

TABLE APPARATUS

This invention relates to a table apparatus.

A table apparatus, particularly an X-Y assembly or rotary table assembly capable of being driven independently along mutually perpendicular axes, is employed as a positioning table in machine tools and in many other fields.

A table apparatus of the above type has a base on which a guide surface (or guide shaft) is provided, and carries a slide which is capable of being slid along the guide surface or guide shaft. In the usual arrangement a drive source (such as a DC motor or pulse motor) is secured to the base, and a feed screw or the like transmits the power provided by the drive source in order to move the slide. Individual tables of this type are stacked to construct an X-Y table assembly, rotary table assembly or the like.

The conventional apparatus has been unable to satisfy the need for a high-speed sliding capability over a long stroke, as well as the need for high positioning accuracy. The problems are as follows:

(1) Costs are raised because a long feed screw is required for the long stroke. Cost are raised even further when a ball screw is used to achieve high speed rotation of the feed screw.

5 (2) The feed screw must be rotated at high speed to slide the table at high speed, but the rotational speed of the feed screw is limited by the material of which the screw and nut are constructed, as well as by their shape, dimensions, method of machining, supporting
10 structure and the like. High speed rotation of the screw even within the allowable limits is undesirable in terms of durability.

(3) To slide a table at high speed it is preferred that the table be as light in weight as possible in
15 order to reduce its inertia. With the conventional arrangement, however, the table of the lower slide serves as the base for the upper slide, and the drive source for the upper slide must be slid together with the table of the lower slide. The inevitable result is
20 greater weight and high inertia.

According to the present invention, there is provided a table apparatus having support blocks and comprising:

a guide way extending between said support blocks;

a non-circular guide shaft extending between said support blocks, in parallel to said guide way;

a lower slide slidably supported by said guide way and said guide shaft, said lower slide being

5 longitudinally movable along said guide way and said guide shaft;

an upper slide slidably mounted on said lower slide;

drive means for rotating said guide shaft; and

a rotation transmission mechanism engaging with said
10 guide shaft and slidable therealong, said rotation transmission mechanism being drivably connected to said upper slide to move said slide in a direction perpendicular to an axis of said guide shaft in response to rotation of said guide shaft.

15 An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a plan view illustrating a preferred embodiment of a table apparatus of the present invention;

20 Fig. 2 is an enlarged view of section A shown in Fig. 1;

Fig. 3 is a sectional view taken along the line III-III of Fig. 1;

Fig. 5 is a sectional view taken along the line V-V of Fig. 4;

5 Fig. 6 is a plan view showing the principal portion
of an upper slide; and

Fig. 7 is a sectional view taken along the line VII-VII of Fig. 6.

A preferred embodiment of the present invention will
10 now be described in conjunction with the accompanying
drawings.

Fig. 1 is a plan view of a table apparatus. The table apparatus 10 has support blocks 11,12, a guideway or guide plate 13 extending between the support blocks 11,12 and a longitudinal slide 16 is slidably supported by the guide plate 13.

and the guide shaft 14.

As shown in Fig. 3, the guide plate 13 is a flat plate which is fixedly secured to a hollow, rectangular column 15 bridging the support blocks 11, 12, and which is embraced from either side by roller pairs 17 a plurality of which are provided on the longitudinal slide 16, allowing the slide to be slid longitudinally as it is guided and supported by the guide plate 13.

The guide shaft 14 is a hollow bar having a hexagonal cross-section, as illustrated in Fig. 4, and lies parallel to the guide plate 13. The guide shaft 14 is rotatably supported at the end portions thereof by the support blocks 11, 12, and is embraced by three guide rollers 18 provided on the longitudinal slide 16. Thus the slide 16 is guided along the guide plate 13 and the guide shaft 14 longitudinally as it is slid.

A pulse motor 19 provided on the support block 11 drives a pulley 20 through suitable speed reduction means, thereby driving a belt 23 stretched parallel to the guide shaft 14 between a pulley 21 provided coaxially with the pulley 20, and a tension pulley 22 provided on the support block 12. The longitudinal slide 16 has a frame 24 to which the belt 23 is fixedly secured, so that rotating the pulse motor 19 slides the longitudinal

slide 16 in the longitudinal direction along the guide shaft 14 and guide plate 13.

The longitudinal slide 16 in the present embodiment is constructed as a frame to lighten its weight as much as possible. Specifically, two guide rails 25,26 formed of shape steel are fixedly secured to the frame 24 so as to lie in parallel with each other, and are interconnected by a connecting rod 27 at the ends thereof.

The guide rails 25,26 are members which define guide surfaces of an upper or cross slide. As shown in Fig. 3, the upper slide comprises guide blocks 31, each block having a pair of guide rollers 29. The guide rails 25,26 are embraced from above and below by the pair of guide rollers 29. Guide blocks 31, are guided along the upper surfaces of the guide rails 25,26 on the inward sides thereof. The guide blocks 31 have rollers 30 supported on vertical shafts 30a and are provided on a flat table 28 whose central portion has been cut out to reduce weight. The guide blocks 31, one provided at each of the four corners of the table 28, permit the table 28 to be slid transversely of the apparatus along the guide rails 25,26.

The guide shaft 14, rotatably supported by the support blocks 11,12 as mentioned above, is

rotated through a gear box 33 by a pulse motor 32 provided on the support block 12. One end of the guide shaft 14 penetrates the gear box 33 and projects from the outer side thereof, defining a cam shaft 34. Timing cams 35 are mounted on the cam shaft 34, and sensing means 36 (proximity switches in this embodiment) are provided to produce timing signals upon sensing the timing cams.

10 The rollers 18 embracing the guide shaft 14 are provided on a rotary block 39 which forms a part of a rotation transmission mechanism and which is rotatably supported on the frame 24 by means of bearings 37, 38, as shown in Fig. 5. Thus the
15 rotary block ³⁹~~38~~ is capable of being slid along the guide shaft 14 in the manner described above and rotates as the guide shaft 14 rotates. Owing to such rotation of the rotary block 39 the upper slide can be slid by any suitable means. An embodiment of such an arrangement is shown
20 in Figs. 6 and 7. In Figs. 6 and 7, idle pulleys 41, 41' are provided at both ends of the table 28, and wire cable 40 is passed along the lower side of the table 28 after it is wound around and secured to the rotary block 39 provided below the table 28. The
25 wire cable 40 is passed over the idle pulleys 41, 41'

until it reaches the upper surface of the table 28 where the ends of the wire cable 40 are affixed thereto.

While any method may be used to affix the ends of the wire cable, in accordance with the embodiment threaded end fixtures 42,42' for the wire cable are inserted into a fixture plate 50, and the ends of the wire cable 40 are attached to the end fixtures 42,42' which are adjusted and locked into place by means of nuts 52,52', 54,54' for the purpose of adjusting the cable tension in simple fashion. The diameter of each idle pulley 41,41' is slightly larger than the thickness of the table 28, and the center of each pulley is positioned on a line passing through the center of the table 28 with respect to the thickness thereof (or, more specifically, at a position where the bending forces acting upon the table will neutralize one another). Owing to this arrangement, the tension applied by the wire cable 40 is converted into a compressive force which acts along said center line of the table 28, so that the table 28 will not bend as long as it is not subjected to a heavy weight. In practice the idle pulleys 41,41' need not be positioned with such precision. That is, the table 28 will be bent very little by tension of ordinary magnitude if the center of each pulley 41,41' is

situated at a point between the upper and lower surfaces of the table.

5 Since rotating the guide shaft 14 rotates the block 39, one end of the wire cable 40 is taken up and one end is payed off. The table 28 thus can be slid along the guide rails 25, 26. In other words, the table 28 is slid transversly when the wire cable 40 is taken up and payed out by the rotary block 39 as the guide shaft 14 rotates.

**Claims:**

1. A table apparatus having support blocks and comprising:

a guide way extending between said support blocks;

5 a non-circular guide shaft extending between said support blocks, in parallel to said guide way;

a lower slide slidably supported by said guide way and said guide shaft, said lower slide being longitudinally movable along said guide way and said
10 guide shaft;

an upper slide slidably mounted on said lower slide;

drive means for rotating said guide shaft; and

a rotation transmission mechanism engaging with said guide shaft and slidable therealong, said rotation
15 transmission mechanism being drivably connected to said upper slide to move said slide in a direction perpendicular to an axis of said guide shaft in response to rotation of said guide shaft.

2. A table apparatus according to claim 1, in which
20 said lower slide comprises a frame composed of a pair of guide rails extending perpendicular to an axis of said guide shaft, and a connecting rod interconnected to said pair of guide rails at ends thereof, said pair of guide rails constituting guide _____



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surfaces for said upper slide.

3. A table apparatus according to claim 2, in which said upper slide has a flat table lying above said lower slide and having guide blocks provided at corners of said flat table, said guide blocks cooperating with said pair of guide rails of said lower slide to permit movement of said flat table along said guide rails.

4. A table apparatus according to claims 1, 2 or 3, in which said rotation transmission mechanism comprises a wire cable and a rotary block operatively disposed on said guide shaft, said rotary block including means engaging with a surface of said guide shaft for moving said lower slide along said guide shaft, said wire cable cooperating with said rotary block to transmit rotation of said guide shaft to said lower slide such that said lower slide moves perpendicular to the axis of said guide shaft when said guide shaft is rotated by said drive means.

5. A table apparatus according to claims 1, 2, 3 or 4, further comprising belt means extending between said support blocks and connected to said lower slide to move said lower slide along the axis of said guide shaft.

6. A table apparatus according to claim 4, further comprising idle pulleys provided at both ends of said



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flat table, such that a center of each of said idle pulleys is positioned on a line passing through a center of said table and said wire cable is tensioned at idle pulleys on both sides of said flat table.

7. A table apparatus substantially as hereinbefore described with reference to the accompanying drawings.
