

TITLE:

Method for repetitively generating a sequence of prescribed linear movements of a moveable table in a machine and apparatus therefor.

TECHNICAL FIELD:

- 5 The present invention relates to a method and apparatus for repetitively generating a sequence of prescribed linear movements of a moveable table in a production or factory machine.

BACKGROUND ART:

- Many systems are known to repetitively generate prescribed linear movements of a table in a machine. For example, a motorised lead-screw together with the appropriate controls can be employed to this effect. Similarly, hydraulically/pneumatically driven mechanical linkages can also be used.

- However the acceleration and speed of such devices may be limited in adjustability and functionality. Furthermore, the main driving element is often intermittently operated, and in both forward and reverse modes, thereby increasing power requirements and long term wear.

SUMMARY OF INVENTION:

- The present invention has therefore as an object to provide an improved method and apparatus for repetitively generating a prescribed sequence of linear movements of a moveable table in a machine, the drive unit for the apparatus operating at nearly constant speed and the inertial load limited mainly to that of accelerating the moveable table and its contents. According to this invention an apparatus for repetitively generating a

(2)

- sequence of prescribed linear movements of a table in a machine, the table being constrained to be able to move in substantially a horizontal line, comprises an endless flexible loop unslippably mounted upon and caused to move around two rotatable end wheels separately located from the
- 5 moveable table, the plane of the moving loop being closely parallel to the line of travel of the table, and two or more releasable gripping mechanisms are attached to the moveable table, each mechanism adapted to grip, hold and release part of the moving loop, there being provided preferably at least one releasable gripping mechanism for each of the two strands of the
- 10 moving loop between the rotatable end wheels. The method for repetitively generating a sequence of prescribed linear movements of a moveable table in a machine comprises, according to the invention, employing the above apparatus, using one of the two or more releasable gripping mechanisms provided to grip, hold and then release any part of the moving loop
- 15 between the two rotatable end wheels, so that the table is caused to make a single movement along its constrained path, in one direction if part of the loop moving in that direction is held by one releasable gripping mechanism, or in the reverse direction if part of the loop moving in the opposite direction is held preferably by another releasable gripping
- 20 mechanism, each releasable gripping mechanism being actuated repeatedly or one after the other to generate a prescribed sequence of table movements which eventually returns the table to its original starting position, from which the sequence of table movements is repeated by repeating the pattern of actuation of the releasable gripping mechanisms.
- 25 Further improvements in features and methods of employing the apparatus are also disclosed.

Not only is the resulting apparatus more economical than other known devices for achieving the same result, but also the accuracy and repeatability with which the apparatus can position the table are found in

30 practice to be as good as, if not better than, such alternative devices.

(3)

SPECIFIC EXAMPLES:

Two specific embodiments of an apparatus in accordance with the invention will now be described by way of example only, with reference to the accompanying drawings, in which:

- 5 Figure 1 is a side view of one embodiment;
Figure 2 is an end view of the apparatus in figure 1, part sectioned through the moving loop (3) and the feed shafts (1,2) and omitting mounting details for the feed shafts (1,2) and sprocket (5);
Figure 3 is a side view of another embodiment; and
10 Figure 4 is an end view of the apparatus in figure 3, part sectioned through the moving loops (47,48), the sprockets (41,42,43,44) and the feed shafts (1,2) and omitting mounting details for the feed shafts (1,2) and sprockets (41,42,43,44);

- In figure 1, a roller chain (3) is moved around sprockets (4,5) mounted on
15 the machine separately from the moveable table (31) which slides in a nearly horizontal line along two feed shafts (1,2). One of the two sprockets (4 or 5) is provided with controllable driving means (not shown) to drive the chain (3). Two releasable gripping mechanisms (13,14) are attached to the table (31), one each for each of the two strands of the
20 chain between the sprockets. Each mechanism (13 or 14) is provided with two substantially planar pads (6,7 or 15,16) which have two opposing gripping surfaces facing each other across the chain (3) passing between the gripping surfaces. The innermost pad (6 or 15) in each mechanism (13 or 14) is fixed at or near its four corners to four parallel rods (two each
25 shown in figure 1:- 9,10 and 18,19; and two each shown in figure 2:- 9,11 and 18,20; the remaining one not shown in the figures). The other pad (7 or 16) is adapted to slide along the four rods at its four corners. The four rods also guide the passage of the chain (3) to remain within a channel defined by the plane of two rods on one side of the chain, the
30 plane of the other two rods on the other side of the chain and the two

(4)

gripping surfaces of the pads (6,7 or 15,16). The four rods are fixed at the other end to the body of a pneumatic actuator (8 or 17) attached to the moveable table (31). The actuating shaft of the pneumatic cylinder (8 or 17) is attached to the pad nearer it (7 or 16). The signal wires, sensors, 5 timers and the tubes carrying air to the pneumatic cylinders are not shown in the figures.

The lower mechanism (13) is shown in the "release" condition with the pads (6,7) apart to allow free passage of the moving chain (3). The upper mechanism (14) is shown in the "hold" condition with one pad (16) 10 moved closer to the other pad (15) by the pneumatic actuator (17) to grip the chain (3) unslippably and cause the table (31) to move, in figure 1 from right to left since this is the direction of movement of that part of the chain (3) held by the mechanism (14). The speed of the table is controlled by setting the controllable driving means to drive one of the 15 sprockets (4 or 5) at the required angular rate.

After the mechanism (14) is actuated to release the chain (3), the moveable table may come to a halt because of frictional or other resistance forces, but also may, either before or after halting, be moved a further step in either direction by actuating one or the other mechanisms (13 or 14).

20 In one example only of a prescribed sequence of movements, the table (31) may be moved , from a starting position, a given distance in either direction by actuating one of the two mechanisms (13 or 14), at a given speed set by the speed of the chain (3), and then returned to the original position by actuating the other mechanism (14 or 13) to move the table 25 (31) back the same distance at the same speed as before. This example of a prescribed sequence of table movements can then be repeated by repeating the sequence of actuations of the gripping mechanisms (13 ,14).

Figures 3 and 4 show an implementation of the invention with two roller

(5)

chains (47, 48) mounted on sprockets (41, 42, 43, 44), each of the two roller chains moving at a different speed from the other. The operation of the releasable gripping mechanisms (13, 14) as specified above now results in a two speed movement of the table (31), one speed in the forward direction when one roller chain is gripped and another speed in the reverse direction when the other roller chain is gripped. In this way, for example, the table can be returned to its original starting position at a higher speed than its forward speed giving faster cycle times for the apparatus.

(6)

CLAIMS:

1. A method for repetitively generating a sequence of prescribed linear movements of a moveable table in a machine, characterised in that a moving endless flexible loop, at any part of the moving loop between two rotatable end wheels separately located from the moveable table, upon which wheels the loop is unslippably mounted and caused to move around at a predetermined speed, is gripped, held and then released by one of two or more releasable gripping mechanisms attached to a table constrained to be able to move in a substantially horizontal line closely parallel to the plane of the flexible loop, so that the table is caused to make a single movement along its constrained path, in one direction if part of the loop moving in that direction is held by one releasable gripping mechanism or in the reverse direction if part of the loop moving in the opposite direction is held preferably by another releasable gripping mechanism, each releasable gripping mechanism being actuated repeatedly or one after the other to generate a prescribed sequence of table movements which eventually returns the table to its original starting position from which the sequence of table movements is repeated by repeating the pattern of actuation of the releasable gripping mechanisms.
2. A method as in claim 1, characterised in that one or more guiding means are attached to the moveable table or to each releasable gripping mechanism so substantially confining the passage of the moving endless flexible loop to a channel within which each releasable gripping mechanism is, at all working times, able to grip, hold or release part of the moving loop.
3. A method as in claims 1 or 2 characterised in that two opposing gripping surfaces are provided in each releasable gripping mechanism, at least one gripping surface of which is moveable laterally to the direction of movement of the part of the moving loop between the two gripping



(7)

surfaces, so that part of the moving loop becomes gripped and held unslippably when the surfaces are brought and held closer together, and the moving loop becomes released to run substantially free of the gripping surfaces when they are moved apart.

- 5 4. A method as in claim 3 characterised in that the guiding means confining the passage of part of the moving loop is also the means by which one gripping surface is constrained to be able to move laterally to the direction of movement of the part of the moving loop between the two gripping surfaces and movement of the other gripping surface is either
10 prevented by fixation to the guiding means or limited laterally away from the moving loop by limiting means attached to the guiding means in each releasable gripping mechanism.

5. A method as in claims 1, 2, 3 or 4 characterised in that one of the two rotatable end wheels is rotated by a controllable driving means, the
15 other end wheel being passively rotated by the moving loop, so that the endless flexible loop, driven at a predetermined speed, causes the table to move at a similar speed when part of the moving loop is held by a releasable gripping mechanism attached to the moveable table.

6. A method as in claims 1, 2, 3, 4 or 5 characterised in that two or
20 more endless flexible loops are provided, each mounted unslippably upon and driven controllably around pairs of rotatable end wheels so that each loop is caused to move at a different speed from the other(s) and, when part of one of the loops is held by a releasable gripping mechanism attached to the moveable table, causing the table to move at a different
25 speed from that obtainable when part of another loop is held by another releasable gripping mechanism attached to the moveable table.

7. An apparatus for repetitively generating a sequence of prescribed linear movements of a table in a machine, the table being constrained to be



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(8)

- able to move in substantially a horizontal line, characterised in that an endless flexible loop is unslippably mounted upon and caused to move around two rotatable end wheels separately located from the moveable table, the plane of the moving loop being closely parallel to the line of travel of the table, and two or more releasable gripping mechanisms are attached to the moveable table, each mechanism adapted to grip, hold and then release part of the moving loop, there being provided preferably at least one releasable gripping mechanism for each of the two strands of the moving loop between the rotatable end wheels.
- 10 8. An apparatus as in claim 7 characterised in that one or more guiding means are attached to the moveable table or to each releasable gripping mechanism, the guiding means adapted to confine the passage of part of the moving endless flexible loop to a channel within which each releasable gripping mechanism is able to grip, hold or release part of the moving loop.
- 15 9. An apparatus as in claims 7 or 8 characterised in that two opposing gripping surfaces are provided in each releasable gripping mechanism, at least one gripping surface of which is moveable laterally to the direction of movement of the part of the moving loop between the two gripping surfaces and actuating means are provided that can bring and hold the
- 20 surfaces closer together to grip and hold part of the moving loop, and that can move the surfaces apart to release the moving loop to run substantially free of the gripping surfaces.
10. An apparatus as in claim 9 characterised in that the guiding means containing the passage of part of the moving loop is also the means by
- 25 which one gripping surface is constrained to be able to move laterally to the direction of movement of the part of the moving loop between the two gripping surfaces and the other gripping surface is either fixed to the guiding means or limited in movement laterally away from the moving loop by limiting means attached to the guiding means in each releasable



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(9)

gripping mechanism.

11. An apparatus as in claims 7, 8, 9 or 10 characterised in that one of the two rotatable end wheels is passively rotated by the moving loop, the other end wheel being rotated by a controllable driving means adapted to drive the endless flexible loop at a predetermined speed causing the table to move at a similar speed when part of the moving loop is held by a releasable gripping mechanism attached to the moveable table.

12. An apparatus as in claims 7, 8, 9, 10 or 11 characterised in that two or more endless flexible loops are provided, each mounted unslippably upon and driven controllably around pairs of rotatable end wheels so that each loop is caused to move to move at a different speed from the other(s), and when part of one of the loops is held by a releasable gripping mechanism attached to the moveable table, the table is caused to move at a different speed from that obtainable when part of another loop is held by another releasable gripping mechanism attached to the table, there being provided preferably at least one releasable gripping mechanism for each of the two strands of each moving loop between each pair of rotatable end wheels.

13. An apparatus according to any one of the claims 7, 8, 9, 10, 11 or 12 characterised in that the apparatus is constructed and arranged substantially as herein described with reference to the description and the accompanying drawings.

14. A method as in any one of the preceding claims characterised in that the method is made up of steps substantially as herein described with reference to the description and the accompanying drawings.



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