May 18, 1948. P. A. ABE 2,441,915

GROOVING MACHINE

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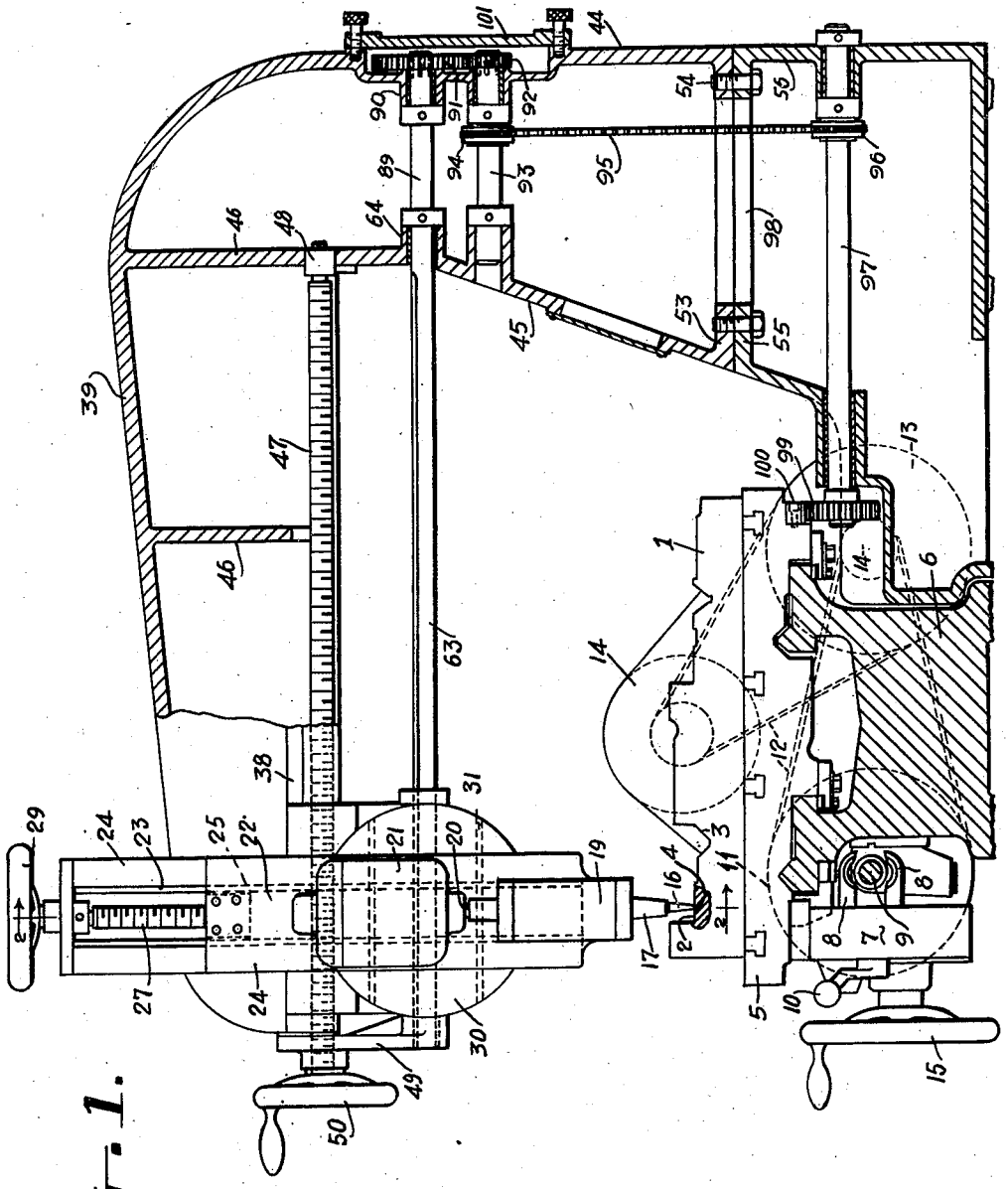


FIG. 1.

INVENTOR
PHILBER A. ABE
BY Toulmin & Toulmin
ATTORNEYS

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FIG. 2.

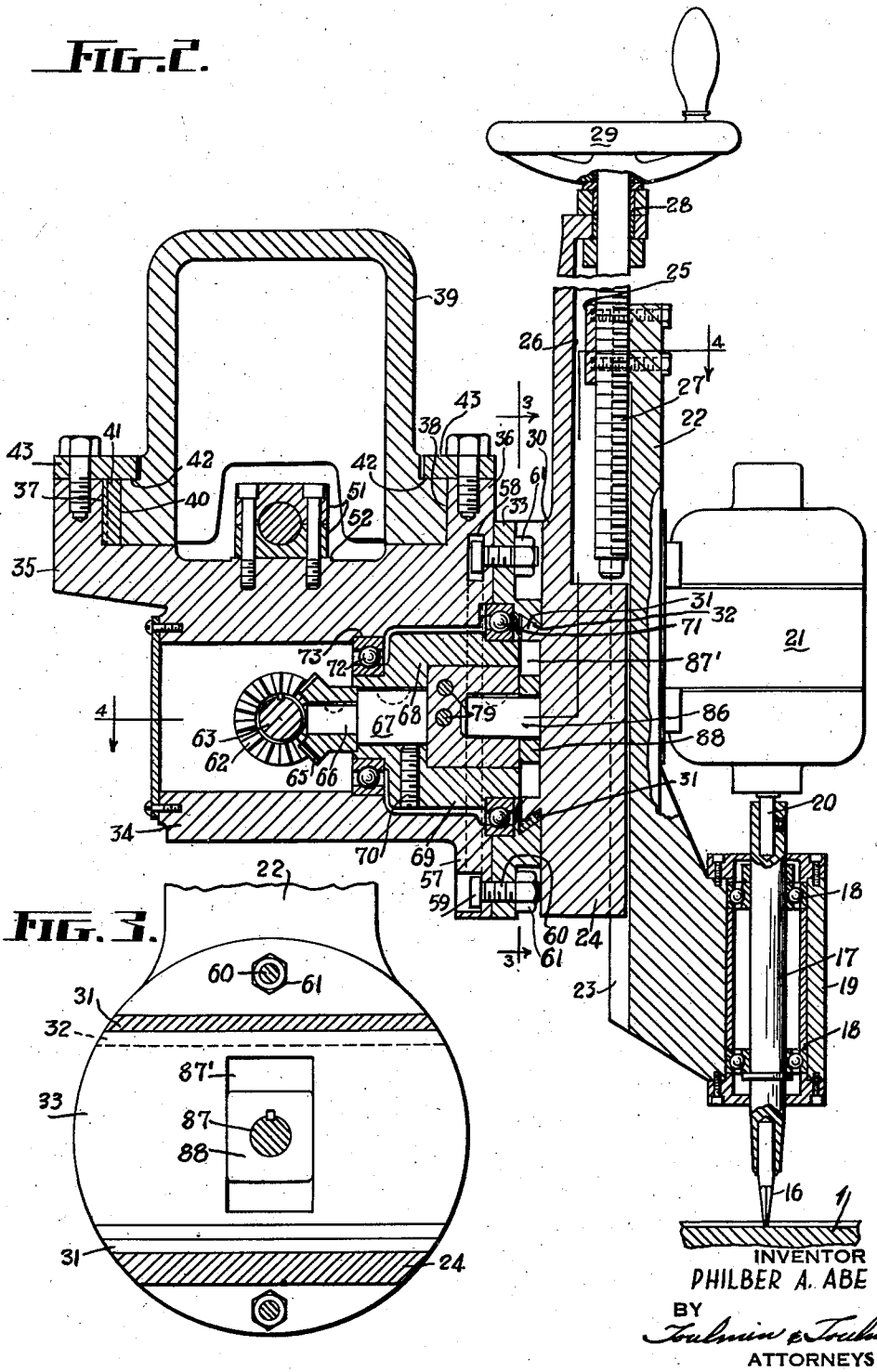


FIG. 3.

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FIG. 4.

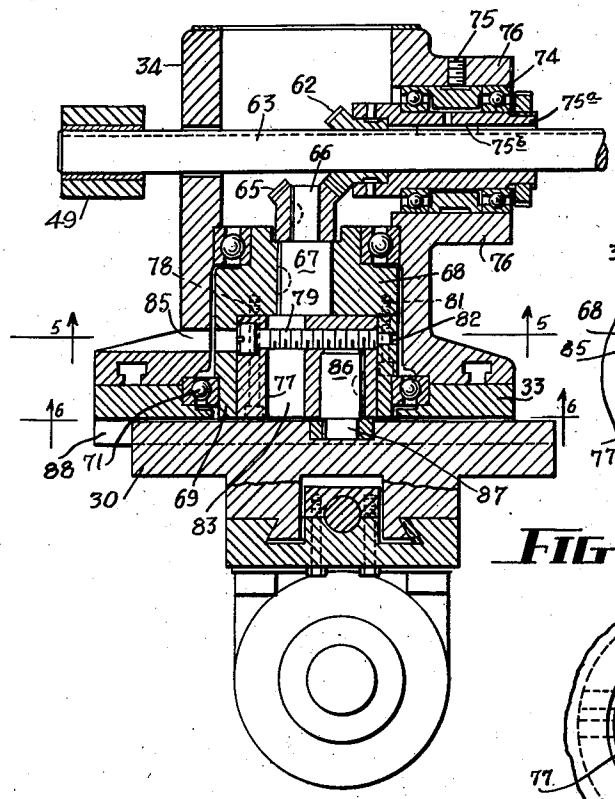


FIG. 5.

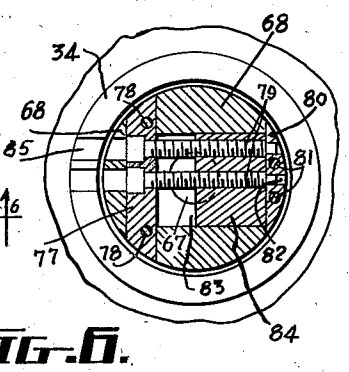


FIG. 6.

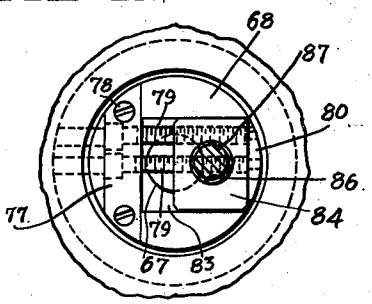
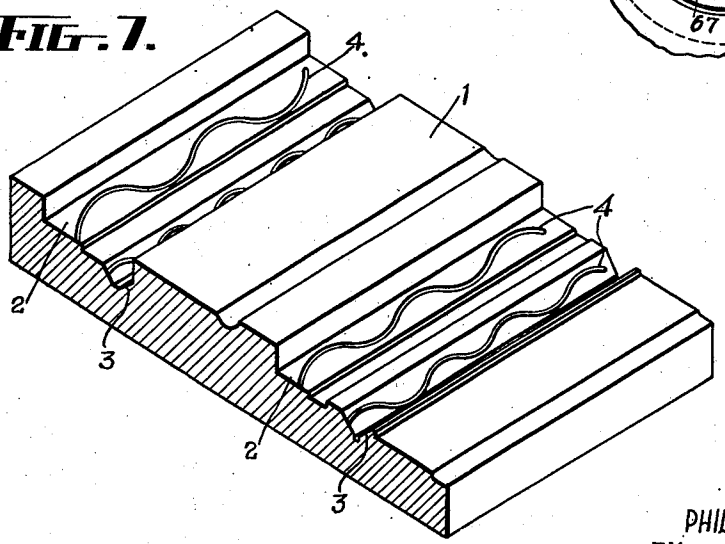


FIG. 7.



INVENTOR
PHILBER A. ABE
BY
Toulmin & Toulmin
ATTORNEYS

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UNITED STATES PATENT OFFICE

2,441,915

GROOVING MACHINE

Philber A. Abe, Sidney, Ohio, assignor to The Monarch Machine Tool Company, Sidney, Ohio, a corporation of Ohio

Application April 3, 1944, Serial No. 529,339

11 Claims. (Cl. 90—15)

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The present invention relates to machine tools and more particularly to machines for cutting lubricating grooves in the ways of lathes, planers, grinding machines, etc.

In the past it has been customary to cut grooves in the bearing surfaces of carriages by hand, using a hammer and chisel and gaging the groove design by eye or pattern. This method is not only slow and introduces difficulty of duplicating a given design, but unless extreme care is taken the grooves themselves may be uneven and perhaps cut to different depths throughout their lengths.

The primary object of the invention is to provide a machine which after being set by adjustment, will cut grooves to a uniform depth.

Another object is to provide a machine for cutting lubricating grooves in the ways of carriages and conforming to any design or shape with a provision for changing the pattern of the grooves and also their depth and the cross-sectional shape of each groove.

Still another object is to provide a machine for forming lubricating grooves in ground surfaces and having any curvilinear shape and occurring in any desired sequence.

These objects are attained in brief by mounting the carriage workpiece in an inverted position on a reciprocatory table or bed and moving the way to be grooved past a rotary cutting tool that is automatically given a transverse movement, which when combined with the longitudinal movement of the carriage, will cut a groove extending over a series of positive and negative loops.

The invention will be better understood when reference is made to the following description and the accompanying drawings in which:

Figure 1 represents a vertical section, partly in elevation, of the improved machine.

Figure 2 is a vertical, sectional view taken along line 2—2 in Figure 1. The motor is shown in elevation.

Figure 3 illustrates a section taken along line 3—3 in Figure 2 and looking in the direction of the arrows.

Figure 4 is a partial horizontal and partial vertical view taken along line 4—4 in Figure 2.

Figure 5 represents a transverse section as seen along line 5—5 in Figure 4 while Figure 6 illustrates an end elevational view taken at the joint indicated by line 6—6 in Figure 4.

Figure 7 is a fragmentary, perspective and enlarged view of the carriage or slide element showing the character of the grooves which are cut into the metal by the improved machine.

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Referring more particularly to Figure 7, the workpiece 1 may constitute a portion of a carriage in an inverted position and is provided with the usual flat sliding surfaces 2 and V-shaped grooves 3. The purpose of the improved machine is to cut the lubricating grooves 4 along each of these surfaces, the grooves preferably taking a sinusoidal shape so as to extend throughout the entire length and width of the bearing surfaces. As explained hereinbefore, such grooves were cut, prior to the present invention, by hand according to a pattern that was marked on the surfaces or else solely by eye.

The workpiece is bolted or clamped to a reciprocatory table 5 shown in Figure 1 and this table is adapted to move over the ways of a heavy bed 6. There is a bracket 7 extending downwardly from the table, this bracket carrying a pair of oppositely disposed half nuts 8 which are adapted to be brought into engagement with a lead screw 9 when a lever 10 is operated. The worm 9 is given a rotary movement through suitable gearing (not shown) actuated by a pulley 11 driven through a series of belts 12 and an intermediate pulley 13 from a motor 14. A hand wheel 15 may be secured to the bracket 7 and is connected through suitable gearing (not shown) to the table 5 and the bed in order to move the table manually with respect to the bed when desired.

There is a cutter head 16 for performing the grooving operation, this head being carried by a spindle 17 which is mounted on ball bearings 18 and positioned within a stationary housing 19. The upper end of the spindle is secured to the shaft 20 of a motor 21. The motor and the housing are carried on a vertical slide 22 provided with a tongue 23 which is received by a groove in a heavy vertical member 24 forming part of the main frame. A metal block indicated at 25 is bolted to the slide 22, this block being adapted to be received by a relatively wide vertical slot 26 formed in the member 24. A screw 27 is threadingly engaged with the block 25 and is journaled at the top in a bearing 28 provided on the member 24. The screw rod 27 terminates in a hand wheel 29. When the latter is turned, the motor 21 and the housing 19 which carries the cutter head are moved in the vertical direction so as to regulate the depth of cut.

At a position approximately midway between the cutter head and the hand wheel, the vertical member 24 merges into a relatively large and heavy circular plate 30 which is provided on its rear face as viewed in Figure 1, with a horizon-

tally extending wedge-shaped tongue indicated at 31. This tongue is slidably carried on a wedge-shaped groove 32 shown more clearly in Figure 2, this groove being formed in a circular plate member 33 of approximately the same size as the member 30. The plate member 33 is bolted or otherwise secured to a relatively large housing or slide 34 which has a pair of upstanding flange portions 35, 36 which serve as restraining slides for permitting the housing 34 and the associating parts, including the member 24, motor 21 and the cutter head housing 19, to move transversely of the machine.

The portions 35, 36 of the housing 34 are provided with ground vertical surfaces 37, 38 and the latter are adapted to bear directly against a sliding surface formed on the front side (as seen in Figure 1) of a goose neck over-arm 39. The latter has a rear sliding surface 40 with which contact is made by the sliding surface 37 of the flange 35 through adjustment gibs 41. Shoulders 42 are provided on opposite sides of the goose neck 39 and straps 43 are bolted to the flange portions 35, 36 for riding on these shoulders. Thus, the housing 34 is adapted to slide along a horizontal trackway formed on opposite sides of the goose neck 39 and the entire structure, including the vertical member 24, associated plates 30 and 33, the motor 21 and the cutter head housing 19 are supported thereby.

The goose neck or frame 39 is a relatively large but hollow casting extending over the entire width of the machine and is supported through a vertical portion 44 having a tapered inner wall 45. Vertically extending ribs 46 may be provided at specified positions throughout the length of the arm 39 for strengthening purposes.

In order to move the housing 34 transversely of the machine there is provided a screw 47 which is carried at the remote end in a bearing 48 supported by one of the ribs 46. The end of the rod 47 nearer the front face of the machine is supported by a bracket 49 bolted or otherwise secured to the goose neck 39 and this end of the rod terminates in a hand wheel 50. The housing 34 is provided with a pair of blocks 51 which are secured together and are bolted to a flat surface 52 formed on top of the housing. These blocks are provided with a threaded bore (not shown) which threadingly engages the screw 47. Thus, when the hand wheel 50 is rotated, the entire structure shown in Figure 2 with the exception of the goose neck is caused to move transversely of the machine, therefore carrying with it the cutter head 16.

The lower end of the goose neck which includes the walls 44 and 45 terminates in a horizontal wall portion 53 which rests on and is secured as by bolts 54 to the wall 55 of a base casting 56. The latter and also the vertical portion of the goose neck are hollow in order to receive operating mechanism for controlling a slow swinging motion imparted to the cutter head as will be explained presently.

In addition to providing a vertical movement of the cutter head controllable by the hand wheel 29 and a horizontal movement controllable by the hand wheel 50, it is desirable when operating the cutting tool along tapered surfaces, to permit the latter to swing in a vertical plane. Thus, the member 24 and its plate must be adapted to be swung through an angle determined by the amount of taper given to the sides of a V-shaped groove formed in the work piece 1. For this purpose, the housing 34 is provided with a circular

flange 57 which is provided with an annular T-shaped groove 58 for receiving the heads 59 of a plurality of bolts 60. These bolts pass loosely through openings provided in the plate 33 and slots are cut into the plate at the position of each bolt in order to permit access to the nuts 61. The arrangement is such that when the nuts are loosened the bolts are permitted to swing about the annular slot or groove carrying with them the plate 33. Inasmuch as this plate is mechanically connected to the plate 30 through the dovetail 31, the entire structure shown to the right in Figure 2 and including the motor 21 and the cutter 16, is adapted to swing in a vertical plane transverse to the ways of the work piece. It is apparent that after the proper amount of swing has been determined, depending on the taper of the V-shaped grooves 3, the nuts 61 can be tightened so as firmly to hold the cutter head in its new position during the grooving operation.

In addition to the vertical and transverse movements as well as the movement in the vertical plane described immediately above, the cutter is also capable of being given an oscillatory movement along the dovetail slides 31. The mechanism for the last mentioned movement will now be described.

Referring more particularly to Figures 2, 4 and 6, a bevel gear 62 is shown secured in any suitable manner to a splined shaft 63. The front end of this shaft is journaled in the bracket 49 (Figure 1) and the rear end is carried in a bushing 64 fitted into the inner wall of the goose neck arm. The gear 62 meshes with a bevel gear 65 keyed to a shaft 66 which forms a shouldered extension on a shaft 67. There is a relatively heavy sleeve-like block 68 keyed to the shaft 67 having a skirt portion 69 which extends toward the vertical member 24. The block 68 is prevented from shifting longitudinally of the shaft 67 by means of a set screw 70. The skirt portion of the block is journaled on ball bearings 71, the stationary race of which may be fitted snugly within a shouldered recess formed in the plate 33. At the other end the block is necked down to a relatively small diameter to be received by a ball bearing 72 of which the outer race may be held within an annular shoulder 73 formed in the housing 34.

Due to the heavy load placed on the bevel gear 62 as will be explained hereinafter, it is desirable to support the shaft 63 at the position of the gear by a ball bearing 74 of any suitable and well known type secured as by a set screw 75 within a cylindrical extension 76 on the housing 34. It is preferred that the bevel gear 62 be not secured directly to the shaft 63 but rather be attached to a rotary sleeve 75a which is in turn keyed as indicated at 75b to the shaft.

Thus, as the shaft 63 is rotated, this rotary effort is transferred to the block 68. The skirt portion of the block is provided with a slot which extends in the diametral direction but is positioned remote from the center of the block in order to receive a metal piece 77 of trapezoidal shape (Figure 6) which may be screwed to the block as indicated at 78. The metal piece is provided with a plurality of transversely extending recessed openings which are adapted to receive the heads of a pair of adjustment screws 79. There is a relatively thin segment-shaped metal piece 80 secured to the block 68 by a pair of counter-sunk screws 81. The skirt portion of the block is cut at the proper position to receive this

segmental piece. The latter is provided with a pair of spaced openings adapted loosely to receive the shouldered ends 82 of the screws 79. Thus, the screws are supported at the head end in the metal piece 77 and at the shank end in the member 80 as can be readily seen in Figure 6. The skirt portion of the block 68 is also provided with a slot 83 which extends from the lower end of the block as seen in Figure 4 as far as the joint between the shaft 67 and the block. The ends of this slot are bounded by the inner surfaces of the metal pieces 77 and 80. This slot loosely receives a rectangularly shaped slide member 84 having a height (as seen in Figure 6) substantially the same as the width of the slot 83 and having a width measured in the horizontal direction considerably less than the length of the slot. The slide 84 is provided with a pair of threaded openings which engage the screws 79. Thus by turning these screws the horizontal position of the slide within its slot may be adjusted.

In order to permit adjustment of the screws 79 an opening 85 extending transversely of the housing 34 is provided, this opening passing also through the block 68 as far as the heads of the screws. It will be noted from Figure 4 that this opening has a slightly smaller diameter than the size of the heads so as readily to permit a screw driver to be inserted for turning the screws and yet will prevent any longitudinal movement of the screws when they are rotated. It will be understood that it is intended that only the slide 84 shall be moved when the screws are turned and that the screws remain in their relative position during their operation.

The slide 84 carries a stub shaft 86 which has a shouldered extension 87. This extension is tightly fitted into a slide member 88 of rectangular configuration. There is a slot 87' provided in the plate member 30 which has a width sufficient snugly but slidably to receive the member 88 and a length considerably greater than the length of the slide member. Actually, the length of the slot in the plate member 30 is sufficient to accommodate the maximum throw of the shaft 86 when the block 68 is rotated. A consideration of Figure 4 will show that the shaft 86 is positioned eccentrically with respect to the axis of the block 68 and this eccentricity may be adjusted by turning the screws 79, which in effect moves the slide 84 within its slot 83 (Figure 6). Consequently, as the block 68 is rotated the stub shaft 86 will have a throw depending on its position with respect to the shaft 67, similar to a crank pin, and this throw can be resolved into two directions of movement at right angles to each other. One direction of movement is accommodated by permitting the slide 88 freely to move in a slot which is sufficiently long to accommodate the entire movement and the other direction of movement can be accommodated only by causing the plate member 30 to move with respect to the plate member 33 since the slide 88 fits snugly within its slot in this direction. Thus, as the block 68 continues to rotate, the plates 30 and 33 are caused to slide past one another at the dovetail joint 31 (Figure 1) giving the cutter head a short oscillatory movement transversely of the machine. It will be understood that this oscillatory or sinusoidal movement of the cutter head is of a continuous character as long as the shaft 63 is rotated. As stated hereinbefore, the extent or amplitude of this oscillatory movement can be controlled by adjusting the screws 79 which in turn determines the amount of eccentricity of the shaft or pin 86.

The shaft 63 is given a continuous rotary movement through mechanism which will now be described. This shaft is provided with an extension 89 which is journaled in a bearing 90 of any suitable character and formed in the outer wall of the goose neck frame. A gear 91 is keyed to the shaft 89, this gear engaging with a pinion 92 keyed to a shaft 93 which is journaled between the walls 44, 45 of the frame. The shaft 93 is provided with a sprocket 94 over which a chain 95 travels to a sprocket 96 keyed to a shaft 97. The latter is journaled in any suitable manner within the base casting 56. The horizontal walls 53, 55 of the frame are provided with an opening 98 sufficiently large to permit clearance to the chain 95. There is an outboard gear 99 keyed to the shaft 97, this gear engaging a rack 100 secured to the table 5. Thus, as the latter is moved longitudinally of the machine, the rack will give a rotary effort to the gear 99 which in turn through the shaft 97, the chain 95, the shaft 93, the pinion 92 and the gear 91 will drive the shaft 63. It will be noted that the latter is splined in order to permit the bevel gear 62 and its associated bearing to move longitudinally of the shaft and still supply a rotary effort between the shaft and the gear.

It is apparent that as the table 5 moves longitudinally of the machine and the cutter head 16 is given a transverse movement in the manner described hereinbefore, the composite effect of these motions is to produce grooves 4 having a sinusoidal shape formed of positive and negative loops. The amplitude of these loops is controlled by the amount of throw of the eccentric 86 and the distance between the center lines of two adjacent positive loops is determined by the rate of rotation of the shaft 63. The speed of the latter is in turn controlled by the rate of movement of the table 5 and more particularly by the gear ratio between the pinion 92 and the gear 91. This ratio may be changed by varying the size of the gears and for this purpose a removable cover 101 is provided. In the event that it is desired to cut the lubricating grooves along tapered surfaces 3, the member 24 which carries the motor 21 and the cutter head is simply swung around to the proper angle by loosening the nuts 61 until the cutter 16 is presented normally to the tapered surface.

It will be noted that when the member 24 is in this position there is no interference with the depth of cut controlling the handle 29 nor of the handle 50 which controls the transverse position of the cutter. Thus, all of the adjustments of the cutter, including every transverse longitudinal and vertical movement of the cutter, are available, even though the position of the cutter has been moved through an angle so as to present the cutting tool to the tapered surface. It is further apparent that except for the motor 21 which drives the cutter no source of mechanical power is necessary other than a single motor 14 so that synchronism is assured between all of the operating movements of the cutter. It is therefore possible to obtain symmetry of shape, including equal amplitudes of the various loops as well as distances between loops throughout any number of cutting operations and the depth of the grooves is maintained constant at any desired depth when the wheel 29 is left in a permanent position.

It is apparent that, if desired, the stub shaft 86 can be placed in line i. e. concentric, with the shaft 67 so that the groove will take the

design of a straight line rather than being formed of reversely extending loops. Furthermore, a mechanical connection could be taken out through the openings 85 from the screws 79 and attached to one or more hand wheels so that the groove cut by the head 16 can be caused to follow any arbitrary path. Such an arrangement may be useful where the width and/or the shape of the sliding surfaces 2 varies and immediate or abrupt changes in the amplitude of oscillation of the grooves are desirable. It is still further evident that instead of using a single cutter head 16 for the grooving operation, I may employ a multiple head in which all of the cutting tools will follow a predetermined design, depending on the degree of eccentricity of the shaft 86 and the relative longitudinal movement of the cutter head as determined by the teeth ratio of the gears 91, 92. It is obvious that the size and shape of the groove, i. e. its configuration in cross-section, can be controlled by inserting a cutting tool of the desired shape and size within its holder.

I desire to comprehend within my invention such modifications as come within the scope of the claims.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a machine for grooving the plane surface of a work piece, a support adapted to receive and translate said work piece in a first direction parallel to said surface, an arm secured to said support and extending over said surface, a slide adjustable on and along said arm in a second direction substantially normal to said first direction, a member pivoted on said slide on a first axis parallel to said first direction, a tool-carrying slide on said member and guided thereby for translation in a second direction normal to said first axis, and means operated by the movement of said support for oscillating said tool carrying slide to generate a sinusoidal groove in said surface.

2. In a machine adapted to groove a plane surface of a work piece, a base, first means on said base to support and translate said work piece in a direction parallel to said surface, an arm on said base extending over said surface, a plate member, means mounting said plate member on said arm for adjustment about an axis parallel to said surface, said member having a guideway diametral of said axis, a tool-carrying slide, means mounting said slide for translation along said guideway, and means to translate said first means and work piece in timed relation with translation of said slide.

3. In a machine for grooving the plane surface of a work piece, an arm, a housing slidable on and along said arm in a first direction, a block pivoted on said housing on an axis normal to said first direction, a plate member carried by said housing and pivotally adjustable thereon about said axis, said plate member having guide means diametral of said axis, a member guided for movement by and along said guide means and adapted to support a tool normal to said axis, a pivotal connection between said block and member eccentric of said axis, and means to rotate said block in timed relation with movement of said surface along and parallel to said axis.

4. In a machine for grooving the plane surface of a work piece, an arm having straight line guide means, a housing slidable on and along said guide means in a first direction, a block journaled in said housing on an axis normal to said direction, a crank pin, means mounting said crank pin on said block to vary the eccentricity thereof with respect to said axis, a plate member carried by said housing and adjustable relative thereto about said axis, said plate member having guide means diametral of said axis, a tool holding member supported by said plate member for movement along said guide means, means pivotally and slidably connecting said crank pin and tool holding member, power means rotating said block in timed relation with movement of said work piece along and parallel to said axis, and means on said tool holding member supporting and moving a tool in a direction normal to said axis.

5. In a grooving machine, means supporting and translating a work piece in a first direction parallel to a plane surface thereof to be grooved, a grooving tool, means mounting said tool for reciprocation parallel to said surface and in a second direction at an angle to said first direction, adjustable throw crank means connected to so reciprocate said tool, means connecting said supporting means for translation in timed relation with rotation of said crank means, and means for angularly adjusting said means mounting said tool for maintaining said tool normal to said surface.

6. In a grooving machine, first means supporting and guiding a work piece in a first direction parallel to a surface of said work piece to be grooved, second means movable in a second direction transversely of said first direction, a plate carried by said second means and having guide surfaces adjustable with said plate means in a plane parallel to said second direction and normal to said first direction, tool holder means slidable on and along said guide surfaces, variable-throw crank means connected to reciprocate said tool holder along said surfaces, and means including change-speed elements, connected to translate said first means and to rotate said crank means in predetermined timed relation.

7. In a machine of the type described, first means adapted to mount a work piece and translate the same in a first direction parallel to a plane surface of said work piece, a support connected with said first means and extending over said surface, a housing slidable on said support in a second direction at an angle to said first direction, means on said arm connected to so slide said housing, a block pivoted on said housing on an axis parallel to said first direction, a crank pin, means mounting said pin on said block for adjustment radially of said axis, a tool holder member, means mounting said member on said housing for reciprocation along a second direction normal to said axis, means pivotally and slidably connecting said crank pin and member, and means including change speed mechanism, connected to translate said first means and rotate said block, in timed relation.

8. In a machine of the character described, a housing, a block member journaled in said housing for rotation on a first axis, a plate having a guideway diametral of said axis, means securing said plate to said housing in adjusted position about said first axis, a member guided for rectilinear movement on and by said guideway, said member having guide means normal to said guideway, a slide fitting said guide means, a crank pin on said block and adjustable to vary its eccentricity with respect to said axis, said crank pin rotatably engaging said slide, and a tool-car-

rying slide mounted upon said member for adjustment normal to said axis.

9. A machine for grooving a workpiece comprising a reciprocatory table on which the workpiece is mounted, said table being mounted on a bed and a frame extending from said bed to a position above said workpiece, a tool holder pivotally secured to said frame and a grooving tool carried thereby to be presented perpendicularly to said workpiece, said holder including a plate directly supporting said tool and adapted to move with respect to said frame in a second direction normal to the direction in which said workpiece moves and at right angles to the axis of said tool, and means for oscillating said plate relative to said workpiece and at variable frequency and amplitude comprising means drivingly connecting said plate and table and including change gears and an adjustable throw eccentric.

10. In a machine for grooving the ways of machine tools, means supporting said ways for translation in a first direction parallel to the ways to be grooved, a frame, a housing, means guiding said housing on said frame in a second direction normal to said first direction, a member pivoted on said housing on an axis parallel to said first direction, means on said member adapted to carry a tool for grooving said ways, and means extending through said housing and engaging said member and operable to oscillate said member along an axis normal to the axis of said tool and also to said first direction in predetermined timed relationship to the translation of said ways.

11. In a grooving machine for grooving a surface of a workpiece, first support means longitudinally movable in a first direction, work holder means for holding the workpiece, tool holder means for holding a grooving tool, second support means for supporting one of said holder means, the other of said holder means being supported by said first support means, laterally movable means for providing relative movement between said work holder means and said tool holder means in a second direction transversely of said first direction, guide means carried by said second support means and having guide surfaces thereon extending in a plane parallel to said second direction and transverse to said first direction, said guide surfaces being adjustable in a plane parallel to said second direction, said one of said holder means being slidable on and along said guide surfaces, variable throw crank means connected to reciprocate said one of said holders along said surfaces, and means including gear elements connected to longitudinally move said first support means in said first direction and to rotate said crank means in predetermined timed relation.

PHILBER A. ABE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
856,306	Smith	June 11, 1907
1,696,660	Wegner	Dec. 25, 1928
1,838,816	Fickett et al.	Dec. 29, 1931
1,879,548	Sethman	Sept. 27, 1932
1,937,408	Johnson	Nov. 28, 1933

FOREIGN PATENTS

Number	Country	Date
133,583	Great Britain	Oct. 16, 1919