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# (54) CLAMPING SYSTEM FOR CLAMPING GRINDING WHEELS

(57) A clamping device (30) for clamping grinding wheels on a driving spindle (11) of a working tool (10), which comprises:
- a rear flange (31) intended to be fitted on the driving spindle (11) in a position proximal to the working tool (10), wherein the rear flange (31) is provided with a front face (312) with which a first damping element (33) is associated;
- a front flange (32) intended to be fitted on the driving spindle (11) and provided with a rear face (322), facing the front face (312) of the rear flange (31), with which a second damping element (34) is associated;
wherein the front face (312) of the rear flange (31) has a width larger than the rear face (322) of the front flange (32) and the first damping element (33) has a hardness lower than the second damping element (34).

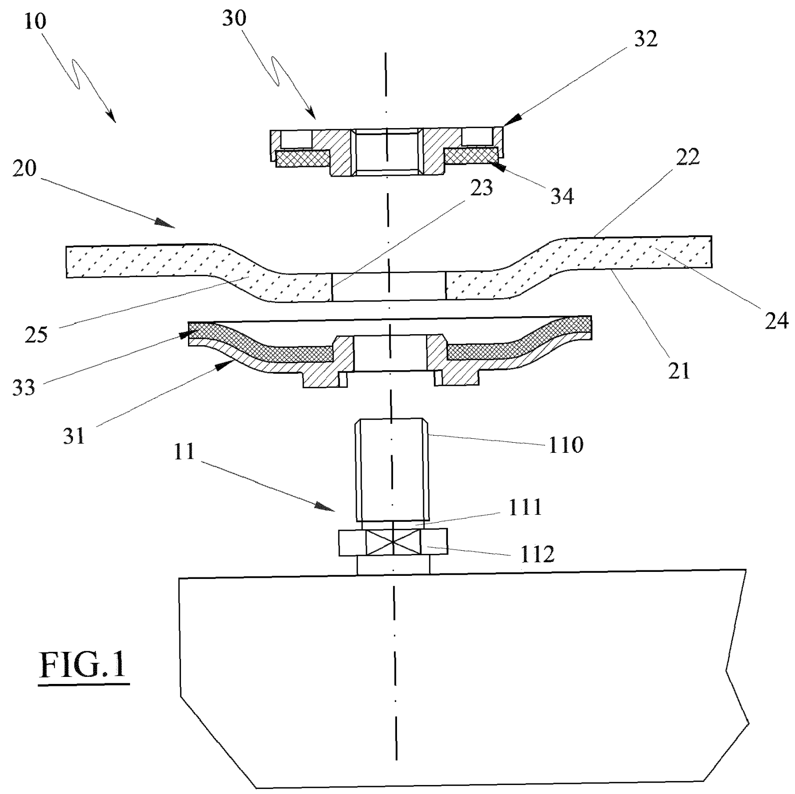


FIG.1

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## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to clamping grinding wheels, in particular depressed centre wheels.

**[0002]** More particularly, the invention relates to a clamping device configured to clamp a grinding wheel, preferably a depressed centre grinding wheel (still more preferably of the "Type 27" (in 115, 125, 150, 180 and 230 mm diameters, which are the most widespread), according to the ISO 603-14:1999 standard) on the driving spindle of a working tool and the working tool provided with such clamping device.

### PRIOR ART

**[0003]** As known, the problem of damping vibrations of grinding wheels of different shapes, that are employed in deburring, cutting and grinding operations has existed for over a century.

**[0004]** Deburring abrasive grindstones, abrasive cutting discs and some type of flap discs are manufactured in various sizes and shapes, however they have in common the same system to be clamped to the portable working tool, commonly called "angular deburring machine".

**[0005]** Such system provides that the grinding wheel is mounted on the shaft (or spindle) of the working tool and is sandwiched between two clamping flanges. The tool shaft is made up of a threaded end (or distal) portion, a cylindrical frustum and finally a shoulder on which one of the two flanges, i.e., the rear or proximal flange, rests.

**[0006]** In some tools a prismatic connection is provided between the shoulder of the spindle and the rear flange, such to transmit the driving torque to the tool.

**[0007]** The rear flange is disc-shaped and provides a front face adapted to contact the grinding wheel, from which a central centering shank rises, which is configured to be fitted into the central hole of the grinding wheel determining the centering thereof with respect to the tool shaft.

**[0008]** The front flange is also disc-shaped and provides a rear face adapted to contact the grinding wheel, from which a further central centering shank rises. The central hole of the front flange is threaded with a thread corresponding to that of the tool shaft, normally with M14 thread size (for European tools) or with 5/8" thread size (for Anglo-Saxon tools).

**[0009]** The front flange can thus be screwed on the tool shaft, with a screwing direction opposite to the shaft rotation direction, thereby when the grinding wheel starts rotating for grinding or cutting operations, such rotation tends to further clamp the flanges.

**[0010]** The front flange is further provided with a disassembling device, defined by two or four holes or by a prismatic facing, adapted to be engaged by specific wrenches to allow unscrewing and/or screwing the flange itself.

**[0011]** Such assembly system, despite providing several advantages, such as the reliability, universality and strength of the flanges, generally made of steel, has however a functional limitation, in that the rigid assembly transmits all the vibrations generated by the grinding action from the grinding wheel to the tool shaft and, by the tool, to the hands and upper limbs of the operator.

**[0012]** Such vibrations may be due to the grinding action, however they are often due to the fact that the grinding wheels are displaced to a certain extent or have a difference of parallelism between the grinding wheel face which is in contact with the material being processed and the planes of the clamping flanges and/or density differences.

**[0013]** Such displacements/unbalances and shape defects, while remaining within the limits established by the standards (e.g., EN and OSA - Organisation for the Safety of Abrasives) may anyway be accepted, however they result in annoying and hazardous vibrations, which can alter the peripheral blood circulation (according to the so called *"white finger disease"*) of the operator.

**[0014]** In this regard, the standards are more and more restrictive and oriented to safeguard the protection, safety and health of operators.

**[0015]** It is thus perceived the need to adopt measures adapted to improve the comfort of use of such working tools, which aim at reducing efficiently the transmission of vibrations to operators' hands and arms and at reducing acoustic pollution.

**[0016]** For this purpose, they are known systems having clamping flanges provided with a coating made of an at least partially elastic material, such as rubber.

**[0017]** However, the presently known systems have not efficiently solved the problem.

**[0018]** It has in fact been observed that the presently known systems have some technical limitations, in that the maximum diameter of at least one of the known clamping flanges must be small (smaller than 44 mm), so as to couple with the concavities of the (depressed centre) grinding wheels and this involves a greater limitation for the contact area between the flanges and the grinding wheel which is generally always smaller than 2200 $mm^2$ (for the two flanges when they have the same diameter).

**[0019]** Provided that the outer diameters of the most widespread depressed centre grinding wheels are 115, 125, 150, 180 and 230 mm (corresponding to 4.5, 5, 6, 7 and 9 inches), the larger the outer diameter of the grinding wheel the greater the power of the motor and torque required. This means that as the driving torque imposed by the motor increases, even the clamping torque to be provided to the clamping flanges must increase in order to transmit efficiently the motion of the tool shaft to the grinding wheel.

**[0020]** It was observed, however, that as the clamping torque increases, even the flattening of the elastic layers interposed between flanges and grinding wheel consequently increases, with a consequent lower efficacy in damping the vibrations exerted by such elastic layers.

**[0021]** Therefore, in order to efficiently transmit the driving torque of the motor to the grinding wheel, the known elastic layers have necessarily a high hardness, for instance greater than 80 Shore A, and an obvious lower capacity of absorbing vibrations (and noise emissions) produced by the grinding wheel.

**[0022]** An object of the present invention is to overcome the mentioned drawbacks of the prior art, within the context of a simple and rational solution and at a contained cost.

**[0023]** Such objects are achieved by the characteristics of the invention given in the independent claim. The dependent claims outline preferred and/or particularly advantageous aspects of the invention.

## DISCLOSURE OF THE INVENTION

**[0024]** The invention, in particular, makes available a clamping device for clamping grinding wheels on a driving spindle of a working tool, which comprises:

- a rear flange intended to be fitted on the driving spindle in a position proximal to the working tool, wherein the rear flange is provided with a front face with which a first damping element is associated;
- a front flange intended to be fitted on the driving spindle and provided with a rear face, facing the front face of the rear flange, with which a second damping element is associated;

wherein the front face of the rear flange has a larger width than the rear face of the front flange and the first damping element has a lower hardness than a hardness of the second damping element.

**[0025]** It has been observed that, thanks to this solution, the vibrations produced by the grinding wheel are efficiently damped, as the grinding wheel remains efficiently floating between the first damping element and the second damping element, even when high clamping torques are required.

**[0026]** Furthermore, thanks to the aforesaid solution, it is possible and comfortable to use very hard grinding wheels, i.e., more efficient and long-lasting, which would otherwise be particularly unconformable for the operator.

**[0027]** In fact, it has been observed that soft grinding wheels are generally preferred by the market, as they are more comfortable, though less performing and efficient.

**[0028]** Thanks to the relevant vibration adsorption carried out by the present invention, however, it is possible and comfortable to use harder and therefore more performing grinding wheels, with obvious advantages for the user who will be able to perform the same grinding operations with fewer grinding wheels and therefore, with an overall cost reduction.

**[0029]** Furthermore, thanks to such solution, it is possible to wear grinding (or deburring) wheels more evenly, as the floating connection of the grinding wheel on the tool shaft, allowed by the first damping element and second damping element of the present invention, allows to efficiently compensate unbalance density variation, displacement and planarity differences which are more or less present in the grinding wheel, thus reducing the working edge bouncing of the grinding wheels on the workpiece causing the irregular wear of such edge and, sometimes, also fractures or detachment of peripheral splinters of the grinding wheel.

**[0030]** Still, thanks to this solution, a reduction in the noise of the grinding wheel has been observed, such as a dampening substantially between 2 dB and 5 dB.

**[0031]** Advantageously, the front face of the rear flange is concave.

**[0032]** Thanks to this solution it is possible to efficiently enclose a wide extrados area of the disc-shaped cap of the grinding wheels.

**[0033]** Preferably, the front face of the rear flange may have an outer diameter larger than 70 mm, preferably between 70 mm and 80 mm and the maximum diameter of the front flange may be smaller than or equal to 44 mm.

**[0034]** Advantageously, the first damping element may comprise a layer of a yielding material, preferably elastically, which extends throughout the front face of the rear flange. Furthermore, the thickness of the first damping element may be substantially comprised between 2 mm and 4 mm, preferably equal to 3 mm.

**[0035]** Still, the first damping element may have a hardness lower than or equal to 50 Shore A, preferably comprised between 10 Shore A and 45 Shore A, e.g., equal to 45 or 10 or 15 (or 20) Shore A.

**[0036]** For instance, the second damping element may have a hardness higher than (or equal to) 40 Shore A, preferably comprised between 46 Shore A and 90 Shore A, e.g., equal to 50 Shore A.

**[0037]** According to an advantageous aspect of the invention, the first damping element may be removably associated to the front face of the rear flange, preferably by snap-fitting, but it may also be associated otherwise.

**[0038]** Thanks to this solution, it is possible to replace the first damping element when it is worn out.

**[0039]** Advantageously, at least one the front flange and rear flange may comprise a centering shank on which the grinding wheel may be fitted, wherein the distal end of the centering shank has a beveled or rounded annular edge.

**[0040]** Preferably, at least an annular edge may be hardened by a surface quenching or concrete-covering process but hardening can be extended also throughout the front and/ rear flange.

**[0041]** Furthermore, at least one of the front flange and rear flange may be made of a metal material, preferably selected from the group consisting in steel, aluminium, zamak, bronze o other metallic alloys, or made of a plastic material.

**[0042]** Still, at least one of the first damping element and second damping element may have an active surface, adapted to be put in contact with the grinding wheel during use, wherein the active surface has a smooth or structured surface with a structure selected from the group consisting in cylindrical cusp-shaped reliefs, pyramid frustum-shaped reliefs, truncated-cone-shaped reliefs, raised radial ridges and concentrical circumferential ridges.

**[0043]** For the same above-mentioned purposes, a further aspect of the invention makes available a working tool comprising:

- a driving unit;
- a driving spindle connected to the driving unit: and
- a clamping device, as above-described, for clamping a grinding wheel on the driving spindle.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0044]** Further characteristics and advantages of the invention will become clear from reading the following description provided by way of non-limiting example, with the aid of the figures illustrated in the accompanying tables.

Figure 1 is a side exploded view of a working tool, according to the invention.

Figure 2 is a side view of Figure 1 in a configuration of use.

Figure 3 is a side exploded view of a clamping device according to the invention.

Figure 4 is a chart relative to the Type 27 grinding wheels according to the standard ISO 603-14:1999.

## BEST MODE OF THE INVENTION

**[0045]** Referring in particular to such figures, 10 denotes as a whole a working tool, preferably a portable (manual) working tool of the angular deburring machine type, which can be used in deburring and cutting operations.

**[0046]** The working tool comprises a body provided with one or more handpieces, within which an electric motor is enclosed that is powered by an electric power source (such as a battery or an electric wire connectable to an electric power supply grid).

**[0047]** The electric motor is configured to start rotating a driving spindle 11 which, for instance, protrudes laterally (i.e., radially) with respect to the longitudinal axis of the body of the working tool 10.

**[0048]** The driving spindle 11 comprises, for instance, a portion of a threaded free (or distal) end 110, a central frustum 111 which can be threaded or not threaded (e.g., cylindrical), and a shoulder 112, defining a portion of engaged (or proximal) end, which enlarges radially relative to the central frustum 111 and/or end portion 110.

**[0049]** On the shoulder 112 prismatic reliefs and/or prismatic seats may be present.

**[0050]** The working tool 10, i.e., the driving spindle 11 thereof, is configured to start rotating an abrasive wheel, preferably a grinding wheel, generally denoted by number 20.

**[0051]** The grinding wheel 20 is preferably a depressed centre wheel, for instance of the "Type 27" as classified according to the ISO 603-14:1999 standard.

**[0052]** The grinding wheel 20 comprises a disc-shaped body which can be associated, substantially coaxially, on the driving spindle 11.

**[0053]** The grinding wheel 20 further comprises a first convex face 21 and defining as a whole the (rear) back of the grinding wheel 20 and an opposite concave second face 22. Furthermore, the grinding wheel 20 comprises a central through hole 23, for instance circular, which can be axially fitted, with a radial clearance, on the driving spindle 11.

**[0054]** In particular, the disc-shaped body of the grinding wheel 20 is made of at least a layer of an abrasive mixture which is made compact and stably bonded by a bonding resin.

**[0055]** In practice, the disc-shaped body of the grinding wheel 20 is obtained by pressing a mixture of a bulk powder of abrasive material, for instance abrasive material such as natural corundum, artificial corundum also recycled or the like, silicon carbide, sol-gel or sintered ceramic abrasives, zirconium corundum, or other, and mixed with a suitable binder, for instance based on binding resins, such as phenolic resins, liquid and/or powdered and possibly modified with epoxy phenoxy resins and/or the like, modified with organic and/or vegetable or synthetic compounds, and other types of polyimide resins and so one, and/or with additives and fillers.

**[0056]** The grinding wheel 20 may be characterised by using ceramic abrasive material (very hard and tough) often associated to layers of a more conventional material (such as corundum).

**[0057]** The abrasive mixture has a particle size substantially comprised between 120 and 12 in mesh (however it is not excluded the use of abrasive mixtures with a larger or smaller particle size than the reported range, according to requirements).

**[0058]** The layer of abrasive mixture may have a thickness smaller than or of about 3 mm, not excluding that it may be larger or smaller than 3 mm according to requirements, for instance between 2.5 mm and 10 mm.

**[0059]** Furthermore, the grinding wheel 20 is preferably of the reinforced type, i.e., the disc-shaped body thereof is provided with one or more reinforcing meshes, such as glass fibre, embedded in the layer/s of abrasive mixture.

**[0060]** The disc-shaped body of the grinding wheel 20 consists of an outer peripheral circular ring 24 and an inner disc-shaped cap 25 coaxial to the through hole 23.

**[0061]** In practice, the disc-shaped cap 25, which comprises the central hole 23, projects radially outwardly of the circular ring 24.

**[0062]** The circular ring 24 substantially lies on a plane orthogonal to the central (and rotation) axis of the grinding wheel (coincident with the axis of the central hole 23).

**[0063]** The circular ring 24 is the active portion of the grinding wheel 20, i.e., the portion thereof which is generally used for the grinding and/or deburring operations it is intended for (rubbing against the workpiece).

**[0064]** The circular ring 24 has an outer diameter De, variable while being used, which defines the outer diameter of the grinding wheel 20.

**[0065]** Such outer diameter De, generally standardised, is equal to 115, 125, 150, 180 or 230 mm (corresponding to 4.5, 5, 6, 7 or 9 inches).

**[0066]** The circular ring 24 has an inner diameter Di, substantially fixed, which defines the outer diameter of the disc-shaped cap 25, which is substantially equal to 70 mm (the extrados).

**[0067]** The disc-shaped cap 25 has an outer diameter De substantially equal to the inner diameter Di of the circular ring 24 and an inner diameter substantially equal to the diameter of the central hole 23 (such as equal to 22.23 mm).

**[0068]** The intrados portion of the disc-shaped cap 25, which defines a portion of the second face 22 of the grinding wheel 20, has a central planar zone which extends from the central hole 23 towards the periphery along a diameter at least equal to 45 mm.

**[0069]** Preferably, the disc-shaped cap 25 has a tract joining the circular ring 24 and the intrados portion of the disc-shaped cap 25, which defines a rounded inner surface (having a rounding inner radius substantially equal to 8 mm) and a rounded outer surface (having a rounding outer radius substantially equal to 8 mm).

**[0070]** Preferably, number 30 designates as a whole a clamping device, configured to clamp a grinding wheel 20 on the driving spindle 11 of the working tool 10.

**[0071]** The clamping device 30 comprises a clamping rear flange 31, which is configured to be fitted on the driving spindle 11 in a position proximal to the working tool 10, i.e., proximal to the shoulder 112 thereof.

**[0072]** The rear flange 31 comprises a disc-shaped body, substantially rigid (i.e., non-deformable under the ordinary stresses it is usually submitted to for the use it is intended for).

**[0073]** The rear flange 31, i.e., the disc-shaped body thereof, has a central hole 310 (with a circular section), which can be fitted (and/or screwable) on the driving spindle 11. The central hole 310 of the rear flange 31, for instance, has an inner thread (corresponding to the one of the driving spindle 11).

**[0074]** The rear flange 31 has a rear flange 311, i.e., facing the working tool 10, and an opposite front face 312.

**[0075]** The central hole 310 and/or the rear face 311 has an anti-rotational coupling element, configured to be connected to prismatic reliefs and/or prismatic seats provided on the shoulder 112 of the driving spindle 11.

**[0076]** For instance, the anti-rotational coupling element comprises prismatic seats and/or prismatic reliefs complimentary to the prismatic reliefs and/or the prismatic seats provided on the shoulder 112 defined in the inner periphery of the central hole 310. Preferably, the front face 312 of the rear flange 31 (or the entire rear flange 31) has an outer diameter larger than 70 mm, preferably larger than or equal to the outer disc-shaped cap 25 of the grinding wheel 20, for instance comprised between 70 mm and 80 mm, preferably equal to 78 mm.

**[0077]** The front face 312 of the rear flange 31 is preferably concave, for instance shaped as complimentary to the shape of the first convex face 21 (of the disc-shaped cap 25) of the grinding wheel 20.

**[0078]** Furthermore, the rear flange 31 has a centering shank 313 (substantially cylindrical) that rises from the front face 312 thereof, which has an inner diameter larger than or equal to the diameter of the driving spindle 11 (so that the driving spindle can fit substantially axially thereon) and an outer diameter smaller than the inner diameter of the central hole 23 of the grinding wheel 20 (so as to fit axially into the central hole 23 of the grinding wheel itself).

**[0079]** Advantageously, the centering shank 313 has a free distal end, which has a beveled or rounded outer annular edge 314, preferably beveled (defining a truncated-cone surface).

**[0080]** For example, the free distal end of the centering shank 313 lies on a plane orthogonal to the central axis of the rear flange 31 on which also the outer periphery of the front face lies 312.

**[0081]** The rear flange 31 may further provide anchoring bores 315, for instance conical (with a conicity converging from the rear face to the front face), whose function will be made clear in the following.

**[0082]** Preferably, the front face 312 of the rear flange 31 has a width (i.e., a surface area) substantially comprised between 4000 $mm^2$ and 6000 $mm^2$, preferably between 4300 $mm^2$ and 5000 $mm^2$, for instance equal to 4650 $mm^2$.

**[0083]** Such width is the area of the concave circular ring from the outer periphery of the (front face 312 of the) rear flange 31 to at least one of the inner edge of the central hole 310 and the base of the centering shank 313 (preferably the base of the centering shank, where required).

**[0084]** The rear flange 31 may be made of a metal material, for instance selected from the group consisting of steel, aluminium, zamak, bronze or other metal alloys.

**[0085]** If the rear flange 31 is made of steel, the annular edge 314 may be hardened by a surface quenching or concrete-covering process; it is not excluded that the rear flange 31 may also be completely hardened by one of such processes.

**[0086]** In alternative, it is possible to provide that the rear flange 31 may be made of a plastic material (such as a highly strong resin), for instance obtained by injection moulding. The clamping device 30 comprises, in addition, a clamping front flange 32 (or clamping nut), which is configured to be fitted on the driving spindle 11 in a distal position from the working tool 10.

**[0087]** The front flange 32 is in practice adapted to clamp the grinding wheel 20 between the rear flange 31 and the front flange 32, so that the grinding wheel 20 is made rotate by the driving spindle 11.

**[0088]** The front flange 32 comprises a disc-shaped body, substantially rigid (i.e., non-deformable under the ordinary stresses it is usually submitted to for the use it is intended for).

**[0089]** The front flange 32, i.e., the disc-shaped body thereof, has a central hole 320 (with a circular section), which is provided with an inner thread that can be screwed on the end portion 110 of the driving spindle 11.

**[0090]** The front flange 32 has a front face 321, i.e., facing the opposite part of the working tool 10, and an opposite rear face 322 facing the working tool 10 (i.e., facing at least a portion of the front face 312 of the rear flange 31).

**[0091]** Preferably, the front flange 32 has a maximum outer diameter that is smaller than or equal to the diameter of the central planar zone of the intrados portion of the disc-shaped cap 25 of the grinding wheel 20.

**[0092]** In practice, the front flange 32 is configured to be axially fitted inside the concavity of the grinding wheel 20 innerly defined by the disc-shaped cap 25.

**[0093]** The rear face 322 of the front flange 32 is preferably or mainly planar (and orthogonal to the central axis of the second damping element 32).

**[0094]** Furthermore, the front flange 32 has a centering shank 323 (substantially cylindrical) which rises from the rear face 322 thereof, within which the inner thread develops, which has an outer diameter smaller than the inner diameter of the central hole 23 of the grinding wheel 20 (so as to fit axially into the central hole 23 of the grinding wheel). Advantageously, the centering shank 323 has a free distal end, which has a beveled or rounded outer annular edge 324, preferably rounded.

**[0095]** Furthermore, the front flange 32 further has a raised annular relief 326 (substantially cylindrical), which rises from the rear face 322 thereof, whose outer diameter is the outer diameter of the front flange 32.

**[0096]** The portion of rear flange 322 interposed between the centering shank 323 and the annular relief 326 is substantially planar and lying on a plane orthogonal to the central axis of the central hole 320 of the front flange 32.

**[0097]** The front flange 32 further provides a driving element configured to screw and/or unscrew the front flange 32 on the driving spindle 11.

**[0098]** The driving element comprises, for instance, one or more pairs of eccentric holes 326, rising at the front face 321 of the front flange 32, which can be engaged by a specific toothed wrench for screwing/unscrewing the front flange 32.

**[0099]** It is not excluded that the driving element may comprise, in alternative or in addition, a prismatic pin (for instance with an hexagonal base) coaxial with the central hole 320, which rises at the front of the front face 321 of the front flange 32, so as to be engaged by a specific spanner (such as a wrench) for screwing/unscrewing the front flange 32. Preferably, the rear face 322 of the front flange 32 has a width (i.e., a surface area) substantially comprised between 800 $mm^2$ and 1200 $mm^2$, for example equal to 1100 $mm^2$.

**[0100]** Such width is the area of the concave circular ring from the outer periphery of the (rear face 322 of the) front flange 32 or from the inner base of the annular relief 326 (where provided) to at least one of the inner edge of the central hole 320 and the base of the centering shank 323 (preferably the base of the centering shank, where provided).

**[0101]** Preferably, therefore, the front face 312 of the rear flange 31 has a width larger than the rear face 322 of the front flange 32, for instance in a ratio greater than 4:1.

**[0102]** The front flange 32 may be made of a metal material, for instance of steel.

**[0103]** In such a case, the annular edge 324 (of the centering shank 323) may be hardened by a surface quenching or concrete-covering process, it is not excluded however that the whole front flange 32 may be hardened by one of said processes.

**[0104]** The clamping device 30 further comprises one first clamping element 33, which is interposed in use between the rear flange 31 and the extrados of the (disc-shaped cap 25 of the) grinding wheel 20.

**[0105]** The first damping element 33 is configured to absorb and damp vibrations and/or noise generated by the use of the grinding wheel 20 on the workpiece.

**[0106]** The first damping element 33 is associated, as better described hereinafter, to the front face 312 of the rear flange 31.

**[0107]** For example, the first damping element 33 comprises (or consists of) a layer of a yielding material, for instance elastically yielding.

**[0108]** Preferably, the layer of yielding material is made of rubber.

**[0109]** The first damping element 33, i.e., the layer of yielding material, is in the form of a disc-shaped body, for instance circular, provided with a central hole 330, which is configured to be fitted (precisely) on the centering shank 313 (where provided).

**[0110]** The first damping element 33, i.e., the layer of yielding material, has a thickness preferably constant throughout the (circumferential and radial) extension thereof.

**[0111]** For instance, the thickness of the first damping element 33, i.e., of the layer of yielding material, varies from a maximum thickness (wherein the first damping element 33 is not deformed, i.e., is not submitted to axial crushing forces) to a minimum thickness (wherein the first damping element 33 is deformed, i.e., crushed by axial crushing forces acting thereon).

**[0112]** The maximum thickness is, for instance, substantially comprised between 2 mm and 4 mm, for instance substantially equal to 3 mm.

**[0113]** Preferably, the centering shank 313 rises from the front face 312 of the rear flange 311 along an axial height substantially greater than the maximum thickness of the first damping element 33, so as to project axially with respect to the first damping element 33 for a height comprised between 1 mm and 2 mm, preferably equal to 1.5 mm.

**[0114]** The first damping element 33 comprises a fixing surface 331 (or rear face), which is configured to contact the (whole) front face 312 of the rear flange 31, and a free (axially) opposite active surface 332 (or front face), which is configured to contact at least a portion (of the back or extrados) of the (disc-shaped cap 25 of the) grinding wheel 20.

**[0115]** Preferably, the first damping element 33, i.e., its fixing surface 331 and/or its active surface 332, extends throughout the entire width of the front face 312 of the rear flange 31, i.e., it has a width that is substantially equal to the width of the front face 312 of the rear flange 31.

**[0116]** The first damping element 33 coat/cover the whole front face 312 of the rear flange 31 (for instance, in such a way that the active surface 332 defines the only resting/contact surface for the second face 22 of the grinding wheel 20).

**[0117]** The first damping element 33 may be freely associated to the (front face 312 of the) rear flange 31, i.e., simply lying thereon, or may be preferably fixed to the (front face 312 of the) rear flange 31, for instance removably or permanently.

**[0118]** Preferably, the first damping element 33 is removably fixed to the (front face 312 of the ) rear flange 31, so as to be replaced if worn out.

**[0119]** For instance, the fixing surface 331 may have one or more anchoring pins 333, each of which is configured to be (snap)-fitted into an anchoring hole 315 provided in the rear flange 31.

**[0120]** It is not however excluded that the first damping element 33 may be fixed permanently to the (front face 312 of the) rear flange 31, for instance adherent thereto, by means of bonding or obtained as a coating (co-moulded with it).

**[0121]** Preferably, the first damping element 33 has a shape which follows the shape of the front face 312 of the rear flange 31.

**[0122]** For instance, the first damping element 33 may be pre-formed with a (final) concave shape, wherein the fixing surface 331 and/or the active surface 332 substantially follows (and is similar to) the shape of the front face 312 of the rear flange 31.

**[0123]** It is not excluded, however, that the first damping element 33 may have a plane non-deformed form, which is configured to be deformed (by flection) so as to adapt to the shape of the front face 312 of the rear flange 31, for instance under the action of an axial pressure directed against the front face 312 of the rear flange 31.

**[0124]** Preferably, the active surface 332 may have a surface smooth finish.

**[0125]** In alternative, it is possible to provide that the active surface 332 may have a surface structured finish, for instance with a structure selected from the group consisting in cylindrical-cusp shaped reliefs, pyramid-frustum-shaped reliefs, truncated-cone-shaped reliefs, raised radial ridges and concentric circumferential ridges.

**[0126]** Globally, the first damping element 33, i.e., the layer of yielding material it is made with, has a thickness smaller than or equal to 50 Shore A, preferably comprised between 10 Shore A and 45 Shore A, for instance substantially equal to 45 Shore A (or equal to 10 or 20 Shore A).

**[0127]** The clamping device 30 further comprises one second clamping element 34, which is interposed in use between the front flange 32 and the extrados of the (disc-shaped cap 25 of the) grinding wheel 20.

**[0128]** The second damping element 34 is configured to (at least partially) absorb and damp vibrations and/or noise generated by the use of the grinding wheel 20 on the workpiece. The second damping element 34 is associated, as better described hereinafter, to the rear face 322 of the front flange 32.

**[0129]** For example, the second damping element 34 comprises (or consists of) a layer of a yielding material, for instance elastically yielding.

**[0130]** Preferably, the layer of yielding material is made of rubber.

**[0131]** The second damping element 34, i.e., the layer of yielding material, is in the form of a disc-shaped body, for instance circular, provided with a central hole 340, which is configured to be fitted (precisely) on the centering shank 323 (where provided).

**[0132]** The second damping element 34, i.e., the layer of yielding material, has a thickness preferably constant throughout the (circumferential and radial) extension thereof.

**[0133]** For instance, the thickness of the second damping element 34, i.e., of the layer of yielding material, varies from a maximum thickness (wherein the second damping element 34 is not deformed, i.e., is not submitted to axial crushing forces) to a minimum thickness (wherein the second damping element 34 is deformed, i.e., crushed by axial crushing forces acting thereon).

**[0134]** The maximum thickness of the second damping element 34 is for example substantially comprised between 2 mm and 4 mm, for instance substantially equal to 3 mm.

**[0135]** Preferably, the centering shank 323 rises from the rear face 322 along an axial height substantially greater than the maximum thickness of the second damping element 34, so as to project axially with respect to the first damping element 34 for a height comprised between 1 mm and 2 mm, preferably equal to 1.5 mm.

**[0136]** The second damping element 34 comprises a fixing surface 341 (or front face) which is configured to contact the rear face 322 of the front flange 32, and a free (axially) opposite active surface 342 (or rear face), which is configured to contact at least a portion (of intrados) of the (disc-shaped cap 25 of the) grinding wheel

20, i.e., the central planar zone thereof.

**[0137]** The second damping element 34, i.e., its fixing surface 341 and/or its active surface 342, has an extension smaller than the extension of the first damping element 33, in particular its active surface 342 has an extension/surface area smaller than the active surface 332 of the first damping element 33 (and its fixing surface 341 has an extension/surface area smaller than the fixing surface 331 of the first damping element 33), for instance in a ratio greater than 4:1.

**[0138]** Preferably, the second damping element 34, i.e., its fixing surface 341 and/or its active surface 342, extends throughout the entire width of the rear face 322 of the front flange 32, i.e., it has a width that is substantially equal to the width of the rear face 322 of the front flange 32.

**[0139]** The second damping element 34 coat/cover the whole rear face 322 of the front flange 32 (for instance, in such a way the active surface 342 defines the only resting/contact surface for the first face 21 of the grinding wheel 20).

**[0140]** The second damping element 34 is for example radially contained between the centering shank 323 and the annular relief 326.

**[0141]** The thickness of the second damping element 34, furthermore, is greater (for instance of 0.5 mm) than the axial height of the annular relief 326.

**[0142]** The second damping element 34 may be freely associated to the (rear face 322 of the) front flange 32, i.e., simply lying thereon, or may be preferably fixed to the (rear face 322 of the) front flange 32, for instance removably or permanently.

**[0143]** Preferably, the second damping element 34 is removably fixed to the (rear face 322 of the) front flange 32, so as to be replaced in case of wear, for example by snap-fitting (between the centering shank 313 and the annular edge 314).

**[0144]** It is not however excluded that the second damping element 34 may be fixed permanently to the (rear face 322 of the) front flange 32, for instance adherent thereto, by means of bonding or obtained as a coating (co-moulded with it).

**[0145]** Preferably, the second damping element 34 has the fixing surface 341 substantially planar and parallel to the active surface 342 substantially (globally). In practice, the fixing surface 341 and the active surface 342 are orthogonal to the central axis of the second damping element.

**[0146]** Preferably, the active surface 342 may have a surface smooth finish.

**[0147]** In alternative, it is possible to provide that the active surface 342 may have a surface structured finish, for instance with a structure selected from the group consisting in cylindrical-cusp shaped reliefs, pyramid-frustum-shaped reliefs, truncated-cone-shaped reliefs, raised radial ridges and concentric circumferential ridges.

**[0148]** Globally, the second damping element 34, i.e., the layer of yielding material it is made with, has a thickness larger than or equal to 40 Shore A, preferably comprised between 46 Shore A and 90 Shore A, for instance substantially equal to 50 Shore A.

**[0149]** In general, the first damping element 33 is less hard than the second damping element 34, preferably in a mutual ratio 1:4.

**[0150]** In light of the above, the operation of the working tool 10 is as follows.

**[0151]** To start grinding and/or deburring operations, it is sufficient to firstly insert on the driving spindle 11 the rear flange 31, so that its concavity is directed towards the free end of the driving spindle 11.

**[0152]** Together with the rear flange 31, also the first damping element 33 (for instance pre-assembled to the rear flange 31) is fitted on the driving spindle 11.

**[0153]** When the rear flange 31 is in position (and the anti-rotational coupling element thereof is connected to prismatic reliefs and/or to the prismatic seats of the shoulder 112 of the driving spindle 11), it is possible to make the grinding wheel 20 fit on the driving spindle 11.

**[0154]** In practice, the central hole 23 of the grinding wheel 20 is fitted on the centering shank 313 of the rear flange 31 and the portion of the rear face 311 of the (disc-shaped cap 25 of the) grinding wheel 20 is contacted with the active surface 332 of the first damping element 33.

**[0155]** Thereafter, it is sufficient to screw on the driving spindle 11 the front flange 32, which is pre-assembled to the second damping element 34, until the active surface 342 of the second damping element 34 is in forced contact with the (intrados central planar zone of the) grinding wheel 20.

**[0156]** The front flange 32 is clamped with a clamping torque such to press at least partially (though not totally) the first damping element 33, which in any case has in its deformed configuration a minimum thickness not smaller than ¼ of the maximum thickness, preferably not smaller than $V_2$ of the maximum thickness.

**[0157]** In practice, it was observed that the entire area concerned by the clamping of the grinding wheel 20 between the active surface 332 of the first damping element 33 and the active surface 342 of the second damping element 34 is of about 5750 $mm^2$, i.e., the sum of the width of the active surface 332 of the first damping element 33 (substantially equal to 4650 $mm^2$) and the width of the active surface 342 of the second damping element 34 (substantially equal to 1100 $mm^2$).

**[0158]** Such overall area is indeed greater than the known solutions, which is substantially equal to 2200 $mm^2$.

**[0159]** As the rotational torque required to make the grinding wheel 20 rotate is proportional to the overall clamping area, the friction coefficient and the specific pressure exerted by the rear flange 31 and front flange 32 on the first damping element 33 and second damping element 34 (and follows an almost linear trend), it derives that, the rotational torque being equal, it is possible to apply with the above-described clamping device 30 (wherein the overall area is increased) a lower specific pressure, for instance ¼ than the known systems (wherein both clamping flanges have a maximum outer diameter of 44 mm).

**[0160]** Reducing the specific pressure allows to reduce, as described above, the hardness of the first damping element 33 (if compared to the known systems, wherein the hardness of both damping elements is higher than 80 Shore A).

**[0161]** Therefore, one first damping element 33, that is, so to speak, soft (hardness substantially equal to 45 or 10 or 20 Shore A) and with a significant thickness (substantially equal to 3 mm), allows the grinding wheel 20 clamped between the clamping device 30 to keep a wide swinging flexibility as damped by the intrinsic characteristics of the first damping element 33 and second damping element 34, consequently remarkably reducing the vibrations transmitted to the working tool 10 (and from it to the operator) and acoustic emissions.

**[0162]** Furthermore, thanks to the aforesaid solution, it was observed that the use of very hard grinding wheels 20 (i.e., those ranked with letter "T" and/or "S" or "R" by producers) is easier and hence convenient and tolerated, with obvious economic advantages and in terms of working performance and wear of the grinding wheel.

**[0163]** Furthermore, it was observed that the clamping device 30, as it is, also improves how grinding wheels 20 wear out.

**[0164]** In fact, as said, density differences, displacements, planarity differences between the faces of the grinding wheels 20 (which are to some extent present in the grinding wheels) often determine, especially in the very hard grinding wheels, a non-uniform wear of the leading edge of the grinding wheels.

**[0165]** It must be noted, in this respect, that a difference of wear is often generated - in use - in the width of the grinding wheel outer ring, often highlighted by a different angle of the wear edge along the periphery of the grinding wheel itself.

**[0166]** This happens as the above noted differences determine an irregular wear of the leading edge of the grinding wheel and a prominent bouncing of the grinding wheel on the workpiece.

**[0167]** The clamping device 30 is configured to keep a floating and "non-rigid" clamping on the grinding wheel 20, which, therefore allows to strongly and efficiently soften the bouncing of the grinding wheel 20 on the workpiece, keeping a more constant contact between the leading edge of the grinding wheel 20 and the workpiece, remarkably improving the tightness and wear regularity of the leading edge.

**[0168]** In practice, the clamping device 30, as it is conformed, acts on the grinding wheel in the same way as dampers of the vehicle wheel suspensions, which brake and soften the oscillating movements of the wheels caused by the road irregular conditions.

**[0169]** The invention thus conceived is susceptible to several modifications and variations, all falling within the scope of the inventive concept.

**[0170]** Moreover, all the details can be replaced by other technically equivalent elements.

**[0171]** In practice, the materials used, as well as the contingent shapes and sizes, can be whatever according to the requirements without for this reason departing from the scope of protection of the following claims.

## Claims

1. A clamping device for clamping grinding wheels on a spindle for driving a working tool, which comprises:

    - a rear flange intended to be fitted on the driving spindle in a position proximal to the working tool, wherein the rear flange is provided with a front face with which a first damping element is associated;
    - a front flange intended to be fitted on the driving spindle and provided with a rear face, facing the front face of the rear flange, with which a second damping element is associated;

    wherein the front face of the rear flange has a greater width than the rear face of the front flange and the first damping element has a lower hardness than the second damping element.

2. The clamping device according to claim 1, wherein the front face of the rear flange is concave.

3. The clamping device according to claim 1, wherein the front face of the rear flange has an outer diameter greater than 70 mm preferably comprised between 70 mm and 80 mm and the maximum diameter of the front flange is smaller than or equal to 44 mm.

4. The clamping device according to claim 1, wherein the first damping element comprises a layer of a yielding material, preferably elastically, which extends throughout the width of the front face of the rear flange.

5. The clamping device according to the preceding claim, wherein the thickness of the first damping element is substantially comprised between 2 mm and 4 mm, preferably equal to 3 mm.

6. The clamping device according to claim 1, wherein the first damping element has a hardness higher than or equal to 50 Shore A, preferably between 10 Shore A and 45 Shore A.

7. The clamping device according to claim 1, wherein the second damping element has a hardness higher than 40 Shore A, preferably between 46 Shore A and 90 Shore A.

8. The clamping device according to claim 1, wherein the first damping element is removably associated to the front face of the rear flange, preferably by a snap-fitting.

9. The clamping device according to claim 1, wherein at least one of the front flange and the rear flange comprises a centering shank on which the grinding wheel can be fitted, wherein the distal end of the centering shank has a beveled or rounded or conic annular edge.

10. The clamping device according to the preceding claim, wherein at least the annular edge is hardened by a surface quenching or concrete-covering process.

11. The clamping device according to claim 1, wherein the rear flange is made of a metal material, preferably selected from the group consisting in steel, aluminium, zamak, bronze or other metal alloys, or is made of a plastic material.

12. The clamping device according to claim 1, wherein at least one of the first damping element and the second damping element has an active surface, adapted to be put in contact with the grinding wheel during use, wherein the active surface has a smooth or structured surface with a structure selected from the group consisting in cylindrical cusp-shaped reliefs, pyramid frustum-shaped reliefs, truncated-cone-shaped reliefs, raised radial ridges and concentrical circumferential ridges.

13. A working tool comprising:

- a driving unit;
- a driving spindle connected to the driving unit: and
- a clamping device, according to claim 1, for clamping a grinding wheel on the driving spindle.

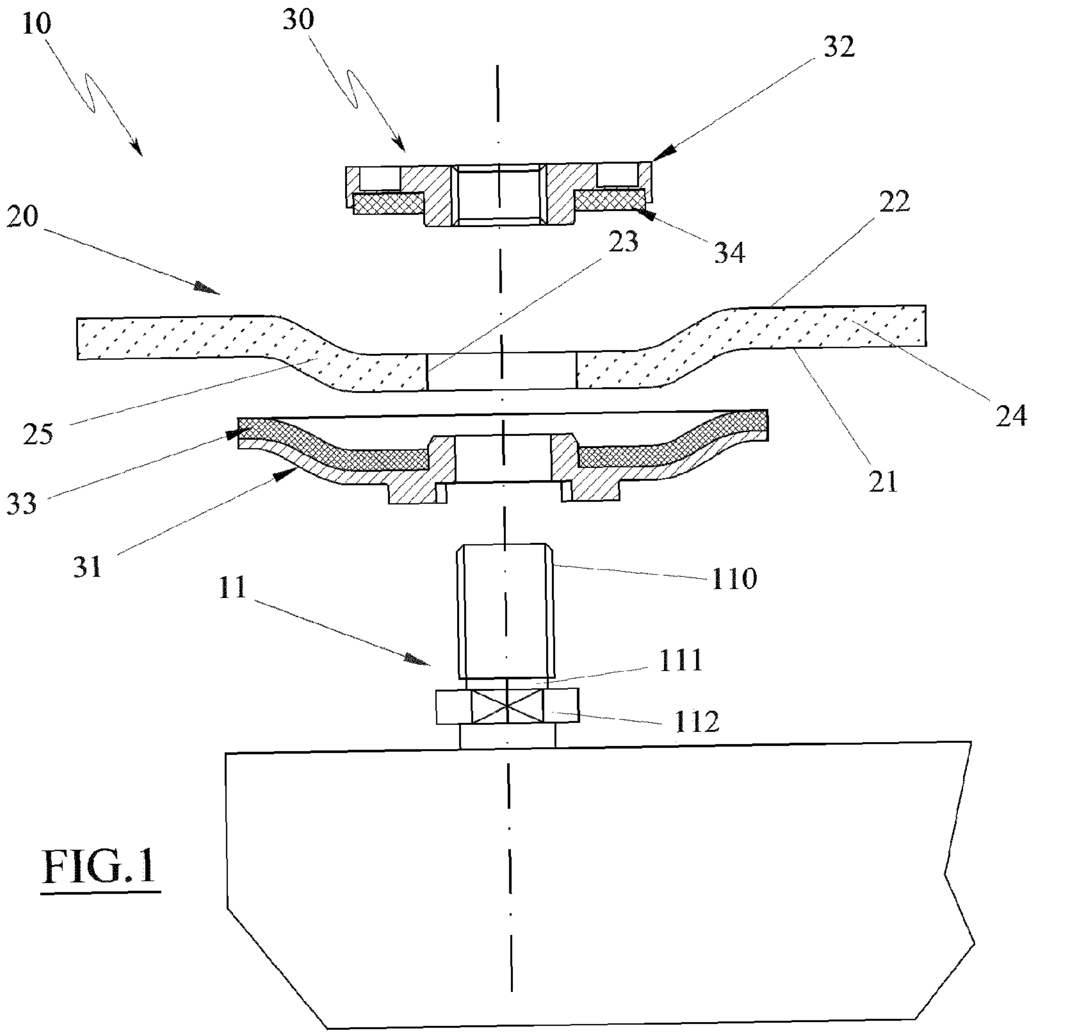


FIG.1

ISO 603-14:1999(E)

3.3 Type 27: Depressed centre grinding wheel

See Figure 5 and Table 5.

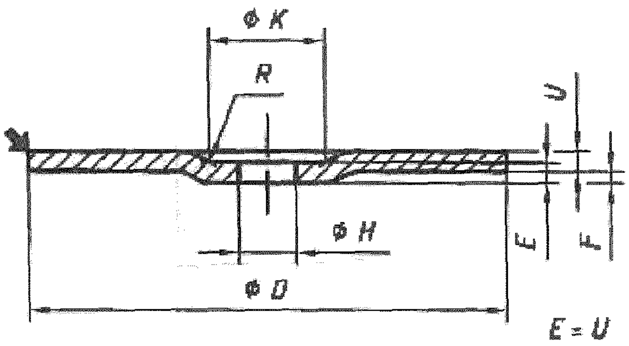


Figure 5 — Type 27

Table 5 — Dimensions of Type 27

FIG.4

| D | U 4 | U 6 | U 8 | U 10 | H | K | F min. | R ≈ |
|---|---|---|---|---|---|---|---|---|
| 115 | X | X | — | — | | | | |
| 125 | X | X | — | — | | | | |
| 150 | X | X | — | — | 22,23 | 45 | 4,6 | 8 |
| 180 | X | X | X | X | | | | |
| 230 | X | X | X | — | | | | |

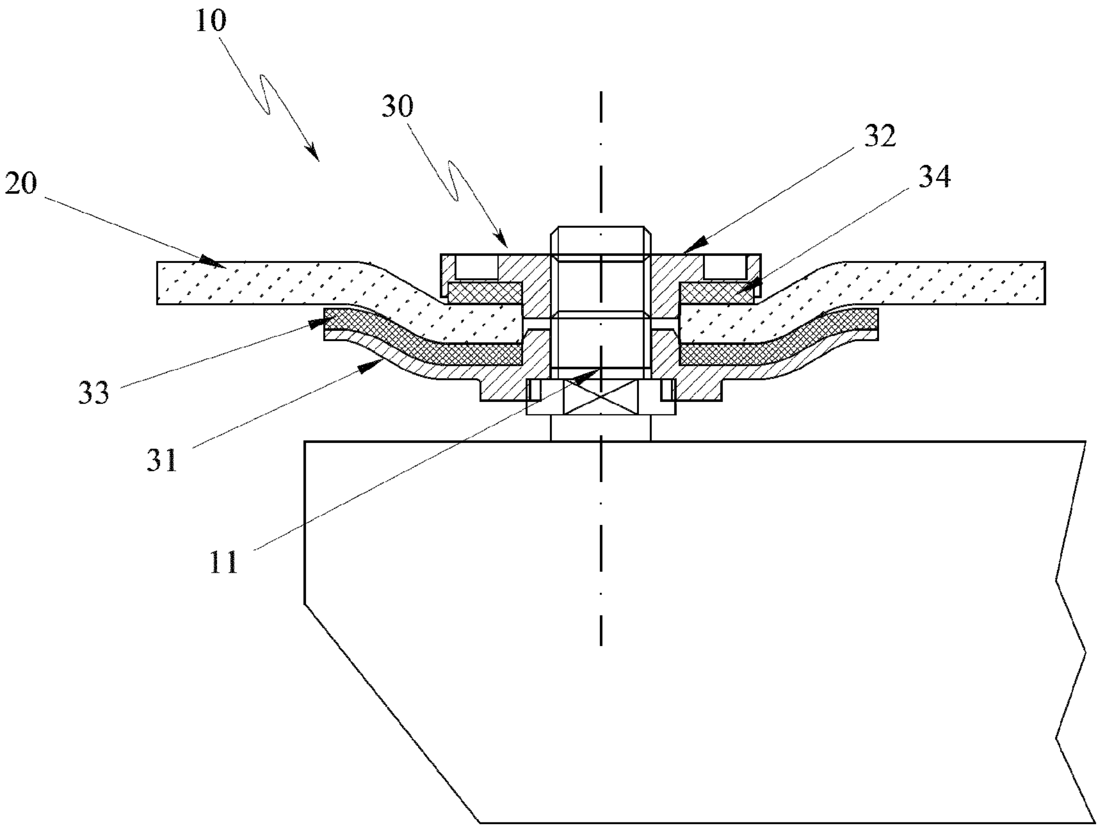
10
30
32
34
20
33
31
11

FIG.2

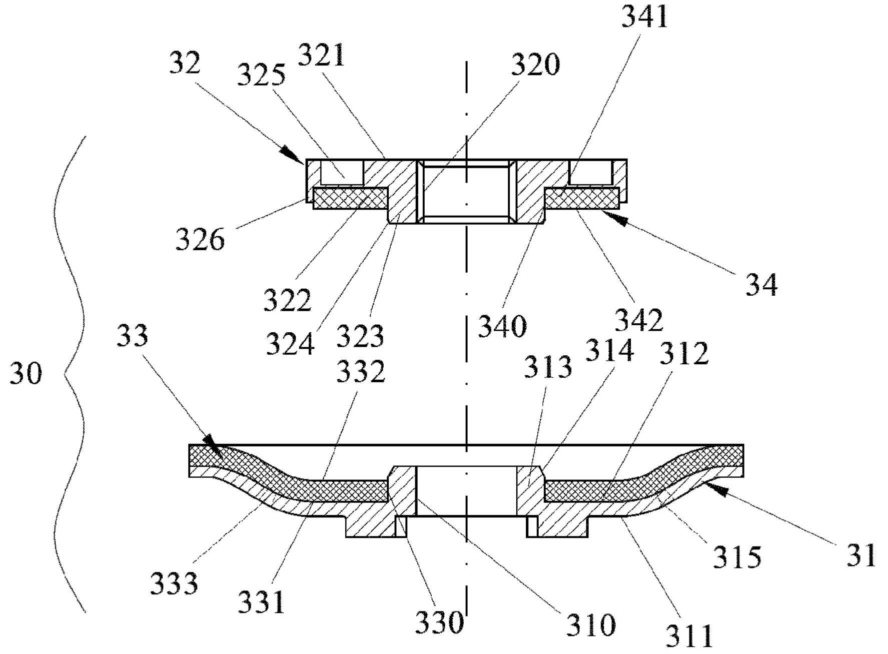
341
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FIG.3

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# EUROPEAN SEARCH REPORT

Application Number
EP 22 15 4294

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B24B
B24D

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| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 30 June 2022 | Bonetti, Serena |

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