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[54] **SUPPORT ADJUSTING DEVICE**

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[51] **Int. Cl.** **B23b 97/26**

[58] **Field of Search**.....90/15, 16, DIG. 28; 29/568; 77/3 A; 83/74; 408/235

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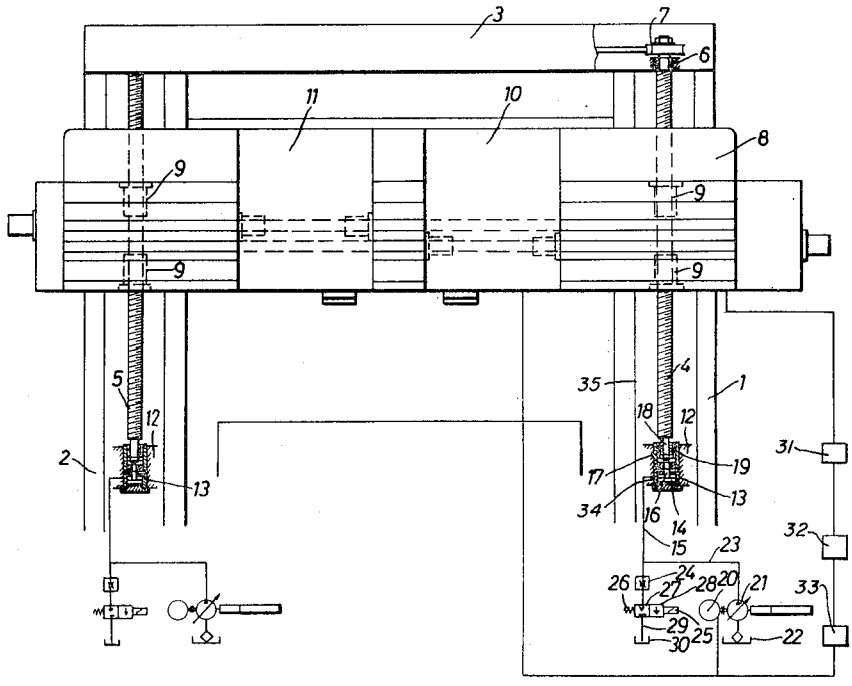
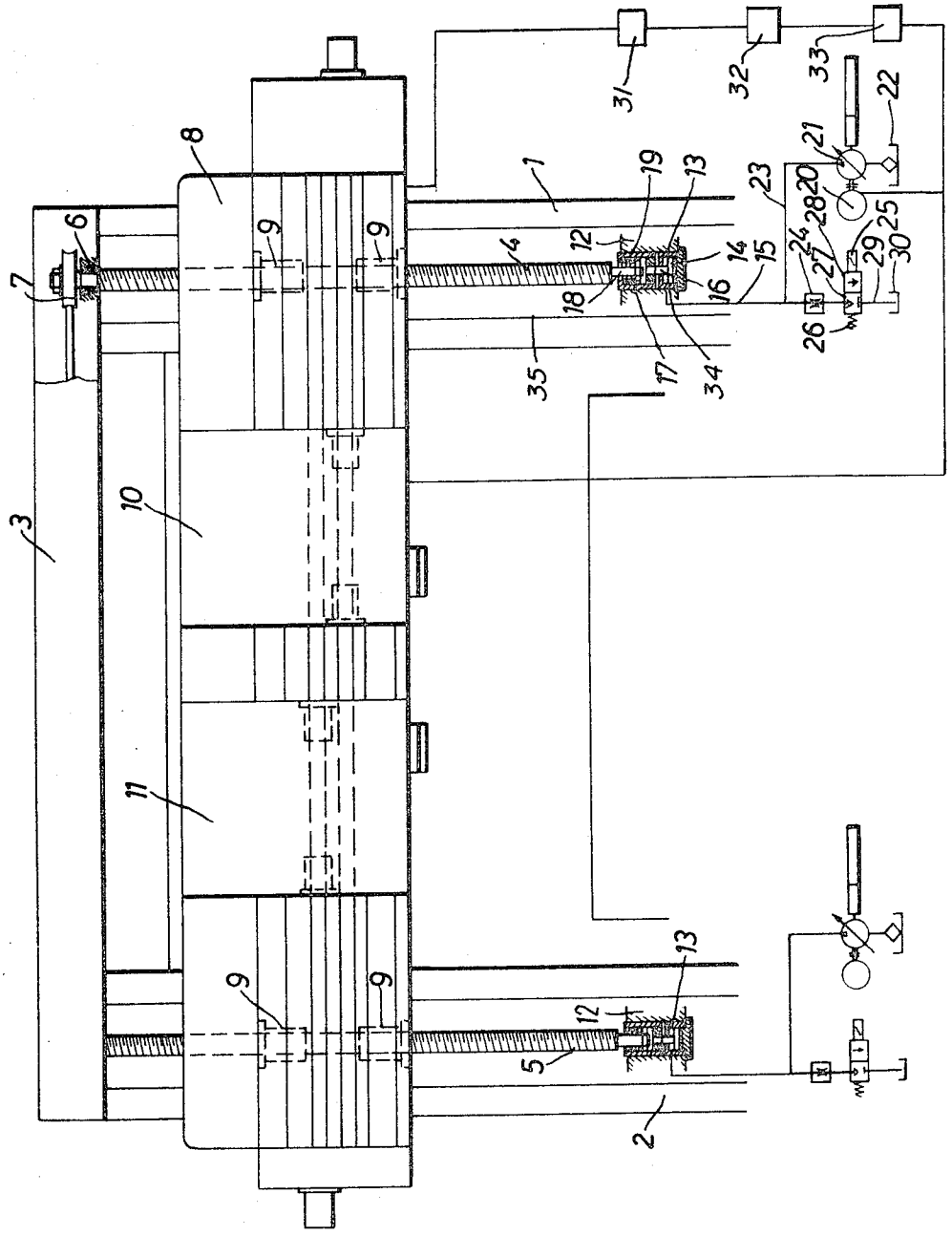
[57] **ABSTRACT**

A device is used for correcting the bearing of transverse carriers of single post and double post machine tools with tool holders movable upon the carriers. The device is particularly characterized by electrical or hydraulic tensioning devices which engage lower ends of spindles. These tensioning devices exert a force which varies depending upon the load of the ends of spindles by the support location and amplify it to a constant total tension.

1 Claim, 1 Drawing Figure





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SUPPORT ADJUSTING DEVICE

This invention relates to a device for correcting the position of transverse carriers of single post and double post machine tools, such as postal milling machines, boring machines, planing machines, surface polishing machines and lathes, as well as combinations of these machines.

When heavy supports are moved upon transverse carriers, the bearing positions of these carriers relatively to the posts are changed due to the fact that the spindles are subjected to different loads depending upon the location of the support or supports and thus are differently extended. This drawback is eliminated as a rule by the provision of a water level with bubble, an electronic device or an auto-collimation telescope, which permit an adjustment of the spindles until the corrected location of the transverse carrier is attained. These devices make possible an action upon differential drives which are provided upon the upper end of the spindles. These known devices have, however, the drawback that the precision of adjustment is not sufficient to make secure a precise treatment of the surfaces of the workpiece. Furthermore, when the extension in length of one transport spindle is taken into consideration that of the second one is not considered, with the result that there is a change in the position of the transverse beam in the vertical direction.

An attempt has been made to diminish this drawback by a preliminary setting of the two transport spindles, but these means do not suffice to make certain an acceptable treatment of the workpiece independently of the momentary position of the support or supports upon the transverse carrier.

Sufficient improvement is also not attained by strengthening the clamping of the transverse beam.

An object of the present invention is the provision of a device operable upon a different principle than those of prior devices and having a greater precision than prior devices.

Other objects of the present invention will become apparent in the course of the following specification.

In the accomplishment of the objectives of the present invention it was found desirable to provide hydraulic or electrical drawing devices engaging the lower ends of the spindles with a tension which varies depending upon the load upon the ends of the spindles by the support location so as to amplify it to a constant total tension.

For that purpose it is possible, by way of example, to provide a tension meter or an expansion strip at the upper non-threaded end of the spindle but below its upper support, so that the tension at this location will be determined and will be held constant by a corresponding draw gear.

An even simpler solution is an adjustment of tension depending upon the stroke, namely, upon the actual location of the support or supports upon the transverse carrier, i.e. their distance from the carrier. This type of actuation is particularly nonsensitive and operates very precisely, since it operates substantially linearly depending upon the distance of the support or supports from the axis of the spindle or from another fixed reference point at the transverse carrier. If several supports are provided upon the transverse carrier, the two distances of the support from the reference point must be added or subtracted.

The actual constructional embodiment can be accomplished hydraulically or pneumatically in a simple manner by providing the lower end of the spindle with a piston or causing it to cooperate with a piston which is movable in a fixed cylinder, for example, a cylinder fixed to the post. Transmitting means, possibly with gears, can be provided between the piston and the lower end of the spindle so that, for example, it is also possible to let the cylinder operate horizontally when this is deemed advisable due to available locations or other constructional considerations.

In case of an electrical device the lower end of the spindle can be provided with a drive, such as a drive corresponding to known differential gears, whereby it is advisable to insert between this point of engagement of the pulling force and the lower end of the spindle a spring package for balancing purposes and also for the utilization of its spring characteristics.

The present invention can be used also in the reverse manner, namely, the arrangement can be such that, as in known balancing devices, the lower ends of spindles are firmly fixed while balancing drives engage the upper ends of spindles. However, these drives are operative not by auto-collimation but by measuring tensions in the spindle or by changes in the position of support or supports.

To set forth the present invention more clearly the following example of the usual portal milling machine is given:

The weight of the transverse beam is 12 t. and the support weight when only one support is used is 8 t. In the central position of the support each spindle is subjected to one half of the weight of the transverse beam plus one half of the weight of the support, or a total of 10 t. In accordance with the present invention in this central position of the support each spindle receives an additional pressure or tension of 10t. Then each spindle is subjected below the bolt of the transverse beam to a load of 10 t., while above the bolt of the transverse beam the spindles are subjected to a load of 20 t. This total load above the bolt of the transverse beam must be mentained constant when the support is moved to one side out of the middle position. If, for example, the support is moved up to the right-hand spindle, then this spindle in addition to one half of the transverse beam weight is loaded with the entire support weight, that is, with 14 t. The left hand spindle, on the other hand, then carries a load corresponding to one half of the weight of the transverse beam, namely, 6 t. Therefore, if the present invention is not utilized the part of the right hand spindle above the transverse beam bolt would carry the load of 24 t. while the corresponding part of the left hand spindle would carry 16 t. Thus the present invention must change the tension in that the tension device of the present invention must add 4 t. to the load of the left hand spindle and must diminish the load of the right hand spindle to the extent of 4 t., so that both spindles will be again subjected to a load of 20t. each.

Since the spindle acted by the support weight is linearly dependant upon the location of the support on the transverse beam, there exist simple calculable relations which make it possible to directly operate the additional loads depending upon the position of the support upon the transverse beam.

If several supports are provided upon a transverse beam forces resulting from the various locations of the support can be combined into a resultant by a simple addition or subtraction. Corresponding actuating devices for regulating the additional spindle force, that is, deviating actuations, are known in the art and do not constitute the subject of the present invention.

In cases of special loads, particularly when great precision is required and when the weights of the supports vary, the present invention provides that the actuation should take place through gauging devices in the head of the spindle which continuously measure the force affecting the spindle and provide tension uniformity in both spindles by a balancing switching device and the device of the present invention providing additional load. This is of particular importance for milling with vertical feed of the transverse beam.

It is apparent that in the case of the arrangement of the present invention the strands of the portal machine are also subjected to constant tention so that here also there are no shape changes. This fact also has an excellent effect upon operational precision of a machine tool of the present invention.

The present invention can be also applied to one stand machine tools wherein it is necessary to maintain constant the torque which changes corresponding to the changes in position of the support upon the transverse carrier, at the base of the stand and also upon the transverse carrier itself, whereby the same conditions apply as have been described already in connection with spindles for machine tools having two stands. Thus the upper end of the stand can be provided with an iron tie or a pressure device by means of which the transverse carrier can be always maintained in a horizontal position depending upon the variable torque produced by the location of the support. The iron tie can be fixed at the stand by a separate slide since this provides the possibility of compensating for the change in the location of the transverse beam caused by play in the guides of the transverse carrier at the stands.

Bendings of the stand itself can be balanced by an iron tie or the like engaging at an acute angle and outside of the swinging range of the stand. Reversely, it is possible to provide at the upper end of the stand corresponding counter arms extending to the transverse carrier. These arms can be swingable jointly with the transverse carrier and can engage iron ties or the like at its outer free ends. The iron ties extend to the base of the stand and their force is so regulated that the horizontal location as well as the high position of the transverse carrier are kept constant independantly of the location of the support or the supports. This just described arrangement constituting a part of the present invention corresponds to the use of the torque balance principle in hammer cranes.

The invention will apear more clearly from the following detailed description when taken in connection with the accompanying drawing the sole FIGURE of which is a digrammatic from view of a two stand portal machine tool with two supports. This embodiment of the present invention is shown by way of example only and parts which are not important for the purposes of the present invention have been left out.

The portal of the illustrated machine consists of a right-hand stand **1** and a left hand stand **2** which are connected by a yoke **3**. Spindles **4** and **5** are mounted in upper longitudual pressure bearings **6** in the stands and are rotatable by a worm drive **7**. A transverse carrier **8** is vertically adjustable by screws **9**. Two supports **10** and **11** are slidable upon the transverse carrier, the supports being shown in symmetrical positions in the drawing.

Bearing brackets **12** are provided in the lower ends of the stands **1** and **2**. According to the present invention cylinders **13** are firmly fixed in these brackets. Pistons **14** are movable in these cylinders and their upper surfaces are engaged by pressure conduits **15**. Piston rods **16** transmit the actions of the pistons to bearing sockets **17**. The lower ends **18** of the spindles held in ball bearings **19** are carried by the sockets **17**. The sockets **17** are secured against rotation in the brackets **12** but are movable longitudinally.

Pressure is regulated by an extension strip (not shown) which is located upon the upper end of each spindle and which acts as the servo-regulator for the driving motor **20** of a hydraulic pump **21** connected with each spindle. The pump transmits the pressure medium from a supply container **22** though a conduit **23** on the one hand to the conduit **15** directed to the piston **13** and on the other hand to a throttle **24** and a regulating valve having a closing part **27** and a flow part **28**, the valve being operated electrically by a relay **25** and subjected to the action of a return spring **26**. Thus oil can flow back to a container **30** which can be combined with the container **22**.

The drawing shows diagrammatically means **31** actuating the tensioning device depending upon the location of the support **10** upon the carrier **8**, and adding and subtracting device **32**, a balancing drive **33**, a spring package **34** and an iron tie **35**.

I claim:

1. In a machine having two stands, a transverse carrier connected with said stands, at least one support upon said carrier and a separate spindle rotatably mounted in each stand; a tensioning device for correcting the bearing of the transverse carrier, said device comprising a separate socket connected with one end of each spindle, a separate cylinder fixed in each stand, a piston movable in said cylinder, a spring package located between said piston and said socket, and means supplying a pressure medium to said cylinder to exert a force variable depending upon the load on the spindle ends, said means comprising a regulatable motor, a hydraulic pump connected with said motor, a container for the pressure medium connected with said pump, a conduit connected with said cylinder, another conduit connected with said pump and the first-mentioned conduit, a regulating valve connected with the first-mentioned conduit, electrical means operating said valve, and another container connected with said valve.

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