

DESCRIPTION

The present invention relates to a collet intended to carry a cutting tool, particularly a tapping tool, subject on the one hand to a rotary movement about its axis, and on the other hand to an axial displacement and intended to be supported by a collet holder mounted on a spindle of a machine tool.

A cutting tool which is subject on the one hand to a rotary movement, and on the other hand to an axial displacement, being movements which are imparted to it by an appropriate machine, is subjected under certain conditions to its own axial movement resulting from the rotation of the tool and from friction on the surface to be machined, which is particularly the case with a tapping tool but the same phenomenon can arise for other kinds of machining.

The majority of present-day machines cannot ensure exact and constant synchronization of the axial movement of the tool itself, for example a tap, relative to the axial movement of the machine, which is in step with the rotation of the headstock. The magnitude of its own axial movement in the case of a tap is a function of the pitch of the tap. In fact, even if present-day digital controls permit exact synchronization during the tapping operation, a greater or lesser desynchronization occurs at the instant of reversal of the direction of rotation, when the desired depth of tapping is reached. The differences depend on the speeds of rotation, and they also result from the difference in inertia between the headstock of the machine and the carriage or the component causing the axial movement imparted by the machine to the tool, causing different accelerations or decelerations as the case may be. Even if machines with digital control have enabled one to do away with mechanical play, which is another source of desynchronization, absolutely constant control throughout the reversal of the direction of rotation, which is necessary in a tapping operation, can only be guaranteed by certain rare machines. The problem

up to the present day has been met by special apparatus for tapping, of widely varying constructions, which themselves take up the differences in the axial movements but have the disadvantage of being only tapping apparatus, which are on the one hand bulky and on the other hand equipped solely for tapping. Certain of these apparatus, with or without built-in reversal of the direction of rotation, have independent travel throughout the whole tapping operation. Sometimes tapping machines are provided with a mechanical system called a "pattern" for ensuring constant synchronisation, which is acceptable at low or medium speed.

Usually, a cutting tool is mounted on the spindle of the machine by means of a collet having a shank of appropriate shape and dimensions. The shank of the tool is mounted in a gripping collet mounted on its side on a collet holder. The gripping of the collet is carried out after the mounting in the collet holder by means of a nut which ensures the radial gripping of the collet on the tool and avoids the axial displacement of the collet and of the tool. To perform a tapping operation, the collet holder is taken out and it is replaced by a collet holder or tapping apparatus comprising an axial compensation. The top is mounted in the collet holder provided with an axial compensation by means of a collet identical or similar to collets used to hold other cutting tools.

A tapping apparatus with an integral collet is disclosed in US-A-1,702,810. It is constituted by a first external body provided with a shank to be mounted on the spindle of a machine, by a second internal body axially movable within a bore of the first body and assembled to the first body for rotation movement by a key. Means limit the axial displacement of the second body and a spring is provided for returning it to a rest position. The second body presents at the end located out of the first body a sleeve axially slotted intended to receive the tap shank. A nut cooperating with the external screw pitch of the sleeve for providing the holding of

the tap. The holding of the top is provided by the end of the second body, while the axial compensation is ensured by the back part of the second body in cooperation with the first body.

There exist tapping apparatus, and also quickchange tool holders, with interchangeable extension pieces of several types. These extension pieces can perform several functions, but never built-in axial compensation within the dimensions of the basic interchangeable extension piece. Moreover the extension piece is added on to its support, which increases the length of the total bulk.

The object of the present invention is to propose a tool-carrying collet enabling automatic compensation of the difference in axial movements of a top avoiding the need to use special and bulky apparatus for the machining, and in particular tapping operations with automatic machines with digital control.

The collet according to the present invention is defined by claim 1.

By equipping the tool carrying collet with an external body, the shape of which corresponds to a usual collet intended to be supported by a known collet carrier, while placing in a bore in this body a socket which will hold the cutting tool and be able to perform an axial displacement within the bore in the external body, between predetermined limits and against deformable resilient means, returning the socket to a predetermined rest position, one obtains automatic axial compensation of an amount which is of course limited by the construction and the dimensions of the collet.

This compensation in relation to the rest position of the socket can be made in one direction or in the other or in both, as will be explained in the discription.

The advantages of this collet with built-in axial compensation are as follows :

The collet according to the invention enables one to provide, in addition to the gripping function by means of radial screws, the function of uni- or bi-directional compensation within the same dimensions as those of standard collets which solely provide the gripping of the tool. It can be mounted within standard collet holders without any adaptation being needed and without increasing the length occupied as is the case with interchangeable extension pieces;

it is no longer necessary to arrange the gripping collet in specific apparatus which are special and bulky, for compensation of the differential axial displacement between the cutting tool and the axial displacement to which it is subjected by the machine tool;

the machining operation, particularly a tapping operation, can be carried out with standard collet holders of different lengths and sizes, thus permitting one to adapt to the differing shapes of the workpieces to be machined, much better than with conventional apparatus;

it is very economical and practical to be able to use the same collet carriers for similar operations, for example boring, reaming and tapping;

with CNC turrets with 3, 4 or 5 controlled shafts or even more, tapping operations often have to be performed on an alignment and in a direction different from the axis of the workpiece, and one often has to carry out several radial or axial tapping operations, even oblique ones, on the same workpiece, and in this case specific apparatus called driven tool carriers perform the functions of boring, reaming and tapping. The driven tool carriers for tapping, having to provide for axial compensation, are of a relatively complicated construction as mentioned above; they are expensive and bulky and can only be used for tapping. The collet for tapping according to the invention enables one to carry out this last operation with the tool carriers for drilling or reaming, this making unnecessary the special installation of a complete specific apparatus for tapping;

the tool-carrying collet according to the invention likewise simplifies the equipping of a workshop with tool carriers and gives to the user great flexibility of use because, since the machines have various attachments for the tool carriers, these can only shift from one machine to another in a relatively limited way, which is not the case with the collets according to the invention which are not bound to the attachment of the tool carrier and which can thus be fitted to any machine whatever. This collet

system thus offers the possibility of rationalizing almost completely the equipment of a workshop as regards different machining operations, especially those performed on CNC turrets, machining centers and CNC reaming machines. Hence the economic advantage is considerable.

The design of the collet makes it a simple and robust accessory which in practice withstands without harm any incorrect actuations or accidents which may occur ; only the means which do the gripping of the tool, which are preferably screws arranged radially in the socket, need to be replaced from time to time, and of course the cutting tool itself.

According to another variation, these means can be matching toothed surfaces provided on the external surface of the socket and the bore.

According to another embodiment, two matching flat surfaces formed on the external surface of the socket and the bore provide for the coupling for movement between the outer body and the socket.

According to another embodiment, the axial displacement of the socket within the bore is limited on the one hand by an added component arranged on the extremity of the socket and on the other hand by respective matching shoulders provided in the bore and on the socket.

The means which are resiliently deformable can be either springs, or resilient washers, or a body of resiliently deformable material.

According to another variation, if axial compensation is required to be provided in both directions, opposed resilient means should be provided to cause the return of the socket to its predetermined rest position.

The invention will be described in more detail, with the help of the accompanying drawing showing two preferred embodiments of the invention.

Figure 1 is a view in partial axial section of a first embodiment of the invention.

Figure 2 is a view in axial section of a second embodiment of the invention.

The collet of Figure 1 is arranged for compensation of axial displacement solely in one direction, namely that indicated by the arrow F.

It is constituted by three essential components, namely : an external body 1 formed with a bore 2, in the interior of which there is a socket 3, and a spring 4 arranged between the socket 3 and the bore 2 against a shoulder 5 of the bore 2 and a shoulder 6 of the socket. The general construction of the collet and more particularly of the external body 1 is not tied to one particular type or shape of collet and it is similar to, or at least compatible with, the gripping collets available on the market. It enables one to fix the cutting tool, the shank of which corresponds to the bore 7 of the socket 3 and is gripped by screws 8 arranged radially in the rear part of the socket 3 and acting against the driving square or against one or more flats machined on the shank of the tool.

The coupling between the external body 1 and the socket 3 for rotary movement is obtained by means of a first prismatic surface 9 of the socket with a corresponding prismatic surface 10 of the external body 1. These same surfaces serve also for axial guidance, during the compensating displacement, of the socket 3 within the body 1. The maximum independent displacement of the socket 3 within the body 1 is determined on the one hand by a shoulder 11 of the socket which abuts against the shoulder 5 of the bore, and on the other hand by a ring 12 fixed in a groove of the socket 3 and which, in the rest position, abuts against the internal surface of the body 1 and particularly abuts at the bottom of a recess 13.

Instead of using prismatic surface to provide the coupling between the body 1 and the socket 3 for rotary movement, other means can be envisaged such as keys, toothed outlines, balls rolling in axial, or inclined, or helical grooves, formed on the one hand in the external surface of the socket and on the other hand in the interior of the bore. In place of the spring 4, one can use resilient washers or a body of resiliently deformable material.

The operation on the collet of Figure 1 with a tapping tool is as follows : the linear feed of the machine is adjusted so that it is slightly less than the feed of the tap itself, which is defined on the one hand by the speed of rotation and on the other hand by the pitch of the thread of the tap. Thus during cutting the tap performs its own compensating displacement, that is to say the socket 3 shifts in the direction F as the tapping operation proceeds. At the end of the tapping operation, during the reversal of the rotation, desynchronization can occur between the axial feed applied by the machine and the feed of the tap itself, and it is compensated by the possibility for the socket to shift in one direction or the other. The feed of the machine is preferably adjusted to 95 % of the feed of the tap itself, thus at the instant of synchronized reversal of the rotation of the headstock and of the feed motion one is at approximately the middle of the compensating travel. The return movement of the machine is adjusted to the value of the return movement of the tap itself, so that the gripping collet remains well within its compensation travel, avoiding all constraint on the tap. The longer the compensation travel of the collet, the simpler is the operation of adjustment. In accordance with the characteristics of the machines and the speed of the tapping operation, a hesitation may be necessary during reversal of the rotation and of the linear feed.

In Figure 2 there is shown a collet for carrying a tool, comprising an external body 15 formed with a bore 16, in the interior of which can shift a socket 17, and two opposed springs 18 and 19 enabling axial displacement of the socket 17 from the rest position in the two directions F1 or F2. The spring 18 is housed in the interior of the bore and it abuts at one end against a shoulder 20 of the body 15 and at the other end against a shoulder 22 of the socket 17. The spring 19 abuts against the other face of the shoulder 20 of the body 15 and against a ring 23 screwed onto the extremity of the socket 17. The minimum axial displacement in the direction F1 is limited by the shoulder 24 of the socket 17, which the shoulder 20 abuts against. In the direction F2 the displacement is limited by the shoulder 25 of the ring 23, which the front part of the external body 15 abuts against. The coupling between the external body 15 and the socket 17 for rotary movement can equally be achieved by matching prismatic surfaces made respectively in the back part of the external body and on the socket, or abreast of the central bearing 28. Screws 16 arranged radially hold the shank of the tool in the interior of the bore 27 in the socket 17.



EUROPEAN PATENT APPLICATION N° 88810674.7 (0360947)

CLAIMS

1. Collet intended to carry a cutting tool, particularly a tapping tool, which is subjected on the one hand to a rotary movement about its axis, and on the other hand to an axial displacement, and intended to be supported by a collet holder mounted on a spindle of a machine-tool, the said collet comprises an external body (1; 15) provided with a cylindrical bore (2; 16) the external shape of which matches the shape of the collet holder and a socket (3; 17) coupled with the external body for rotary movement by means, the said socket (3; 17) being movable axially within the bore (2; 16) and provided with means (8; 26) for holding the cutting tool, the said bore (2; 16) of the external body (1; 15) comprises at least a polygonal female surface (10) cooperating with at least a polygonal male surface (9) of the socket (3; 17) aimed to couple the external body (1; 15) and the socket (3; 17) together for rotary movement and provide also the axial guidance of the said socket within the said body, and means (5, 11, 12; 20, 24, 25) limiting the axial displacement of the socket (3; 17) within the bore (2; 16), resiliently deformable means (4; 18, 19) being provided for returning the socket (3; 17) to a predetermined rest position the said means to hold the tool being radial screws (8, 26).

2. The collet as claimed in claim 1, wherein the means coupling the external body (1; 15) and the socket (3; 17) together for rotary movement comprise matching



toothed outlines formed respectively on part of the external surface of the socket and within the bore in the external body.

3. The collet as claimed in claim 1, wherein the means coupling the external body (1; 15) and the socket (3; 17) together for rotary movement are constituted by two matching flat surfaces formed on the external surface of the socket and on the surface of the bore in the external body.

4. The collet as claimed in one of claims 1 to 3; wherein the means limiting the axial displacement of the socket (3; 17) within the bore (2; 16) comprise, for limitation in one direction an added component (12; 23) arranged on the socket (3; 17), and for limitation in the opposite direction an internal shoulder (5; 20) in the bore (2; 16) in the external body, cooperating with a shoulder (11; 24) on the socket.

5. The collet as claimed in one of claims 1 to 4, wherein the resiliently deformable means (18, 19) are opposed to each other, to permit axial displacement of the socket (17) in two opposite directions (F1, F2) in relation to its predetermined rest position.

6. The collet as claimed in one of claims 1 to 5, wherein the resiliently deformable means are helical springs.

7. The collet as claimed in one of claims 1 to 5, wherein the resiliently deformable means are resilient washers.

8. The collet as claimed in one of claims 1 to 5,



wherein the resiliently deformable means are constituted by blocks of a resiliently deformable material.