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(54) ATTACHMENT ASSEMBLY FOR RELEASABLE ATTACHMENT OF AN ADAPTER ELEMENT TO A TOOL SHAFT OF A HAND-HELD POWER TOOL, HAND-HELD POWER TOOL AND ADAPTER ELEMENT

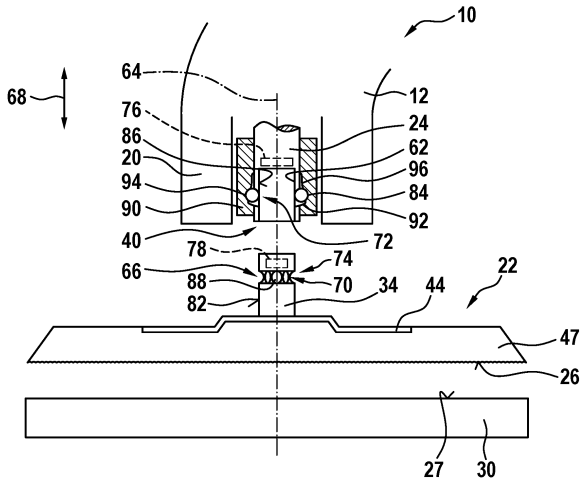
(57) The invention refers to an attachment assembly (40) for releasable attachment of an adapter element (22; 36; 30; 48; 44) to a distal end of a tool shaft (24) of a hand-held power tool (10), comprising

- a mechanical axial fastening mechanism (66) for releasably holding the adapter element (22; 36; 30; 48; 44) in respect to the tool shaft (24) in an axial direction (68) after attachment of the adapter element (22; 36; 30; 48; 44) to the tool shaft (24), and
- a rotation preventing device (74) adapted to transmit torque from the tool shaft (24) to the adapter element (22; 36; 30; 48; 44).

The releasable mechanical axial fastening mechanism (66) being adapted to switch between a fastening position, in which the adapter element (22; 36; 30; 48; 44) is held in respect to the tool shaft (24) in the axial direction (68), and a release position, in which the adapter element (22; 36; 30; 48; 44) is removable from the tool shaft (24) in the axial direction (68).

It is suggested that the attachment assembly (40) comprises magnetic elements (76, 78), at least one assigned to the tool shaft (24) and at least another one assigned to the adapter element (22; 36; 30; 48; 44), the magnetic elements (76, 78) adapted to attract each other magnetically in order to provide for a holding of the adapter element (22; 36; 30; 48; 44) in respect to the tool shaft (24) in the axial direction (68) by means of magnetic force.

Fig. 9



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Description

[0001] The present invention refers to an attachment assembly for releasable attachment of an adapter element to a distal end of a tool shaft of a hand-held power tool, in particular in the form of a hand-held sanding or polishing power tool. The attachment assembly comprises a releasable mechanical axial fastening mechanism adapted for releasably holding the adapter element in respect to the tool shaft of the power tool in an axial direction extending parallel in respect to a rotational axis of the tool shaft, after attachment of the adapter element to the tool shaft. The releasable mechanical axial fastening mechanism is adapted to switch between a fastening position, in which the adapter element is held in respect to the tool shaft in the axial direction, and a release position, in which the adapter element is not held in respect to the tool shaft in the axial direction and in which the adapter element is removable from the tool shaft in the axial direction. The attachment assembly further comprises a rotation preventing device adapted to prevent a rotation of the adapter element in respect to the tool shaft about the rotational axis of the tool shaft after attachment of the adapter element to the tool shaft and in order to transmit torque from the tool shaft to the adapter element.

[0002] The adapter element may be in the form of a backing plate (to the bottom surface of which a sanding or polishing member may be releasably attached) or a sanding or polishing pad (having a bottom surface with abrasive or polishing characteristics) or an eccentric element (a backing plate, sanding or polishing pad attached thereto in a freely rotatable manner for realising a random-orbital or an eccentric working movement of the backing plate, sanding or polishing pad) or an extension shaft (a backing plate, sanding or polishing pad attached thereto in a manner such that a torque can be transmitted for realising a rotary working movement of the backing plate, sanding or polishing pad) or the like.

[0003] Furthermore, the invention refers to a hand-held power tool, in particular in the form of a hand-held sanding or polishing power tool, comprising a tool shaft and an electric or pneumatic motor for driving the tool shaft and rotating it about its rotational axis, and an attachment assembly for releasable attachment of an adapter element to a distal end of the tool shaft. Finally, the invention also refers to an adapter element, in particular in the form of an eccentric element or of an extension shaft, adapted for releasable attachment to a distal end of a tool shaft of a hand-held power tool, in particular in the form of a hand-held sanding or polishing power tool, by means of an attachment assembly.

[0004] Hand-held power tools of the above-mentioned kind are well-known in the prior art, for instance, in the form of the RUPES® Big Foot® iBrid® Nano. That power tool is a so-called mini polisher and has a battery-operated electric motor for driving the tool shaft. Different types of adapters, e.g., in the form of different eccentric elements for realizing a random orbital working movement having 3mm or 12mm orbit, or an extension shaft for realizing a rotary working movement, can be releasably attached to the distal end of the tool shaft. The respective attachment assembly comprises a threaded connection between a mounting shaft of the eccentric element or the extension shaft and the tool shaft. Thus, this power tool does not have an axial fastening mechanism where at least one of the first and second components is adapted to switch between a fastening position and a release position.

[0005] Another hand-held power tool of the above-mentioned kind is the FLEX® PXE 80 10.8-EC. This power tool has an axial mechanical fastening mechanism which is adapted to switch between a fastening position and a release position. Thus, this power tool also has an attachment assembly of the above-mentioned kind.

[0006] One problem of the known attachment assemblies of the above-mentioned kind and of the power tools known from the prior art is the fact that when the releasable axial fastening mechanism is brought into the release position, the adapter element is instantly released from the distal end of a tool shaft and - if the power tool is held in an orientation of intended use - fall down due to the gravitational force. This may lead to an uncontrolled release of the adapter element and consequently to damage of the adapter element itself or - even worse - of a workpiece surface to be worked by the power tool, if the adapter element falls on the surface.

[0007] Therefore, it is an object of the present invention to provide for an attachment assembly, where instant release and uncontrolled separation of the adapter element (i.e., the backing plate or the sanding or polishing pad or the eccentric element or the extension shaft) from the tool shaft is avoided, when the releasable axial fastening mechanism is brought into the release position.

[0008] This object is solved by the attachment assembly according to claim 1. In particular, starting from the attachment assembly of the above-mentioned kind, it is suggested that the attachment assembly comprises magnetic elements, at least one of the magnetic elements assigned to the tool shaft and at least another one of the magnetic elements assigned to the adapter element, the magnetic elements adapted to attract each other magnetically in order to provide for a holding of the adapter element in respect to the tool shaft in the axial direction by means of magnetic force, at least when the adapter element is attached to the tool shaft in the axial direction and at least when the releasable axial fastening mechanism is in its release position.

[0009] The invention has the advantage that the adapter element is still held in respect to the tool shaft in the axial direction by means of magnetic force even if the releasable axial fastening mechanism is brought into the release position. An instant release of the adapter element (i.e., the backing plate or the sanding or polishing pad or the eccentric element or the extension shaft) and an uncontrolled falling off from the tool shaft is prevented. In order to separate the adapter element from the tool

shaft, after the releasable axial fastening mechanism has been brought into the release position, the user has to manually grip the adapter element with his hand and pull it in the axial direction away from the tool shaft, thereby overcoming the magnetic force acting between the magnetic elements. This greatly improves user safety, because the user will not be injured by an adapter element falling off the power tool in an uncontrolled manner, as well as working quality, because an adapter element falling off the power tool in an uncontrolled manner and damage of the workpiece surface to be worked is prevented. Additionally, cost savings may be achieved, because the adapter element cannot be damaged due to falling off the power tool in an uncontrolled manner and hitting the ground, another surface (e.g., a work surface of a workbench) or another part or element (e.g., a vice, a toolbox or the like).

[0010] According to a preferred embodiment of the invention, the attachment assembly comprises

- a mounting shaft attached to the adapter element, preferably in a torque-proof manner, or forming an integral part of the adapter element, and
- a receiving opening provided in the distal end of the tool shaft and adapted for receiving the mounting shaft in the axial direction,
- wherein the releasable axial fastening mechanism is adapted to releasably fasten the mounting shaft in the receiving opening in the axial direction and comprises a first component assigned to the mounting shaft and a second component assigned to the receiving opening, wherein at least one of the first and second components of the releasable axial fastening mechanism is adapted to switch between the fastening position, in which the first and second components of the releasable axial fastening mechanism enter into an operative connection with each other in order to provide for the fastening of the mounting shaft in the receiving opening in the axial direction, and the release position, in which the first and second components of the releasable axial fastening mechanism release their operative connection in order to allow a removal of the mounting shaft from the receiving opening, and
- wherein the tool shaft and the mounting shaft are provided with the magnetic elements adapted to attract each other magnetically in order to provide for a holding of the mounting shaft in the receiving opening in the axial direction by means of magnetic force at least when at least one of the first and second components of the releasable axial fastening mechanism is in the release position.

[0011] According to a preferred embodiment of the present invention, it is suggested that the magnetic elements comprise permanent magnets and/or ferromagnetic elements. It is possible that both shafts, the tool shaft as well as the mounting shaft, each comprise at least one permanent magnet. The permanent magnets of the tool shaft on the one hand and the mounting shaft on the other hand have preferably opposed polarities, so that they attract each other magnetically.

[0012] It is suggested that one of the tool shaft and the mounting shaft is provided with at least one permanent magnet and the other one of the tool shaft and the mounting shaft is provided with a ferromagnetic element. The ferromagnetic element is magnetically attracted by the respective permanent magnet.

[0013] In order to save manufacturing time and costs, it is suggested that the ferromagnetic element is realized by a material of the tool shaft or of the mounting shaft itself. To this end, it is suggested that at least part of the tool shaft surrounding the receiving opening or at least part of the distal end of the mounting shaft received by the receiving opening is made of or comprises a ferromagnetic material. In particular, it is suggested that the material of at least part of at least one of the tool shaft and the mounting shaft is iron, cobalt or nickel or a composite material comprising iron, cobalt or nickel.

[0014] The rotation preventing device prevents rotation of the mounting shaft in respect to the receiving opening of the tool shaft about the rotational axis of the tool shaft. However, axial movement of the mounting shaft in respect to the receiving opening parallel to the rotational axis of the tool shaft is not prevented by the rotation preventing device. This may be prevented by a separate releasable axial fastening mechanism. In particular, the rotation preventing device serves for transmitting torque from the tool shaft to the mounting shaft and the adapter element during operation of the hand-held power tool.

[0015] It is possible that the releasable axial fastening mechanism is separate from the rotation preventing device. For example, the first component of the releasable axial fastening mechanism could comprise a circumferential annular groove which is formed on an external circumferential surface of the mounting shaft. The second component of the releasable axial fastening mechanism could comprise at least one movable protruding element provided on an internal circumferential surface of the receiving opening of the tool shaft and adapted to be moved in a radial direction between a protruding position, in which the at least one protruding element protrudes in a radial direction towards the rotational axis of the tool shaft beyond the internal circumferential surface of the receiving opening into the annular groove, and a retracted position, in which the at least one protruding element is retracted in a radial direction away from the rotational axis of the tool shaft aligned with or beyond the internal circumferential surface of the receiving opening. The at least one protruding element could have the shape of a pin, a cuboid, a sphere or similar. Many other possible embodiments of the releasable axial fastening mechanism separate from the rotation preventing device are conceivable, too.

[0016] When the at least one protruding element is in its protruding position, it engages with the circumferential

annular groove of the mounting shaft, thereby fastening the mounting shaft in the receiving opening in the axial direction. However, rotation of the mounting shaft inside the receiving opening of the tool shaft is not prevented by the at least one of the first and second components of the releasable axial fastening mechanism being in the fastening position. In that case, rotation of the mounting shaft inside the receiving opening of the tool shaft may be prevented by a separate rotation preventing device.

[0017] The rotation preventing device may comprise a non-rotationally symmetrical cross-sectional form of the internal circumferential surface of the receiving opening and a respective non-rotationally symmetrical cross-sectional form of the external circumferential surface of the distal end of the mounting shaft received by the receiving opening. The non-rotationally symmetrical form may be a triangle, a rectangle, a square, or any other kind of polygon, in particular a hexagon or an octagon. Preferably, the non-rotationally symmetrical form is an equilateral and equiangular polygon. Many other possible embodiments of the rotation preventing device are conceivable, too.

[0018] It is further possible that the releasable axial fastening mechanism also forms the rotation preventing device. For example, the first component of the releasable axial fastening mechanism could comprise a plurality of discrete recesses equidistantly distributed in a circumferential direction on an external circumferential surface of the mounting shaft. The second component of the releasable axial fastening mechanism could comprise at least one movable protruding element provided on an internal circumferential surface of the receiving opening of the tool shaft and adapted to be moved in a radial direction between a protruding position, in which the at least one protruding element protrudes in a radial direction towards the rotational axis of the tool shaft beyond the internal circumferential surface of the receiving opening into one of the discrete recesses, and a retracted position, in which the at least one protruding element is retracted in a radial direction away from the rotational axis of the tool shaft aligned with or beyond the internal circumferential surface of the receiving opening and removed from the discrete recess. Each of the discrete recesses is adapted to receive a protruding element in its protruding position. The at least one protruding element could have the shape of a pin, a cuboid or a sphere or similar. Many other possible embodiments of the releasable axial fastening mechanism also forming the rotation preventing device are conceivable, too.

[0019] The at least one movable protruding element may be urged radially inwards towards the rotational axis of the tool shaft, i.e., into its protruding position, by the force of a spring or the like. It is also possible that an axially movable external locking element is provided which can be moved between a locking position, in which it urges the at least one radially movable protruding element into its protruding position, and a release position, in which it allows the at least one protruding element to retract in a radial direction into its retracted position. The external locking element may be held in its locking position by the force of a spring, by magnetic force or the like.

[0020] In order to achieve a particularly compact and easy to use power tool, it is suggested that the releasable axial fastening mechanism also works as the rotation preventing device. With other words, the functionality of fastening the mounting shaft in the receiving opening in the axial direction and the functionality of preventing a rotation of the mounting shaft in respect to the receiving opening about the rotational axis of the tool shaft may be realized by one and the same mechanism or device.

[0021] It is further suggested that the first component of the releasable axial fastening mechanism comprises at least one discrete recess provided in a radial direction on an external circumferential surface of the mounting shaft. Preferably, the releasable axial fastening mechanism comprises a plurality of discrete radially extending recesses arranged annularly on the external circumferential surface of the mounting shaft and spaced apart from each other in a circumferential direction. It is further preferred that neighbouring recesses are evenly spaced in respect to each other in the circumferential direction, i.e., the spaces between neighbouring recesses are the same. The radially extending recesses may have the shape of a cylinder, possibly with a pointed or spherically rounded bottom, or the recesses have the shape of a hemisphere.

[0022] According to a further embodiment of the invention, the second component of the releasable axial fastening mechanism comprises at least one movable protruding element provided on an internal circumferential surface of the receiving opening of the tool shaft and adapted to be moved in a radial direction between a protruding position, in which the at least one protruding element protrudes in a radial direction towards the rotational axis of the tool shaft beyond the internal circumferential surface of the receiving opening, and a retracted positon, in which the at least one protruding element is retracted in a radial direction away from the rotational axis of the tool shaft aligned with or beyond the internal circumferential surface of the receiving opening. When the at least one protruding element of the tool shaft is in its protruding position, it may engage with at least one of the recesses of the mounting shaft. Then, the mounting shaft is fastened in the receiving opening in the axial direction and at the same time a rotation of the mounting shaft in respect to the receiving opening about the rotational axis of the tool shaft is prevented. If, instead of one or more discrete recesses an annular groove is provided on the external circumferential surface of the mounting shaft, only the mounting shaft is fastened in the receiving opening in the axial direction, while a rotation of the mounting shaft in respect to the receiving opening about the rotational axis of the tool shaft would still be possible.

[0023] The at least one radially movable protruding element may have the shape of a cylinder, possibly with a pointed or spherically rounded tip. Many other shapes of

the protruding elements are conceivable, too. Preferably, the at least one protruding element has the form of a sphere.

[0024] It is further suggested that movement of the at least one movable protruding element is achieved by means of an actuating device provided on an external surface of a tool housing of the hand-held power tool or constituted by part of the tool housing of the hand-held power tool. The actuating device may actively promote movement of the at least one protruding element in at least one direction. Alternatively, the actuating device may simply enable or prevent movement of the at least one protruding element, wherein the movement of the at least one protruding element itself is achieved through the force of a spring, magnetic force or the force of gravity. The movement of the at least one protruding element itself may also be achieved in a direction radially outwards through the mounting shaft being pulled out of or inserted into the receiving opening of the tool shaft. In the opposite direction radially inwards movement of the at least one protruding element itself may be achieved by means of the actuating device when it is moved from a release position in which it allows radial movement of the at least one protruding element into a locking position in which it urges the at least one protruding element into its protruding position and prevents movement of the at least one protruding element into its retracted position.

[0025] Thus, the actuating device may simply have the function of an axially movable external locking element. The locking element may be adapted to be moved between a locking position, in which it urges the at least one radially movable protruding element into its protruding position, and a release position, in which it allows the at least one protruding element to retract in a radial direction into its retracted position. The external locking element may be held in its locking position by the force of a spring, by magnetic force or the like.

[0026] According to a particularly preferred embodiment of the invention it is suggested that the actuating device is constituted by at least part of a protective cap or shroud receiving and surrounding at least part of an eccentric element or an extension shaft attached to the tool shaft of the hand-held power tool. For instance, the actuating device may be constituted by an annular part of the protective cap or shroud, preferably movable in an axial direction in respect to the fixed part of the protective cap or shroud. Alternatively, the actuating device is constituted by the entire protective cap or shroud, preferably movable in an axial direction in respect to a fixed part of the power tool, in particular the power tool housing.

[0027] The present invention also suggests a hand-held power tool, in particular in the form of a hand-held sanding or polishing power tool, comprising a tool shaft and an electric or pneumatic motor for driving the tool shaft and rotating it about its rotational axis, and an attachment assembly for releasable attachment of a backing plate or a sanding or polishing pad or an eccentric element or an extension shaft to a distal end of the tool shaft, wherein the hand-held power tool comprises an attachment assembly according to the present invention and described above.

[0028] Further features and advantages of the present invention will become apparent from the following description referring to the accompanying drawings. It is emphasised that each of the features shown in the drawings may in itself be essential to the invention, even if this is not expressly mentioned in the description. Furthermore, several of the features shown in the drawings may also be essential to the invention in any combination with each other, even if this is not expressly shown in the drawings and is not expressly mentioned in the description. The drawings show:

Fig. 1 a hand-held power tool according to a preferred embodiment of the present invention in a side view;

Fig. 2 a distal end of a front part of a tool housing of the power tool of Fig. 1 in a perspective view;

Fig. 3 various types of backing plates for attachment to an adapter element of Fig. 4 in a perspective view;

Fig. 4 various types of adapter elements for releasable attachment to a distal end of a tool shaft of a hand-held power tool according to the present invention by means of an attachment assembly according to the present invention in a perspective view;

Fig. 5 an example of a backing plate for releasable attachment to a distal end of a tool shaft of a hand-held power tool according to the present invention by means of an attachment assembly according to the present invention in a perspective view;

Fig. 6 an example of a polishing pad for releasable attachment to a distal end of a tool shaft of a hand-held power tool according to the present invention by means of an attachment assembly according to the present invention in a perspective view;

Fig. 7 an example of a sanding pad for releasable attachment to a distal end of a tool shaft of a hand-held power tool according to the present invention by means of an attachment assembly according to the present invention in a perspective view;

Fig. 8 a backing plate for releasable attachment to a distal end of a tool shaft of a hand-held power tool according to the present invention by means of an example of an attachment as-

sembly according to the present invention in a sectional view;

Fig. 9 a distal end of a front part of a tool housing of a power tool according to the present invention with an axially movable external locking element in a release position and a backing plate for releasable attachment to the distal end of a tool shaft of the power tool according to the present invention by means of another example of an attachment assembly according to the present invention in a sectional view; and

Fig. 10 the distal end of the front part of the tool housing of the power tool of Fig. 9 with the axially movable external locking element in a locking position.

[0029] A hand-held power tool 10 according to a preferred embodiment of the present invention is shown in Fig. 1. In this example, the power tool 10 is embodied as an electrically operated polishing power tool. Of course, the power tool 10 could also be embodied as a sanding power tool or any other kind of hand-held power tool 10. Furthermore, the power tool 10 according to the invention could also be operated pneumatically by means of compressed air.

[0030] The power tool 10 comprises an elongated tool housing 12, in which an electric motor 14 is accommodated. Of course, if the power tool 10 was a pneumatically operated power tool, the motor 14 would be a pneumatic motor. The tool housing 12 has a rear part 16 preferably made of a plastic or composite material, and adapted and formed to be gripped by a hand of a user of the power tool 10 thereby holding the power tool 10 during its intended use. In the shown embodiment, the rear part 16 of the tool housing 12 is made up of two halves, separated from each other by a vertical plane, a left half 18 and a right half (not shown), which are screwed together by means of screws. The rear part 16 of the tool housing 12 is preferably manufactured by means of injection moulding.

[0031] The tool housing 12 further comprises a tubular front part 20 preferably made of metal, in particular aluminium, or a material compound comprising a metal. The front part 20 of the tool housing 12 is preferably made by milling or by die cast. The front part 20 may be attached to the rear part 16 of the tool housing 12, e.g., by means of a threaded connection, screws or the like. It would also be conceivable for the front part 20 of the tool housing 16 to be inserted between the two halves 18 of the rear part 16 of the tool housing 12 and to be held in place by them when the two halves 18 are closed and fastened together. The front part 20 has a smaller external diameter than the rear part 16 of the tool housing 12.

[0032] In the back of the rear part 16 of the tool housing 12 a cavity is located for receiving a battery 100, in particular a rechargeable battery. A rear part 102 of the inserted battery 100 protrudes from the cavity and forms a distal rear end of the tool housing 12. The battery 100 provides electric energy to an electronic control unit (ECU) 104, which controls operation of the electric motor 14.

[0033] On a top side of the rear part 16 of the tool housing 12, a lever 106 is provided, adapted for being actuated by a palm of a user's hand and for actuating an electric switch 108 for turning on and/or off the electric motor 14. The lever 106 can be pivoted about a pivot axis 110 which extends essentially transversely in respect to a longitudinal extension of the tool housing 12. Of course, the lever 106 and the switch 108 could also be located on a bottom side of the rear part 16 of the tool housing 12.

[0034] Further, on the top side of the rear part 16 of the tool housing 12, in front of the lever 106, the rear part 16 of the housing 12 forms an elevation 112 in which an actuating element 114, e.g., in the form of a knurled wheel, is arranged. The actuating element 114 may be rotated about a rotational axis extending radially in respect to the longitudinal extension of the tool housing 12 and is designed to actuate a potentiometer 116, which in turn is designed to change the speed of the electric motor 14. The elevation 112 has lateral cut-out-sections 118, which allow an actuation of the actuating element 114 with a user's thumb and finger(s) from the side.

[0035] Both, the electric switch 108 and the potentiometer 116 are in electrical contact with the ECU 104. For the sake of clarity, the respective electrical lines are not shown.

[0036] The electric motor 14 drives a motor shaft 120 and sets it in a rotational movement about a rotational axis 122 of the motor shaft 120. The motor shaft 120 is attached to an intermediate shaft 124, which also rotates about the rotational axis 122. A reduction gear arrangement 126 may be functionally located between the motor shaft 120 and the intermediate shaft 124. The reduction gear arrangement 126 reduces the rotational speed of the intermediate shaft 124 (output shaft) in respect to the motor shaft 120 (input shaft) by a transmission ration i > 1, thereby increasing the transmitted torque. An angular gear arrangement 128 may be functionally located between the intermediate shaft 124 and a tool shaft 24. The gear arrangement 128 is preferably embodied as a bevel gear arrangement. A rotational axis 64 of the tool shaft 24 extends in an angle α in respect to the rotational axis 122 of the motor shaft 120 and the intermediate shaft 124. The angle α is preferably between 80° and 100°, particularly preferable about 90°. In the shown embodiment, the angle α is about 97°.

[0037] The angular gear arrangement 128 may have a transmission ratio i = 1. However, it would also be possible to incorporate the functionality of the reduction gear arrangement 126 in the angular gear arrangement 128. In that case the angular gear arrangement 128 could have a transmission ratio i > 1 and the reduction gear arrangement 126 between the motor shaft 120 and the intermediate shaft 124 could be omitted.

[0038] Furthermore, the power tool 10 has a moveable backing or support plate 22 protruding externally from the tool housing 12, in particular from the front part 20 of the tool housing 12. The electric motor 14 is adapted to actuate the backing plate 22. Depending on the type of connection of the backing plate 22 to the tool shaft 24 of the power tool 10, the backing plate 22 may perform a rotational, a random-orbital, an eccentric or a gear-driven working movement in its plane of extension. The backing plate 22 is preferably made of a rigid material such as plastic and/or metal.

[0039] A bottom surface 26 of the backing plate 22 (see Fig. 5) is adapted to detachably hold a polishing or sanding member 28 (see Fig. 1, corresponding to polishing member 30 in Fig. 9 and sanding member 42 in Fig. 8). To this end, the bottom surface 26 of the backing plate 22 may be provided with an adhesive layer or with a layer of a hook-and-loop fastener (Velcro®) (see Figs. 8 and 9). The polishing or sanding member 28 may have a corresponding even top surface 27 for attachment to the adhesive layer or a corresponding layer of the hook-and-loop fastener (Velcro®) of the bottom surface 26 of the backing plate 22. Of course, other types of releasable attachment of a polishing or sanding member 28 to the bottom surface 26 of the backing plate 22 are conceivable, too.

[0040] The backing plate 22 is adapted for releasable attachment to a distal end of the tool shaft 24 of the power tool 10 by means of an attachment assembly 40 according to the present invention. As can be seen in Fig. 5, the backing plate 22 has an integrated central support structure 44 made of a rigid material such as plastic and/or metal. In the embodiment shown in Fig. 5, the backing plate 22 further comprises a damping layer 46 made of a resilient material, such as foamed polyurethane. In the embodiment shown in Fig. 5, the bottom surface 26 of the backing plate 22 comprises a layer of Velcro® for releasable attachment of a separate polishing member 22 or sanding member 42. A mounting shaft 34 is attached to a top surface of the support structure 44. The mounting shaft 34 may form an integral part of the support structure 44, may be fixedly attached thereto, for instance by welding, or may be attached to the support structure 44 in a releasable manner, for instance by means of a threaded connection. The mounting shaft 34 is received in a receiving opening (see Fig. 9) provided in a distal end of the tool shaft 24 and held therein.

[0041] Fig. 6 shows a polishing pad 30 for releasable attachment to a distal end of the tool shaft 24 of the power tool 10 by means of an attachment assembly 40 according to the present invention. The polishing pad 30 has an integrated central support structure 32 made of a rigid material such as plastic and/or metal, to which the polishing member 22 is fixedly attached. In this embodiment, the polishing member 22 comprises wool or micro fibre. Of course, the polishing member 22 could also comprise other polishing materials, for example a sponge or foam (see Fig. 1). A mounting shaft 34 is attached to a top surface of the support structure 32. The mounting shaft 34 may form an integral part of the support structure 32, may be fixedly attached thereto, for instance by welding, or may be attached to the support structure 32 in a releasable manner, for instance by means of a threaded connection. The mounting shaft 34 is received in a receiving opening (see Fig. 9) provided in a distal end of the tool shaft 24 and held therein.

[0042] Fig. 7 shows a sanding pad 36 for releasable attachment to a distal end of the tool shaft 24 of the power tool 10 by means of an attachment assembly 40 according to the present invention. The sanding pad 36 has an integrated central support structure 38 made of a rigid material such as plastic and/or metal, to which a sanding member 42 is fixedly attached. The sanding member 42 may comprise a layer of abrasive particles. Additionally, the sanding member 42 may comprise a damping layer (not shown), for example made of a resilient plastic material, between the support structure 38 and the layer of abrasive elements. Alternatively, the sanding member 42 may comprise a rough and relatively rigid material having a net or foamed structure and having abrasive characteristics (see Fig. 7). Abrasive particles may be embedded into the net or foamed structure. A mounting shaft 34 is attached to a top surface of the support structure 38. The mounting shaft 34 may form an integral part of the support structure 38, may be fixedly attached thereto, for instance by welding, or may be attached to the support structure 38 in a releasable manner, for instance by means of a threaded connection. The mounting shaft 34 is received in a receiving opening (see Fig. 9) provided in a distal end of the tool shaft 24 and held therein.

[0043] Fig. 4 shows on the left an extension shaft 44 for releasable attachment to a distal end of the tool shaft 24 of the power tool 10 by means of an attachment assembly 40 according to the present invention. The extension shaft 44 comprises a tube-like element 46 having an internal threaded hole 60 (see Fig. 2) along a longitudinal extension of the extension shaft 44. The threaded hole 60 serves for receiving a corresponding threaded shaft 50 of a backing plate 52 like one of those shown in Fig. 3 or of any other type of adapter element, e.g., in the form of a rotary brush. The backing plate 52 on the left of Fig. 3 comprises merely a support structure 54 and possibly on the bottom surface 56 an adhesive or Velcro® layer for releasable attachment of a polishing member 22 or a sanding member 42. The backing plate 52 in the middle and on the right of Fig. 3 comprises a support structure 54, a damping layer 58 made or resilient material and on the bottom surface 56 an adhesive or Velcro® layer for releasable attachment of a polishing member 22 or a sanding member 42.

[0044] Opposite to the threaded hole 60, the tube-like element 46 comprises a mounting shaft 34. The mounting shaft 34 may form an integral part of the tube-like element 46, may be fixedly attached thereto, for instance by welding, or may be attached to the tube-like element 46 in a releasable manner, for instance by means of a threaded

connection. The mounting shaft 34 is received in a receiving opening 62 (see Fig. 9) provided in a distal end of the tool shaft 24 and held therein. When the extension shaft 44 is attached to the tool shaft 24, the backing plate 52 attached to the extension shaft 44 performs a rotational working movement upon activation of the motor 14.

[0045] Fig. 4 shows in the middle and on the right an eccentric element 48 for releasable attachment to a distal end of the tool shaft 24 of the power tool 10 by means of an attachment assembly 40 according to the present invention. The eccentric element 48 has an internal threaded hole 60 (see Fig. 2) for releasable attachment of a corresponding threaded shaft 50 of a backing plate 52 like one of those shown in Fig. 3. The backing plate 52 is attached to the eccentric element 48 in a manner freely rotatable about a rotational axis of the backing plate 52. Opposite to the threaded hole 60, the eccentric element 48 comprises a mounting shaft 34. When attached to the eccentric element 48 the rotational axis 65 of the backing pad 52 is spaced apart from the rotational axis of the mounting shaft 34 (corresponding to the rotational axis 64 of the tool shaft 24) and runs parallel thereto. The mounting shaft 34 may form an integral part of the eccentric element 48, may be fixedly attached thereto, for instance by welding, or may be attached to the eccentric element 48 in a releasable manner, for instance by means of a threaded connection. The mounting shaft 34 is received in a receiving opening 62 (see Fig. 9) provided in a distal end of the tool shaft 24 and held therein. When the eccentric element 48 is attached to the tool shaft 24, the backing plate 52 attached to the eccentric element 48 performs a random-orbital working movement upon activation of the motor 14.

[0046] The present invention refers to an attachment assembly 40 (see Fig. 9) for releasable attachment of a backing plate 22 or a sanding pad 36 (see Fig. 7) or a polishing pad 30 (see Fig. 6) or an eccentric element 48 (see Fig. 4) or an extension shaft 44 (see Fig. 4) to a distal end of a tool shaft 24 of the hand-held power tool 10. The attachment assembly 30 comprises

- a mounting shaft 34 attached to the backing plate 22 or the sanding pad 36 or the polishing pad 30 or the eccentric element 48 or the extension shaft 44,
- a receiving opening 62 provided in the distal end of the tool shaft 24 and adapted for receiving the mounting shaft 34 in an axial direction 68 extending essentially parallel to a rotational axis 64 of the tool shaft 24,
- a releasable axial fastening mechanism 66 adapted for releasably fastening the mounting shaft 34 in the receiving opening 62 in the axial direction 68 and comprising a first component 70 assigned to the mounting shaft 34 and a second component 72 assigned to the receiving opening 62. At least one of the first and second components 70, 72 of the releasable axial fastening mechanism 66 is adapted to switch between a fastening position (see Fig. 10), in which the first and second components 70, 72 of the releasable axial fastening mechanism 66 enter into an operative connection with each other in order to provide for the fastening of the mounting shaft 34 in the receiving opening 62 in the axial direction 68, and a release position (see Fig. 9), in which the first and second components 70, 72 of the releasable axial fastening mechanism 66 release their operative connection in order to allow a removal of the mounting shaft 34 from the receiving opening 62, and
- a rotation preventing device 74 adapted to prevent a rotation of the mounting shaft 34 in respect to the receiving opening 62 about the rotational axis 64 of the tool shaft 24.

[0047] Furthermore, the invention refers to a hand-held power tool 10, in particular in the form of a hand-held sanding or polishing power tool, comprising a tool shaft 24 and an electric or pneumatic motor 14 for driving the tool shaft 24 and rotating it about its rotational axis 64, and an attachment assembly 40 for releasable attachment of a backing plate 22 or a sanding pad 36 or a polishing pad 30 or an eccentric element 48 or an extension shaft 44 to a distal end of the tool shaft 24.

[0048] In order to provide for an attachment assembly 40, where instant release and uncontrolled separation of an adapter element (i.e., the backing plate 22 or the sanding pad 36 or the polishing pad 30 or the eccentric element 48 or the extension shaft 44) from the tool shaft 24 is avoided, when at least one of the first and second components 70, 72 of the releasable axial fastening mechanism 66 is brought into the release position, it is suggested that the tool shaft 24 and the mounting shaft 34 are provided with magnetic elements 76, 78 adapted to attract each other magnetically in order to provide for a holding of the mounting shaft 34 in the receiving opening 62 in the axial direction 68 by means of magnetic force at least when at least one of the first and second components 70, 72 of the releasable axial fastening mechanism 66 is in the release position.

[0049] This has the advantage that the mounting shaft 34 is still held in the receiving opening 62 in the axial direction 68 by means of magnetic force even if at least one of the first and second components 70, 72 of the releasable axial fastening mechanism 66 is brought into the release position. An instant release of the mounting shaft 34 and an uncontrolled falling of the mounting shaft 34 with the adapter element 22, 36, 30, 48, 44 attached thereto out of the receiving opening 62 of the tool shaft 24 is prevented. In order to separate the mounting shaft 34 from the tool shaft 24, after at least one of the first and second components 70, 72 of the releasable axial fastening mechanism 66 has been brought into the release position, the user has to manually grip the adapter element 22, 36, 30, 48, 44 and pull it in the axial direction 68 away from the tool shaft 24, thereby overcoming the magnetic attraction between the magnetic elements 76, 78. This greatly improves user safety, because the user will not be injured by an adapter element 22, 36, 30, 48,

44 falling out of the power tool 10 in an uncontrolled manner, and working quality, because damage of the surface to be worked by an adapter element 22, 36, 30, 48, 44 fallen out of the power tool 10 is avoided.

[0050] Preferably, the releasable axial fastening mechanism 66 works mechanically for releasably fastening the mounting shaft 34 in the receiving opening 62 in the axial direction 68. In the fastening position, the first and second components 70, 72 enter into a mechanical engagement with each other.

[0051] It is suggested that the magnetic elements 76, 78 comprise permanent magnets and/or ferromagnetic elements. It is possible that both shafts, the tool shaft 24 as well as the mounting shaft 34, each comprise at least one permanent magnet. The permanent magnets of the tool shaft 24 on the one hand and the mounting shaft 34 on the other hand have preferably opposed polarities, so that they attract each other magnetically.

[0052] It is suggested that the tool shaft 24 or the mounting shaft 34 is provided with at least one permanent magnet and the other shaft 34; 24 is provided with a ferromagnetic element. Preferably, the tool shaft 24 is provided with at least one magnetic element 76 in the form of a permanent magnet and the mounting shaft 34 is provided with at least one magnetic element 78 in the form of a ferromagnetic element. The ferromagnetic element 78 is magnetically attracted by the respective permanent magnet 76 holding the mounting shaft 34 in the receiving opening 62 of the tool shaft 24 in the axial direction 68.

[0053] It is suggested that the ferromagnetic element is realized by a material of the tool shaft 24 or of the mounting shaft 34 itself. To this end, in the embodiment of Figs. 6 and 7, at least part of the mounting shaft 34, in particular the distal end of mounting shaft 34, received by the receiving opening 62 is made of or comprises a ferromagnetic material. In particular, it is suggested that the material of at least part of the mounting shaft 34 is iron, cobalt or nickel or a composite material comprising iron, cobalt or nickel.

[0054] According to the embodiment shown in Fig. 8, the releasable axial fastening mechanism 66 is separate from the rotation preventing device 74. In that example the first component 70 of the releasable axial fastening mechanism 66 comprises a circumferential annular groove 80 which is formed on an external circumferential surface 82 of the mounting shaft 34. The second component 72 of the releasable axial fastening mechanism 66 comprises at least one movable protruding element 84 (see Figs. 9 and 10) provided on an internal circumferential surface 86 of the receiving opening 62 of the tool shaft 24 and adapted to be moved in a radial direction between a protruding position (see Fig. 10), in which the at least one protruding element 84 protrudes in a radial direction towards the rotational axis 64 of the tool shaft 24 beyond the internal circumferential surface 86 of the receiving opening 62, and a retracted positon (see Fig. 9), in which the at least one protruding element 84 is retracted in a radial direction away from the rotational axis 64 of the tool shaft 24 aligned with or beyond the internal circumferential surface 86 of the receiving opening 62. The at least one protruding element 84 could have the shape of a pin, a cuboid, a sphere or similar. In the shown embodiment the protruding elements 84 have the shape of a sphere. Preferably, radial holes are provided in a hollow cylinder-shaped part of the tool shaft 24 limiting the receiving opening 62 in a radial direction, in order to receive the protruding elements 84 and to allow their movement between the retracted positions into the protruding positions.

[0055] When the at least one protruding element 84 is in its protruding position (see Fig. 10), it engages with the circumferential annular groove 80 (see Fig. 8) of the mounting shaft 34, thereby holding the mounting shaft 34 in the receiving opening 62 in the axial direction 68. However, rotation of the mounting shaft 34 inside the receiving opening 62 of the tool shaft 24 would theoretically still be possible. This may be prevented by a separate rotation preventing device 74.

[0056] In the embodiment of Fig. 8, the separate rotation preventing device 74 comprises a non-rotationally symmetrical cross-sectional form of the internal circumferential surface 86 of the receiving opening 62 and a respective non-rotationally symmetrical cross-sectional form of the external circumferential surface 82 of the distal end of the mounting shaft 34 received by the receiving opening 62. The non-rotationally symmetrical form may be a triangle, a rectangle, a square, or any other kind of polygon. In the embodiment shown in Fig. 8, the non-rotationally symmetrical form is a hexagon.

[0057] The rotation preventing device 74 prevents rotation of the mounting shaft 34 in respect to the receiving opening 62 of the tool shaft 24 about the rotational axis 64 of the tool shaft 24, corresponding to the rotational axis of the mounting shaft 34. However, axial movement of the mounting shaft 34 in respect to the receiving opening 62 parallel to the rotational axis 64 of the tool shaft 24 is not prevented by the rotation preventing device 74. This may be prevented by the separate releasable axial fastening mechanism 66 as previously described.

[0058] According to the embodiment of Fig. 9, the releasable axial fastening mechanism 66 also works as the rotation preventing device 74. With other words, the functionality of fastening the mounting shaft 34 in the receiving opening 62 in the axial direction 68 and the functionality of preventing a rotation of the mounting shaft 34 in respect to the receiving opening 62 about the rotational axis 64 of the tool shaft 24 is realized by one and the same mechanism or device.

[0059] To this end it is suggested that the first component 70 of the releasable axial fastening mechanism 66 comprises at least one discrete recess 88 extending in a radial direction and provided on the external circumferential surface 82 of the mounting shaft 34 (see Figs. 9 and 10). In the shown embodiment, the releasable axial fastening mechanism 66 comprises a plurality of discrete radially extending recesses 88 arranged annularly on the

external circumferential surface 82 of the mounting shaft 34 and evenly spaced apart from each other in a circumferential direction. The radially extending recesses 88 may have the shape of a cylinder, possibly with a pointed or spherically rounded bottom. In the shown embodiment, the radially extending recesses 88 have the shape of hemispheres.

[0060] The second component 72 of the releasable axial fastening mechanism 66 comprises at least one movable protruding element 84 provided on the internal circumferential surface 86 of the receiving opening 62 of the tool shaft 24 and adapted to be moved in a radial direction between the protruding position (see Fig. 10) and the retracted positon (see Fig. 9). When the at least one protruding element 84 of the tool shaft 24 is in its protruding position, it may engage with at least one of the recesses 88 of the mounting shaft 34. Then, the mounting shaft 34 is held in the receiving opening 62 in the axial direction 68 and at the same time a rotation of the mounting shaft 34 in respect to the receiving opening 62 about the rotational axis 64 of the tool shaft 24 is prevented. Again, the at least one radially movable protruding element 84 may have the shape of a cylinder, possibly with a pointed or spherically rounded tip. Many other shapes of the protruding elements are conceivable, too. In the shown embodiment, the at least one protruding element 84 has the form of a sphere.

[0061] The at least one movable protruding element 84 may be urged radially inwards towards the rotational axis 64 of the tool shaft 24, i.e., into its protruding position, by the force of a spring or the like. Movement of the protruding elements 84 could also be provoked by magnetic force or the force of gravity.

[0062] It is suggested that an axially movable external locking element 90 is provided which can be moved between a locking position (see Fig. 10), in which it urges the at least one radially movable protruding element 84 into its protruding position, and a release position (see Fig. 9), in which it allows the at least one protruding element 84 to retract in a radial direction into its retracted position. The external locking element 90 may be held in its locking position by the force of a spring, by magnetic force or the like.

[0063] It is further conceivable that movement of the at least one movable protruding element 84 is achieved by means of an actuating device 97 provided on an external surface of the tool housing 12 of the hand-held power tool 10 or constituted by part of the tool housing 12 of the power tool 10. The actuating device 97 may actively promote movement of the at least one protruding element 84 in at least one radial direction, inwards or outwards. Alternatively, as shown in the Figs., the actuating device 97 may simply enable or prevent radial movement of the at least one protruding element 84, wherein the movement of the at least one protruding element 84 itself is achieved through the force of a spring, magnetic force or the force of gravity. In the latter case, the actuating device 97 corresponds to the external locking element 90 or serves for actuating (axial movement) of the locking element 90.

[0064] In the shown embodiments, the movement of the at least one protruding element 84 itself is achieved in a direction radially outwards through the mounting shaft 34 being pulled out of or inserted into the receiving opening 62 of the tool shaft 24. In the opposite direction radially inwards, movement of the at least one protruding element 84 itself is achieved by means of the external locking element 90 when it is moved from the release position (see Fig. 9), in which it allows radial movement of the at least one protruding element 84, into a locking position (see Fig. 10), in which it urges the at least one protruding element 84 into its protruding position and prevents return of the at least one protruding element 84 into its retracted position (see Fig. 9). Only after movement of the external locking element 90 axially upwards into the release position (see Fig. 9), can the protruding elements 84 be moved radially outwards into their retracted positions again.

[0065] To this end it is suggested that the axially movable external locking element 90 has an internal circumferential groove 92 having different depths displaced in respect to each other in the axial direction. A larger depth 94 of the groove 92 is adapted to receive a first part of the radially movable protrusion elements 84 or the complete protrusion elements 84. A smaller depth 96 of the groove 92 can only receive a smaller second part of the protrusion elements 84 or cannot receive them at all. The smaller depth 96 could correspond to no depth at all, i.e., to an internal circumferential surface of the external locking element 90 lying externally on the external circumferential surface of the tool shaft 24. The different depths 94, 96 are realized annularly and next to each other in the axial direction 68. When the protrusion elements 84 are received in the larger depth 94 of the groove 92, they are in their retracted positions. When the protrusion elements 84 are received in the smaller depth 96 of the groove 92, they are in their protruding positions.

[0066] Thus, in the shown embodiments, the actuating device 97 simply has the function of axially moving the external locking element 90. However, as stated above, the actuating device 97 could also actively provoke movement of the radially movable protruding elements 84 in at least one direction, i.e., radially inwards or outwards.

[0067] It is suggested that the actuating device 97 comprises at least part of a protective cap or shroud 98 receiving and surrounding at least part of an adapter element (e.g., an eccentric element 48 or an extension shaft 44) attached to the tool shaft 24 of the hand-held power tool 10. In particular, the actuating device 97 may be constituted by an annular part of the protective cap or shroud 98, preferably movable in the axial direction 68 in respect to a fixed part of the protective cap or shroud 98. Alternatively, the actuating device 97 is constituted by the entire protective cap or shroud 98, preferably movable in the axial direction 68 in respect to the fixed part of the

power tool 10, in particular the power tool housing 12. Axial movement of the protective cap or shroud 98 provokes the axial movement of the external locking element 90.

[0068] Summing up, the present invention suggests a fast coupling attachment assembly 40 for releasable attachment of an adapter element (i.e., a backing plate 22 or a sanding pad 36 or a polishing pad 30 or an eccentric element 48 or an extension shaft 44) to a distal end of a tool shaft 24 of a hand-held power tool 10, where the adapter element 22, 36, 30, 48, 44 is held in respect to the tool haft 24 by magnetic force, even if the attachment assembly 40 or the an axial fastening mechanism 66 of the attachment assembly 40, respectively, is released.

Claims

1. Attachment assembly (40) for releasable attachment of an adapter element (22; 36; 30; 48; 44) to a distal end of a tool shaft (24) of a hand-held power tool (10), in particular in the form of a hand-held sanding or polishing power tool, comprising

   - a releasable mechanical axial fastening mechanism (66) adapted for releasably holding the adapter element (22; 36; 30; 48; 44) in respect to the tool shaft (24) of the power tool (10) in an axial direction (68) extending parallel in respect to a rotational axis (64) of the tool shaft (24), after attachment of the adapter element (22; 36; 30; 48; 44) to the tool shaft (24),
   - wherein the releasable mechanical axial fastening mechanism (66) is adapted to switch between a fastening position, in which the adapter element (22; 36; 30; 48; 44) is held in respect to the tool shaft (24) in the axial direction (68), and a release position, in which the adapter element (22; 36; 30; 48; 44) is not held in respect to the tool shaft (24) in the axial direction (68) and in which the adapter element (22; 36; 30; 48; 44) is removable from the tool shaft (24) in the axial direction (68), and
   - the attachment assembly (40) further comprising a rotation preventing device (74) adapted to prevent a rotation of the adapter element (22; 36; 30; 48; 44) in respect to the tool shaft (24) about the rotational axis (64) of the tool shaft (24) after attachment of the adapter element (22; 36; 30; 48; 44) to the tool shaft (24) and in order to transmit torque from the tool shaft (24) to the adapter element (22; 36; 30; 48; 44),

   characterized in that
   the attachment assembly (40) further comprises magnetic elements (76, 78), at least one of the magnetic elements (76, 78) assigned to the tool shaft (24) and at least another one of the magnetic elements (76, 78) assigned to the adapter element (22; 36; 30; 48; 44), the magnetic elements (76, 78) adapted to attract each other magnetically in order to provide for a holding of the adapter element (22; 36; 30; 48; 44) in respect to the tool shaft (24) in the axial direction (68) by means of magnetic force.

2. Attachment assembly (40) according to claim 1, wherein the magnetic elements (76, 78) are dimensioned and positioned such that the magnetic force between the magnetic elements (76, 78) is large enough that the adapter element (22; 36; 30; 48; 44) does not fall off the tool shaft (24) due to gravity when the releasable mechanical axial fastening mechanism (66) is in its release position.

3. Attachment assembly (40) according to claim 1 or 2, wherein the magnetic elements (76, 78) comprise permanent magnets and/or ferromagnetic elements.

4. Attachment assembly (40) according to one of the preceding claims, wherein one of the tool shaft (24) and the adapter element (22; 36; 30; 48; 44) is provided with at least one permanent magnet and the other one of the tool shaft (24) and the adapter element (22; 36; 30; 48; 44) is provided with a ferromagnetic element.

5. Attachment assembly (40) according to claim 3 or 4, wherein the ferromagnetic element is realized by a material of the tool shaft (24) or of the adapter element (22; 36; 30; 48; 44) itself.

6. Attachment assembly (40) according to claim 5, wherein the material of at least one of the tool shaft (24) and the adapter element (22; 36; 30; 48; 44) is iron, cobalt or nickel or a composite material comprising iron, cobalt or nickel.

7. Attachment assembly (40) according to one of the claims 3 to 6, wherein the tool shaft (24) comprises a magnetic element (76) in the form of a permanent magnet and a magnetic element (78) in the form of a ferromagnetic element is assigned to the adapter element (22; 36; 30; 48; 44), in particular wherein at least part of the adapter element (22; 36; 30; 48; 44) is made of or comprises a ferromagnetic material.

8. Attachment assembly (40) according to one of the preceding claims, wherein the releasable axial fastening mechanism (66) also works as the rotation preventing device (74).

9. Attachment assembly (40) according to one of the preceding claims, wherein the attachment assembly (40) comprises

   - a mounting shaft (34) attached to the adapter

element (22; 36; 30; 48; 44), and
- a receiving opening (62) provided in the distal end of the tool shaft (24) and adapted for receiving the mounting shaft (34) in the axial direction (68),
- wherein the releasable axial fastening mechanism (66) is adapted to releasably fasten the mounting shaft (34) in the receiving opening (62) in the axial direction (68) and comprises a first component (70) assigned to the mounting shaft (34) and a second component (72) assigned to the receiving opening (62), wherein at least one of the first and second components (70, 72) of the releasable axial fastening mechanism (66) is adapted to switch between the fastening position, in which the first and second components (70, 72) of the releasable axial fastening mechanism (66) enter into an operative connection with each other in order to provide for the fastening of the mounting shaft (34) in the receiving opening (62) in the axial direction (68), and the release position, in which the first and second components (70, 72) of the releasable axial fastening mechanism (66) release their operative connection in order to allow a removal of the mounting shaft (34) from the receiving opening (62), and
- wherein the tool shaft (24) and the mounting shaft (34) are provided with the magnetic elements (76, 78) adapted to attract each other magnetically in order to provide for a holding of the mounting shaft (34) in the receiving opening (62) in the axial direction (68) by means of magnetic force at least when at least one of the first and second components (70, 72) of the releasable axial fastening mechanism (66) is in the release position.

10. Attachment assembly (40) according to claim 9, wherein the first component (70) of the releasable axial fastening mechanism (66) comprises at least one recess (80, 88) provided in a radial direction on an external circumferential surface (82) of the mounting shaft (34).

11. Attachment assembly (40) according to claim 10, wherein the at least one recess (80, 88) is at least one radially extending discrete recess (88).

12. Attachment assembly (40) according to one of the claims 9 to 11, wherein the second component (72) of the releasable axial fastening mechanism (66) comprises at least one movable protruding element (84) provided on an internal circumferential surface (86) of the receiving opening (62) of the tool shaft (24) and adapted to be moved in a radial direction between a protruding position, in which the at least one protruding element (84) protrudes in a radial direction towards the rotational axis (64) of the tool shaft (24) beyond the internal circumferential surface (86) of the receiving opening (62), and a retracted positon, in which the at least one protruding element (84) is retracted in a radial direction away from the rotational axis (64) of the tool shaft (24) aligned with or beyond the internal circumferential surface (86) of the receiving opening (62), in particular wherein the at least one protruding element (84) has the form of a sphere.

13. Attachment assembly (40) according to claim 12, wherein movement of the at least one movable protruding element (84) into its protruding position is achieved by means of an actuating device (97) provided on an external surface of a tool housing (12) of the hand-held power tool (10) or constituted by part of the tool housing (12) of the hand-held power tool (10).

14. Attachment assembly (40) according to claim 13, wherein the actuating device (97) is constituted by at least part of a protective cap or shroud (98) receiving and surrounding at least part of adapter element (22; 36; 30; 48; 44), in particular an eccentric element (48) or of an extension shaft (44), attached to the tool shaft (24) of the hand-held power tool (10).

15. Hand-held power tool (10), in particular in the form of a hand-held sanding or polishing power tool, comprising a tool shaft (24) and an electric or pneumatic motor (14) for driving the tool shaft (24) and rotating it about its rotational axis (64), and an attachment assembly (40) for releasable attachment of an adapter element (22; 36;30; 48; 44) to a distal end of the tool shaft (24),
characterized in that
the tool shaft (24) of the hand-held power tool (10) is configured for releasable attachment to the adapter element (22; 36; 30; 48; 44) by means of an attachment assembly (40) according to one of the preceding claims.

16. Adapter element (22; 36; 30; 48; 44) adapted for releasable attachment to a distal end of a tool shaft (24) of a hand-held power tool (10), in particular in the form of a hand-held sanding or polishing power tool, by means of an attachment assembly (40),
characterized in that
the adapter element (22; 36; 30; 48; 44) is configured for releasable attachment to the distal end of the tool shaft (24) of the hand-held power tool (10) according to claim 15 by means of an attachment assembly (40) according to one of the claims 1 to 14.

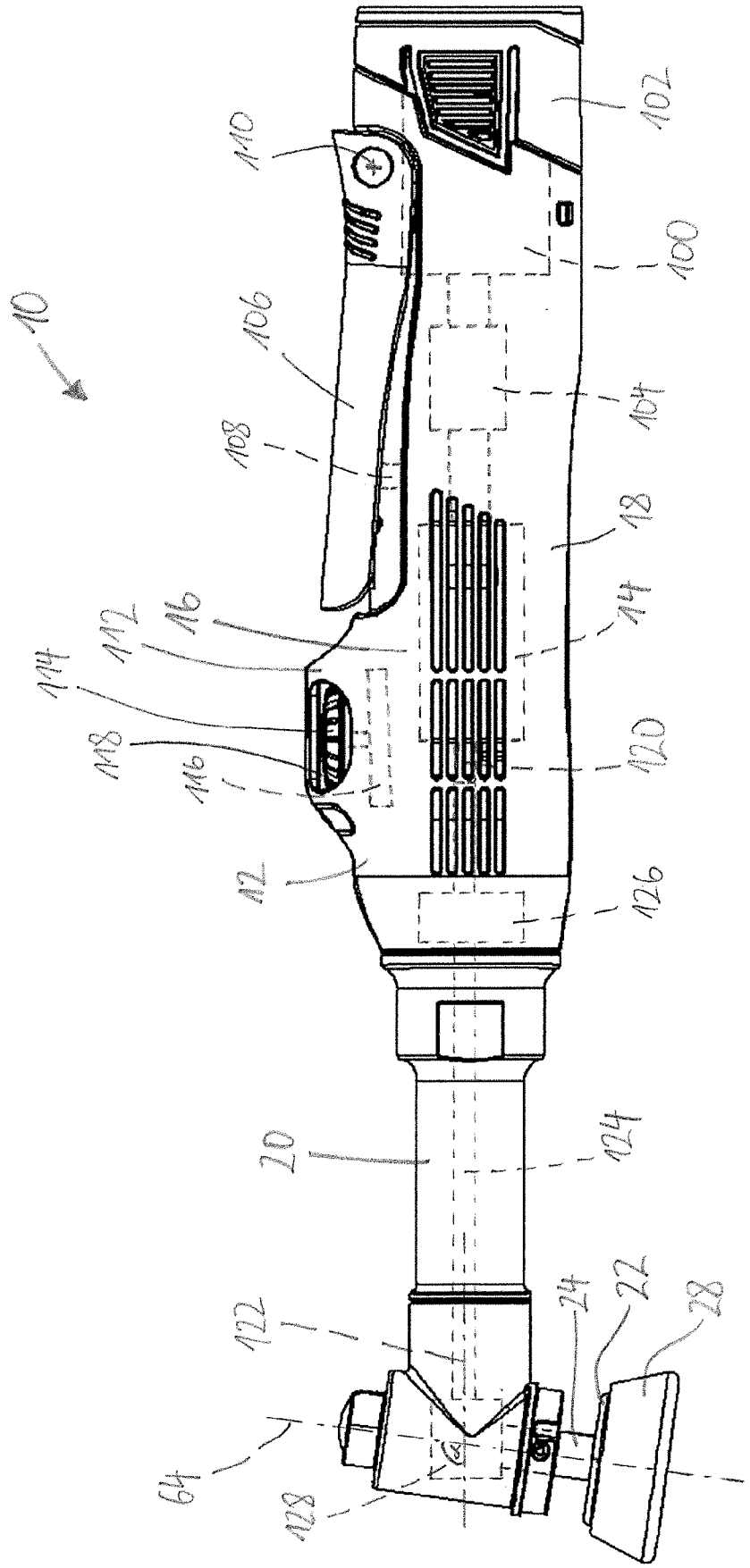
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Fig. 1

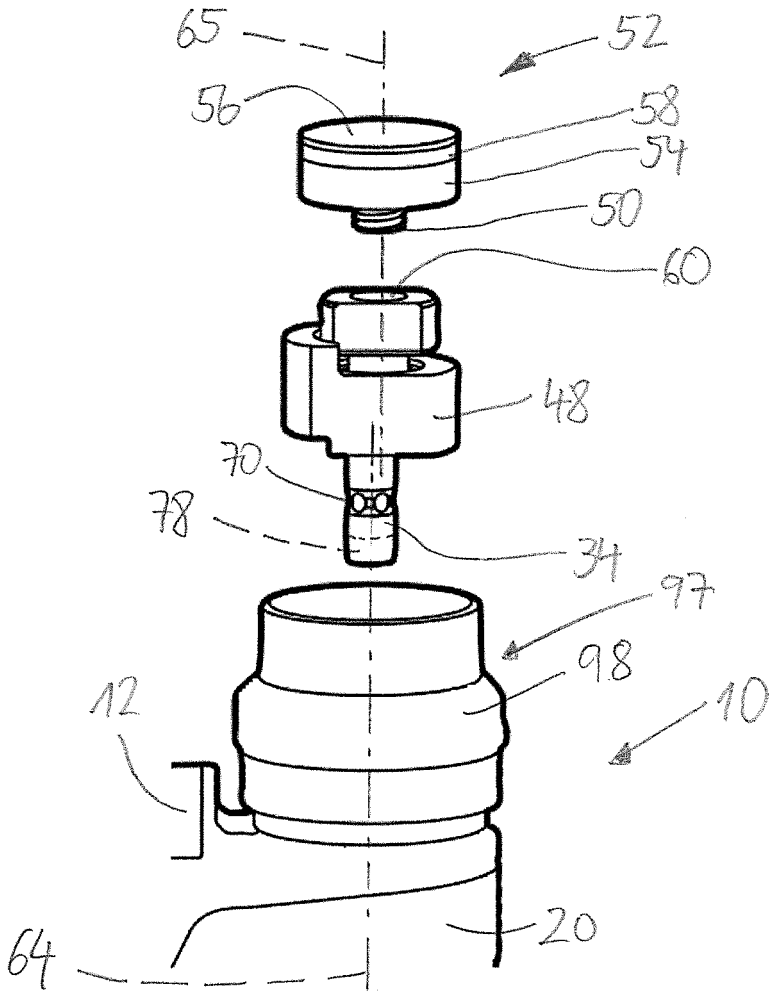

Fig. 2

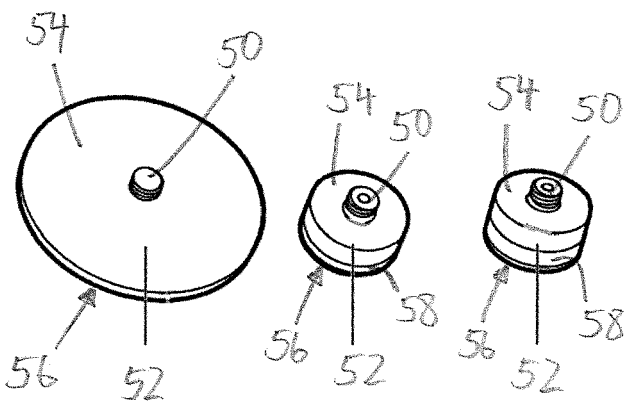

Fig. 3

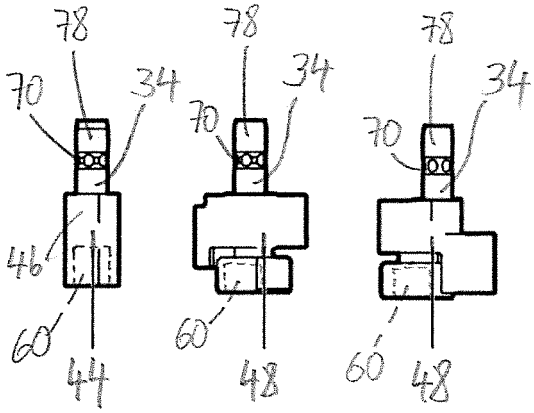

Fig. 4

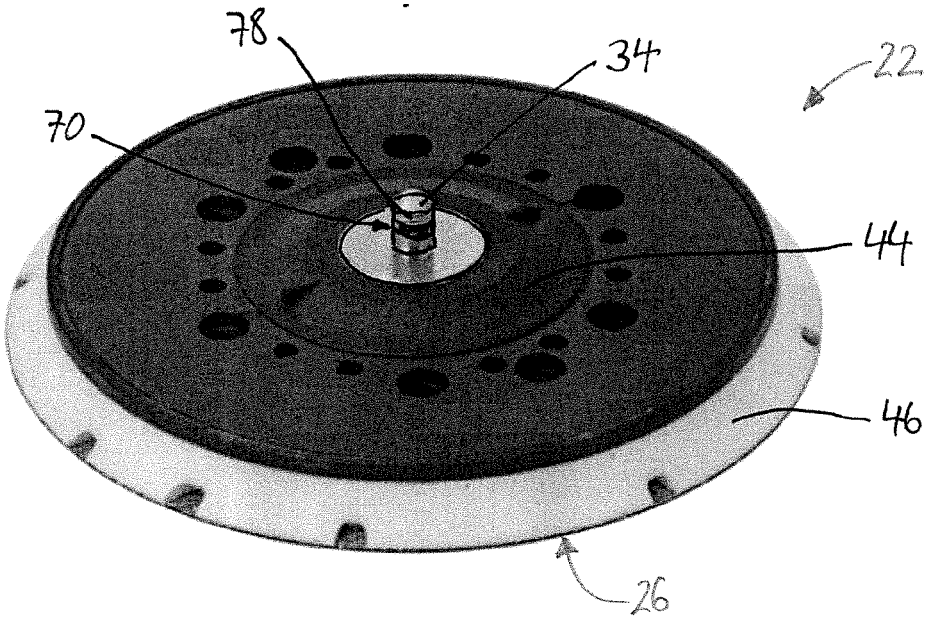

Fig. 5

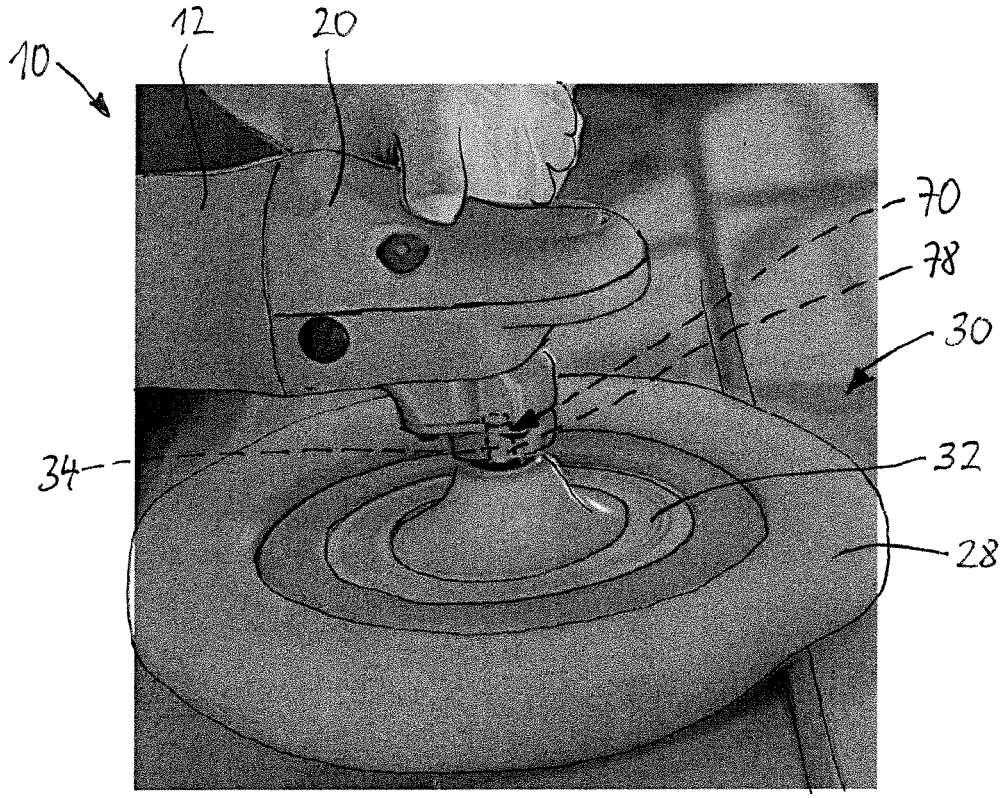

Fig. 6

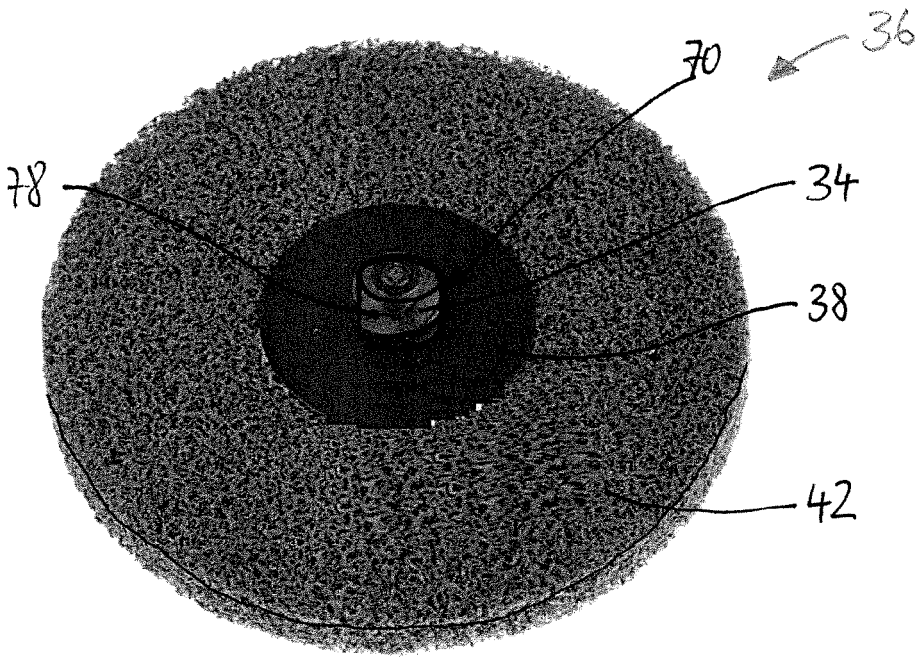

Fig. 7

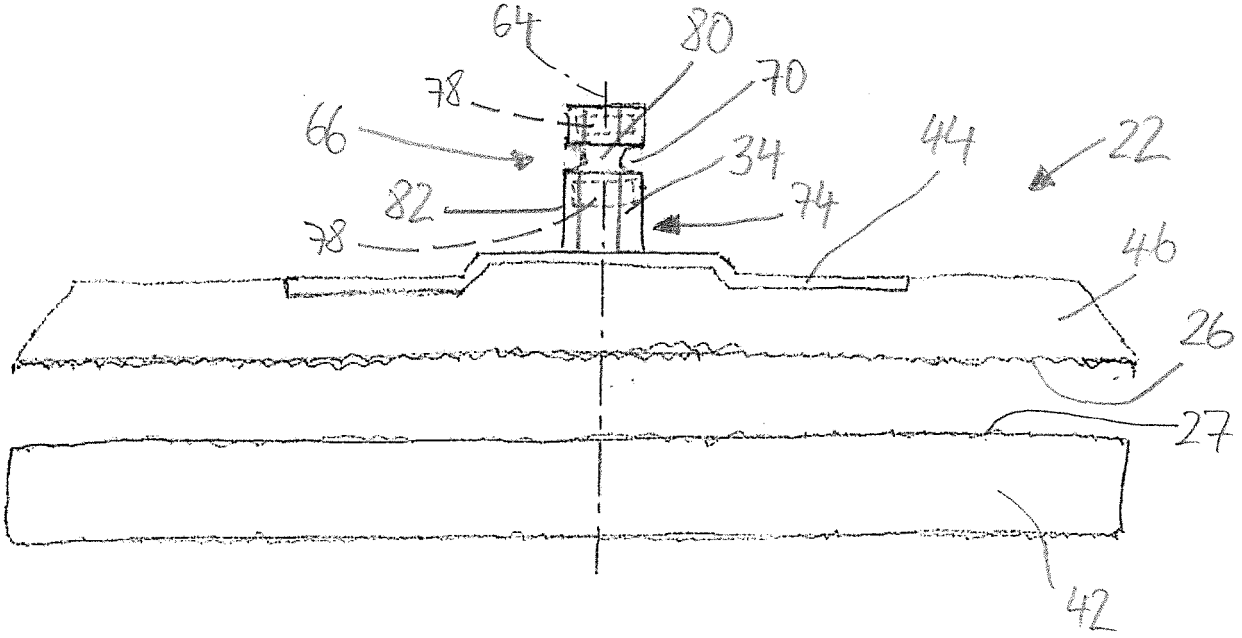

Fig. 8

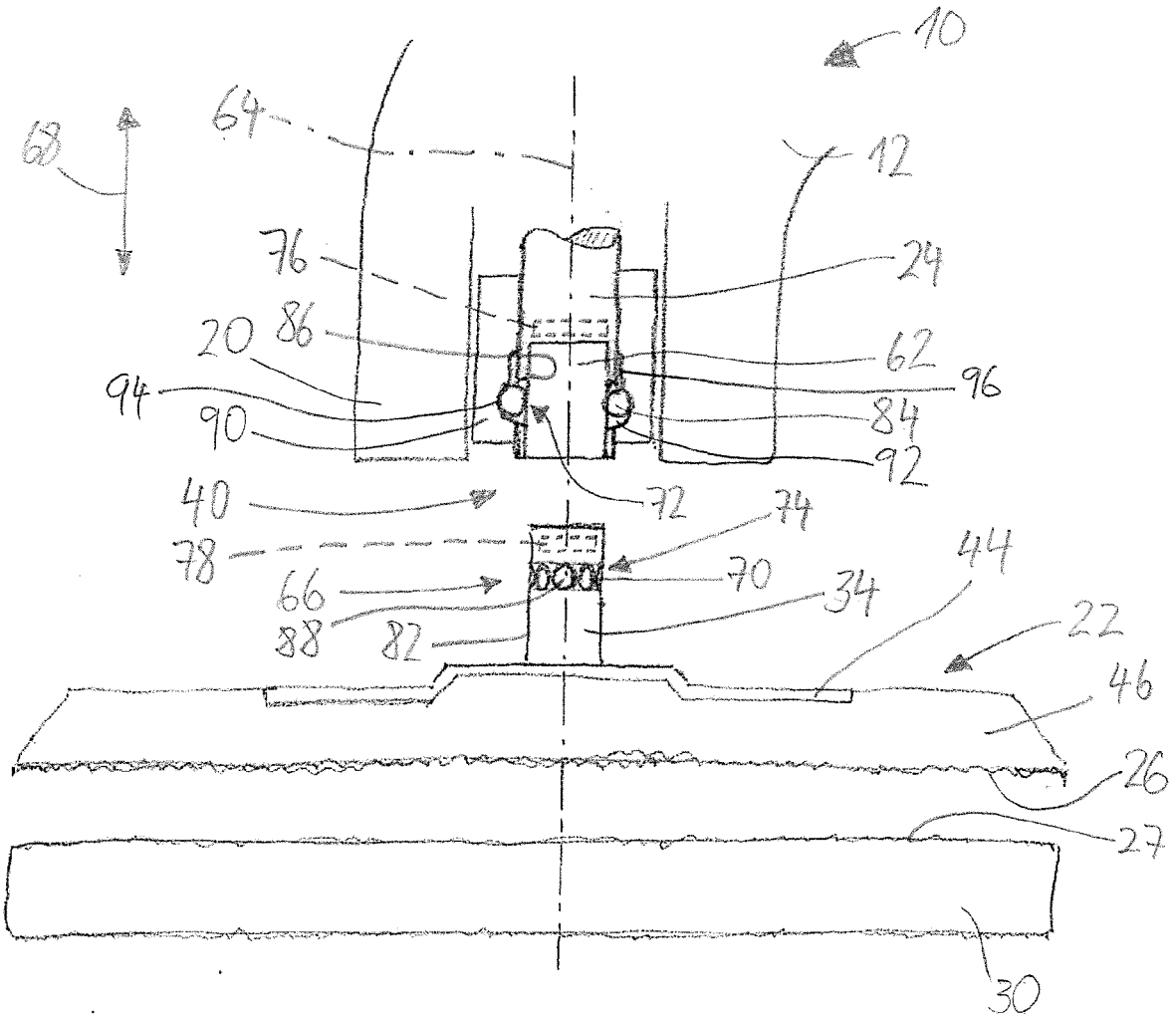
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Fig. 9

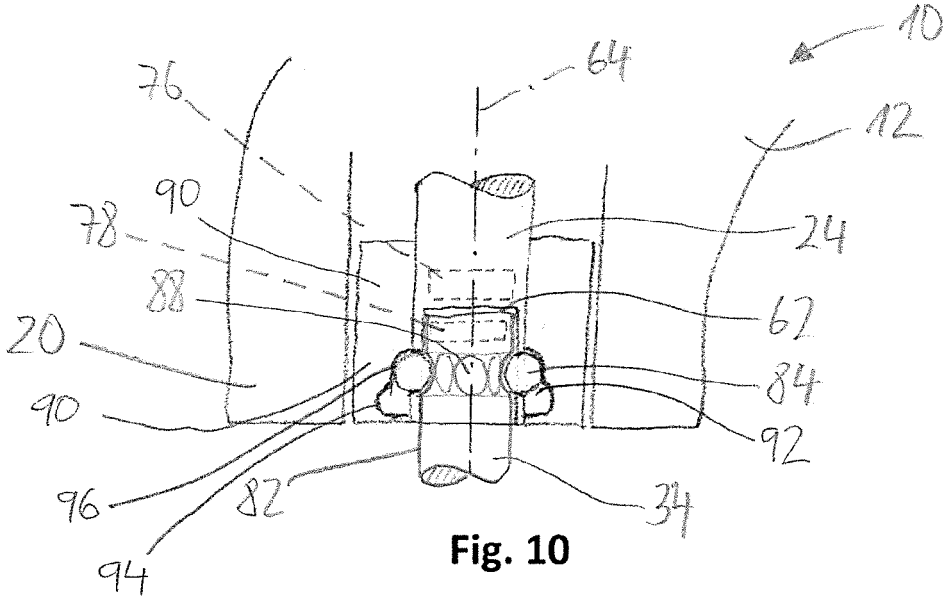
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Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 1410

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 October 2023	Bermejo, Marco

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