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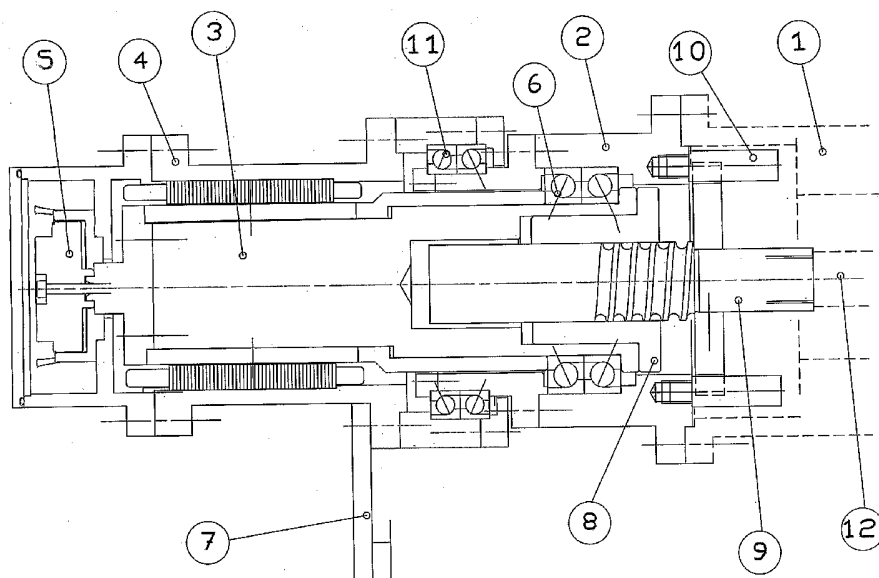
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(54) Title: ELECTRONIC DRIVE EQUIPMENT FOR SPINDLES



(57) Abstract: An electronic drive equipment is described, able to control a clamping device mounted on a rotating member (1) of a machine tool. Said electronic drive equipment is mounted on the rotating member (1) and it is fastened to the machine tool basement (7). The electric motor (4) of the electronic drive equipment puts in rotation a shaft (3), integral with a lead nut element (8) actuating a ball screw (9), this rotation causing the axial displacement of the ball screw (9) which actuates a tie rod (12) connected, by means of thrust bearings, to the clamping device, that is thus operated. A pulse emitting device (5) is provided, able to control the position of the electric motor (4) and to transmit all the required data related to the machine tool rotating member (1), together with the position of the clamping device, to the machine tool numeric control device.

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“ELECTRONIC DRIVE EQUIPMENT FOR SPINDLES”

The present invention is about an electronic drive equipment able to control a
5 clamping device mounted on a rotating member, preferably but not necessarily a
lathe spindle.

At present, the control of clamping devices mounted either on rotating or fixed
elements is performed by hydraulic cylinders able to put in motion a tie rod.
Therefore, a properly dimensioned hydraulic equipment is required to operate these
10 cylinders, in order to supply oil at the desired pressure and flow rate. The force
required to clamp the element to be machined on the machine tool is transmitted by
means of the hydraulic drive equipment. The stroke performed by the hydraulic
cylinder is then controlled by electric devices, giving the signal of reached position
required to safely continue the machining operations.

15 In known assemblies, the clamping force must be predetermined according to
the machining to be performed and it cannot be changed during said machining, i.e.
when the clamping device is rotating, since the hydraulic system does not provide the
required safety conditions for the operator.

However, for machining more and more accurate workpieces, they have to be
20 clamped with forces able to minimize the workpiece deformation, and it is thus
required to modify the clamping force according to the machining to be performed.

For this purpose, in known assemblies, it is required to stop the spindle
rotation, modify the hydraulic pressure and then restart the machine tool spindle.
These operations require a considerable idle time, and the clamping force control is
25 not accurate and it cannot be changed during the workpiece machining, i.e. when the
spindle speed rate is changed, since it is extremely dangerous for the operator.

Therefore, electronic systems for controlling the clamping devices have been
proposed, said systems being provided with an electric collector. However, this
electric collector has the disadvantage that high speed rates of the machine tool are
30 not allowed, and said electric collector is subject to wear phenomena.

It is thus an object of the present invention to provide for a drive equipment for
the clamping device of a machine tool which allows, with respect for the safety rules,
to manage the clamping force of the workpiece on the machine tool in an analogue
way, i.e. with electronic components instead of hydraulic ones, as a function of the

machining parameters and/or machining technology requirements, said driving equipment having a speed limit comparable with that of the machine tool on which it is installed.

5 The use of an electronic system instead of an hydraulic one and the elimination of the electric collector allow to modify in an analogue way the clamping force of the workpiece to be machined, directly from the machine tool control panel, being possible as well to modify the stroke of the driving tie rod in an analogue way, as already happens for the machine axis. Furthermore, the elimination of the electric collector allows to improve both the machine performances, since the rotation speed
10 limits are increased, and the safety for the operator, while the elimination of the hydraulic drive equipment allows to reduce the machine overall size and cost, as well as to introduce environmental advantages, since the exhaust fluids disposal is no more required.

Characteristics, objects and advantages of the present invention will be better
15 highlighted in the following description with reference to the annexed figure of drawing, showing a cross sectional view of an embodiment of the invention given in a not limiting way.

With reference to the annexed figure, a generic rotating element of a machine tool, like for example a lathe spindle, is shown in phantom and it is indicated with
20 numeral 1.

The electronic drive equipment according to the present invention is mounted on the machine tool spindle 1, by means of the flange 2 and the thrust bearings 6 and 11, and it is thus fastened to the machine tool basement in the point indicated with numeral 7. Said electronic drive equipment performs its control function on the
25 clamping device through the axial movement of a lead nut element 8 mounted on the machine tool spindle 1, and it is provided with an electric motor 4 of brushless type for its actuation.

When the machine tool is not working, with the drive motor of the spindle 1 in torque, the electric motor 4 of the electronic drive equipment puts in rotation the shaft
30 3, integral with the lead nut 8. This rotation causes the axial displacement of a ball screw 9 which actuates a tie rod 12 connected, by means of thrust bearings, to the clamping device, that is thus operated.

The electronic drive equipment according to the present invention is furthermore provided with a pulse emitting device 5, such as an encoder or a phonic

wheel, whose function is to control the position of the electric motor 4 and consequently to transmit all the required data related to the machine spindle 1, together with the position of the clamping device, to the machine tool numeric control device.

5 To allow the axial movement only of the screw 9, an anti-rotation device 10 is provided.

The axial movement of the tie rod 12 is performed through the relative movement of the machine tool spindle 1 drive motor and the brushless electric motor 4 of the electronic drive equipment according to the invention. When the machine tool
10 spindle 1 is idle, the electric motor 4 is put in rotation and, as previously mentioned, the displacement of the tie rod 12 is obtained, with consequent opening and closing of the clamping device. When the desired movement has been completed, the two motors rotate with perfect synchronism, keeping the tie rod 12 position fixed. In this way, it is possible to wire the electric motor 4 without using rotating electric collectors.

15 It is thus possible to control the clamping device through the machine tool numeric control device, as a function of the spindle 1 speed, and the clamping force of the workpiece can be changed as well in a continuous way, obtaining a prompt and reliable response from the whole assembly.

A safety brake, preventing the movement in case of voltage failure, can be
20 furthermore provided.

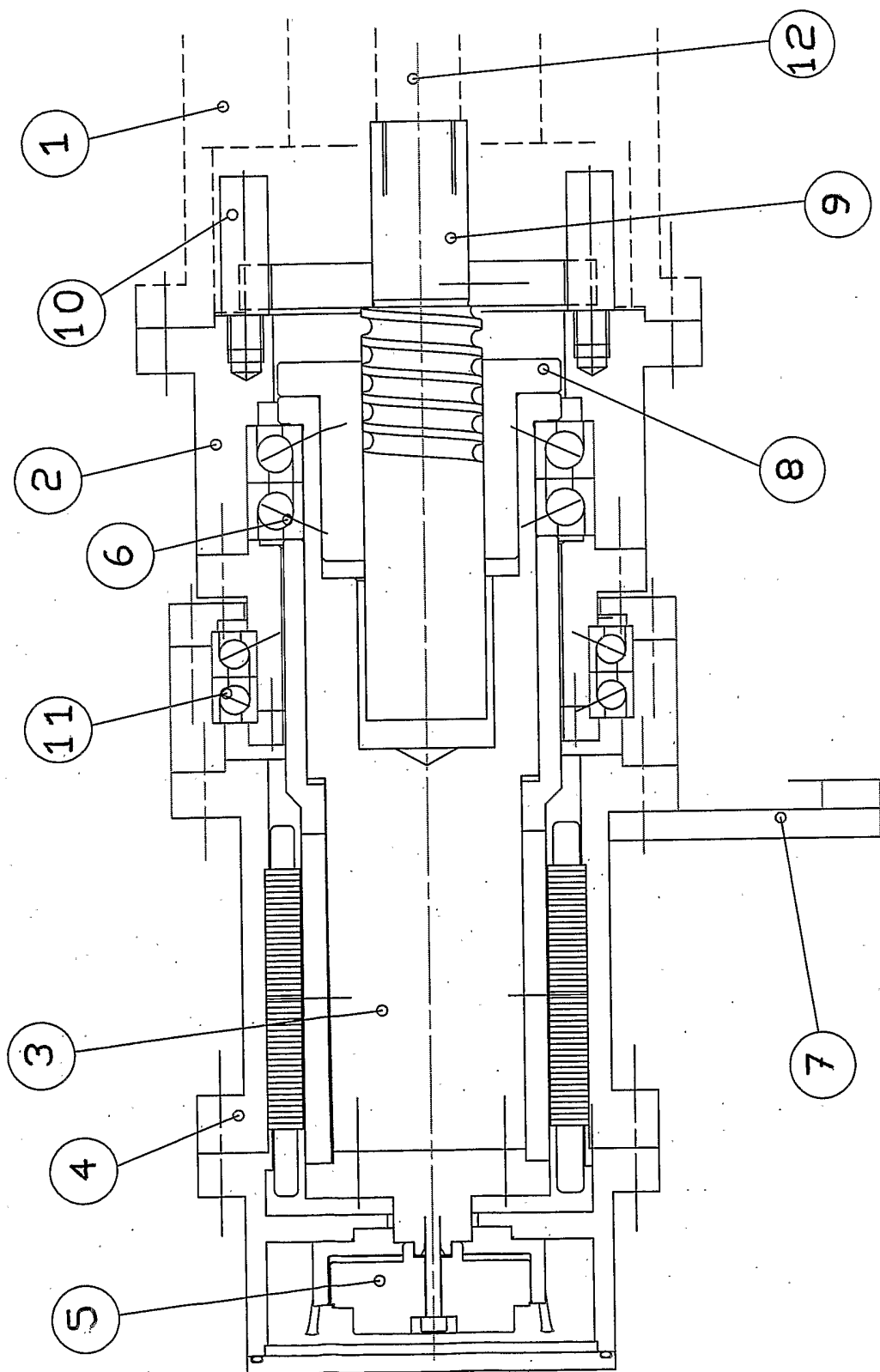
Therefore, the electronic drive equipment according to the present invention fully achieves the intended objects, allowing a better control of a machine tool clamping device and increasing at the same time the performances and the safety in respect of an hydraulic system. Furthermore, a considerable reduction of the
25 machine overall size and the productive costs is achieved.

It is to be understood that several modifications, additions, and/or replacements of equivalent elements could be made to the electronic drive equipment according to the present invention, described with explanatory purpose only, without falling outside its scope of protection as defined in the appended claims.

CLAIMS

1. An electronic drive equipment able to control a clamping device mounted on a rotating member (1) of a machine tool, the clamping device comprising a rotating shaft (3) integral with a lead nut element (8) actuating a ball screw (9), characterized
5 in that the rotation of said shaft (3) is performed by an electric motor (4), said rotation causing the axial displacement of said ball screw (9) which actuates a tie rod (12) connected, by means of thrust bearings, to said clamping device, that is thus operated.
2. The electronic drive equipment according to claim 1, characterized by
10 comprising at least a pulse emitting device (5) able to control the position of the electric motor (4) and to transmit all the required data related to the machine tool rotating member (1), together with the position of the clamping device, to the machine tool numeric control device.
3. The electronic drive equipment according to claim 1, characterized in that an
15 anti-rotation device (10) is provided, in order to allow the axial movement only of the lead nut element (8).
4. The electronic drive equipment according to claim 2, characterized in that the pulse emitting device (5) is an encoder or a phonic wheel.
5. The electronic drive equipment according to claim 1, characterized in that the
20 electric motor (4) is a brushless type motor.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
B23B31/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B23B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 114 685 A (FUJI MACHINE MFG. CO. LTD) 11 July 2001 (2001-07-11) column 9, line 14 - column 9, line 35 -----	1-4
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A	US 4 573 380 A (BALD ET AL) 4 March 1986 (1986-03-04) the whole document -----	1-5

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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