DEVICE FOR CLAMPING A TAPER SHANK TOOL-HOLDER IN THE NOSE OF A ROTARY MACHINE-TOOL SPINDLE

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ABSTRACT
A device for clamping a tapershank tool-holder in the nose of a rotary machine-tool spindle, of the type comprising a retaining element capable of hooking on a mating element of the tool-holder and urged axially in the direction of clamping by a restoring spring, said retaining element being displaced, against the force of said spring, by an unclamping control member axially slidable within the machine spindle. It is possible to increase the strength clamping the tool-holder while the effort necessary to unclamp it may be maintained to a relatively low value, by the fact that the device further comprises a locking member axially connected to the retaining element and engaging a locking cam secured to the machine spindle, with said locking member being subjected to the action of a control member.

5 Claims, 2 Drawing Figures
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BACKGROUND OF THE INVENTION

The present invention relates to the devices for clamping a taper shank tool-holder in the nose of a rotary machine-tool spindle, of the type comprising a retaining element capable of hooking on a mating element of the tool-holder and urged axially in the direction of clamping by a restoring spring, said retaining element being displaced against the force of said spring by an unclamping control member axially slideable within the machine spindle.

Clamping devices of this kind have been described and shown in French Pat. No. 1,451,525 filed by the same applicant on July 22, 1965.

Such devices are advantageous by the fact that the clamping effort is obtained by an internal action in the spindle and, therefore, without any external interference during operation of the machine. However, they have to be withdrawn because when it is desired to increase the effort clamping the tool-holder in the spindle, the effort necessary to unclamp the tool-holder should also be increased; now, this latter effort is backed by the anti-friction bearings for the rotary spindle, which may lead to excessive strain on said bearings.

OBJECTS AND SUMMARY OF THE INVENTION

One object of the invention is to provide a clamping device of the type involved which has not the aforesaid drawbacks of the known devices.

To this end, according to the invention, the device further comprises a locking member axially connected to the retaining element and adapted to engage a locking cam secured to the machine spindle, with said locking member being subjected to the action of a control member.

Owing to the fact that the locking member connected to the retaining element is capable while engaging the cam to provide an additional force for clamping the tool-holder in the nose of a spindle, it is possible, for a predetermined final clamping effort, to reduce greatly the strength of the spring for restoring the retaining element, with said spring having only to provide the moderate effort for driving home the tool-holder. Whatever the means adopted for controlling the locking member, it is possible to make this control require but a weak effort so that even though this control is subjected to the action of a further restoring spring, it is possible to provide this latter spring with a relatively weak force and, in any case, a force weaker than that of the spring for restoring the retaining element and which, in the new improved proposed arrangement, has a strength weaker than that of the spring in the known prior devices. In other words, for a given total effort clamping the tool-holder in the nose of the spindle, it is possible to ensure unclamping of the tool-holder by means of an effort much weaker and therefore relieve accordingly the anti-friction bearings in which the spindle is journalled.

In an advantageous embodiment, the control member for the locking member is also axially movable within the spindle and resiliently urged in the direction for engaging the locking member against the cam, by a locking spring having a force weaker than that of the spring for restoring the retaining element and backed against an abutment part secured to said retaining element.

In a particular embodiment, the control member for the locking member is adapted to engage said abutment part secured to the retaining element and also to serve as an unclamping control member.

One form of construction of said clamping device will now be described solely by way of example without any implied limitation, reference being made to the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows, in longitudinal section, the clamping device with the tool-holder clamped in the nose of the spindle, and

FIG. 2 is a view similar to FIG. 1 but in which the device is represented with the tool-holder in released position.

DETAILED DESCRIPTION OF THE INVENTION

A standard taper shank tool-holder 1 is mounted in a corresponding taper bore 2 of the nose of a rotary spindle 3 of a milling machine for instance. The taper mounting is completed, in a conventional manner, by one or several keys 4 each of which is secured in a radial slot 5 of the spindle nose and is engaged in a corresponding notch 6 provided in a circular flange 7 of the tool-holder.

The device for clamping the tool-holder 1 in the nose of the spindle 3 comprises first a retaining or clamping element constituted by a resilient clamp 11 of the type described in detail in the aforesaid French Patent. Said clamp is, for example, made of tempered steel and has a generally substantially cylindrical tubular configuration with longitudinal slots which determine resilient tongues 13 secured by one of their ends in an annular portion forming a base 14, whereas their other end is free and has a hook 16 and an inclined heel 17.

The hooks 16 are adapted to catch a mating element constituted by an enlarged portion 21 of the inner end of the tool-holder 1 and constituted, for instance, by the head of a screw mounted in said end of the tool-holder.

The diameter of the cylindrical space between the inner ends of the hooks 16 of the tongues of the resilient clamp in a free state is slightly larger than the diameter of the enlarged portion 21 in order to enable the tool-holder to be driven home into the bottom of the spindle nose past said hooks.

The resilient clamp 11 may slide within bore 23 of the spindle, the diameter of which is such that the inclined heels 17 of the clamp force the hooks 16 against the annular face of the enlarged portion 21 of the tool-holder. A portion 24 of the bore of the spindle 3 in which are located the ends of the resilient tongues 13 of the clamp under released condition of the tool-holder (FIG. 2) has a diameter slightly larger so that, when the heels 17 are located in this portion, the resilient tongues 13 of the clamp may move apart and enable the hooks 16 to move away from one another while letting out axially the enlarged portion 21 of the tool-holder. Both portions 23 and 24 of the bore of the spindle merge into a connecting tapering portion 25 forming a ramp for the heels 17, with said ramp being constituted, in the example represented by one end of a sleeve 27 having a force fit in the bottom of the portion 24 of the bore of the spindle.
The base 14 of the clamp 11 is applied against one end of a rod 31 by means of a shouldered shaft 32, one end 33 of which is screwed in the corresponding end of the rod 31, whereas its other end is formed with a thrust member 34 for ejecting the tool-holder. A calibrated ring 35 interposed between the end of the rod 31 and the base 14 of the resilient clamp provides for an accurate axial positioning of the latter.

The rod 31 may slide freely within the bore 23 of the spindle; it has a variable length which is a function of the length of the spindle, whereas the other portions of the mechanism may be identical for different machines.

The other end of the rod 31 is terminated by a screw-threaded portion 36 screwed into one end of a sleeve 37 which carries a centering ring 38 in an enlarged portion 39 of the bore of the spindle.

The sleeve 37 and, therefore, the rod 31 and the clamp 11 which are secured to said sleeve, are subjected to the action of a restoring or clamping spring 41 constituted, in this example, by a helical compression spring one end of which bears against the ring 38 and the other end against a shoulder 42 which separates from each other both portions 23 and 39 of the bore of the spindle. The axial stroke of the sliding assembly is limited by a screw 44 radially mounted in the spindle 3 and the end of which is engaged in a groove 45 provided along a generatrix of the rod 31.

The sleeve 37 carries, near its other extremity, a second resilient or locking clamp 51 of the same type as the clamp 11 but tongues 55 of which, as a contrast, have a natural tendency to be brought toward one another instead of away from one another as in clamp 11. A base 52 of this locking clamp is screwed on the sleeve 37 and it is firmly secured thereto by means of a screw 53. Each tongue 55 of the clamp 51 has an inner heel 56 and an outer heel 57. The outer heels 57 are adapted to engage a camming portion 58 formed by an annular frusto-conical surface coaxial with the spindle 3 and the apex angle of which is substantially 140° with said surface belonging, for instance, to a ring 59 having a force fit in this end of the spindle. The inner heels 56 of the resilient locking clamp 51 bear against a tapering portion 62 of a member 63 for controlling the locking clamp, which is, at the same time, a general unclamping control member by the fact that it comprises an inner portion or piston 64 at the end of which is adapted to bear against a shoulder 65 of the sleeve 37 through an abutment part constituted by a disc 66.

The locking and unclamping control member 63 is subjected to the action of a second or locking spring 61 constituted, in this example, by a helical compression spring, one end of which bears against the disc 66 and the other end against a shoulder 67 of the control member 63. The strength of this spring is weaker than that of the clamping spring 41 and its value as well as the values of the slopes of the tapering portion 62 of the locking control member and of the cam portion 58 are determined in such a manner as to provide for the additional clamping force to clamp the tool-holder 1 in the nose of a spindle, in addition to the force already provided directly by the clamping spring 41.

The stroke of the control member 63 is limited by a screw 69 radially mounted in the sleeve 37 and the end of which is engaged in a longitudinal groove 71 in the control member 63. A calibrated ring 68 is interposed between the rod 31 and the sleeve 37. The aim of this ring is to allow, when the spindle has a short length, to mount the resilient clamp 11 and the ring 35 directly on the sleeve 37 while omitting the rod 31 and the ring 68. In such a case, the location of the screw 44 is changed for instance facing the screw 69 so that it may act against the locking clamp 51.

The control member 63, the disc 66, the rod 31 and the shaft 32 are pierced throughout with an axial bore 72 through which it is possible to conduct a jet of compressed air in order to clean the tapering surfaces of the tool-holder 1 and of the bore 2 of the spindle which are to engage each other during the clamping action.

The operation of the device is as follows:

It will be assumed that a tool-holder has just been ejected and that, therefore, a pressure has been exerted in the direction of the arrow / (FIG. 2) against the unclamping control member 63 so that the piston 64 is engaged against the disc 66 and maintains the rod 31 pushed away as well as the clamp 11, the tongues of which are open. A new tool-holder 1 is introduced into the nose 2 of the spindle; its enlarged portion 21 passes freely between the open hooks 16 of the clamp 11. The pressure against the control member 63 is released. The clamping spring 41 displaces therefore the sleeve 37, the rod 31 and the clamp 11 towards the left in the figure, so that the heels 37 of this clamp slide against the tapering portion 25 and bring the hooks 16 together behind the enlarged portion 21 while pulling the tool-holder home. When the latter bears perfectly against the taper bore 2 of the spindle, the first step of the clamping process is ended and has produced a clamping effort which corresponds exactly to the force of the clamping spring 41. The control member 63 moves back in a direction reverse to that of the arrow / under the action of the second spring 61 so that the piston 64 moves away from the disc 66. The tapering portion 62 of this control member moves the heels 56 of the locking clamp 51 outwardly while the heels 55 of said locking clamp 51 slide also outwardly against the conical ramp 58 (FIG. 1), thus providing an additional pulling effort against the sleeve 37 with respect to the spindle 3, in addition to the clamping force already provided by the clamping spring 41.

In order to unclamp the tool-holder, a pressure is exerted against the control member 63 in the direction of the arrow /. In a first step of the unclamping procedure, the force of the second spring 61 is to be opposed. The locking clamp 51 is brought together or contracted under the effect of its own resiliency which necessitates no force to be exerted therefor. In a second step, the end of the piston 64 of the control member 63 comes into engagement with the disc 66 so that, from now on, it is sufficient to oppose the force of the clamping spring 41 only. Further movement of the unclamping control member 63 causes sliding movement of the sleeve 37, the rod 31 and the clamp 11, the tongues of which move outwardly naturally (FIG. 2) under the action of their own resiliency and free the tool-holder 1 finally separated from the bore 2 of the spindle at the moment when the thrust member 34 hits against the end of the enlarged portion 21 of the tool-holder.

It will be noticed that the presence of the locking system acting against the frusto-conical cam 58 provides an additional clamping action of the tool-holder in the spindle, which makes it possible to reduce in a great proportion the force of the clamping spring 41 which, in the prior known devices, was the only element adapted to provide the clamping effort.
In the device of the present invention, it is thus possible to reduce to a great extent the force of this clamping spring 41 while preserving a total clamping effort of the tool-holder equivalent to that obtained in the prior devices. To provide for unclamping, it is thus sufficient to oppose the force of a restoring spring much weaker so that the anti-friction bearings in which the spindle is journaled are relieved in proportion.

Of course, the invention is not limited to the embodiment described and represented which was given solely by way of example, and many modifications may be adapted according to the applications contemplated without departing from the scope of the invention.

Thus, for instance the unclamping and locking control member 63 could be actuated positively in either direction instead of being subjected in one direction to the action of a restoring spring such as spring 61.

The unclamping control member and the locking control member could be distinct from each other, for instance in the form of coaxial members.

What I claim is:

1. A device for clamping a taper shank tool-holder in the nose of a rotary machine-tool spindle, comprising: retaining element axially movable within said spindle, a corresponding mating element carried by the tool-holder and adapted to be engaged by said retaining element, a restoring spring urging said retaining element in the direction ensuring clamping of said tool-holder in said spindle, an unclamping control member axially slidable within said spindle and adapted to push said retaining element against the action of said restoring spring to unclamp said tool-holder, a locking member axially slidable with respect to said spindle and operatively connected to said retaining element, a locking cam secured to said spindle and adapted to be engaged by said locking member, and a locking control member for controlling said locking member for cooperation with said locking cam.

2. A device for clamping a taper shank tool-holder in the nose of the rotary machine-tool spindle, comprising a retaining element axially movable within said spindle, a corresponding mating element carried by the tool holder and adapted to be engaged by said retaining element, a restoring spring urging said retaining element in the direction ensuring clamping of said tool-holder in said spindle, an unclamping control member axially slidable within said spindle, and adapted to push said retaining element against the action of said restoring spring to unclamp said tool-holder, a locking member axially slidable with respect to said spindle and operatively connected to said retaining element, a locking cam secured to said spindle and adapted to be engaged by said locking member, and a locking control member for controlling said locking member for cooperation with said locking cam.

3. A device for clamping a taper shank tool-holder in the nose of a rotary machine-tool spindle, comprising a retaining element axially movable within said spindle, a corresponding mating element carried by the tool holder and adapted to be engaged by said retaining element, a restoring spring urging said retaining element in the direction ensuring clamping of said tool-holder in said spindle, an unclamping control member axially slidable within said spindle and adapted to push said retaining element against the action of said restoring spring to unclamp said tool-holder, a locking member axially slidable with respect to said spindle and operatively connected to said retaining element, a locking cam secured to said spindle and adapted to be engaged by said locking member, and a locking control member for controlling said locking member for cooperation with said locking cam, said locking cam being constituted by a frusto-conical surface coaxial with said spindle and having an apex angle of approximately 140°.

4. The device according to claim 3, wherein said locking member is constituted by a sleeve having longitudinal resilient tongues the tips of which are naturally urged toward one another, each of said tongues having an outer heel for engagement with said locking cam and an inner heel, said locking control member having a conical portion and said inner heels engaging said conical portion of said locking control member.

5. The device according to claim 2, wherein said locking control member is adapted to engage said abutment part secured to said retaining element and also to serve as unclamping control member.

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