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Device for fastening a tool on a driveable tool spindle of a machine tool in a progressively adjustable manner

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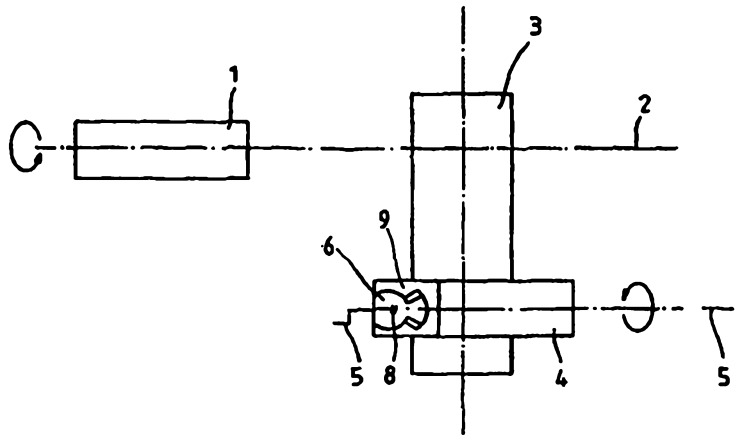
(54) Title: DEVICE FOR FASTENING A TOOL ON A DRIVEABLE TOOL SPINDLE OF A MACHINE TOOL IN A PROGRESSIVELY ADJUSTABLE MANNER

(54) Bezeichnung: VORRICHTUNG ZUR STUFENLOS VERSTELLBAREN HALTERUNG EINES WERKZEUGES AN EINER ANTREIBBAREN WERKZEUGSPINDEL EINER WERKZEUGMASCHINE



(57) Abstract

The invention relates to a device for fastening a tool (7) on a driveable tool spindle (4) of a machine tool in a progressively adjustable manner. In order to provide such a device which permits an exact adjustment of the tool (7) in the range of micrometers while simultaneously avoiding centrifugal force-related balance errors, the invention provides that the tool (7) is fastened on a tool carrier (6) such that it can be changed out and the tool carrier is mounted in a housing (9) such that it can pivot around a tool carrier rotating axis (8) which preferably forms a right-angle with the tool spindle rotating axis (5).

Abstract

The invention concerns a device for infinitely variable support of a tool (7) on a drivable tool spindle (4) of a machine tool. To provide such a device which allows exact adjustment of the tool (7) within a range of one millimetre, at the same time avoiding centrifugal force-related imbalances, it is proposed that the tool (7) is exchangeably attached to a tool carrier (6) which is mounted in a housing (9) so as to be pivotable about an axis of rotation (8) of the tool carrier extending at an angle, preferably at a right angle, to the axis of rotation (5) of the tool spindle.

(Fig. 1)

The invention concerns a device for infinitely variable support of a tool on a driveable tool spindle of a machine tool, wherein the tool is exchangeably attached to a tool carrier which is mounted in a housing so as to be pivotable about an axis of rotation of the tool carrier extending at an angle, preferably at right angle, to the axis of rotation of the tool spindle.

For infinitely variable adjustment of tool support on a machine tool, for example a lathe, so-called facing slides are known from practice. These facing slides comprise a translationally moving carriage by which the tool can be moved towards the workpiece. For equalisation of the centrifugal force-related imbalances which arise during sliding of the slide, the known facing slides have equalisation either via a countermoving slide or via counterweights.

A disadvantage with these known devices for infinitely variable support of a tool on a spindle of a machine tool is that on the one hand only a translational movement of the tool can take place and on the other hand, owing to the residual imbalances and centrifugal forces, infinitely variable adjustment within micrometric range is not possible at high machining speeds.

A further possibility to adjust a tool carrier in an infinitely variable manner is shown in FR 457 327. This publication shows a tool carrier with all features of the generic part of the claim, as it is worded in claim 1. In this case the pivoting of the tool carrier is carried out by rotating an adjusting screw, the thread of which engages an end of a threaded section of a pivotable mounted tool carrier formed in the housing.

The disadvantage of such an adjustment possibility is that they are manually operated and for this reason the machine tool has to be well secured. In addition, with such a manually actuated adjusting screw it is difficult to achieve the required adjusted position in the micrometric region.

It is the object of the invention to provide a device for infinitely variable adjustment of a tool on a drivable tool spindle of a machine tool which, with almost perfect equalisation of the centrifugal force-related imbalances, allows all-round adjustment of the tool within micrometric range.

According to the invention this objective is achieved by that the tool carrier is pivotable in the housing by a motor, magnetically or by a fluid drive.

By pivoting the tool carrier about an axis which intersects the axis of rotation of the tool spindle at an angle, preferably a right angle, there is the possibility of equalising the masses of the tool carrier and tool located on both sides of the pivot axes in such a way that the mass centre of gravity lies on the point of intersection of the pivot axis and the axis of rotation, so that, on rotation of the tool carrier mounted adjustably in the housing, there is no imbalance arising because of centrifugal force. Only due to this avoidance of centrifugal force-related imbalances is it possible to adjust the tool carrier and hence the tool so sensitively that changes of movement within micrometric range are possible, which are in turn a condition of continuous adjustment, in particular by CNC.

Owing to the pivotable mounting of the tool carrier it is furthermore possible with the device according to the invention to carry out not only purely translational movements of the tool.

The invention proposes that the tool carrier is pivotable in the housing by a motor, magnetically or by a fluid drive. According to a preferred embodiment of the invention the tool carrier is provided with a pivot piston which is arranged in a cylinder chamber of the housing and can admit a fluid on opposite sides. With this embodiment as a fluid-

operated pivot piston, particularly sensitive and easy pivoting of the tool carrier at high force is possible by pumping the fluid round.

According to a practical embodiment of the tool carrier provided with a pivot piston, the tool carrier is constructed after the fashion of a disc with integrally formed pivot piston in the form of a ring section which is arranged in a ring section-shaped cylinder chamber of the housing. In this embodiment the ring section-shaped pivot piston constitutes the counterweight for actual tool support together with tool, owing to which in turn mass equalisation takes place.

Furthermore with the invention it is proposed that the lateral surfaces and end faces of the tool carrier and pivot piston are constructed as guide surfaces relative to the housing. In this embodiment the lateral surfaces and end faces simultaneously form the sealing surfaces when a fluid drive is provided as the drive for the pivot piston.

In order to allow adjustment of the tool carrier and hence the tool without play and without transmission error, according to a preferred embodiment of the invention between the housing and the tool carrier is arranged a direct measuring system. Direct means in this connection that the measuring system directly registers the adjustment of the tool carrier without the interposition of further transmission elements.

Finally with the invention it is proposed that the tool is releasably attached to the tool carrier non-rotatably by means of a quick-change system with accurate repetition. By using such a quick-change system it is ensured that on the one hand tool changing can take place fully automatically and without long stopping times and on the other hand by non-rotatable attachment of the tool with accurate

reproduction it is guaranteed that, owing to the known tool geometries, machining can be continued without realignment and measurement of the tool.

According to a practical embodiment of the invention, gaseous and/or liquid media for cooling, cutting and cleaning purposes can be supplied to the tool quick-change system and/or the tool through the tool carrier. These gaseous and/or liquid media can be for example compressed air for cleaning, lubricating oil for cutting and cooling, or nitrogen for cooling.

Further characteristics and advantages of the invention are apparent from the description of the associated drawings below, in which is shown schematically the construction of a practical example of a device according to the invention for infinitely variable support of a tool on a drivable spindle of a machine tool. The drawings show:

Fig. 1 a schematic construction of a machine tool with workpiece spindle and tool spindle offset with parallel axis and

Fig. 2 a schematic top view of infinitely variable support of a tool according to the invention.

In Fig. 1 is shown schematically the basic construction of a machine tool. The machine tool, not shown in more detail, with chucking for at least one workpiece comprises a drivable workpiece spindle 1 by which the workpiece is turned about a workpiece axis of rotation 2. The machine tool further includes a carriage 3 by which a tool spindle 4 is movable both radially to the axis of rotation 2 of the workpiece and axially in the longitudinal direction of the axis of rotation 2 of the workpiece, wherein the tool

spindle 4 is driven in rotation about an axis of rotation 5 of the tool spindle.

As can further be seen from Fig. 1, the tool spindle 4 comprises a tool carrier 6 to which is non-rotatably attached an exchangeable tool 7. This tool carrier 6 is mounted in a housing 9 so as to be pivotable about an axis of rotation 8 of the tool carrier running at an angle to the axis of rotation 5 of the tool spindle.

Due to the pivotable mounting of the tool carrier 6 in the housing 9 of the tool spindle 4, with a machine tool constructed in this way it is possible to move the tool 7 not only translationally by adjustment of the tool spindle 4 by the carriage 3 towards the axis of rotation 2 of the workpiece, but furthermore also to pivot the tool 7 relative to the axis of rotation 2 of the workpiece.

The more detailed construction of the tool carrier 6 is shown schematically in Fig. 2. To support the tool 7, the tool carrier 6 comprises a quick-change system 10 in which the tools 7 to be used each time can be fixed non-rotatably and with accurate reproduction. Fixing the tools 7 with accurate reproduction is indispensable for constant accuracy of machining, as the geometrical dimensions of each tool 7 go as starting values into the computer-controlled machining programmes of the machine tool. Therefore in spite of the known geometry of the tool 7 used, unusable workpieces would be produced by inaccurate placing of a tool 7 on the tool carrier 6, as the tool 7 would not be positioned in the correct position relative to the axes of rotation 2, 5 and 8.

In the embodiment shown of a device for infinitely variable support of a tool 7 on a drivable tool spindle 4 of a machine tool, the tool carrier 6 is provided with a pivot piston 11 which, arranged in a cylinder chamber 12 of the housing 9, can admit fluid for pivoting the tool carrier 6. The tool carrier 6 constructed after the fashion of a disc with the integrally formed pivot piston 11 in the form of a ring section is pivotable about the axis of rotation 8 of the tool carrier, which runs at right angles to the axis of rotation 5 of the tool spindle in the embodiment shown.

The tool carrier 6 is pivoted by the fact that a fluid is introduced via supply means, not shown in more detail, into the also ring section-shaped cylinder chamber 12. When the fluid is pumped round from one compartment 12a to the other compartment 12b of the cylinder chamber 12, a different pressure is applied to the end faces 11a of the pivot piston 11, so that the pivot piston 11 is pivoted about the axis of rotation 8 of the tool carrier.

The lateral surfaces 6a and 11b of the tool carrier 6 and of the pivot piston 11 and also the end faces 11a of the pivot piston 11 serve in the embodiment shown as guide surfaces relative to the housing 9. At the same time these surfaces 6a, 11a and 11b serve as sealing surfaces for the fluid introduced into the cylinder chamber. In order to achieve mounting of the tool carrier 6 in the housing 9 with as little friction as possible, it is possible to provide at least the lateral surfaces 6a and 11b of the tool carrier 6 and of the pivot piston 11 with a coating which reduces frictional resistance.

By arranging a direct measuring system 13 between the housing 9 and the tool carrier 6 it is possible to measure the degree of pivoting of the tool carrier 6 without play and without transmission error. The direct measuring system 13 can for example consist of a measuring strip which is arranged on the lateral surface 11b of the pivot piston 11 and which is scanned directly by a scanning system arranged in the housing 9.

By pivoting the tool carrier 6 about the axis of rotation 8 of the tool carrier which intersects the axis of rotation 5 of the tool spindle at an angle, preferably a right angle, the possibility arises of equalising the masses of the tool carrier and tool 7 located on both sides of the axis of rotation 8 of the tool carrier in such a way that the mass centre of gravity lies on the point of intersection of the axis of rotation 8 of the tool carrier and the axis of rotation 5 of the tool spindle. On rotation of the tool carrier 6 mounted adjustably in the housing 9, therefore, owing to the centrifugal force there is no imbalance which would make exact guiding of the tool 7 impossible.

Only because of this avoidance of centrifugal force-related imbalances is it possible to adjust the tool carrier 6 and the tool 7 so sensitively that changes of movement within micrometric range are possible.

For further compensation of the centrifugal forces occurring at speeds of the axis of rotation 5 of the tool spindle of well over 15,000 revolutions per minute, the housing 9 can be surrounded by an outer pressure sleeve 14, as is the case in the embodiment shown.

Naturally the device described above for infinitely variable support of a tool 7 can be used on any kind of machining stations, not just on lathes, as is the case in the embodiment shown.

List of reference numbers

1 workpiece spindle

2 axis of rotation of workpiece

3 carriage

4 tool spindle

5 axis of rotation of tool spindle

6 tool carrier

6a lateral surface

7 tool

8 axis of rotation of tool carrier

9 housing

10 quick-change system

11 pivot piston

11a end face

11b lateral surface

12 cylinder chamber

12a compartment

12b compartment

13 measuring system

14 pressure sleeve

(Newly worded) patent claims

1. Device for infinitely variable support of a tool on a driveable tool spindle (4) of a machine tool, wherein the tool (7) is exchangeably attached to a tool carrier (6) which is mounted in a housing (9) so as to be pivotable about an axis of rotation (8) of the tool carrier extending at an angle, preferably at right angle, to the axis of rotation (5) of the spindle, characterised in that the tool carrier (6) is pivotable in the housing (9) by a motor, magnetically or by a fluid drive.

2. Device according to claim 1, characterised in that the tool carrier (6) is provided with a pivot piston (11) which is arranged in a cylinder chamber (12) of the housing (9) and can admit fluid on opposite sides.

3. Device according to claim 2, characterised in that the tool carrier (3) is constructed after the fashion of a disc with integrally formed pivot piston (11) in the form of a ring section which is arranged in sealed relationship in a ring section-shaped cylinder chamber (12) of the housing (9).

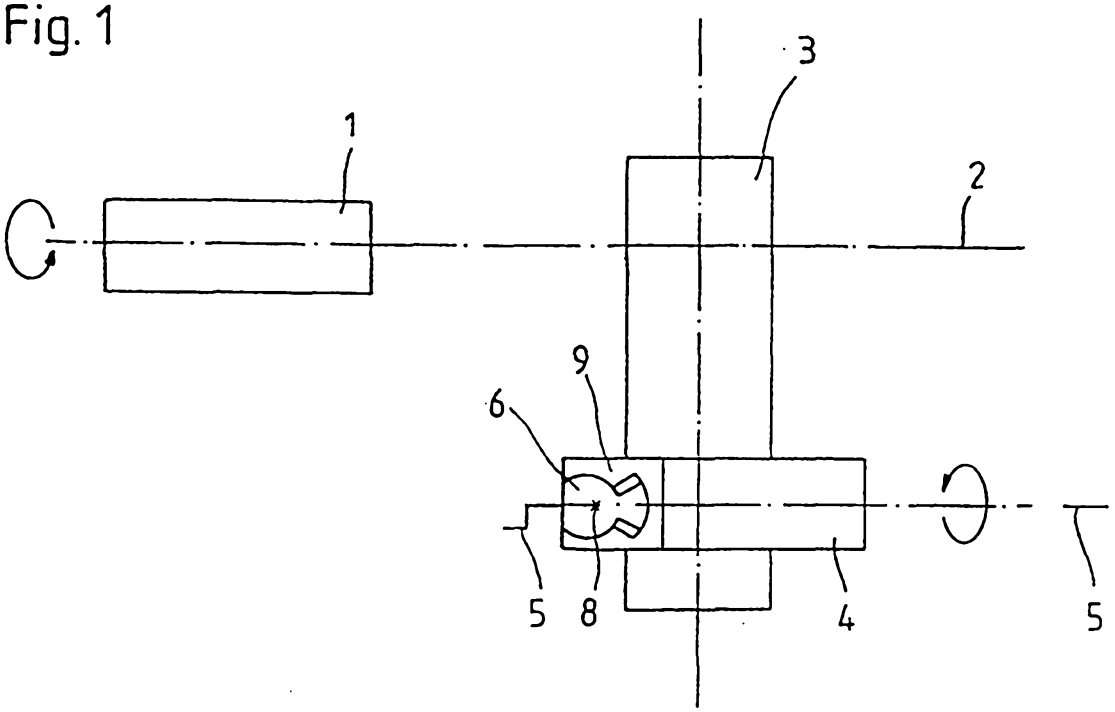
4. Device according to claim 3, characterised in that the lateral surfaces (6a, 11b) and end faces (11a) of the tool carrier (6) and pivot piston (11) are constructed as guide surfaces relative to the housing (9).

5. Device according to one or more of claims 1 to 4, characterised in that between the housing (9) and the tool carrier (6) is arranged a direct measuring system (13).

6. Device according to one or more of claims 1 to 5, characterised in that the tool (7) is releasably attached to the tool carrier (6) non-rotatably by means of a quick-change system (10) with accurate repetition.

7. Device according to claim 6, characterised in that gaseous and/or liquid media can be supplied to the quick-change system (10) and/or the tool (7) through the tool carrier (6).

Fig. 1



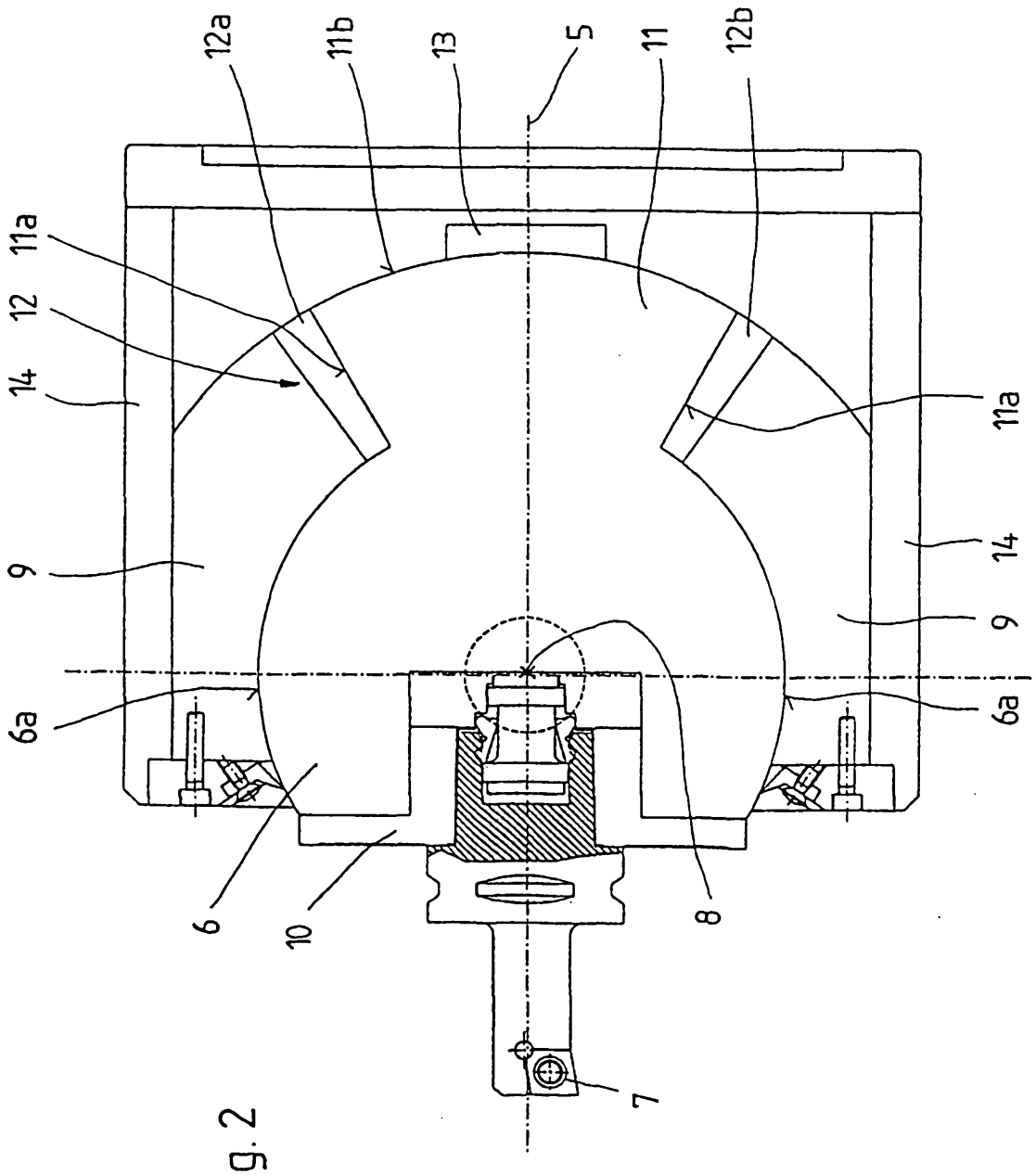


Fig. 2