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Rødbro et al.(10) **Pub. No.: US 2023/0096988 A1**(43) **Pub. Date: Mar. 30, 2023**(54) **BENCH GRINDER APPARATUS**(71) Applicant: **INELCO A/S**, Fjerritslev (DK)(72) Inventors: **Søren Rødbro**, Fjerritslev (DK); **Bruno Hastrup**, Løgstør (DK); **Jeppe Vangsgaard**, Aalborg (DK)(73) Assignee: **INELCO A/S**, Fjerritslev (DK)(21) Appl. No.: **17/908,336**(22) PCT Filed: **Mar. 2, 2021**(86) PCT No.: **PCT/DK2021/050062**

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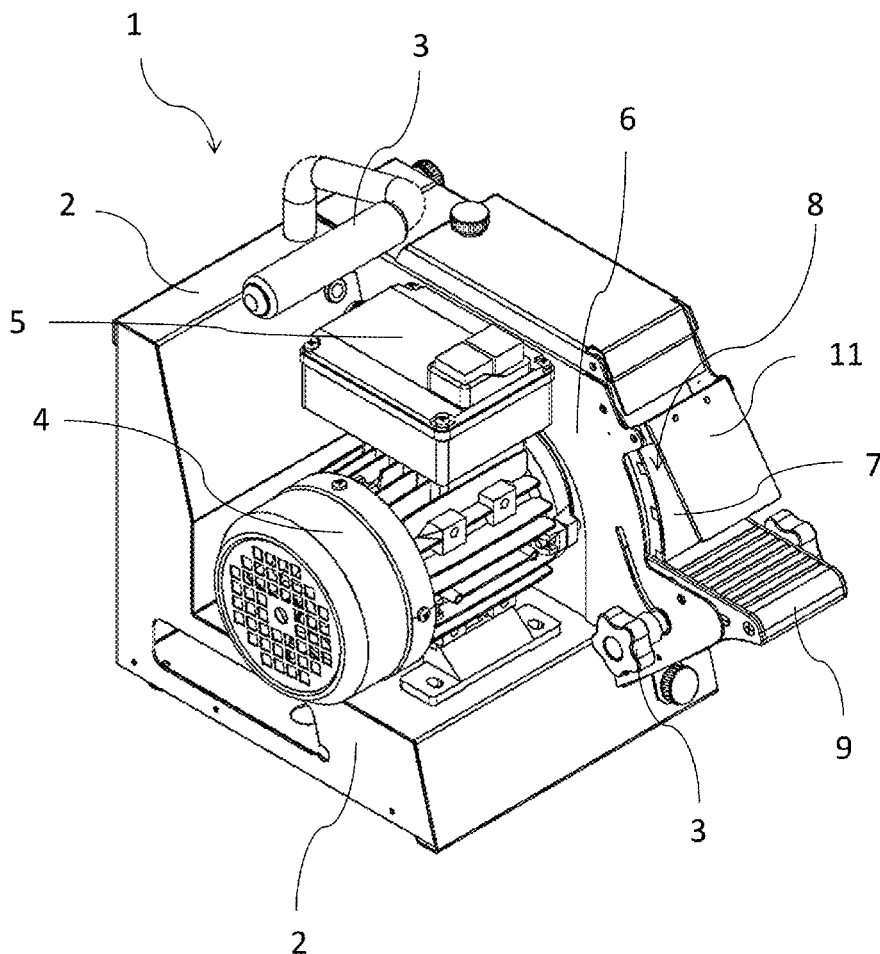
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ABSTRACT

The present invention relates to a bench grinder apparatus. The object of the invention is to provide a bench grinder apparatus and a method for safe and exact grinding of tools, and at the same time minimizing the damage to the tools and to the user during grinding. Bench grinder apparatus for grinding tools comprising: —at least one grinding wheel with a grinding surface arranged in a wheel casing, where the wheel casing is provided with one working opening which provides an access to a part of the grinding surface, —an operational means arranged in relation to said grinding wheel, capable of rotating the grinding wheel, —at least one tool rest moveably attached to the wheel casing, and arranged in a predefined distance to the grinding wheel, —at least one angle adjustable means capable of moving the tool rest in said predefined distance to the grinding wheel from a first grinding angle position to a second grinding angle position.



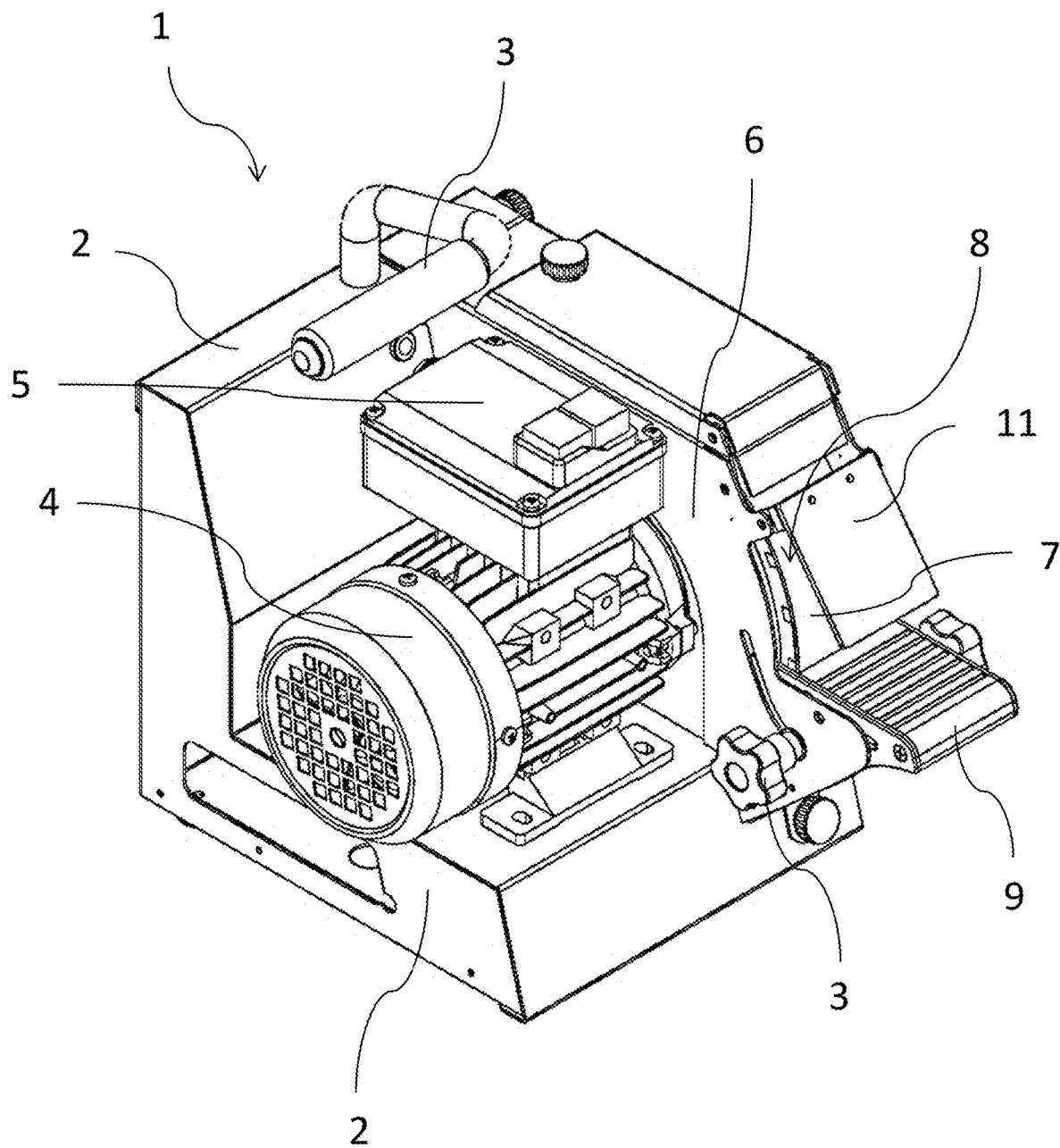


Fig. 1

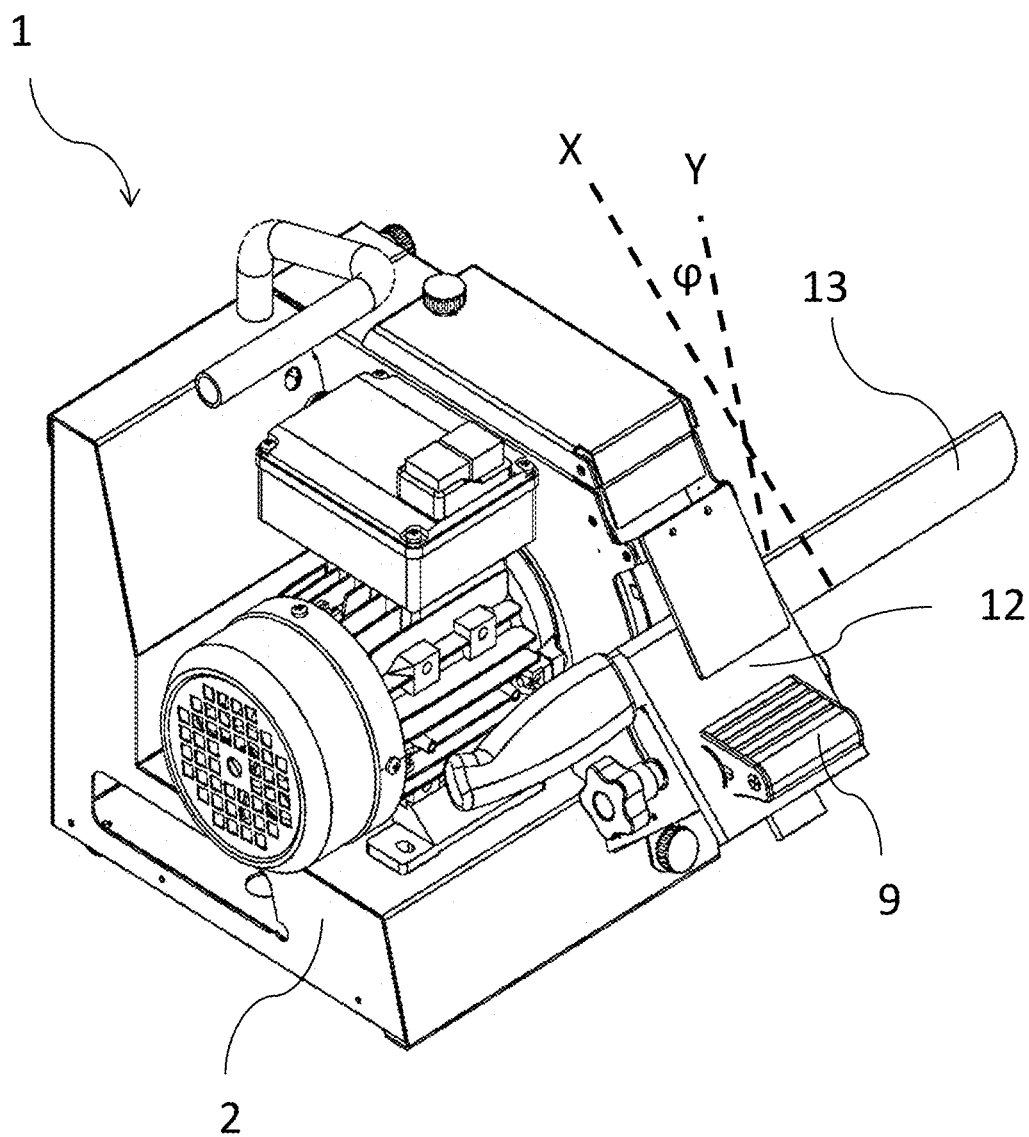


Fig. 2

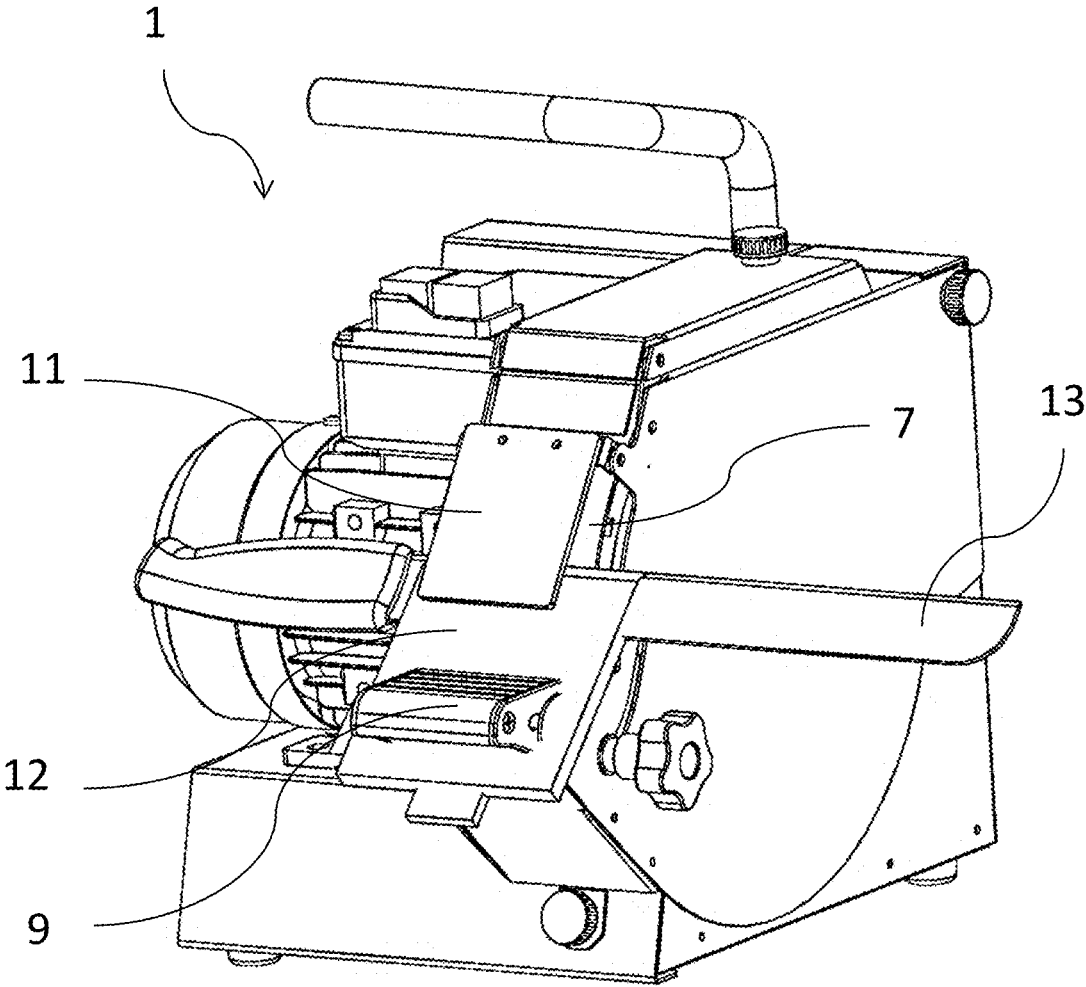


Fig. 3

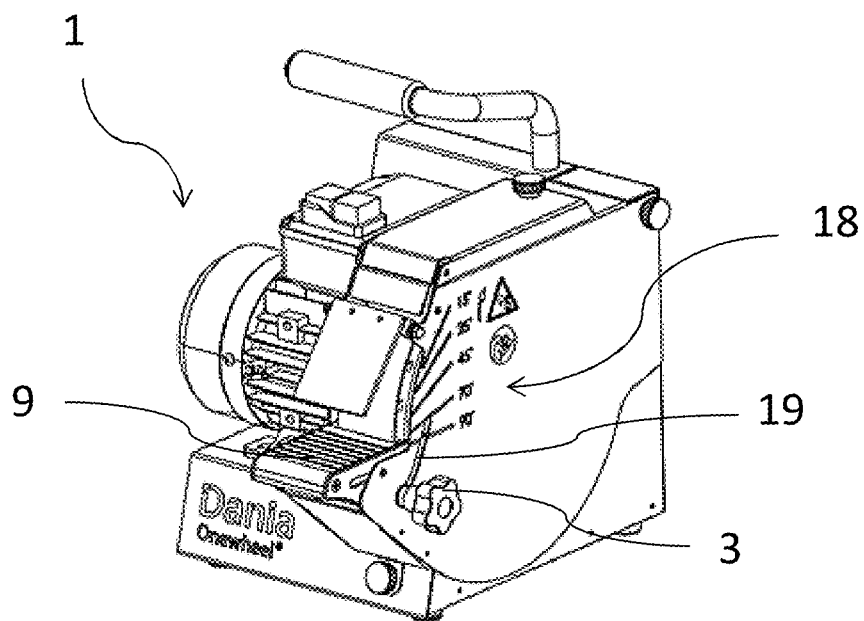


Fig. 4

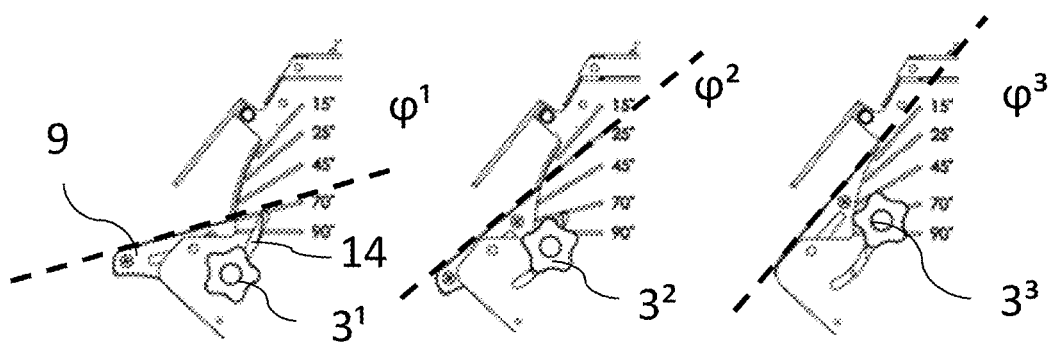


Fig. 5a

Fig. 5b

Fig. 5c

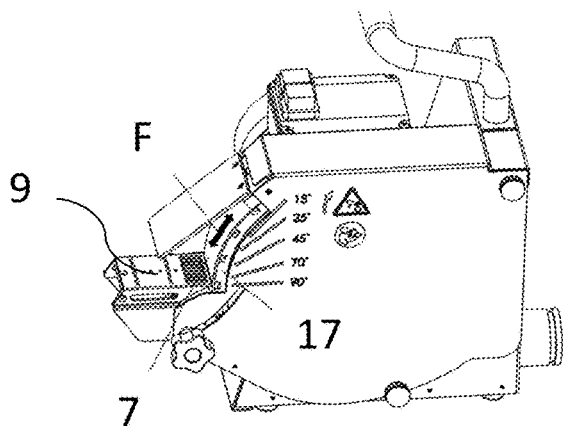


Fig. 6a

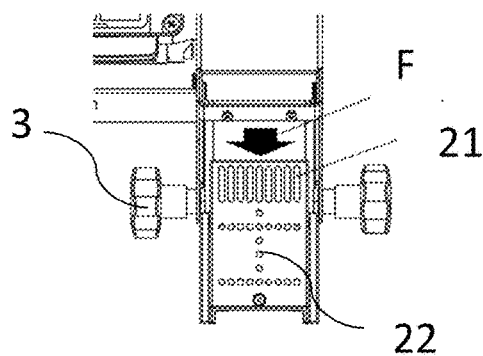


Fig. 6b

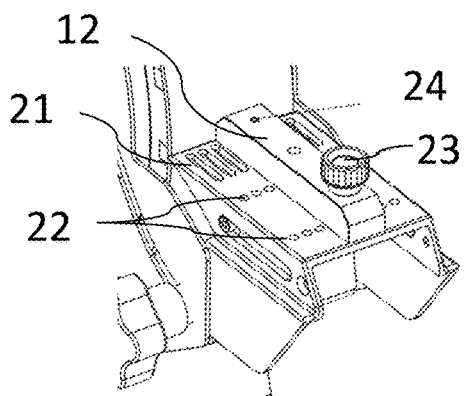


Fig. 7a

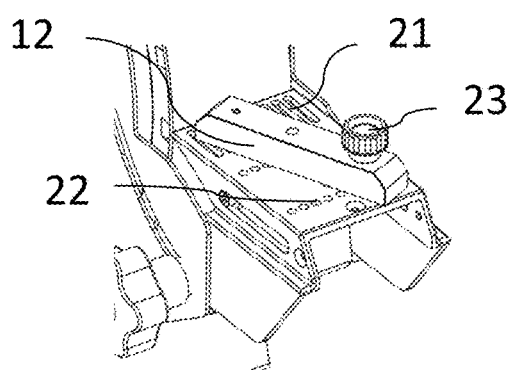


Fig. 7b

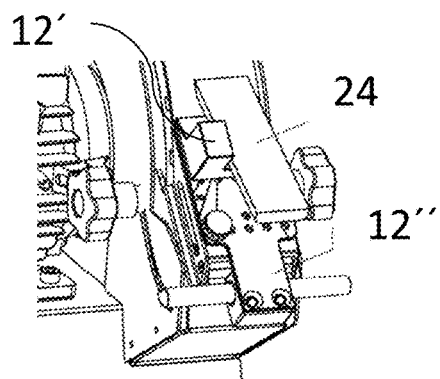


Fig. 7c

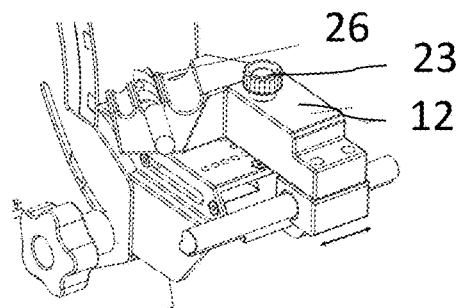


Fig. 7d

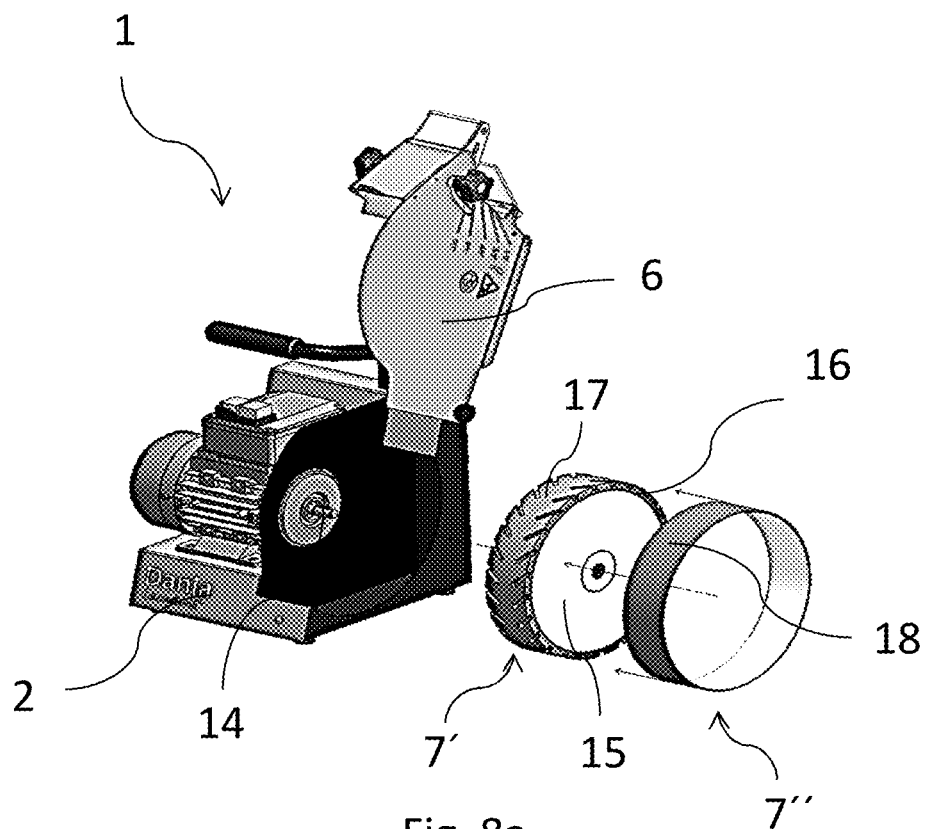


Fig. 8a

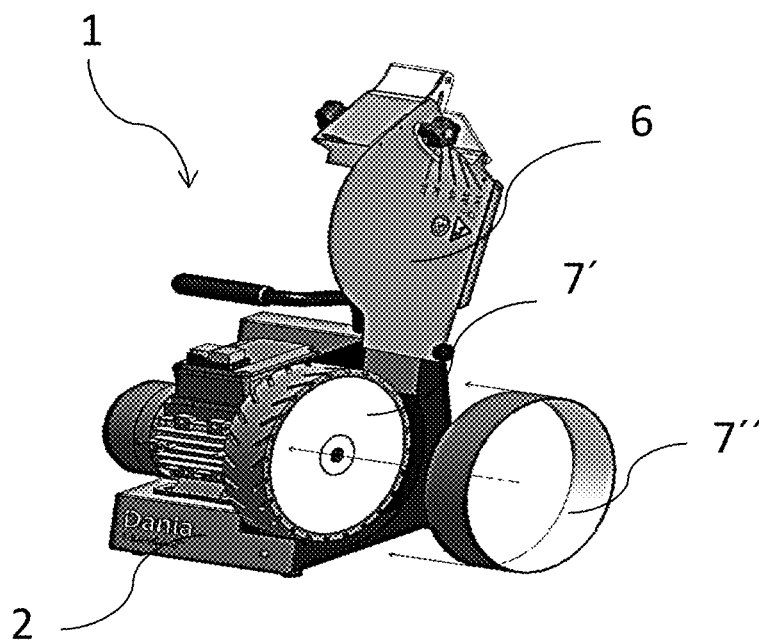


Fig. 8b

BENCH GRINDER APPARATUS

FIELD OF THE INVENTION

[0001] The present invention relates to a bench grinder apparatus.

BACKGROUND OF THE INVENTION

[0002] A bench grinder is a useful tool which is used to carry out significant tasks of tool repair. The bench grinder wheels for knives are spun at a high speed to trim off wood, metal, and plastic or sharpen blades. Most professional knife sharpeners use bench grinders for employing their craft.

[0003] Various profiles and cross sections are available depending on the intended usage for the wheel. The grinding wheels are often made from a solid steel or aluminium disc with particles bonded to the surface. As the wheel rotates on a grinder, it abrades the metal surface, causing sharp edges of the grains to either break off, leaving sharper edges, or wear down. Gradually, the worn grains are pulled out of the binder, exposing sharper grains in place behind them. The bench grinder apparatus may be provided with grinding wheels of different grain sizes for roughing and finishing operations. The bench grinder apparatus, which is very heavy, is secured to a workbench or floor stand, and is therefore very difficult to move to another location.

[0004] U.S. Pat. No. 4,936,053 A discloses a tool holding device for lawnmower blade with adjustable means, which is used to vary the distance/grinding angle between the grinding wheel and the holding device. The adjustable means is used to vary the distance/grinding angle must be adjusted separately for each grinding of a tool. It is difficult for the user to use the holding device and it takes time to adjust the correct position and correct grinding angle. The result is a very expensive and complicated grinding process. The quality of the grinding is poor, because it is difficult to keep the lawnmower blade steady during grinding. It is also a risk for the user to get hurt when the lawnmower blade is arranged in the tool holding device and during the grinding of the lawnmower blade.

[0005] Most of the tools are grinded while the user is holding the tools in their hands and move the tools accordingly. This is both dangerous for the user and provides an unstable and inaccurate result. A user mistake may easily occur resulting in a defect tool during grinding, and much worse the user may get hurt in the grinding process.

OBJECT OF THE INVENTION

[0006] The object of the invention is to provide a bench grinder apparatus and a method for safe and exact grinding of tools, and at the same time minimizing the damage to the tools and to the user during grinding.

DESCRIPTION OF THE INVENTION

[0007] The present invention addresses this by providing a bench grinder apparatus for grinding tools comprising:

[0008] at least one grinding wheel with a grinding surface arranged in a wheel casing, where the wheel casing is provided with one working opening which provides an access to a part of the grinding surface,

[0009] an operational means arranged in relation to said grinding wheel, capable of rotating the grinding wheel,

[0010] at least one tool rest moveably attached to the wheel casing, and arranged in a predefined distance to the grinding wheel,

[0011] at least one angle adjustable means capable of moving the tool rest in said predefined distance to the grinding wheel from a first grinding angle position to a second grinding angle position.

[0012] A bench grinder apparatus is especially used in the metal working process, where the process of adjusting varying sized parts needs to be simplified and made easy for the user. The bench grinder apparatus may be used for reparation and maintenance purposes, where different kind of tools may need to be grinded in order to carry out a tool function properly. This invention provides a bench grinder apparatus, which has an increased controllability and consistency in handling the tools during grinding. Alternatively, the portable bench grinder apparatus may be a portable bench grinder apparatus.

[0013] The bench grinder apparatus may be provided with a replaceable grinding wheel, so the grinding wheel fits the purpose that the wheel is intended for. The grinding wheel is a wheel composed of an abrasive compound and used for various grinding, abrasive cutting and abrasive machining operations. The grinding wheel may be made from a solid steel or aluminium disc, with particles bonded to the grinding surface. There are several characteristics of a cutting wheel, for example material hardness, grain size, wheel grade, grain spacing, and bond type. These characteristics are often indicated by codes on the grinding wheel's label.

[0014] A fine grinding wheel is typically used for shining or polishing pieces of steel or other metal tools. A rough grinding wheel is often used for repairing tools. The abrasive particles in the grinding wheel remove material from the tool. The grinding process may therefore be handled carefully and precisely, so the tool is not damaged during the process. The grinding process must not take too long time either, due to the maintenance cost. A working balance must be provided.

[0015] The bench grinder apparatus may be provided with a handle, so the bench grinder apparatus is easy to transport to an alternative location. The bench grinder apparatus may also be provided with light, emitting the light to the grinding work area, for example emitting the light towards the tool rest.

[0016] The grinding wheel may be arranged in a wheel casing for safety protection. The wheel casing is provided with one working opening, which provides the user access to part of the grinding surface. The shield cover is also provided for safety protection, for example for protecting the users face, especially the eyes, for being hurt by one of the many pieces of wheel and tool fragments, which are disposed during grinding. The shield cover is pivotally attached to the wheel casing. The shield cover is capable of covering part of said tool holding device, so part of the tool holding device is arranged between said shield cover and said grinding wheel. The bench grinder apparatus may also comprise an extraction system, to extract the wheel and tool fragments away from the grinding area, near the grinding wheel and the tool rest.

[0017] The grinding wheel comprises a rubber surface. The wheel may for example be an aluminum wheel with durable rubber coating or rubber layer. A belt suitable for grinding an item such as a knife may easily be arranged onto the wheel. The belt may not be tight when the wheel is in

stop mode and not rotating. During grinding, when the wheel is rotating in a rotating mode, the rubber will be forced away from the rotating axle. The rubber will expand outwards and tighten the belt to the wheel, so the belt becomes firmly attached to the surface of the wheel, thereby preventing any unwanted vibration or wobble during grinding, and providing a smoothly grinding function.

[0018] During grinding of metal item, such as knives and tools etc., the wheel's rubber surface and/or the belt might heat up. To prevent an overheating during grinding, the rubber may be provided with a serrated surface for a cooling purpose. The recesses in the rubber for cooling the wheel provide the serrated surface, which prevents the heat of the wheel to increase during grinding. The serrated rubber surface on the wheel may therefore be provided with a predefined pattern. The predefined pattern may be related to the type of item to be grinded and/or the rotation speed to be used during grinding.

[0019] The grinding wheel may therefore have an improved serrated dynamically balanced and grinder wheel design for high work efficiency, which increases security and durability of the bench grinder apparatus.

[0020] The bench grinder apparatus may be provided with a replaceable grinding wheel, so the user may be able to change the grinding wheel so the grinding wheel is optimal for the tool to be grinded. The wheel and/or the belt are replaced easily and fast. The bench grinder apparatus may provide an easy and fast process of shaping tool parts or various tools that need to be made or repaired. The bench grinder may be operated partly manually and/or partly automatically using controlling means.

[0021] An operational means is arranged in relation to said grinding wheel, for example in a control unit attached to the base housing of the bench grinder apparatus. The operational means is capable of controlling a motor having an axle, which is rotating the grinding wheel. The bench grinder apparatus may be powered by battery and/or by electricity.

[0022] The tool, such as a knife or other tools may easily be arranged in a tool holding device. The tool holding device may thereafter easily be arranged in relation to said tool rest. The tool rest is moveably attached to the wheel casing, and arranged substantially adjacent to the grinding wheel, where the tool rest and the tool holding device may be arranged substantially adjacent to the grinding wheel. The tool may then be held in a steady position relative to and in touch with the grinding wheel. The user does not need to hold the knife during the grinding process, which provides a safety for the user. The knife is also held in a steady position, which is not altered by the user during the grinding process. This reduces the failures during the grinding process.

[0023] The grinding wheel has rubber layer surface provided with belt comprising a grinding surface arranged in a wheel casing. The rubber layer surface may be serrated with a predefined pattern of recesses. The wheel casing is provided with one working opening, which provides an access to a part of the grinding wheel and a part of the grinding surface. Through the working opening an airflow may be provided. The airflow is generated by the rotation of the grinding wheel and is extracted the dust and/or sparks from grinding away from the working area. The dust and/or sparks may be extracted through the tool rest or part of the tool rest and away from the bench grinder apparatus. The tool rest may be provided with apertures, so dust and/or sparks may be extracted through the apertures and away

from the working area. The dust and/or sparks may be removed using an exhaustion system. An external exhausting system and exhausting means may be arranged in relation to bench grinder apparatus.

[0024] It is preferred that the distance to the grinding wheel is kept constant to ensure a precise grinding of the tool. Some part of the tool may be grinded in one grinding angle and another part of the tool may be grinded in another grinding angle. The bench grinder apparatus comprises a grinding angle scale. The grinding apparatus comprises at least one angle adjustable means. The angle adjustable means may comprise at least one releasable locking means to lock the tool rest in a predefined position relative to the grinding surface. The angle adjustable means is capable of moving the tool rest in said predefined distance to the grinding wheel from a first grinding angle position to a second grinding angle position. The angle adjustable means is also capable of moving the tool rest while rotating said grinding wheel. This ensures a safe and exact grinding of tools, and at the same time minimizing the damage to the tools during grinding. The user does not have to stop the grinding process in order to change the grinding angle or adjust the tool rest further. This reduces the time and costs of grinding tools.

[0025] In an advantageous embodiment of the invention, the angle adjustable means capable of moving the tool rest stepless using at least one sliding means. This makes it very easy to provide an exact grinding angle between a tool and the grinding surface. The sliding means may be a groove or a rail, wherein the angle adjustable means may slide back and forth. This makes it very easy to provide an exact distance between a tool and the grinding surface.

[0026] In a further advantageous embodiment of the invention, the distance between the tool rest and the grinding wheel is adjustable using distance adjustable means.

[0027] The tool holding device may be adjusted relative to the grinding wheel. The distance between the tool holding device and the grinding wheel depends on the shape and size of the tool to be grinded. The distance adjustable means easily moves the tool holding device in a horizontal and/or vertical direction away from or nearer to the grinding wheel. When the tool holding device is in the correct grinding position, the distance adjustable means attaches the tool holding device to the bench grinder apparatus.

[0028] Alternatively, the distance adjustable means easily moves the tool rest, with or without the tool holding device, in a horizontal and/or vertical direction away from or nearer to the grinding wheel. When the tool rest, with or without the tool holding device, is in the correct grinding position, the distance adjustable means attaches the tool rest to the bench grinder apparatus.

[0029] The tool is arranged in a position on the tool rest. The distance between the tool and the grinding surface is adjustable using distance adjustable means. The distance to the grinding surface is kept constant when moving the tool rest from a first grinding angle position to a second grinding angle position.

[0030] In an advantageous embodiment of the invention, said tool rest comprises attachment means for attaching at least one tool holding device to the tool rest, such that, the tool holding device is arranged in relation to said grinding wheel and the angle adjustable means are capable of moving

the tool holding device from a first position to a second position relative to the grinding wheel, when moving the tool rest.

[0031] The tool holding device comprises a first and a second flange extending in substantially the same direction, where a flange distance between the first and the second flanges is capable of varying, where in use a tool is arranged in between the first and the second flange.

[0032] The tool holding device is arranged in relation to the tool rest. Part of the tool holding device is arranged above the tool rest. The first and the second flange extend in substantially the same direction away from the tool rest. The shield cover is capable of covering part of the first and the second flange, so part of the first and the second flange is arranged between said shield cover and said grinding wheel. A tool, such as a knife, is arranged between the first and a second flange. The cutting side on the blade of the knife is turned upwards and away from the tool rest. The edge of the cutting side is meant to be sharp in order to fulfill the purpose of a good knife. If the edge of the cutting side is blunt, the blade may be sharpened using a bench grinder with a grinding wheel. The edge of the cutting side is grinded, until the cutting side becomes sharp again. The tool holding device ensures a safe grinding process for the user, so the user does not need to hold the knife during the grinding process.

[0033] The tool holding device may be arranged in relation to said tool rest, in such way that a part of the tool holding device is arranged above the tool rest and said shield cover is capable of covering part of said tool holding device, so that part of the tool holding device is arranged between said shield cover and said grinding wheel.

[0034] In a further advantageous embodiment of the invention, the grinding angle may be adjusted automatically with the use of controlling means to adjust the tool rest relative to the grinding wheel, such that the tool rest is moved in said predefined distance to the grinding wheel from said first grinding angle position to said second grinding angle position.

[0035] The grinding of a tool may be performed by a controlled process. The controlling means may control one or more functions of grinding. For example the controlling means may control the speed of the grinding wheel, the grinding angle and/or the distance between the tool and the grinding surface. The user may add the grinding parameters. The controlling means may comprise sensors capable of monitoring the grinding process. The grinding process may be related to the tool, which is to be grinded.

[0036] In a still further advantageous embodiment of the invention, the tool rest comprises attachment means for attaching the tool holding device to the tool rest in a predefined position. The tool rest comprises furthermore apertures for attaching the tool holding device to the tool rest using said attachment means. The tool holding device may comprise stepless adjustable attachment means, such that the tool holding device is stepless adjustable relative to the tool rest.

[0037] In a still further advantageous embodiment of the invention, the tool rest comprises at least one elongated aperture.

[0038] The grinding rest may be perforated. When the grinding cylinder is rotating an airstream is created. The airstream captures and removes the grinding dust through the apertures to the exhaust. Due to the apertures in the tool

rest the grinding surface and the tool are kept clean. This provides an optimal grinding of tools,

[0039] The tool holding device is capable of being attached to a tool rest in the bench grinder. In a still further advantageous embodiment of the invention, said tool holding device comprises at least one holding means, wherein said holding means is capable of holding a tool in a grinding position.

[0040] The tool holding device may comprise a different shape which is related to a specific tool. The tools may be arranged correctly into the shaped tool holding device during grinding. The tool holding device may comprise different shapes and sizes, such as grooves, protrusions and/or rails etc. The tool holding device is provided with attachment means, such that the tool holding device is capable of being attached to the tool rest in a predefined position.

[0041] The tool holding device, which holds the knife, may be adjusted relative to the grinding wheel, for example so that a blade of the knife is arranged in a grinding angle relative to the grinding wheel. The distance between the tool holding device and the grinding wheel depends on the shape and size of the blade of the knife to be grinded. The angle adjustable means easily pivots the tool holding device in relation to the grinding surface of the grinding wheel. When the tool holding device is in the correct grinding position, the angle adjustable means attaches the tool holding device to the bench grinder apparatus. The angle adjustable means may be the same as or equal to the distance adjustable means.

[0042] In a further advantageous embodiment of the invention, said tool holding device is adjustable in a horizontal direction relative to said grinding wheel using sliding means.

[0043] To ensure a uniform grinding, the tool holding device may be arranged onto or into a sliding means, for example a rail system. The tool holding device may then be capable of sliding back and forth the rail system during grinding. If the shape of the cutting side is even along the edge of the cutting side, then the grinding will be much easier to handle for the user, instead of the user holding the knife in their hands during grinding. If the shape of the cutting side is uneven along the edge of the cutting side, the user may control the angle adjustable means and the distance adjustable means during the process if the angle adjustable means and the distance adjustable means are capable of being controlled automatically by the operational means.

[0044] In a still further advantageous embodiment of the invention, said operational means controls a rotational speed of said grinding wheel.

[0045] The operational means may control the rotational speed of said grinding wheel. The rotational speed may be accelerated or decelerated, or maintain a constant speed during the grinding process. The operational means may also take into consideration the type of grinding wheel and/or the size and/or shape of the tool to be grinded. The operational means may also control start and stop of the grinding process.

[0046] In a further advantageous embodiment of the invention, said operational means controls a rotational direction of said grinding wheel, so that the grinding wheel is capable of switching between rotating clockwise and counterclockwise relative to an axis of rotation.

[0047] The operational means may control the rotational direction of said grinding wheel. The rotational rotation may be rotating clockwise and counterclockwise relative to an axis of rotation. The rotational direction of said grinding wheel is important to control when shaping different types of tools. A bench grinder apparatus tends to rotate down toward the tool rest, keeping the tool on the rest. With a downwards rotation an unwanted burr forms on top of the tool, for example on the edge of the cutting side of a knife. This is due to the deformation of the edge on the unsupported top surface of the tool as the grinding wheel moves into the edge.

[0048] A method of adjusting a tool rest in a grinding apparatus, comprising the steps of

[0049] arranging said tool rest in predefined distance to the grinding wheel using distance adjustable means,

[0050] moving said tool rest from a first grinding angle position to a second grinding angle position using at least one angle adjustable means, while maintaining the predefined distance to the grinding wheel.

[0051] The tool rest is arranged in a predefined distance to the grinding wheel using distance adjustable means. The tool rest is moved from a first grinding angle position to a second grinding angle position using at least one angle adjustable means. The tool rest maintains the predefined distance to the grinding wheel.

[0052] A method of grinding tools using a grinding apparatus comprises the steps:

[0053] providing a tool to be grinded,

[0054] arranging said tool on the tool rest or in a tool holding device on a tool rest, and arranging said tool in relation to a tool rest and a grinding wheel,

[0055] placing the tool such that a tool part is resting against a grinding surface of the grinding wheel in a predefined angle,

[0056] rotating said grinding wheel.

[0057] A method of grinding tools using a grinding apparatus may comprise one or more of the steps, wherein a tool which is to be grinded is arranged on the tool rest or in a tool holding device arranged on a tool rest. Alternatively, the tool is arranged in a grinding position relative to a grinding surface. The tool such that a tool part is resting against a grinding surface of the grinding wheel in a predefined angle. The tool is grinded while rotating said grinding wheel. The grinding angle may be varied during grinding.

[0058] The tool rest is then moved using at least one angle adjustable means from a first grinding angle position to a second grinding angle position.

[0059] Method of grinding items using a bench grinder apparatus comprising the steps:

[0060] providing a tool to be grinded,

[0061] arranging said tool in a tool holding device, and arranging said tool holding device in relation to a tool rest and a grinding wheel, so a shield cover covers part of said tool and said tool holding device

[0062] rotating said grinding wheel

[0063] placing the tool part to be grinded, so that the tool part is resting against a grinding surface of the grinding wheel.

[0064] The bench grinder apparatus comprises steps for grinding a tool or different kinds of tools. The bench grinder apparatus is placed in a position on a stable surface. The method of grinding a blade of a knife or other tools with the bench grinder apparatus comprises one or more steps. First

a bunt knives is provided, where the blade of the knife needs to be sharpened. The knife is arranged in the tool holding device, so the cutting side on the blade of the knife is turned upwards and away from the tool rest. Also, the tool holding device is arranged in relation to the tool rest and the grinding wheel. The shield cover is pivoted into a position, so the shield cover covers part of the knife and/or the tool holding device. The tool holding device is fastened in a fixed or a varying position to the bench grinder apparatus during grinding.

[0065] The distance between the tool holding device and the grinding wheel is arranged so that the cutting side on the blade of the knife is placed in a predefined position relative to the grinding wheel. The rotational direction of said grinding wheel is set to clockwise or counterclockwise rotation. The rotational speed of said grinding wheel is adjusted to a predefined rotational speed. The edge on the blade of the knife is pressed against a grinding surface of the grinding wheel while the grinding wheel is rotating. During the grinding process, the grinding angle, rotational speed and the rotational direction may be altered to provide a perfect grinding result.

[0066] Controlling the rotational speed or the rotational direction of said grinding wheel is provided using the operational means, when grinding the tool. Adjusting the grinding angle of said tool and said grinding wheel is provided using the angle adjustable means, when grinding the tool. A controlling unit comprised in the bench grinder apparatus may control the operational means.

[0067] The invention has now been explained with reference to a few embodiments which have only been discussed in order to illustrate the many possibilities and varying design possibilities achievable with the embodiment of a bench grinder apparatus according to the present invention.

DESCRIPTION OF THE DRAWING

[0068] The embodiments of the invention are described in the following with reference to:

[0069] FIG. 1: Illustrating an embodiment of a bench grinder apparatus

[0070] FIG. 2: Illustrating an embodiment of a bench grinder apparatus comprising a tool holding device in a first side view.

[0071] FIG. 3: Illustrating an embodiment of a bench grinder apparatus comprising a tool holding device in a second side view.

[0072] FIG. 4: Illustrating an embodiment of a bench grinder apparatus comprising a grinding angle scale.

[0073] FIG. 5a,b,c: Illustrating an embodiment of a bench grinder apparatus comprising a tool rest arranged in different grinding angle.

[0074] FIG. 6a,b: Illustrating an embodiment of a tool rest.

[0075] FIG. 7a,b,c,d: Illustrating an embodiment of a tool holding device placed in different positions on a tool rest.

[0076] FIG. 8a,b: Illustrating a grinding wheel comprising rubber surface.

DETAILED DESCRIPTION OF THE INVENTION

[0077] An embodiment of the invention is explained in the following detailed description. It is to be understood that the invention is not limited in its scope to the following descrip-

tion or as illustrated in the drawings. The invention is capable of other embodiments and of being practiced or carried out in various ways.

[0078] FIG. 1 illustrates an embodiment of a bench grinder apparatus 1. The bench grinder apparatus 1 comprises a portable base housing 2 having a handle 3. The bench grinder apparatus 1 also comprises an operational means, such as a motor 4, a control unit 5 and a wheel casing 6. Within the wheel casing 6, a grinding wheel 7 is arranged so the grinding wheel can be rotated by the motor 4. The wheel casing 6 is provided with one working opening 8, which provides an access to part of the grinding surface on the grinding wheel 7.

[0079] A tool rest 9 is moveably attached to the wheel casing 6 using distance adjustable means 10, so the tool rest 9 is capable of changing position relative to the wheel casing 6 and the grinding wheel. The distance adjustable means 10 may be a threaded rod and nut and/or nuts, which may be tightened on each side of the tool rest 9 and/or the wheel casing 6. The tool rest 9 may be arranged in a predefined position substantially adjacent to the grinding wheel 7. The tool rest 9 is arranged in a predefined position which provides a gap between the tool rest 9 and the grinding surface of the grinding wheel 7, so the tool rest 9 unintentionally becomes grinded and/or damaged by the grinding wheel 7.

[0080] A shield cover 11 is a safety shield which is arranged above the tool rest 9 covering the hole or parts of the working opening 8. The shield cover 11 is pivotably attached to the wheel casing, so the shield cover 11 is capable of pivoting upwards and away from the tool rest 9. The shield cover 11 may be a transparent and/or magnifier plate.

[0081] The bench grinder apparatus 1 is provided with a control unit 5, where the control unit 5 comprises operational means for controlling for example the on/off function and the rotational speed and rotational direction of the grinding wheel 7.

[0082] The rotational direction of said grinding wheel 7 can be switched between clockwise and counterclockwise rotation when switching the operational means into the selected rotational direction. The rotational speed of said grinding wheel 7 is adjustable, when adjusting the operational means stepwise and/or stepless. The rotational direction and the rotational speed may be operated at the same time and in relation to each other, when grinding the tool.

[0083] During grinding of the knife, the grinding wheels 7 rubber surface and/or the belt might heat up. To prevent an overheating during grinding, the rubber may be provided with a serrated surface for a cooling purpose. The recesses in the rubber for cooling the wheel, provides the serrated surface. The working opening 8 and the recesses in the rubber provides the air flow generated when the grinding wheel 7 is rotation. This prevents the heat of the wheel from increasing the temperature during grinding. The grinding wheel 7 has an improved serrated dynamically balanced and grinder wheel design for high work efficiency, which increases security and durability of the bench grinder apparatus 1.

[0084] FIG. 2 illustrates an embodiment of a bench grinder apparatus 1 comprising a tool holding device 12 in a first side view. The tool holding device 12 is holding a knife which is to be sharpened using a grinding wheel 7. The tool holding device 12 is arranged in relation to said tool rest

9. Part of the tool holding device 12 is arranged above the tool rest 9 and part of the tool holding device 12 is arranged below the tool rest 9. The part of the tool holding device 12, which is arranged above the tool rest 9, is partly covered by the shield cover 11, so part of the tool holding device 12 is arranged between the shield cover 11 and the grinding wheel 7. The knife 13 is capable of engaging the grinding surface of the grinding wheel 7.

[0085] The tool holding device 12 comprises a tool plate or flange, so that the knife 13 may be held in a fixed position during grinding. The tool holding device 12 is capable of fixing different sizes or shapes of knives 13 or other types of tools. If the tool holding device 12 comprises two plates or two flanges, the knife 13 may be arranged firmly between the two plates or two flanges. The distance between the two plates may vary accordingly for holding the knife 13 in a correct grinding position.

[0086] The cutting side on the blade of the knife 13 is turned upwards and away from the tool rest 9. The edge of the cutting side is meant to be sharp in order to fulfill the purpose of a good knife 13. If the edge of the cutting side is blunt, the blade may be sharpened using a bench grinder with a grinding wheel 7. The edge of the blade is pressed carefully towards the rotating grinding wheel 7. The edge of the cutting side is grinded, until the cutting side becomes sharp again.

[0087] The distance between the tool holding device 12 and the grinding wheel 7 is adjustable using distance adjustable means adjusting the tool holding device 12 in a predefined distance to the grinding wheel 7. The adjustable tool holding device 12 is adjusted so that the knife 13, fixed in the tool holding device 12, is provided with a predefined distance optimal for the grinding effect on the blade of the knife 13. Also, the knife 13, fixed in the tool holding device 12, is provided with a predefined pressure towards the grinding surface for optimal grinding effect on the blade of the knife 13. If the predefined distance and/or pressure for the grinding effect are not optimal, the grinding effect may cause irreversible damage to the knife 13 or tool.

[0088] An axis X illustrates the axis of the blade of the knife 13 and an axis Y is the tangent axis of the grinding surface of the wheel 7. The angle between the axis X and the axis Y is the grinding angle φ . The grinding angle φ of the blade of the knife 13 relative to the the grinding wheel 7 is adjusted, by adjusting the tool holding device using angle adjustable means. The grinding angle φ of the blade of the knife 13 in relation to the grinding surface causes a grinding effect on the blade of the knife 13 when the grinding wheel 7 is rotating. The grinding angle of the blade of the knife 13 relative to the the grinding wheel 7 may be varied during grinding. If the predefined grinding angle is not optimal, the grinding effect may cause an extended grinding time and/or irreversible damage to the knife 13 or tool.

[0089] The tool holding device is adjustable in a horizontal direction relative to said grinding wheel using sliding means. These sliding means are not shown on the FIG. 2. The sliding means may be rails, which are capable of sliding the tool holding device 12 to a first side or a second side relative to the grinding wheel 7. The sliding means provides an even grinding effect to the blade of the knife 13, when the blade of the knife 13 is kept in a predefined position during grinding.

[0090] FIG. 3 illustrates an embodiment of a bench grinder apparatus comprising a tool holding device in a

second side view. A method of grinding a blade of a knife 13 using a grinding apparatus 1 comprising one or more of following steps: First one or more knives 13 is provided, where the blade of the knife 13 needs to be sharpened. The knife is arranged in the tool holding device 12, and the tool holding device 13 is arranged in relation to the tool rest 9 and the grinding wheel 7. The shield cover 11 is arranged in a position so the shield cover 11 covers part of the knife 13 and the tool holding device. The tool holding device 12 is fastened in a fixed position to the bench grinder apparatus 1 during grinding.

[0091] The distance between the tool holding device 12 and the grinding wheel 7 is arranged so that the blade of the knife 13 is placed in a predefined position relative to the grinding wheel 7. The grinding angle φ , as showed in the FIG. 2, of the blade of the knife 13 is also arranged in a predefined position relative to the grinding wheel 7.

[0092] The rotational direction of said grinding wheel 7 is set to rotate clockwise or counterclockwise. The rotational speed of said grinding wheel 7 is adjusted to a predefined rotational speed, for example slow speed for sharpening edges of the blade of the knife 13 or high speed for quick and rough metal removal. The blade of the knife 13 tool is pressed against a grinding surface of the grinding wheel, thereby sharpening the edge of the blade. During the grinding process, the grinding angle, rotational speed and the rotational direction may be altered to provide a perfect grinding result.

[0093] FIG. 4 illustrates an embodiment of a bench grinder apparatus comprising a grinding angle scale. The distance from the tool rest 9 to the grinding wheel 7 is kept constant to ensure a precise grinding of the tool. Some part of the tool may be grinded in one grinding angle and another part of the tool may be grinded in another grinding angle. The bench grinder apparatus comprises a visual grinding angle scale 18. The grinding apparatus 1 comprises at least one angle adjustable means, which comprises a handle 3 and a rail or a recess 19. The angle adjustable means may comprise at least one releasable locking means, which may be the handle which can be screwed in a tight position to lock the tool rest in a predefined position relative to the grinding surface.

[0094] FIG. 5a,b,c illustrates an embodiment of a bench grinder apparatus comprising a tool rest arranged in different grinding angle. The angle adjustable means is capable of moving the tool rest upwards and downwards in an angled position and at the same time in said predefined distance to the grinding wheel. The tool rest may slide from a first grinding angle position to a second grinding angle position. The angle adjustable means is also capable of moving the tool rest 9, illustrated by the dotted line, while rotating said grinding wheel. FIG. 5a shows the tool rest 9 in a grinding angle of approximately 70° positioned by the handle 3¹ in the rail. FIG. 5b shows the tool rest 9 in a grinding angle of approximately 25° positioned by the handle 3² in the rail. FIG. 5c shows the tool rest 9 in a grinding angle less than 15° positioned by the handle 3³ in the rail. The user does not have to stop the grinding process in order to change the grinding angle or adjusted the tool rest further.

[0095] FIG. 6a,b illustrates an embodiment of a tool rest. The wheel casing is provided with one working opening, which provides an access to a part of the grinding wheel 17 and a part of the grinding surface 7. Through the working opening an airflow F may be provided. The airflow F is

generated by the rotation of the grinding wheel 17, and the dust and/or sparks from grinding is extracted away from the working area. The dust and/or sparks may be extracted through the tool rest 9 or part of the tool rest 9 and away from the bench grinder apparatus 1. The tool rest 9 may be provided with apertures 22,23, such that dust and/or sparks may be extracted through the apertures 22,23 and away from the working area. Some of the apertures 23 may be elongated and providing a larger area for airflow. The dust and/or sparks may be removed using an exhaustion system. An external exhausting system and exhausting means may be arranged in relation to bench grinder apparatus 1, not showed on the FIG. 6a,b.

[0096] FIG. 7a,b,c,d illustrates an embodiment of a tool holding device placed in different positions on a tool rest. The tool rest 9 may also use the apertures for attaching the tool holding device 12 to the tool rest 9 using said attachment means 23. The attachment means 23 may be splits, screws or bolts. The tool rest comprises attachment means for attaching the tool holding device 12 to the tool rest in a predefined position. The tool holding device's 12 attachment means may engage two different apertures 22,23 to maintain the position during grinding, showed in FIG. 7a,b. FIG. 7c shows the tool holding device 12', 12'', which is divided in two parts capable of holding the tool in the right position during grinding. FIG. 7d. shows one embodiment of a tool holding device 12 holding a drill. The tool holding device 12 is capable of holding different sizes of drills. The tool holding device 12 is capable of being slid from side to side. The tool holding device 12 comprises stepless adjustable attachment means, such that the tool holding device is stepless adjustable relative to the tool rest 9, not shown on FIG. 7a,b,c,d.

[0097] FIG. 8 illustrates a grinding wheel 7' comprising a rubber surface. The bench grinder apparatus 1 is provided with a replaceable grinding wheel 7' and/or belt 7'', so the user may be able to change the grinding wheel 7' and/or belt 7'', so the grinding wheel is optimal for the tool to be grinded. When replacing the grinding wheel 7' and/or belt 7'', the wheel casing 6 is opened by pivoting part of the wheel casing 6 upwards and away from the base housing 2, uncovering the grinding wheel 7' and the belt 7''.

[0098] FIG. 8a shows an open wheel casing 6. The rotational axle 14 is ready to receive a grinding wheel 7'. The grinding wheel 7' may comprise an aluminum wheel 15 with durable rubber layer 16, provided with a predefined serrated pattern on the surface 17. A belt 7'' with a grinding surface 18 is suitable for grinding knives and tools. The belt 7'' fits the circumference of the grinding wheel 7'. The predefined pattern on the surface 17 is related to the type of item to be grinded and/or the rotation speed to be used during grinding.

[0099] FIG. 8b shows an open wheel casing 6 comprising a grinding wheel 7' receiving a belt 7''. The grinding wheel 7' and/or the belt 7'' are replaced easily and fast. The belt 7'' may be moveable attached to the grinding wheel 7'. During the grinding process, when the grinding wheel 7' is rotating, the rubber will be forced away from the rotating axle, due to a force opposite the centripetal force. The rubber will expand outwards and tightened the belt 7'' to the grinding wheel 7', so the belt 7'' becomes firmly attached to the surface of the grinding wheel 7'.

1. Bench grinder apparatus for grinding tools comprising: at least one grinding wheel with a grinding surface arranged in a wheel casing, where the wheel casing is

provided with one working opening which provides an access to a part of the grinding surface,
 an operational means arranged in relation to said grinding wheel, capable of rotating the grinding wheel,
 at least one tool rest moveably attached to the wheel casing, and arranged substantially adjacent in a predefined distance to the grinding wheel, and
 at least one angle adjustable means capable of moving the tool rest in said predefined distance to the grinding wheel from a first grinding angle position to a second grinding angle position.

2. Bench grinder apparatus according to claim **1**, wherein the angle adjustable means is capable of moving the tool rest stepless using at least one sliding means.

3. Bench grinder apparatus according to claim **1**, wherein the distance between the tool rest and the grinding wheel is adjustable using distance adjustable means.

4. Bench grinder apparatus according to claim **1**, wherein said tool rest comprises attachment means for attaching at least one tool holding device to the tool rest, such that, the tool holding device is arranged in relation to said grinding wheel and the angle adjustable means are capable of moving the tool holding device from a first position to a second position relative to the grinding wheel, when moving the tool rest.

5. Bench grinder apparatus according to claim **1**, wherein the grinding angle is adjusted automatically with the use of controlling means to adjust the tool rest relative to the grinding wheel, such that the tool rest is moved in said predefined distance to the grinding wheel from said first grinding angle position to said second grinding angle position.

6. Bench grinder apparatus according to claim **1**, where said operational means controls a rotational speed of said grinding wheel.

7. Bench grinder apparatus according to claim **1**, where said operational means controls a rotational direction of said grinding wheel, so that the grinding wheel is capable of switching between rotating clockwise and counterclockwise relative to an axis of rotation.

8. A tool rest for a bench grinder, wherein the tool rest comprises attachment means for attaching the tool holding device to the tool rest in a predefined position.

9. A tool rest according to claim **8**, wherein the tool rest comprises apertures for attaching the tool holding device to the tool rest using said attachment means.

10. A tool rest according to claim **8**, wherein the tool holding device comprises stepless adjustable attachment means, such that the tool holding device is stepless adjustable relative to the tool rest.

11. A tool holding device for a bench grinder, wherein the tool holding device is capable of being attached to a tool rest in the bench grinder.

12. A tool holding device according to claim **11**, wherein said tool holding device comprises at least one holding means, wherein said holding means is capable of holding a tool in a grinding position.

13. Method of adjusting a tool rest in a grinding apparatus, comprising the steps of

arranging said tool rest in predefined distance to the grinding wheel using distance adjustable means,
 moving said tool rest from a first grinding angle position to a second grinding angle position using at least one angle adjustable means, while maintaining the predefined distance to the grinding wheel.

14. Method of grinding tools using a grinding apparatus according to claim **13**, comprising the steps:

providing a tool to be grinded,
 arranging said tool on the tool rest or in a tool holding device on a tool rest, and arranging said tool relative to a grinding surface,
 placing the tool such that a tool part is resting against the grinding surface of the grinding wheel in a predefined angle, and
 rotating said grinding wheel.

15. Method according to claim **14**, comprising further steps:

moving the tool rest from a first grinding angle position to a second grinding angle position using at least one angle adjustable means.

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