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(19)

(54) A ROTARY TOOL HOLDER

(71) We, ROBERT BOSCH GMBH, a German company of Postfach 50, 7000 Stuttgart 1, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to rotary tool holders.

According to the invention there is provided a rotary tool holder for use with a tool having a shank with at least one flat chordal surface defining the base of an axially closed recess in the periphery of the shank, comprising at least one locking element for engaging the tool shank so as to transmit torque from the tool holder to the tool and which is displaceable to enable the tool to be inserted in and removed from the tool holder, the locking element having a curved surface at which to make tangential engagement with a flat chordal surface of the shank when the tool is inserted in the tool holder, and the tool holder having a rigid wall supporting the peripheral region of the locking element remote from the curved surface thereof by which, when the tool holder is in operation, the transmitted torque will produce a reaction force the line of action of which will pass through the locking element to be resisted by the rigid wall in a direction substantially perpendicular to the flat chordal surface of the inserted tool shank.

A rotary tool holder has been proposed for a drilling machine and which is arranged to receive a drilling or drilling and chiselling tool, the shank of which tool is provided with an axially closed recess for engagement with a displaceable locking element arranged in the tool holder. During operation of such a drilling machine, the locking element transmits torque to the tool.

One such proposed tool holder utilizes a cylindrical locking element arranged for radial displacement in a radial slot formed in the tool holder and held in engagement with the recess in the tool shaft by a sleeve. During the transmission of torque, the locking element is subjected to severe edge pressure against the circumferential edge of the recess and against the wall of the slot in the region of the inner edge of the slot. This can cause considerable wear on the torque transmitting parts.

A rotary tool holder may be constructed in accordance with the invention which results in a considerable improvement in torque transmission with a considerable reduction in wear on the torque transmitting parts.

In one preferred rotary tool holder in accordance with the invention, the locking element is displaceable in a direction parallel to, but offset from, a radius extending from the rotary axis of the tool holder. In that arrangement, the locking element may be guided in a slot provided with parallel walls and having a radially external opening closed by elastic material.

The elastic material may be in the form of a continuous strip of rubber for example, passing around the tool holder.

In a second preferred rotary tool holder in accordance with the invention, the locking element is displaceable in a direction parallel to the rotary axis of the tool holder.

To enable a tool to be easily inserted in and removed from the second preferred tool holder, the locking element may be slidable along a slide track arranged at an acute angle to the rotary axis of the tool holder. This may be achieved by means of a pin fixed to the locking element and movable in a slot in the tool holder on displacement of a sleeve in a direction parallel to the rotary axis of the tool holder and against the force of a spring.

More usually, a tool holder in accordance with the invention will be provided with more than one locking element and its associated parts, two locking elements arranged for symmetrical displacement with respect to the rotary axis of the tool holder being the preferred arrangement.

In order that the invention may be well understood, the two preferred rotary tool holders, which are given by way of example of the invention, will now be described with reference to the accompanying drawings, in which:

Figure 1 is a longitudinal section through one of the preferred rotary tool holders, shown mounted on a drill hammer and with a tool inserted;

Figure 2 is a section taken on the line II—II in Figure 1;

Figure 3 is a longitudinal section through the second preferred rotary tool holder; and

Figure 4 is a section taken on the line IV—IV in Figure 3.

The tool holder illustrated in Figures 1 and 2 is shown in Figure 1 attached to a drill hammer. The forward or tool end of the housing 1 of the drill hammer is provided with an annular extension 2 from which projects a tool spindle 3. The cross-sectional area of the spindle 3 increases away from the housing 1 to form the body of the tool holder 4. A bore 5 is arranged concentrically in the tool holder 4, in which is inserted the shank 6 of a tool 7, for example a drilling tool.

Two axially closed recesses 8, that is to say recesses which are closed at both ends viewed in the axial direction of the drilling tool 7, are arranged opposite each other in the shaft 6. Each recess 8 has a flat chordal surface defining its base the chordal surfaces being arranged parallel to each other. Locking elements, which are formed as rollers 9 with their axes arranged parallel to the rotary axis of the tool holder, engage the recesses 8 in the tool shank.

The rollers 9 are guided in slots 10 provided with parallel walls and radially external openings closed by resilient means in the form of a continuous strip 15 of elastic material, such as rubber, passing around the tool holder 4 and retained in a circumferential groove formed by slots 16 milled out of the tool holder body.

As can be seen from Figure 2, the rollers 9 are arranged in the tool holder in such a manner that each of their curved surfaces makes tangential engagement with a flat chordal surface of the shank 6 when the tool 7 is inserted in the tool holder. The tool holder also has rigid wall surfaces 14 each supporting the peripheral region of a locking element 9 remote from the curved surface thereof engaging the base of a recess 8, by which, when the tool holder is in operation, the torque transmitted from the tool holder to the tool 7 will produce a reaction force the line of action of which will pass through a locking element 9 to be resisted by a rigid wall 14 in a direction substantially perpendicular to a flat chordal surface of the inserted tool shank 6. These lines of action are represented by the arrows 11 in Figure 2. Moreover, the rollers 9 are displaceable along the centre lines 12 of the slots 10 in a direction substantially perpendicular to the lines of action 1 passing through the rigid walls 14, thus enabling the tool 7 to be inserted in and removed from the tool holder.

During operation of the drill hammer, the elastic strip 15 retains the rollers 9 in engagement with flat chordal surfaces of the recesses 8, as shown in Figure 2, so that torque transmission can take place. The elasticity of the strip 15 allows the rollers 9 to move outwardly along the centre lines 12 of the slots 10 for the passage past the rollers of the non-recesses end of the drilling tool 7 when it is inserted in and removed from the drill hammer.

As will be appreciated from Figure 2, the rollers 9 are displaceable along the centre lines 12 against the elasticity of the strip 15, in a direction parallel to, but offset from a radius extending from the rotary axis of the tool holder 4.

The length of the slots 10, in the direction of displacement of the rollers 9 is greater than the extent of displacement of the rollers 9 along the centre lines 12, caused by the insertion or removal of the tool. Furthermore, the length of each slot 10, measured in the direction of a centre line 12, is substantially equal to the dimension of a roller measured along the line 12. In Figure 2, that dimension is the diameter of a roller 9. This relationship is achieved by providing the milled slots 16 which enable the elastic strip 15 to engage the rollers 9 notwithstanding the shortened slots 10. As the rollers 9 are urged beyond the outer ends of the slots 10, they are guided axially by the walls of the milled slots 16.

On insertion of the tool 7 in the tool holder 4, the rollers 9 are pushed outwardly into the slots 10 by the conical end 17 of the shank 6 and with the drill completely inserted, the rollers 9 can latch in the recesses 8 in the drill shank 6 by rotating the tool 7 in a sense opposite to the sense of rotation of the drill during operation denoted by the arrow 13. During drilling, the tool 7 is entrained in the sense of rotation of the arrow 13 whilst the forces 11 originating from the torque pass substantially perpendicularly through the rigid surfaces 14 of the tool holder 4 and through the flat chordal surfaces of the recesses 8. The rollers 9 exhibit a very favourable wear characteristic, since they are not only engaged by a flat surface area of the recesses 8 but also by the rigid surfaces 14 (Figure 2).

To release the tool 7 it is simply rotated by hand in the sense of the arrow 13. In so doing, the flat chordal base surfaces of the recesses 8 displace the rollers 9 outwardly and in an inclined manner into the slots

10 against the elastic continuous strip 15 until the tool 7 may be removed axially from the tool holder 4.

The tool holder 24 illustrated in Figures 3 and 4 is likewise arranged at the free end of a tool spindle 23 which is fixed in a drill hammer in a similar manner as the tool spindle 3 of Figures 1 and 2. A tool corresponding to the tool 7 of Figure 1 with a shank 6 and recesses 8, is retained in the tool holder 24. The body of the tool holder 24 is formed by the thickened forward portion 25 of the tool spindle 23 which has a coaxial reveiving bore 26 for receiving the shank 6 of the tool 7.

The locking elements are in the form of sliding members 29 guided in radial slots 28 lying diagonally opposite one another. The sliding members 29 have laterally extending regions which seat on flat slide tracks 30 milled parallel to tangential planes at the forward conical portion 25 of the tool spindle 23. Thus, the slide tracks 30 lie at an acute angle to the rotary axis of the tool holder 24, the acute angle corresponding to half the angle of cone of the forward portion 25. The sliding members 29 are prevented from falling out of the slots 28 by a cylindrical portion 27, which has an inner conicity corresponding to the conicity of the forward portion 25. The cylindrical portion 27 is fixed to the forward portion 25 of the tool spindle 23 in a manner which is not illustrated in detail.

Once again, the radially inward curved surfaces of the sliding members 29 engage flat chordal surfaces of the recesses 8 as in the previous embodiment and their regions remote from those curved surfaces are supported by rigid wall surfaces 38 in the inner periphery of the portion 27 of the tool holder.

A radial pin 31 is fixed to each sliding member 29, the pin being accommodated in a radial bore 33 in a sleeve 34 and passing through an associated longitudinal slot 32 in the cylindrical portion 27. The sleeve 34 is arranged on the outside of the cylindrical portion 27 for displacement, against the force of resilient means in the form of a spring 35, in the direction parallel to the rotary axis of the tool holder 24.

On insertion of the tool 7 into the tool holder, the sliding members 29 are pushed rearwardly and simultaneously outwards into the slots 28 by the conical end 17 of the drill shaft. Thus, the sliding members 29 are also displaceable in a direction radially of the tool holder as a result of their axial displacement parallel to the rotary axis of the tool holder. With the tool pushed in, the members 29 engage in the recesses 8 in the tool shank, on rotation of the tool 7 in a sense opposite to the sense of rotation shown by the arrow 36, and are retained in engagement with the recesses 8 by the force of the spring 35 acting through the sleeve 34 and the pins 31.

During drilling, the tool is entrained in the sense of rotation 36, whilst the lines of action illustrated by the arrows 37 and representing the reaction forces to the torque are resisted by the rigid surfaces 38 and the flat chordal surfaces of the recesses 8 through which they pass substantially perpendicularly.

On removal of the tool 7 from the drilled hole, the sliding members 29 and the sleeve 34 retain the tool 7 in the tool holder by means of the milled recesses 8. To release the tool 7, the sliding members 29 are pushed rearwards by the sleeve 34 and the pins 31 and are thus pushed outwards by the slide track arranged at an acute angle, until the tool 7 can be removed from the tool holder 24. This displacement of the locking elements, in the form of the members 29, is in a direction perpendicular to the directions of the forces represented by the arrows 37.

It will be appreciated that although only one locking element and its associated parts would suffice to transmit torque, two such devices are preferred as provided in the specific arrangements described above.

WHAT WE CLAIM IS:—

1. A rotary tool holder for use with a tool having a shank with at least one flat chordal surface defining the base of an axially closed recess in the periphery of the shank, comprising at least one locking element for engaging the tool shank so as to transmit torque from the tool holder to the tool and which is displaceable to enable the tool to be inserted in and removed from the tool holder, the locking element having a curved surface at which to make tangential engagement with a flat chordal surface of the shank when the tool is inserted in the tool holder, and the tool holder having a rigid wall supporting the peripheral region of the locking element remote from the curved surface thereof by which, when the tool holder is in operation, the transmitted torque will produce a reaction force the line of action of which will pass through the locking element to be resisted by the rigid wall in a direction substantially perpendicular to the flat chordal surface of the inserted tool shank.

2. A rotary tool holder according to claim 1, in which the locking element is displaceable in a direction substantially perpendicular to the line of action of the reaction force.

3. A rotary tool holder according to claim 2, in which the locking element is displaceable in a direction parallel to, but offset

from, a radius extending from the rotary axis of the tool holder.

4. A rotary tool holder according to any one of claims 1 to 3, in which the locking element is guided in a slot provided with parallel walls and a radially external opening closed by elastic material.

5. A rotary tool holder according to claim 4, in which the elastic material is in the form of a continuous strip passing around the tool holder.

6. A rotary tool holder according to claim 5, in which the elastic material is rubber.

7. A rotary tool holder according to claim 5 or claim 6, in which the strip of elastic material is retained in a circumferential groove passing around the tool holder.

8. A rotary tool holder according to any one of claims 4 to 7, in which the length of the slot, in the direction of displacement of the locking element, is greater than the extent of displacement of the locking element caused by the insertion or removal of the tool.

9. A rotary tool holder according to claim 8, in which the said length of the slot is at least equal to the dimension of the locking element measured in the direction of its displacement.

10. A rotary tool holder according to any preceding claim, in which the locking element is a roller the rotary axis of which is arranged parallel to the rotary axis of the tool holder.

11. A rotary tool holder according to claim 1 or claim 2, in which the locking element is displaceable in a direction parallel to the rotary axis of the tool holder.

12. A rotary tool holder according to claim 11, in which the locking element is also displaceable in a direction radially of the tool holder as a result of its displacement in a direction parallel to the rotary axis of the tool holder.

13. A rotary tool holder according to claim 12, in which the locking element is slidable along a slide track arranged at an acute angle to the rotary axis of the tool holder.

14. A rotary tool holder according to any one of claims 11 to 13, in which a sleeve displaceable against the force of a spring, in a direction parallel to the rotary axis of the tool holder is provided with a radial bore accommodating a pin fixed to the locking element and moveable in a slot in the tool holder on displacement of the sleeve.

15. A rotary tool holder according to any preceding claim, in which two locking elements are arranged for symmetrical displacement with respect to the rotary axis of the tool holder.

16. A rotary tool holder for use with a tool as defined in claim 1, substantially as herein described with reference to Figures 1 to 2 or Figures 3 and 4 of the accompanying drawings.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*