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(19) **United States**(12) **Patent Application Publication****Hessbruggen et al.**(10) **Pub. No.: US 2009/0004954 A1**(43) **Pub. Date: Jan. 1, 2009**(54) **DRIVE FOR A GRINDING SPINDLE**(30) **Foreign Application Priority Data**(76) Inventors: **Markus Hessbruggen**, Goppingen (DE); **Otto Bruntrup**, Salach (DE)

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Correspondence Address:

K.F. ROSS P.C.**5683 RIVERDALE AVENUE, SUITE 203 BOX 900
BRONX, NY 10471-0900 (US)**(51) **Int. Cl.**
B24B 9/00 (2006.01)(52) **U.S. Cl.** **451/177**(57) **ABSTRACT**

The invention relates to a grinding-spindle assembly comprising a fixed shaft and a ring motor that has a stator and a rotor, wherein the stator is connected in a fixed fashion to the shaft, the rotor is a hollow shaft and is pivotal on the fixed shaft, and the grinding tool is connected in a rotationally fixed fashion to the rotor, and the ring motor extends through the grinding tool. The fact that the grinding tool is mounted directly on the rotor produces an especially space-saving construction.

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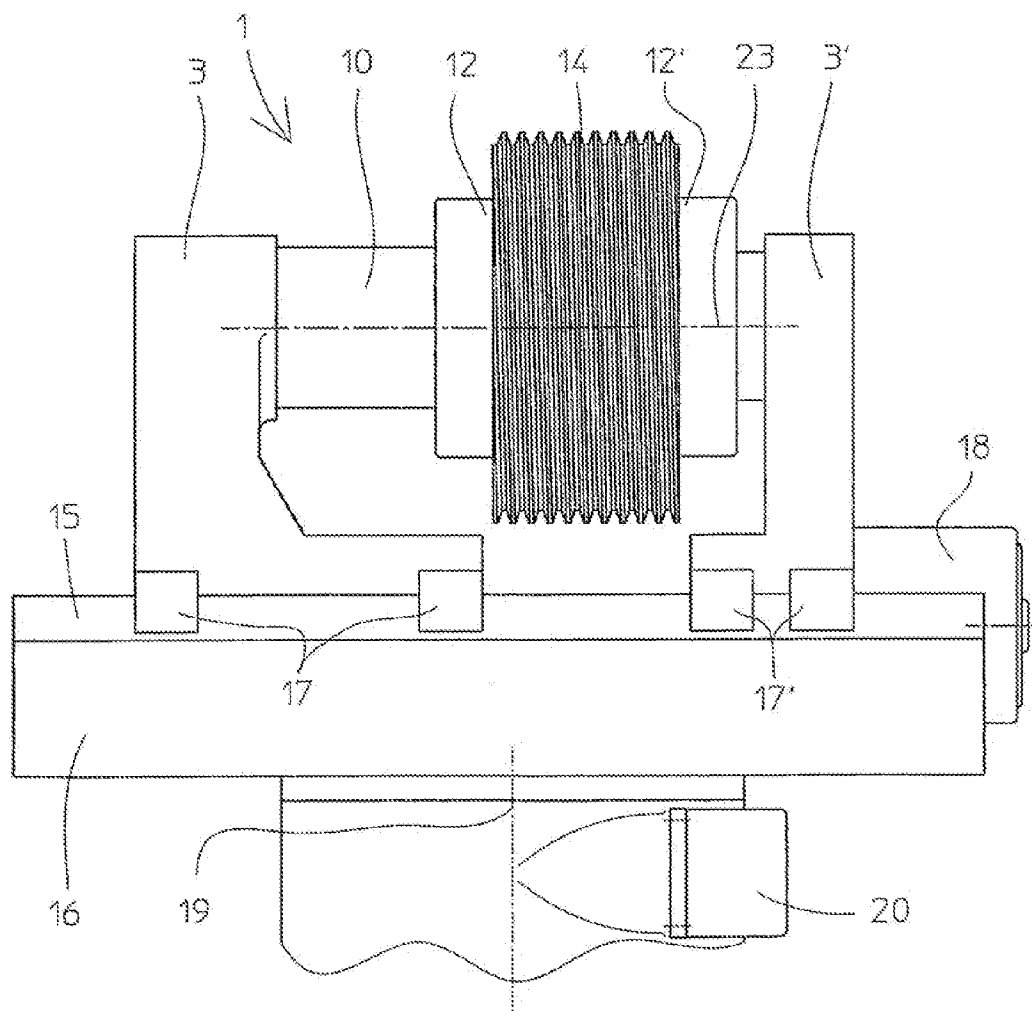
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Fig. 1

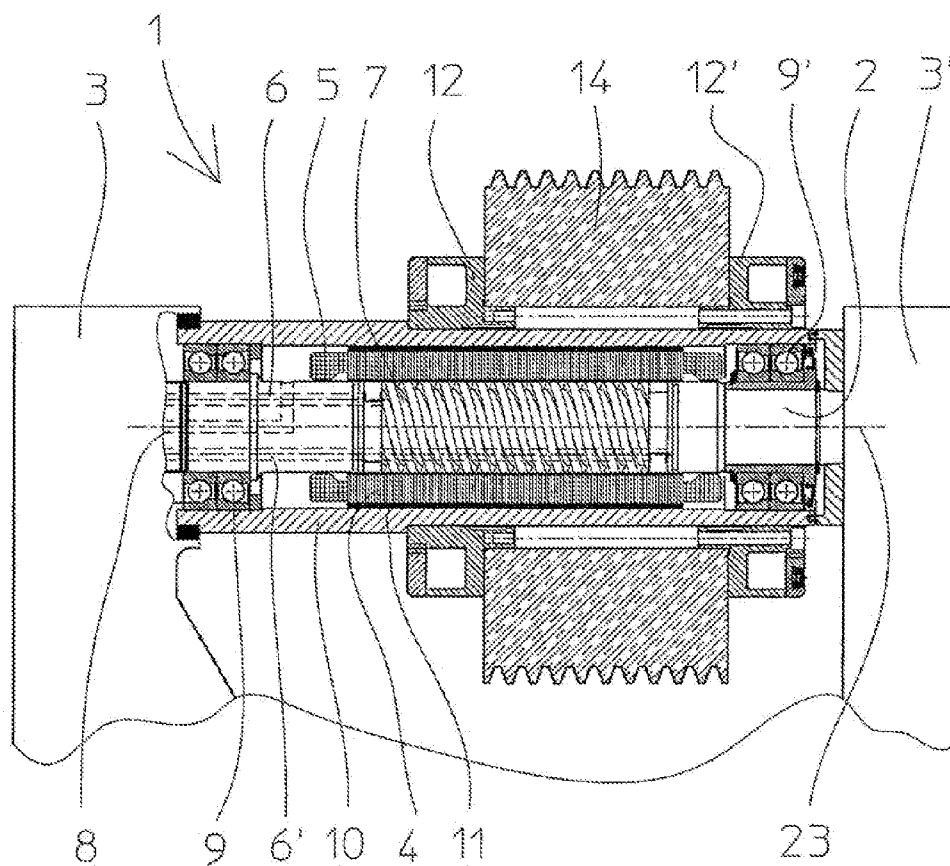


Fig. 2

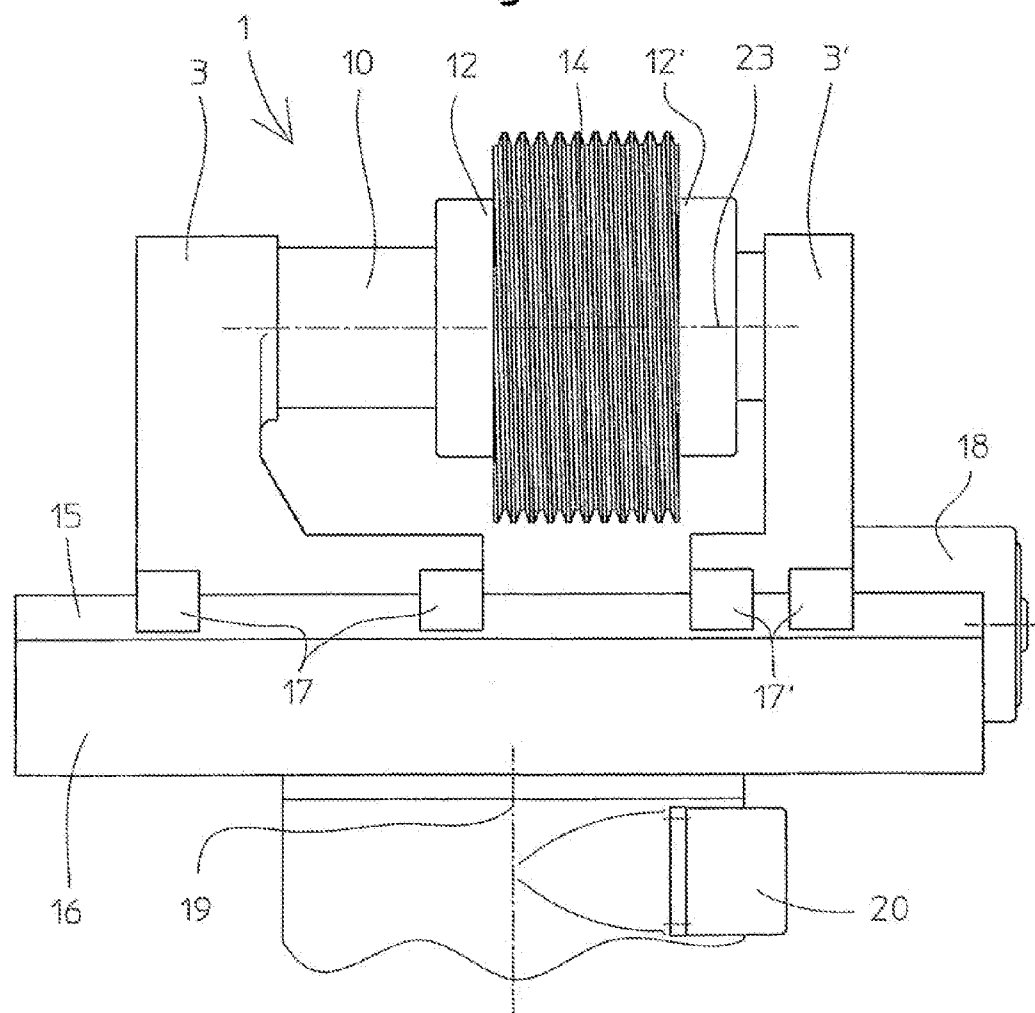
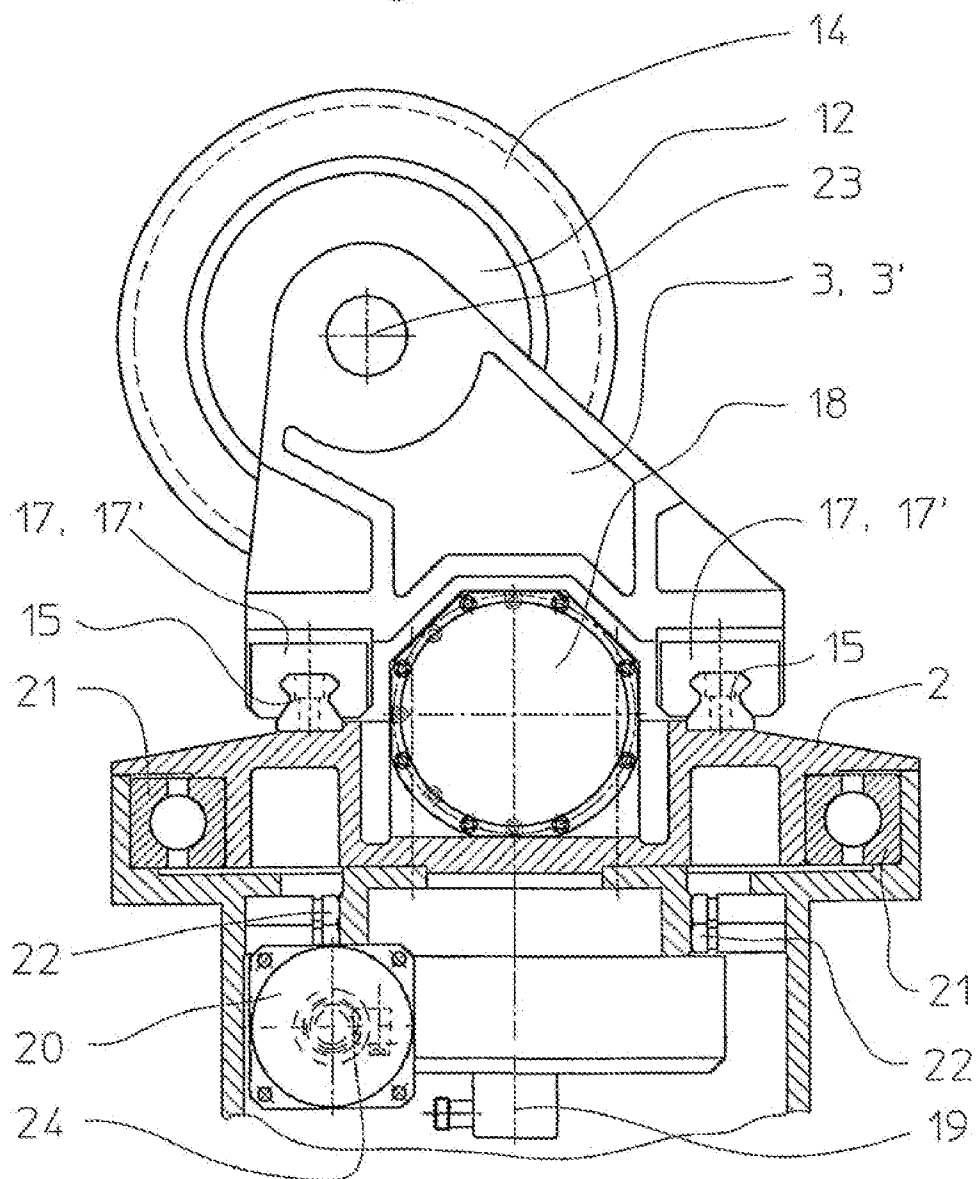


Fig. 3



DRIVE FOR A GRINDING SPINDLE

[0001] The invention relates to a grinding spindle unit as specified in the preamble of claim 1.

[0002] DE 693 06 528 [U.S. Pat. No. 5,462,470] discloses a grinding-spindle assembly where the grinding wheel is mounted on a fixed shaft in a split housing. A rotor along with a flange supports a grinding stone at its outer periphery. The rotor is mounted on a fixed shaft in a radial magnetic bearing. A second magnetic bearing is provided to take up the axial forces. The drive motor is located either between the flange and the housing wall, or it is mounted laterally next to the grinding wheel between the inner periphery of the rotor and the outer periphery of the fixed shaft.

[0003] The object of the invention is to provide a grinding-spindle assembly with a compact drive.

[0004] This object is attained by a grinding-spindle assembly having the features of claim 1.

[0005] An advantageous aspect of the invention consists in the fact that the drive is implemented as a ring motor. Ring motors of the type used here are synchronous motors with an electric coil in the stator and multiple permanent magnets in the rotor. According to the invention, the rotor is a hollow shaft that accommodates the permanent magnets and supports the grinding-wheel tool. The fact that the grinding tool is mounted directly on the rotor produces a particularly space-saving construction. The stator with the coils is mounted on a fixed shaft that in an advantageous design accommodates the feed lines for electrical power and coolant. The fact that the mount holds the fixed shaft at both ends in the bearing blocks results in a very rigid design. However, the stator can also be mounted at only one end. In an advantageous embodiment, the grinding tool can be slid along its rotation axis, for example, to effect shift movements. To this end, the bearing blocks are movably guided on a bed along guides. With a two-ended mounting of the stator, it is possible to slide the bearing blocks apart along the guides for maintenance purposes. This facilitates installation and removal of the grinding tool.

[0006] The compact construction and provision of the ring motor inside a hollow shaft provides an especially rigid mounting for the grinding tool. This tool can then be advantageously employed to machine gear teeth based on the gear-generation or partial-gear-generation method.

[0007] The following discussion explains the invention in more detail based on an illustrated embodiment. Therein:

[0008] FIG. 1 is a front partly sectional view of the grinding unit;

[0009] FIG. 2 shows the grinding unit of FIG. 1 with a shift axle;

[0010] FIG. 3 is a side partly sectional view of the grinding unit.

[0011] In the grinding unit of FIG. 1, the shaft 2 is rotationally fixed in mounting blocks 3 and 3'. The stator 4 with coils 5 is fixed on the shaft 2. The shaft 2 has supply passages 6 and 6' and a helicoidal passage 7 through which coolant to cool the ring motor is supplied and removed. The power-supply passages for the coils 5 are routed through the passage 8. Bearings 9 and 9' for a rotor 10 are mounted in the shaft 2 axially flanking the stator 4. Permanent magnets 11 are located level with the stator 4 on the inside wall of rotor 10. The grinding tool 14 is clamped on the outer periphery of the rotor 10 between flange rings 12 and 12'. The flange rings 12 and 12'

are in turn clamped radially to the rotor 10 by expansion chucks 13. A hob-grinding wheel serving as a grinding tool 14 serves for machining gear teeth. The rotor 10, formed as a hollow shaft, the internally mounted stator 4, and the externally attached grinding tool 14 provide an especially compact and torsionally rigid construction.

[0012] FIG. 2 shows the grinding unit of FIG. 1 with a shift axle. A bed 16 is pivotal about an axis 19 in an unillustrated grinding machine.

[0013] Pivoting about the axis 19 is required, for example, in order to be able to machine helical gear teeth. A pivot motor 20 functions as the drive here. The bed 16 carries guides 15 mounted on the bed 16 on which bearing blocks 3 and 3' with slide shoes 17 and 17' are guided in a linearly movable fashion. The grinding tool 14 can be moved along the guides 15 in the direction of its rotation axis 23. The motor 18 can be provided as the drive for these motions, the motor moving the bearing blocks 3 and 3' by means of an unillustrated threaded spindle. The bearing blocks 3 and 3' can be moved apart as required. As a result, installation and removal of grinding tool 14 is facilitated.

[0014] FIG. 3 shows a cross-section through the grinding unit of FIG. 2. For purposes of pivoting about the axis 19, the bed 2 is mounted in a pivot bearing 21. The pivot motor 20 is effectively connected to the bed 2 through a worm drive 24. After pivoting, the bed 2 is fixed in place by clutches 22.

LIST OF REFERENCE NOTATIONS

[0015]	1 grinding unit
[0016]	2 shaft
[0017]	3 3' bearing block
[0018]	4 stator
[0019]	5 coil
[0020]	6 6' supply passage
[0021]	7 cavity
[0022]	8 passage
[0023]	9 9' bearing
[0024]	10 rotor
[0025]	11 permanent magnet
[0026]	12 12' flange ring
[0027]	13 expansion chuck
[0028]	14 grinding tool
[0029]	15 guide
[0030]	16 bed
[0031]	17 17' slide shoe
[0032]	18 motor
[0033]	19 pivot axis
[0034]	20 pivot motor
[0035]	21 pivot bearing
[0036]	22 clutch
[0037]	23 rotation axis
[0038]	24 worm drive

1. A grinding-spindle assembly comprising a rotationally driven grinding tool and a ring motor, wherein
the ring motor has a stator and a rotor,
the stator is held in at least one bearing block,
the rotor is a hollow shaft and is pivotal,
the grinding tool is connected to the rotor in a rotationally fixed manner,
characterized in that
the rotor extends through the grinding tool.

2. The grinding-spindle assembly according to claim 1 wherein the stator has an electrical coil, and the rotor has permanent magnets.

3. The grinding-spindle assembly according to claim 2 wherein the permanent magnets are mounted on an inner periphery of the rotor.

4. The grinding-spindle assembly according to claim 2 wherein the stator and the permanent magnets are mounted at least partially within a mounting hole of the grinding tool.

5. The grinding-spindle assembly according to claim 1 wherein the stator is mounted inside a shaft and is attached in a rotationally fixed manner to this shaft.

6. The grinding-spindle assembly according to claim 1 wherein the shaft holds part of the supply means for the ring motor.

7. The grinding-spindle assembly according to claim 6 wherein part of the supply means for the ring motor is at least one passage for an electrical line and/or at least one supply passage for coolant.

8. The grinding-spindle assembly according to claim 1 wherein the grinding tool is a profile-grinding tool.

9. The grinding-spindle assembly according to claim 8 wherein the grinding tool is a tool to machine gear teeth using the gear-generation or partial-gear-generation method.

10. The grinding-spindle assembly according to claim 2 wherein the at least one bearing block is guided in a linearly movable fashion on a bed along at least one guide.

11. The grinding-spindle assembly according to claim 10 wherein at least two bearing blocks are provided that are guided in movable fashion both jointly as well as relative to each other.

12. The grinding-spindle assembly according to claim 10 wherein a motor is provided as the drive for the linear motion.

13. The grinding-spindle assembly according to claim 8 wherein the bed is pivotal about an axis.

14. A grinding-spindle assembly comprising:
a pair of stationary bearing blocks spaced apart along an axis;
a shaft fixed to and extending axially between the bearing blocks;
a tubular rotor coaxially surrounding the shaft between the bearing blocks;
bearings on the shaft supporting the rotor for rotation about the axis on the shaft;
a stator on the shaft forming with the rotor a ring motor; and
a grinding tool rotationally fixed to the rotor.

15. The assembly defined in claim 14 wherein the stator is a coil on the shaft.

16. The assembly defined in claim 15 wherein the rotor is provided with at least one permanent magnet juxtaposed with the coil.

17. The assembly defined in claim 14 wherein the bearings axially flank the stator and rotor.

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