reinforcing mesh 17 is for example disc-shaped and substantially coplanar to at least the first face 14 of the disc-shaped element 11.

[0053] The grinding wheel 10 can have a plurality of reinforcing meshes 17 and a plurality of layers of abrasive material of different nature, according to needs. By appropriately selecting the ratio between the grain size of the abrasive mixture used, which depends on the intended use of the grinding wheel, and the opening of the meshes of/and reinforcing mesh/es 17, the penetration of the mixture through the mesh thereof can be advantageously optimised.

[0054] A label 18 can be placed on the first face 14, i.e. the back of the wheel 10, illustrated schematically in figure 2; the label can be paper or foil or other like material.

[0055] The abrasive mixtures of the layer of abrasive mixture, as well as the reinforcing mesh 17 and the label 18, are of a type widely known in the industry.

[0056] The label 18 can otherwise be applied once the grinding wheel 10 has been fired/polymerised, by gluing or applying self-adhesive labels, by screening, pad printing, spraying or another form of stencil painting.

[0057] Lastly, the grinding wheel 10 includes one or more metal annular elements, commonly known as washers or sleeves 19, which delimit the attachment hole of the grinding wheel 10 to the pivot of the grinding machine.

[0058] The washer 19 is fixed to the first face 13 (or label) of the disc-shaped element 11 and, for example, extends radially substantially over the entire disc-shaped cap 16 exhibiting the concave shape.

[0059] The washer 19 comprises a hollow central

shank 190 that inserts substantially snugly in the through-hole 12 and which exhibits an axial thickness that is substantially identical to (or slightly smaller than) the axial thickness of the grinding wheel 10 (the layer of abrasive mixture that constitutes the disc-shaped element 11).

[0060] The method for realising a grinding wheel 10 as described above comprises a step of raw-moulding a semi-finished grinding wheel that is substantially planar, i.e. so that the not-yet-concave central area that will form the disc-shaped cap 16 is substantially coplanar to the disc-shaped circular annulus 15.

[0061] The substantially planar raw moulding grinding wheel 10 is realized using a mould able to press the abrasive mixture together with the binder resin and give it the desired disc-shape.

[0062] Once the semi-finished grinding wheel has been formed the forming method continues by deforming the central portion of the grinding wheel, so as to define the disc-shaped cap 16 having an external diameter substantially equal to the internal diameter Di of the circular annulus 15, wherein the external diameter of the disc-shaped cap is substantially less than 60 mm. The step of deforming the semi-finished grinding wheel is advantageously done by inserting the grinding wheel into a mould, the bottom die of which (and/or the punch) is shaped such as to impart the desired shape to the grinding wheel.

[0063] Finally, the grinding wheel 10 thus-formed (i.e. deformed) is subjected to a heat treatment of firing, for example in special polymerization oven, where the polymerization is completed of the binder resin that solidifies and stably retains the abrasive mixture that constitutes the disc-shaped element 11.

[0064] In practice, the grinding wheel 10 is subjected to a thermal cycle which involves the insertion thereof in an oven at a temperature of substantially between 120° and 220° C for a time substantially comprised between 1 and 50 hours, or it can be fired in situ in the heated mould suitable for forming of the 10 depressed-centre grinding wheel.

[0065] The invention as it is conceived is susceptible to numerous modifications and variants, all falling within the scope of the inventive concept.

[0066] Further, all the details can be replaced by other technically-equivalent elements.

[0067] In practice, the materials used, as well as the contingent shapes and dimensions, can be any according to requirements, without forsaking the scope of protection of the following claims.

Claims

1. A depressed-centre grinding wheel (10) comprising at least a circular cutting annulus (15) made of a substantially planar compacted abrasive material lying on a plane that is perpendicular to the rotation axis of the grinding wheel (10) and a concave central portion (16) provided with a central through-hole (12) for attachment, **characterised in that** the external diameter (De) of the circular annulus (15) is comprised between 100 and 125 mm and the internal diameter (Di) of the circular annulus (15), coinciding with the external diameter of the concave portion (16), is not greater than 55 mm.

2. The grinding wheel (10) of claim 1, wherein the external diameter of the concave portion (16) is substantially comprised between 45 and 55 mm.

3. The grinding wheel (10) of claim 2, wherein the external diameter of the concave portion is substantially 55 mm.

4. The grinding wheel (10) of any one of the preceding claims, **characterised in that** it comprises at least a reinforcing mesh sunk into the abrasive material.

5. The grinding wheel (10) of any one of the preceding claims, wherein the concave portion (16) comprises a substantially planar first central section (161) and a concave cap wall (162), wherein an inclination of the cap wall (162) is substantially comprised between 40° and 70°.

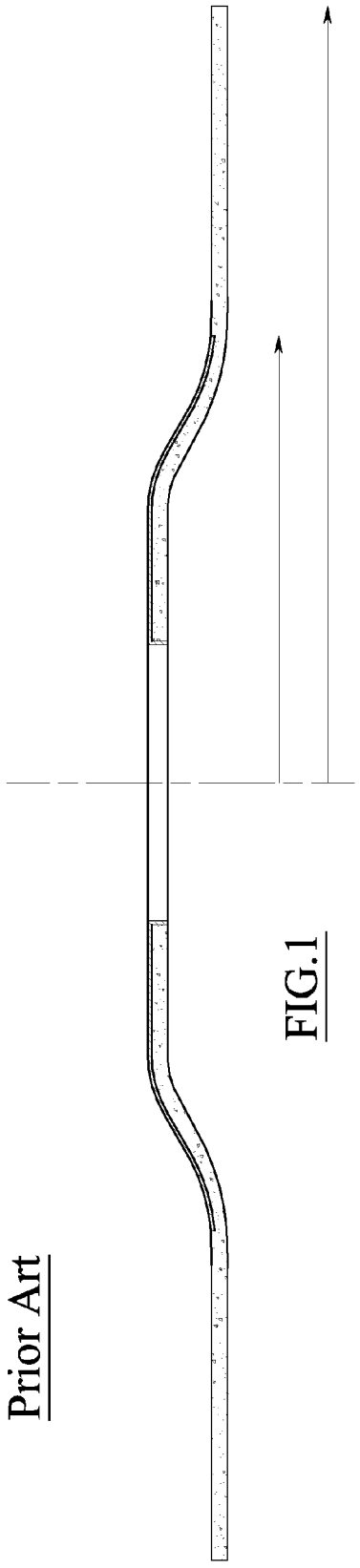
6. The grinding wheel (10) of claim 5, wherein the inclination of the cap wall (162) is substantially 60°.

7. Grinding system which comprises a grinding machine having a rotary shaft which inserted into the grinding wheel (10), according to any of the preceding claims, and a coupling flange suitable to be inserted into the concave portion (16) of the grinding wheel (10) and having an external diameter substantially equal to 42 mm.

8. A method for realising a depressed-centre grinding wheel (10), according to any one of the preceding claims from 1 to 6, which comprises steps of:

   - raw-moulding a substantially planar semi-finished grinding wheel;
   - deforming the central portion of the semi-finished grinding wheel, so as to define a depressed concave portion (16) having an external diameter that is substantially identical to an internal diameter (Di) of the external planar circular annulus (15) of the undeformed semi-finished grinding wheel, where the external diameter of the concave portion (16) is not greater than 55 mm.

9. The method of claim 8, **characterised in that** it comprises a step of firing the deformed semi-finished grinding wheel.



Prior Art

FIG.1

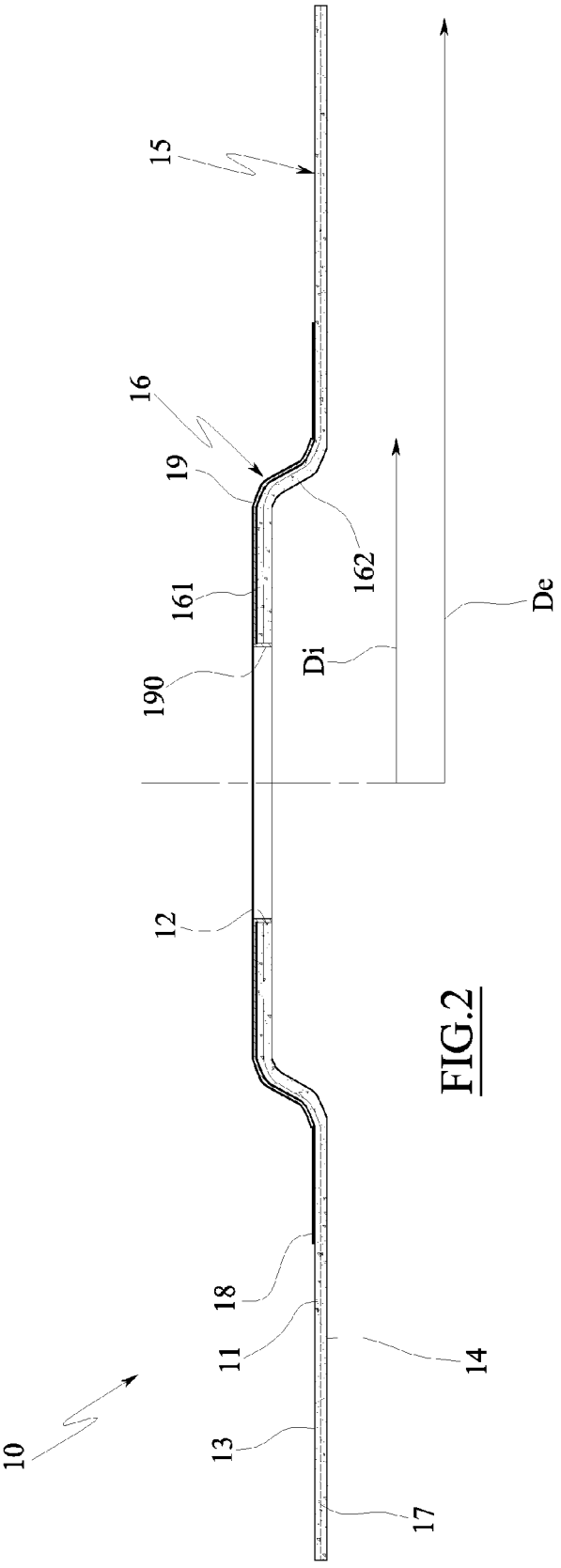


FIG.2

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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 3188

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	WO 2012/092610 A1 (SAINT GOBAIN ABRASIVES INC [US]; SAINT GOBAIN ABRASIFS SA [FR]) 5 July 2012 (2012-07-05) * page 5, lines 10-11 * * page 6, lines 6-22 * * page 8, lines 20-28 * * page 10, lines 28-31 * * page 12, line 33 - page 15, line 7 * * figures 1A-C * -----	1-9	INV. B24D5/12 B24D5/04 B24D7/04 B24D5/16 B24D7/16
Y	Anonymous: "Norton Abrasives improves and expands depressed center wheels offering for metal fabricating", , 9 November 2010 (2010-11-09), XP055164314, Retrieved from the Internet: URL:http://www.nortonindustrial.com/news-improvedexpandeddepressedcenterwheelline.aspx [retrieved on 2015-01-22] * the whole document * -----	1-9	
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A	US 3 836 345 A (GRAHAM R) 17 September 1974 (1974-09-17) * figure 2 * -----	5	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 January 2015	Endres, Mirja

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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