June 30, 1942. M. PÉGARD 2,288,420

CARRIAGE CONTROL MEANS OF MACHINE-TOOLS

Filed Jan. 5, 1940 2 Sheets-Sheet 1

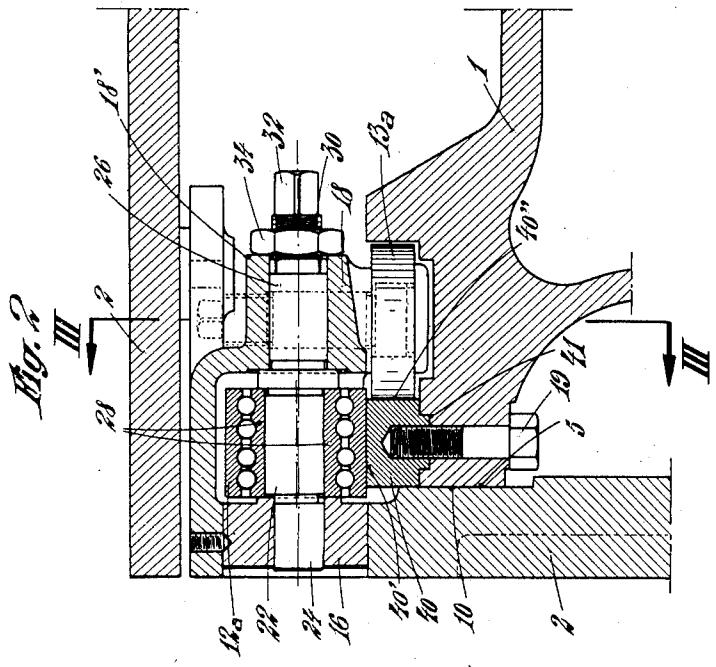

Fig. 2

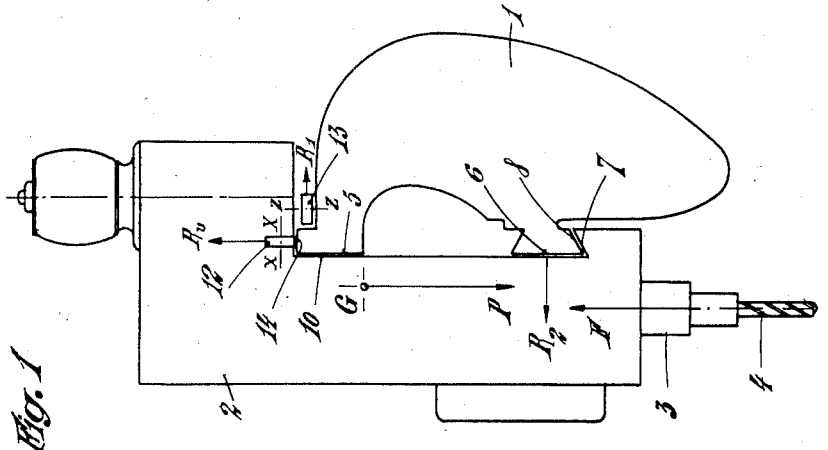

Fig. 1

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CARRIAGE CONTROL MEANS OF MACHINE-TOOLS

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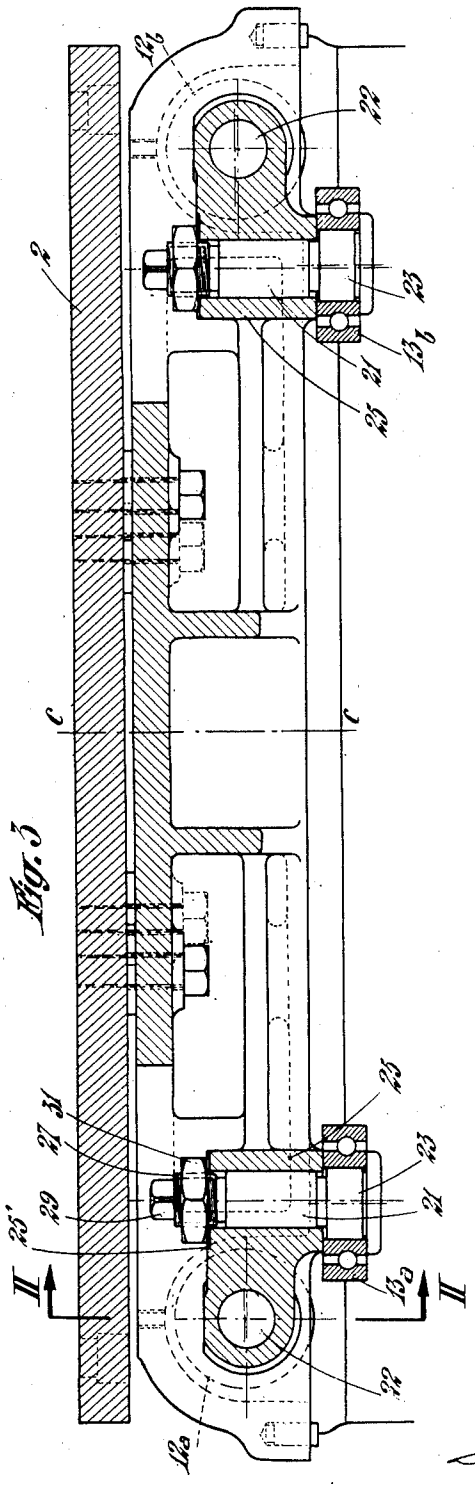

Fig. 3

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CARRIAGE CONTROL MEANS OF MACHINE TOOLS

Marcel Pégard, Paris, France

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13 Claims. (Cl. 77—27)

The present invention relates to devices for guiding and locking carriages on their supports and especially, although not exclusively, carriages of machine tools carrying drilling heads, said carriages being, in this case, subjected to the reactions of the tool during the periods of work.

The object of the present invention is to provide a device of this kind which is better adapted to meet the requirements of practice than those used for the same purpose up to the present time.

The essential feature of the invention relates to the reduction of the frictional stresses between the carriage and its slideway. It consists in mounting the carriage on ball or roller bearings so as to transform most or the whole of the frictional stresses which are produced by the displacement of the carriage on its track into small rolling resistances, these rolling means and their roller tracks being arranged in such manner that the positions of the tool carrying spindle respectively before and after the locking of the carriage along its slideway correspond exactly.

According to another feature of the present invention, the rolling means are so arranged with respect to the guiding surfaces that they are protected against the important reactions produced on said guiding surfaces by the tool when the latter is in operation.

According to still another feature of the present invention, which greatly increases the efficiency of the devices above mentioned, a roller track of very hard steel is fixed along one slideway and cooperates with the rolling means above mentioned. This band of steel eliminates both the wear and tear distributed over a certain zone of the total stroke of the carriage and which may result from more frequent displacements of the carriage along this zone, and the wear and tear localized to certain points which might result from a deformation of the band protected slideway by the reaction of the tool if said points of the slideway were not protected by said band.

With the device according to the present invention, the adjustment of the force serving to apply the rollers on their roller tracks is made particularly easy, which permits of maintaining the whole of the device in good working conditions.

Other features of the present invention will appear from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawings, given merely by way of example, and in which:

Fig. 1 is an end elevational view showing in a diagrammatic manner the supporting arm and the carriage of a radial drilling machine made according to the present invention;

Fig. 2 is a side sectional view on an enlarged scale showing the relative arrangement of the rollers and the upper slideway of the arm of the drilling machine, this section being made on the line II—II of Fig. 3;

Fig. 3 is a longitudinal sectional view of the same device on the line III—III of Fig. 2.

Fig. 1 illustrates the application of the theoretical principles of the invention to a radial drilling machine. In this machine, the arm **1**, movable about the axis of a supporting column which is not visible, supports a carriage **2** fitted with a working head **3** on which is mounted a drill **4**. Carriage **2** moves along the arm, which is seen in end view, in a plane perpendicular to that of the drawing. It is guided by slideways or guiding faces **5** and **6**. As a rule, the center of gravity G of carriage **2** is located ahead (on the left hand side on the drawing) of the vertical plane of guiding faces **5** and **6**.

The displacements of the carriage with respect to the arm take place when said carriage is not locked on said arm and when the tool is not working. The efforts transmitted to the arm result, in this case, merely from the action of the weight of the carriage, to wit P. This weight is balanced by the vertical reaction R_v of the upper part of slideway **5** and by torque R_1, R_2, due to the horizontal reactions of the front faces of contact of the upper slideway **5** and the lower slideway **6**, respectively, this torque being due to the fact that the center of gravity G of the carriage is not located in the vertical plane of faces **5** and **6**.

When the tool is working, an upwardly directed force F is applied to spindle **3**. It tends to apply the carriage, through its bearing surface **7** against the lower face **8** of the lower slideway **8** of the arm, the vertical face **10** of the carriage tending to be applied against the vertical bearing face **5** of the upper slideway of the arm. This is the position that is to be occupied during the working period by the carriage when the latter is locked on the arm of the drilling machine. In a highly accurate drilling machine, this position must correspond exactly to that occupied by the carriage before the locking thereof, that is to say when the tool is not working and force F does not exist.

According to the present invention, this result is obtained owing to the following arrangement:

Carriage 2 is fitted with a first set of rollers 12, of horizontal axis X—X, bearing on the upper face 14 of the slideway 5 of arm 1. These rollers 12 are located in a vertical plane passing through the middle of the lower surface 8 of slideway 6, and they are therefore directly opposed to said surface. A second set of rollers 13, of vertical axis Z—Z, is mounted in carriage 2, in such manner as to be applied on the rear face of the upper slideway of the arm, that is to say in a position directly opposed to the front vertical surface 5.

By very exactly adjusting the relative height of the axis X—X of rollers 12, the bearing surface 7 of the carriage is directly applied, without producing any oblique or horizontal effort of displacement, against the lower surface 8 of slideway 6, with any amount of accuracy as may be desired. Likewise, an adjustment of the relative position of rollers 13 permits of more or less strongly applying the face 10 of the carriage against the vertical bearing surface 5 of the arm, without involving any displacement of the carriage. Furthermore, this is true whatever be the position of the carriage on the supporting arm, since, in any position, reaction R_v passes through the center of rollers 12 and reaction R_1 through the center of rollers 13. These two sets of rollers 12 and 13 therefore absorb most of the efforts which, in other devices, produce sliding frictions when the carriage is moving along the arm. Reaction R_2, which is the only one to produce sliding frictions, is of little importance due to the small distance between the center of gravity G and the vertical face of slideways 5 and 6. On the other hand, by ensuring the simultaneous application of the bearing surfaces 7 and 10 of the carriage against the faces 8 and 5 of the arm, these rollers keep the carriage in practically the same position whether it is locked or not on the arm.

During the working of the tool, force F and the resisting torque of the spindle are balanced by the faces 8, 6 and 5 of the arm. Rollers 12 and 13 are therefore protected against the effects of the reactions of the arm to these efforts, excepting the very rare case in which force F is of downward direction, for very special kinds of machining, in which the intensity of said force is very small.

In particular cases, it will suffice to provide a third set of rollers, of vertical axis, running along face 6, for absorbing reaction R_2 and having then only rolling frictions.

Figs. 2 and 3 show an example of arrangement of the two sets of rollers 12 and 13 on carriage 2 and with respect to the arm 1 of a radial drilling machine.

In this embodiment, the carriage rests vertically on arm 1 through the intermediary of two double ball bearings 12*a* and 12*b* the supporting spindles of which are located symmetrically with respect to the axis C—C of the carriage, with a view to distributing the stresses in a suitable manner with respect to one another.

The horizontal spindles 22 which support rollers 12*a* and 12*b* include journals 24 and 26, housed in bearings 16 and 18, respectively, fixed to carriage 2, and a ball race 28 the axis of which does not exactly coincide with that of journals 24 and 26. It is thus possible to vary the height of rollers 12*a* and 12*b* in the carriage by turning through a certain angle the spindles 22 with respect to bearings 16 and 18. These spindles carry a threaded extension 30, with an end 32 of square section on which a key of corresponding shape can be fitted, whereby it is possible to turn the whole each spindle 22 so as to adjust the position of the rollers.

Nut 34, screwed on part 33, permits of locking shaft 22 by being applied against the face 19' of bearing 18.

The second set of rollers 13*a*, 13*b*, of vertical axis, is mounted close to the first set. The ball bearing rollers 13*a*, 13*b* run, like those above described, on tracks carried by piece 40. They are mounted on rolling bearing surfaces 23 which are each slightly eccentric with respect to the axis of the supporting spindle 21 housed in a corresponding bearing 25 of the carriage, which permits of adjusting the horizontal position of rollers 13*a*, 13*b* by rotating their spindles 21 in their respective bearings. In this case, also, spindles 21 are each provided with a threaded extension 27 on which is screwed the locking nut 31, and with a portion 29 of square section, on which acts a key, which permits of controlling the adjustment of the position of rollers 13*a* and 13*b* with respect to the carriage.

The two above mentioned sets of rollers 12*a*, 12*b* and 13*a*, 13*b*, run respectively on the horizontal face 40' and the vertical face 40'' of a band 40 of very hard material, fixed on the top of the slideway 5 of arm 1 by means of bolts 19. A longitudinal projection or tenon 41 serves to adjust the roller track band 40 on slideway 5. This band, which is fixed on arm 1, after a treatment such as case-hardening or the like, is rectified simultaneously with the slideway, which ensures a perfect parallellism between the faces 40' and 40'' thereof and the corresponding surfaces of slideway 5.

The interlocking due to the presence of projection 41 is generally sufficient for supporting the small reaction R_1 due to the weight of the carriage.

Of course, the arrangements above described are not limited to the case of radial drilling machines and they might be applied to other machine-tools.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of the present invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the appended claims.

What I claim is:

1. In a machine of the type described, the combination of a support including top and bottom slideways disposed respectively toward the top and bottom of said support, both including guiding faces extending in substantially vertical planes, the top slideway further including a horizontal surface and a second vertical guiding face parallel and opposed to the first mentioned guiding face thereof, a carriage having guiding surfaces adapted to cooperate with the guiding faces of said support, the center of gravity of said carriage being located on the opposite side of said first-mentioned vertical guiding face to said second vertical guiding face of the top slideway, and rollers of vertical axis journalled on said carriage adapted to run along said last mentioned vertical guiding face of said top slideway, to balance one of the horizontal reactions of the torque produced by the weight of said

carriage, the bottom slideway being adapted to oppose movement of the carriage about a horizontal axis.

2. In a machine of the type described, the combination of a support including top and bottom slideways disposed respectively toward the top and bottom of said support, both including guiding faces extending in substantially vertical planes, the top slideway further including a top horizontal roller track and a vertical roller track parallel and opposed to the above mentioned vertical guiding face thereof, and the other slideway including an oblique guiding face on the side opposed to the vertical guiding face thereof, a carriage having guiding surfaces adapted to fit along the guiding faces of said support, the center of gravity of said carriage being located at one side of said top slideway opposite to said vertical roller track, rollers of horizontal axis journalled in said carriage adapted to run along said horizontal roller track, said rollers having their common middle plane in coincidence with the middle plane of the oblique guiding surface of the lower slideway, and rollers of vertical axis journalled on said carriage adapted to run on said vertical roller track, to balance one of the horizontal reactions of the torque produced by the weight of said carriage.

3. In a machine of the type described, the combination of a support including top and bottom slideways, both including vertical guiding faces located in the same plane, the top slideway further including a horizontal surface and a vertical guiding face parallel and opposed to the first mentioned guiding face thereof, and the other slideway including an oblique guiding face on the side thereof opposed to the first mentioned guiding face, a carriage having guiding surfaces adapted to cooperate with the guiding faces of said support, said carriage having a transverse vertical plane of symmetry, the center of gravity of said carriage being located on the opposite side of said first-mentioned plane to said second vertical guiding face of the upper slideway, and rollers of vertical axis journalled on said carriage symmetrically with respect to said plane of symmetry and adapted to run along said last mentioned vertical guiding face of said top slideway, to balance one of the horizontal reactions of the torque produced by the weight of said carriage.

4. In a machine of the type described, the combination of a support including top and bottom slideways both including vertical guiding faces located in the same plane, the top slideway further including a top horizontal roller track and a vertical roller track parallel and opposed to the above mentioned vertical guiding face thereof, and the other slideway including an oblique guiding face on the side opposed to the vertical guiding face thereof, a carriage having guiding surfaces adapted to fit along the guiding faces of said support, the center of gravity of said carriage being located on one side of said vertical plane opposed to said vertical roller track, rollers of horizontal axis journalled in said carriage adapted to run along said horizontal roller track, said rollers having their common middle plane in coincidence with the middle plane of the oblique guiding surface of the bottom slideway, and rollers of vertical axis journalled in said carriage adapted to run on said vertical roller track, to balance one of the horizontal reactions of the torque produced by the weight of said carriage, said rollers being adjustable with respect to said carriage by displacement of their axes parallel to themselves.

5. A machine of the type described which comprises, in combination, a support including top and bottom slideways including vertical guiding faces located in the same plane, the top slideway further including a top horizontal roller track and a vertical roller track parallel and opposed to the above mentioned vertical guiding face thereof, and the other slideway including an oblique guiding face on the side opposed to the vertical guiding face thereof, a carriage having guiding surfaces adapted to fit along the guiding faces of said support, the center of gravity of said carriage being located on one side of said vertical plane opposed to said vertical roller track, rollers of horizontal axis journalled on said carriage adapted to run along said horizontal roller track, said rollers having their common middle transverse plane in coincidence with the middle plane of the oblique guiding surface of the bottom slideway, rollers of vertical axis journalled on said carriage adapted to run on said vertical roller track, to balance one of the horizontal reactions of the torque produced by the weight of said carriage and jounals for said rollers pivoted to said carriage about axes parallel to but distinct from the respective axes of said rollers.

6. A machine according to claim 5, including, for each of said rollers, a pivot, a spindle rigid with said pivot journalled in said frame about an axis parallel to, but distinct from, the axis of said pivot, a threaded part rigid with said spindle, a lock nut screwed on said threaded part, and an end of square section on said threaded part adapted to receive a key for turning said spindle.

7. A machine of the type described which comprises, in combination, a support including a slideway, a carriage mounted on said support and movable with respect thereto along said slideway, a tool mounted on said carriage, said support and said carriage being provided with respective cooperating guiding surfaces for keeping them in predetermined relative positions with respect to each other, rollers mounted on said carriage for transmitting thereto the reactions exerted by said support as a result of the action thereon of the weight of said carriage, a roller track consisting of a band of hard steel fixed to said support along the said slideway, adapted to cooperate with said rollers, said rollers being arranged to keep said cooperating guiding surfaces of the support and the carriage applied against one another, said guiding surfaces being so arranged, with respect to said rollers, as to protect the latter against the reactions of the tool when said tool is working.

8. A machine according to claim 7 including a set of rollers of horizontal axis and a set of rollers of vertical axis, said steel band including a horizontal face and a vertical face adapted to cooperate with said rollers, respectively.

9. A combination according to claim 2 further including a hard steel band fixed to said carriage along said top slideway, the top horizontal roller track and vertical roller track of claim 2 being constituted by faces of said steel band.

10. A combination according to claim 2 further including a hard steel band fixed to said carriage along said top slideway, said carriage being provided with a longitudinal groove parallel to said slideway, and a longitudinal rib carried by the under face of said steel band adapted to fit in said groove, the top horizontal roller track and

vertical roller track of claim 2 being constituted by faces of said steel band.

11. A combination according to claim 2 further including a hard steel band fixed to said carriage along said top slideway, said carriage being provided with a longitudinal groove parallel to said slideway, and a longitudinal rib carried by the under face of said steel band adapted to fit in said groove, the top horizontal roller track and vertical roller track of claim 2 being constituted by faces of said steel band rectified simultaneously with the guiding faces of said top slideway.

12. In a machine of the type described, the combination comprising a horizontally-disposed elongated support member, a carriage member disposed at one side of said support member and adapted for horizontal movement therealong, two slideways, comprising coacting portions of both said members, adapted for preventing rotation of said carriage member about a horizontal axis, one of said slideways comprising weight-carrying means for carrying the vertical downward thrust of the weight of the carriage member and separate means, including a roller, for carrying the force generated by the tendency of the weight of said carriage member to cause the latter to turn about an axis which is substantially coincident with the other one of said slideways.

13. In a machine of the type described, the combination according to claim 12, further characterized in that the said roller is mounted upon one of said members and is in rolling engagement with a plane surface on the other of said members which is substantially parallel to a plane extending through both said slideways.

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