
Rotary table having a clamping brake

Description:

5 The invention relates to a rotary table having a braking device, in particular comprising a stationary housing and an indexing plate for accommodating a workpiece, which indexing plate is supported rotatably about a central rotational axis relative to the stationary housing, wherein at least one clamping brake, which can be actuated from a clamping position into a non-clamping position, is formed between the stationary
10 housing and the rotatably supported indexing plate, and wherein the clamping brake comprises a spring element for actuating a brake pad as well as a means for applying an adjustable force onto the spring element, wherein the means can exert at least one force directly or indirectly onto the brake pad, which force is controllable, more particularly is adjustable in its magnitude, in the direction of the spring force of the
15 spring element.

A rotary table to position workpieces according to the technical field of the invention is already known from DE 20 2014 103 937 U1. Rotary tables are used in particular as a swivel or positioning axis, and as workpiece carriers, in machine tools, but also in the field of assembly tasks. Rotary table units are now integrated into high-precision
20 machines as essential components. For example, rotary tables for machine tools are known, which rotary tables are indexed sequentially and clamped after each partial step, such that the machining of the workpieces can take place in a defined position while the rotary table is at a standstill. Typically, the clamping of these rotary tables is performed by one or multiple clamping devices acting on the outer table circumference or on the vicinity of the same. Such clamping devices are actuated either purely
25 mechanically or hydraulically. The actuation creates corresponding forces which are introduced into the components of the table. If, for example, the plate of a rotary table is clamped directly, the plate of the table may warp, which leads to positional inaccuracies. It is disadvantageous and problematic in this type of clamping that the clamping devices

engage only at individual points, which means that a very large point force is required for securing the table in place, which in turn may warp the table.

Another disadvantage of known clamping devices is the lack of safety for the operating personnel, as the clamping effect ceases in the event of failure of the electrical and/or mechanical supply. As a result, additional expenses are required for safety devices, especially at high weights and moments of inertia of the machine.

The problem underlying the present invention therefore is to overcome the aforementioned disadvantages and to provide a rotary table which provides improved clamping with increased safety precautions for failures of the electrical and/or mechanical supply, and which can simultaneously be operated with high positioning accuracy.

These problems are solved by the combination of characteristics according to Claim 1.

According to the invention, a rotary table therefore is proposed, which comprises a stationary housing and an indexing plate for accommodating a workpiece, which indexing plate is mounted rotatably about a central rotational axis relative to the stationary housing. At least one clamping brake, which can be actuated from a clamping position into a non-clamping position, is formed between the stationary housing and the rotatably mounted indexing plate. The clamping brake comprises a spring element for actuating a brake pad as well as a means for applying an adjustable force onto the spring element. Furthermore, the means can exert at least one force directly or indirectly onto the brake pad, which force is controllable, more particularly is adjustable in its magnitude, in the direction of the spring force of the first spring element. Therein, it is advantageous that the clamping brake can retard the rotation of the indexing plate or fix the indexing plate against a rotation relative to the stationary housing. This arrangement improves the clamping, which means that the system can be operated with a higher positioning accuracy.

In an advantageous embodiment variant, it is provided that said means can also exert a force on the brake pad, which force can be controlled to act against the spring force of the spring element. In this manner, the rotatably supported indexing plate can be

released from the clamping as soon as the controllable force exceeds the spring force of the spring element.

Preferably, the rotary table is designed such that the clamping brake has a brake disc and a brake spring. Therein, the brake spring represents the spring element.

5 In an exemplary embodiment of the invention, it is advantageously provided that the brake spring is designed in the clamping brake under preload, such that, in a state in which no voltage is applied to the rotary table and its active devices, or in which said devices are not ready for operation, or alternatively also in a state in which said devices are ready to operate, a spring force presses the brake pad against the brake disc, and
10 the clamping brake is in the clamping position. As a result, the default state of the clamping brake is the clamping position, which means that no additional force has to be applied to secure the position of the indexing plate for mounting workpieces, for example. This condition is called "normally closed" because, regardless of the presence of a hydraulic brake, of an operational readiness or even in the event of a failure of the
15 voltage supply or operating means supply, the brake always securely blocks the rotary table.

Furthermore, an embodiment is favorable in which a force from the means is applied to the brake pad for moving the clamping brake from the clamping position to the non-clamping position. By activating this force, preferably a hydraulically or pneumatically
20 generated force by means of, e.g., a hydraulic piston, a force acts on the brake pad against the spring force of the spring element. This opens the clamping brake to the extent that the brake pad and the brake disc are no longer in contact with each other.

In a further advantageous variant, it is provided that a force, preferably a hydraulically or pneumatically generated force, additional to the spring force of the spring element, is
25 applied to the brake pad in the direction of the spring force for completely blocking a rotational movement of the indexing plate. By exerting the additional force in the direction of the spring force, the clamping brake increases the resistance against a rotation of the indexing plate, whereby higher forces can act on the indexing plate while mounting a workpiece, for example, without the indexing plate rotating. This also results

in a particularly effective braking capacity, especially when high masses have to be brought to a standstill, which would take too long with only a mechanical spring brake. For static cases, the clamping force can be adjusted as desired. In an alternative embodiment, the means uses the spring element to press the brake pad against a
5 second spring element and the second spring element presses the brake disc against the housing.

In a favorable application example, the spring force as well as the braking forces and the counteracting forces act parallel to the central rotational axis.

10 In an embodiment variant, the rotary table according to the invention is designed such that the braking forces of the brake pad act directly on the indexing plate. This is advantageous because no additional braking force losses are caused by coupling components.

15 It is further advantageous if fluid-conducting lines for the hydraulics or the pneumatics are designed within the stationary housing and the indexing plate for activating the force of the means. This proves advantageous, since the fluid-conducting lines then extend within the rotary table and the additional source of danger of lines rotating along with the indexing plate or extending outside the rotary table is consequently avoided. If the supply of the fluid fails, e.g., due to a break in a line, the effect of the spring element is nevertheless securely maintained.

20 In a refinement of the present rotary table according to the invention, it is further provided that the force of the means acts directly on or at the spring element — connected in series with the spring element, so to speak — for reducing or releasing the braking force.

25 In a preferred embodiment of the invention, the indexing plate is thus blocked by the spring element when the means is inactive or in case of failure of the effect of the means. As a result, the operational safety of the rotary table is significantly increased, as the indexing plate cannot be rotated in the event of a malfunction.

In addition, the failure of the effect of the agent is a state in which the pneumatics for generating the force of the agent are inactive.

Furthermore, the failure of the effect of the means is a state in which the control electronics for controlling the spring force of the means is inactive.

- 5 Other advantageous refinements of the invention are characterized in the dependent claims and/or are described in more detail through the drawings in conjunction with the description of the preferred embodiment of the invention. The drawings show:

Fig. 1 A sectional view of a rotary table with a clamping brake

Fig. 2 A schematic diagram of a clamping brake for a rotary table

- 10 Fig. 3 A schematic diagram of an alternative embodiment of a clamping brake for a rotary table

In the following, the invention is described with reference to Figs. 1 and 2 on the basis of an exemplary embodiment, wherein identical reference numbers indicate identical structural and/or functional features.

- 15 Fig. 1 shows a sectional view of a rotary table 1 with a clamping brake 4. The rotary table comprises a stationary housing 2 and an indexing plate 3 for accommodating a workpiece, which indexing plate 3 is supported rotatably about a central rotational axis Z relative to the stationary housing 2. Therein, two clamping brakes 4, which can be actuated from a clamping position into a non-clamping position, are designed between
20 the stationary housing 2 and the rotatably mounted indexing plate 3. Furthermore, the respective clamping brakes 4 comprise a spring element 5 for actuating a brake pad 7 and a means 6 for applying an adjustable force to the spring element 5.

- The clamping brake 4 has a brake disc 8 and a brake spring 9. Therein, the brake spring 9 represents the first spring element 5. The clamping brakes 4 are shown once in
25 the clamping position and once in the non-clamping position. The portion of the clamping brake 4 consisting of the brake pad 7 and the brake spring 9 is fixed to the stationary housing 2 by means of a fastening means. Conversely, the brake disc 8 of

the clamping brake 4 is attached to the indexing plate 3 by means of a fastening means. The respective fastening means is designed as a screw, for example.

As the brake spring 9 is installed in the clamping brake 4 under preload, the clamping brake 4 (in the "normally closed" state) in the clamping position is in a state in which the
5 spring force presses the brake pad 7 against the brake disc 8.

In the other clamping brake 4, a force of the means 6, preferably a hydraulically or pneumatically generated force, was activated, which counteracted the spring force F of the spring element 5, thus displacing the brake pad 7 from the clamping position to the non-clamping position. The direction of movement of the brake pad 7 from the clamping
10 position to the non-clamping position extends parallel to the rotational axis Z .

Additionally, fluid-conducting lines for the hydraulics or the pneumatics are designed within the stationary housing 2 and the indexing plate 3 for activating the force of the means 6.

Fig. 2 shows a schematic diagram of a clamping brake 4 for a rotary table 1. The
15 clamping brake 4 is designed between a stationary housing 2 and a rotatably mounted indexing plate 3, and comprises a brake pad 7, a brake disc 8, a spring element 5 and a means 6.

Furthermore, the schematic diagram from Fig. 2 has a fluid-conducting line 10, which leads to the means 6 of the clamping brake 4.

20 The brake pad 7 is supported moveably in the clamping brake 4, such that said brake pad 7 can be moved back and forth in a vertical direction parallel to the central rotational axis between the stationary housing 2 and the rotatably mounted indexing plate 3. The displacement of the brake pad 7 results from the forces acting on it. The spring force of the spring element 5 acts in the direction of the indexing plate 3. As the
25 means 6 (shown in this example as a hydraulically actuated piston) is connected in series to the spring element 5, the forces of the two components add up or are subtracted from each other. The direction of action or the magnitude of the force of the

adjustable means 6 can be adjusted by means of the fluid-conducting line leading to the means 6.

Fig. 3 shows a schematic diagram of an alternative embodiment of a clamping brake 4 for a rotary table 1. The clamping brake 4 is designed between a stationary housing 2 and a rotatably mounted indexing plate 3, and comprises a brake pad 7, a brake disc 8, a spring element 5, a second spring element 11 and a means 6, namely a piston.

Furthermore, the schematic diagram from Fig. 3 has two fluid-conducting lines 10a, 10b, which lead to the piston 6 of the clamping brake 4. To brake, the spring element 5 presses the brake pad 7 against the second spring element 11. Thereby, the second spring element 11 presses the brake disc 8 against the housing 2 and the rotating indexing plate 3 is decelerated to a standstill.

Following the braking process, the indexing plate 3 is connected to the brake disc 8 in a non-positive manner and without play. To increase the retaining force, the brake disc 8 is clamped between the second spring element 11 and the housing 2. To increase the clamping or braking force, a fluid is pressed through the fluid-conducting line 10b. A force acts on the piston 6 by means of the resulting pressure against the piston 6, which is pressed against the brake pad 7 and increases the clamping or braking force. In addition, pressure is applied through the fluid-conducting line 10a for releasing the clamping or braking force. The resulting pressure against the mean 6 causes a force to act against the piston 6, which is pressed against the spring element 5. If the force of the spring element 5 is exceeded, the brake disc 8 is released and the indexing plate 3 is able to rotate.

The embodiments of the invention are not limited to the aforementioned preferred exemplary embodiments. Rather, a number of variants are conceivable, which make use of the solution shown here even if they arrive at fundamentally different embodiments.

Claims

1. A rotary table (1), comprising a stationary housing (2) and an indexing plate (3) for accommodating a workpiece, which indexing plate (3) is mounted rotatably about a central rotational axis (Z) relative to the stationary housing (2), wherein at least one
5 clamping brake (4), which can be actuated from a clamping position into a non-clamping position, is formed between the stationary housing (2) and the rotatably mounted indexing plate (3), and wherein the clamping brake (4) comprises a spring element (5) for actuating a brake pad (7) as well as a means (6) for applying an adjustable force onto the spring element (5), wherein the means (6) can exert at
10 least one force directly or indirectly onto the brake pad (7), which force is controllable, more particularly is adjustable in its magnitude, in the direction of the spring force of the spring element (5).
2. The rotary table (1) according to Claim 1, wherein said means (6) can also exert a force on the brake pad (7), which force can be controlled to act against the spring
15 force of the spring element (5).
3. The rotary table (1) according to Claims 1 and 2, characterized in that the clamping brake (4) has a brake disc (8) and a brake spring (9), wherein the brake spring (9) represents the spring element (5).
4. The rotary table (1) according to Claims 1 to 3, characterized in that the brake spring
20 (9) is designed in the clamping brake (4) under preload, such that a spring force (F) presses the brake pad (7) against the brake disc (8) and the clamping brake (4) is in the clamping position.
5. The rotary table (1) according to Claims 1 to 4, characterized in that a force of the means (6), preferably a hydraulically or pneumatically generated force counteracting
25 the spring force (F) of the spring element (5), is activated, and in that said activated force is applied to the brake pad (7) for displacing the clamping brake (4) from the clamping position to the non-clamping position.

6. The rotary table (1) according to any one of Claims 1 to 5, characterized in that a piston (6) presses the brake pad (7) against a second spring element (11) by means of the spring element (5), and in that the second spring element (11) presses the brake disc (8) against the housing (2).
- 5 7. The rotary table (1) according to Claims 1 to 5, characterized in that a force, preferably a hydraulically or pneumatically generated force, is applied to the brake pad (7) in the direction of the spring force (F) for completely blocking a rotational movement of the indexing plate (3).
8. The rotary table (1) according to Claims 1 to 6, characterized in that the spring force
10 as well as the braking forces and the counteracting forces act parallel to the central rotational axis (Z).
9. The rotary table (1) according to Claims 1 to 7, characterized in that the braking forces of the brake pad (7) act directly on the indexing plate (3).
10. The rotary table (1) according to Claims 1 to 8, characterized in that fluid-conducting
15 lines (10) for the hydraulics or the pneumatics are designed in the stationary housing (2) and the indexing plate (3) for activating the spring force of the means (6).
11. The rotary table (1) according to Claims 1 to 9, characterized in that the force of the means (6) acts directly on or at the spring element (5) for reducing or releasing the braking force.
- 20 12. The rotary table (1) according to Claims 1 to 10, characterized in that the spring element (5) blocks the indexing plate (3) when the means (6) are inactive or in case of failure of the effect of the means (6).
13. The rotary table (1) according to Claims 1 to 11, characterized in that the failure of
25 the effect of the means (6) is a state in which the pneumatics for generating the force of the means (6) is inactive.

14. The rotary table (1) according to Claims 1 to 11, characterized in that the failure of the effect of the means (6) is a state in which the control electronics for controlling the spring force of the means (6) is inactive.