

June 14, 1949.

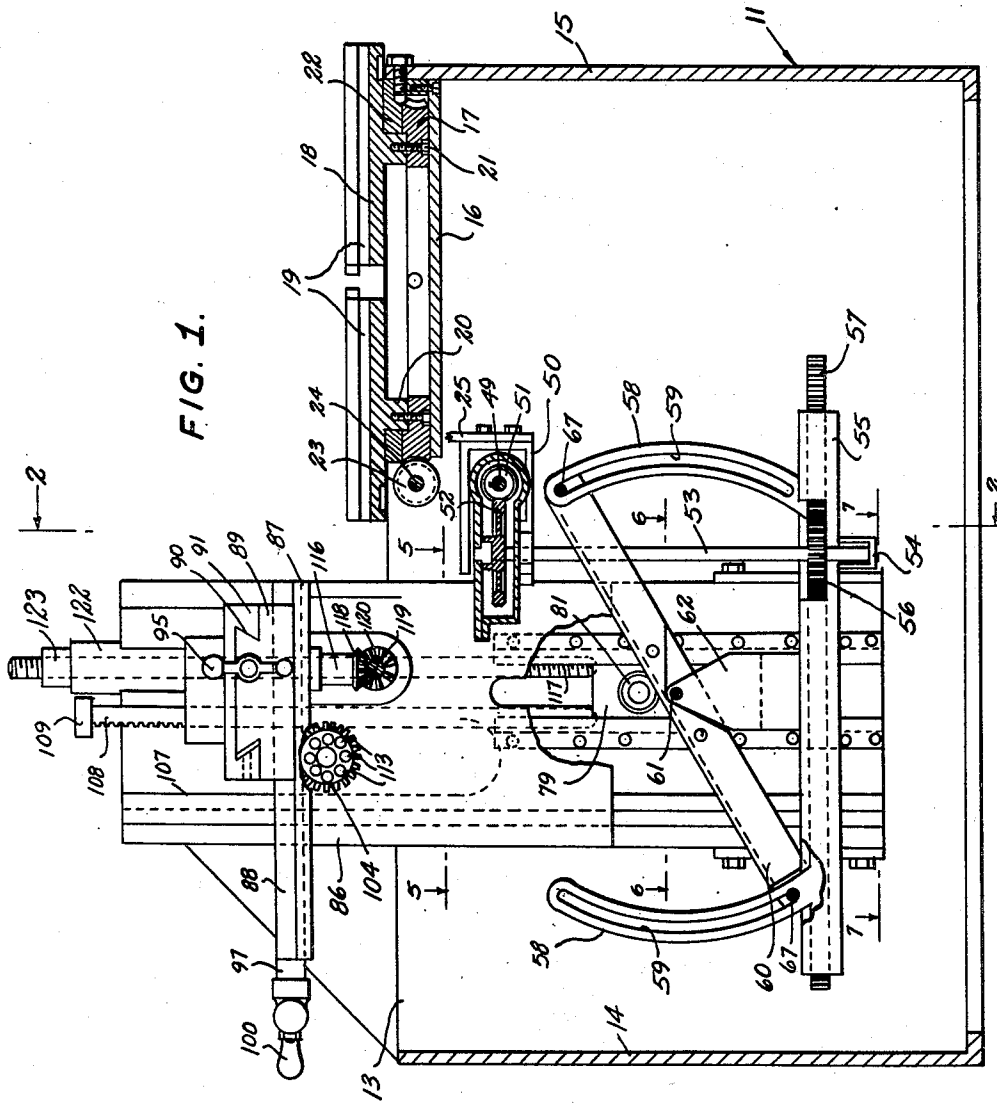
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2,472,902

CAM MAKING MACHINE

Filed July 15, 1947

6 Sheets-Sheet 1



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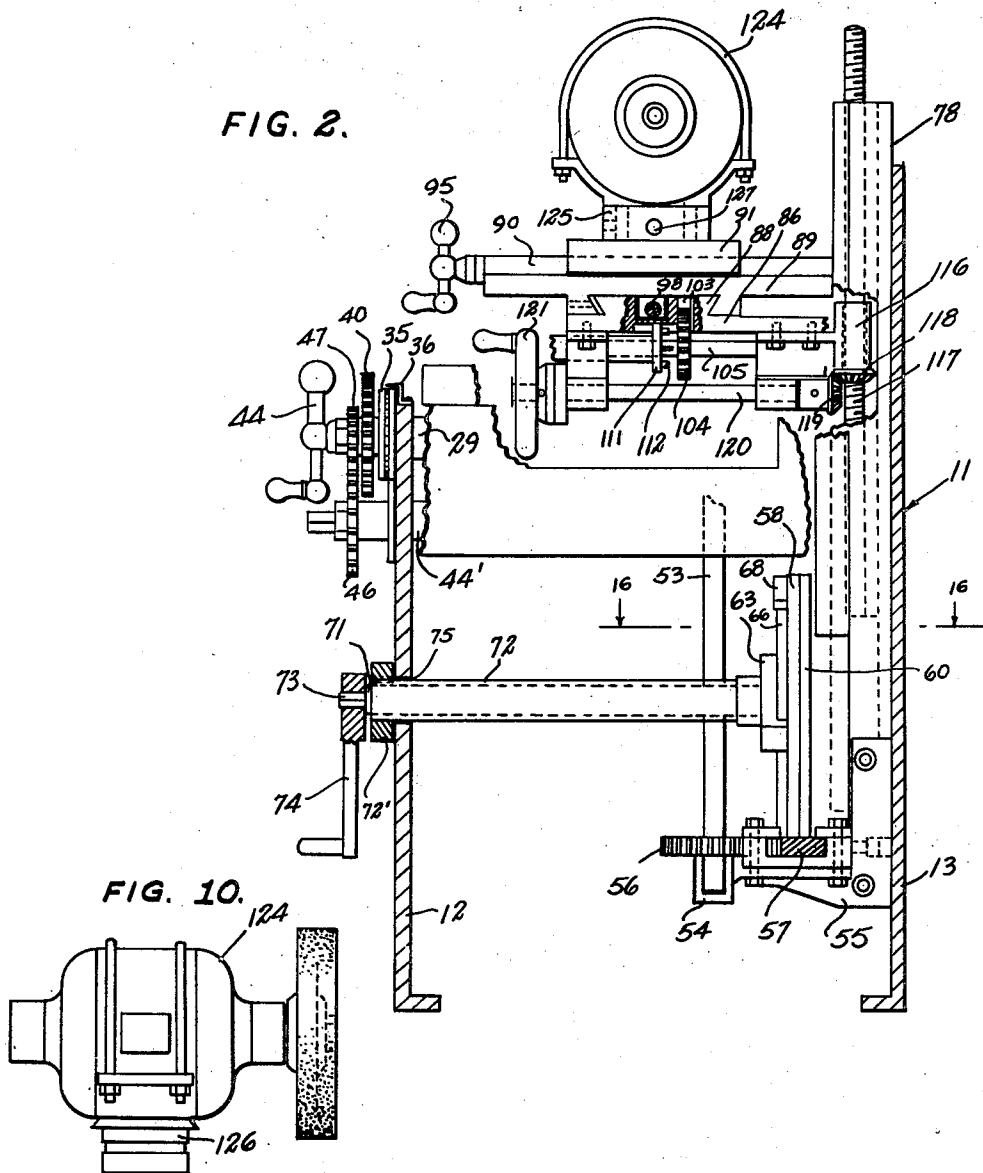
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CAM MAKING MACHINE

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6 Sheets-Sheet 2

FIG. 2.



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CAM MAKING MACHINE

2,472,902

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6 Sheets-Sheet 3

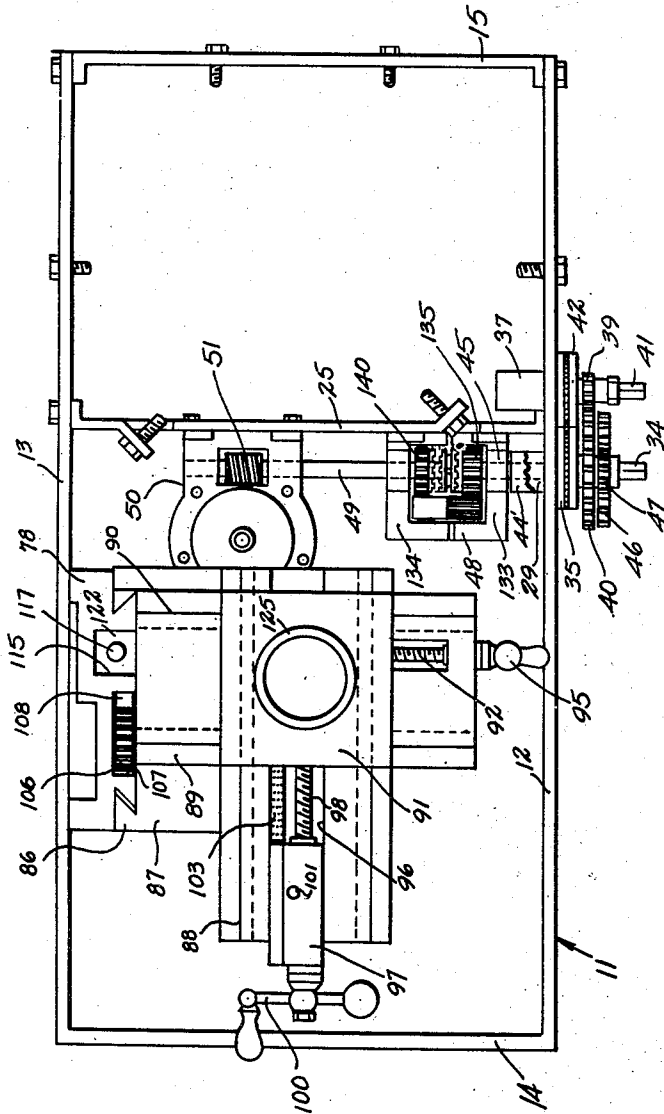


FIG. 3.

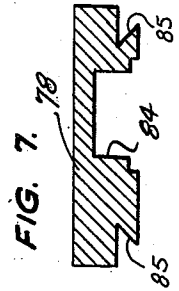


FIG. 7.

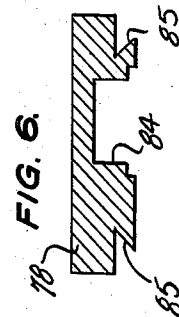


FIG. 6.

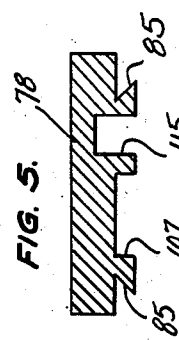


FIG. 5.

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CAM MAKING MACHINE

2,472,902

Filed July 15, 1947

6 Sheets-Sheet 5

FIG. 11.

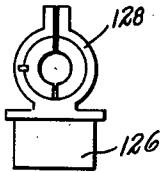
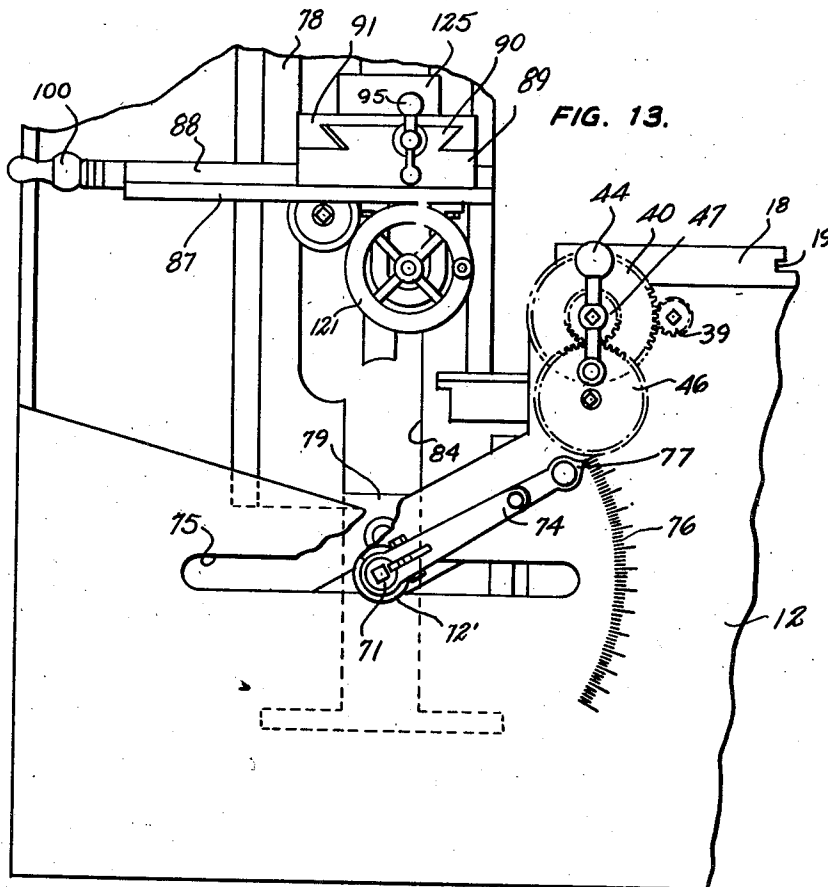
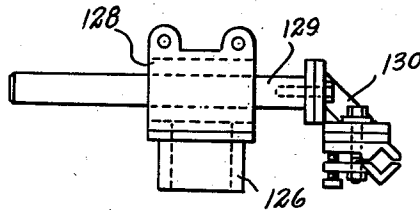


FIG. 12.



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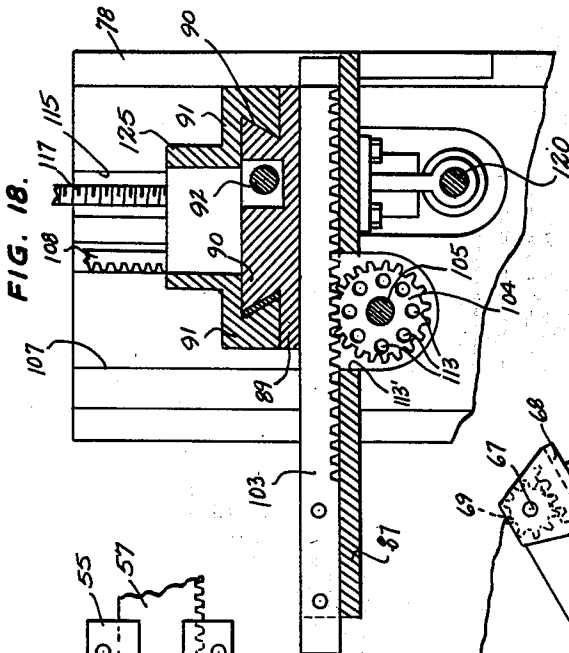
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2,472,902

CAM MAKING MACHINE

Filed July 15, 1947

6 Sheets-Sheet 6



UNITED STATES PATENT OFFICE

2,472,902

CAM MAKING MACHINE

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Application July 15, 1947, Serial No. 760,973

11 Claims. (Cl. 51—50)

1

This invention relates to cam generating machines, and more particularly to a machine for manufacturing cams of either the radial or axial type without the use of master cams.

A main object of the invention is to provide a novel and improved cam forming machine which is simple to operate, accurate in performance and readily adjustable for forming either radial cams or axial cams as desired.

A further object of the invention is to provide a novel and improved cam forming machine which may be employed to generate cams of either the radial or axial type without the use of master cams, said machine being sturdy in construction, reliable in operation and adjustable for a very wide range of cam designs.

A still further object of the invention is to provide an improved machine for manufacturing cams of either the radial type, wherein the cam surface is generated around the periphery of a disc-like planar element, or of the axial type, wherein the cam surface is generated along the longitudinal contour of an axially rotatable three-dimensional element, the generation of the cam in either type being accomplished by moving a follower along a guide track formed to provide vertical movement of the generating follower in accordance with the intended movement which it is desired to impart to the cam follower which must ultimately cooperate with the finished cam, the movement of the generating follower being transmitted to the cam forming tool and the cam blank being rotated around a vertical axis synchronously with the movement of said cam forming tool.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

Figure 1 is a front elevational view partly in cross-section, and with its front wall removed of a cam forming machine constructed in accordance with the present invention.

Figure 2 is a vertical transverse cross-sectional view taken on line 2—2 of Figure 1 and showing the cam forming tool in operative position thereon.

Figure 3 is a top plan view of the cam forming machine of Figure 1 with the rotating means for the cam blank removed.

Figure 4 is a top plan view similar to Figure 3 but partly broken away to reveal internal structural details and showing the cam blank support mounted in operative position on the machine.

Figure 5 is a cross-sectional detail view of the

2

vertical guide support for the forming tool mechanism taken on line 5—5 of Figure 1.

Figure 6 is a cross-sectional detail view of the vertical support for the forming tool mechanism taken on line 6—6 of Figure 1.

Figure 7 is a detail cross-sectional view of the vertical support for the forming tool mechanism taken on line 7—7 of Figure 1.

Figure 8 is a rear elevational view of a bearing collar for the screw gear adjusting shaft employed in adjusting the angle of inclination of the follower guide employed in the machine of Figure 1.

Figure 9 is a side elevational view of the bearing collar of Figure 8.

Figure 10 is a side elevational detail view of a cam grinding tool which may be employed on the machine of Figure 1.

Figure 11 is an end elevational detail view of a supporting bracket for a cutting torch which may be employed on the machine of Figure 1.

Figure 12 is a side elevational view of the torch supporting bracket of Figure 11.

Figure 13 is a fragmentary side elevational view of the cam forming machine of Figure 1 showing the indicating means for determining the angle of adjustment of the follower guide.

Figure 14 is an enlarged plan detail view of a reversing mechanism employed in the machine of Figure 1 for reversing the motion of the cam forming tool with respect to that of the cam blank.

Figure 15 is an elevational view of the reversing mechanism of Figure 14.

Figure 16 is an enlarged cross-sectional detail view taken on line 16—16 of Figure 2.

Figure 17 is an enlarged front elevational view of the adjustable securing means for the follower guide employed in the machine of Figure 1.

Figure 18 is an enlarged cross-sectional detail view taken on line 18—18 of Figure 4.

Figure 19 is an enlarged cross-sectional detail view taken on line 19—19 of Figure 4.

Referring to the drawings, 11 designates a generally rectangular supporting table structure, said table structure comprising front and rear vertical walls 12 and 13, a left end vertical wall 14 and a right end vertical wall 15, said vertical walls being rigidly secured together by any suitable means to define a rectangular enclosure. Secured in the top portion of the enclosure at the right end thereof is a horizontal bearing plate 16 on which is rotatively mounted an annular worm gear 17. Secured to worm gear 17 is a circular face plate 18 which is formed at its top surface with a plu-

ality of inverted T-shaped equally spaced radial grooves 19 for clamping a cam blank thereto. Face plate 18 is formed with a depending annular flange 20 which seats on worm gear 17 and at which the face plate is secured by bolts 21 to the worm gear. An apertured bracket plate 22 secured to the walls of the table 11 receives the annular flange 20 and overlies the worm gear 17 to restrain the worm gear and face plate against upward movement and translational movement in a horizontal plane while allowing said worm gear and face plate to rotate around a vertical axis. Meshing with worm gear 17 is a transversely extending worm 23 carried on a shaft 24. Secured inside the table 11 adjacent the shaft 24 and below the bearing plate 16 is a transverse vertical plate member 25 and secured thereto below the shaft 24 is a horizontal bracket plate 26. Worm shaft 24 is journaled in a bearing bracket 27 which is pivoted at 28 to bracket plate 26. A vertical shaft 30 having a top handle 31 extends through bracket 27. Shaft 30 carries at its lower end an eccentric 31' which is rotatable in bracket plate 26. By rotating handle 31 in a horizontal plane the bracket 27 may be swung outwardly to disengage worm 23 from worm gear 17, thereby permitting the face plate 18 to be freely revolved if such is desired.

The end of worm shaft 24 is pivotally connected at 32 to a shaft 33 journaled in a bearing sleeve 29 secured to front wall 12, said shaft passing through the table wall 12 and terminating at its outer portion in a squared end 34 adapted to be engaged by a suitable operating crank 44. A calibrated drum 35 is carried by shaft 33 and an index pointer 36 mounted on wall 12 adjacent said drum indicates the degrees of rotation of said shaft 33.

Journalled in a bearing sleeve 37 carried by wall 12 adjacent sleeve 29 is a second operating shaft 38 for worm gear 17, said shaft 38 being coupled to shaft 33 by a small gear 39 carried by shaft 38 which is meshed with a large gear 40 carried by shaft 33, thereby obtaining a reduced rate of rotation of the face plate 18 when the squared end 41 of shaft 38 is rotated by the operating crank. Shaft 38 carries a calibrated drum 42 and wall 12 carries an index pointer 43 overlying the periphery of drum 42 for indicating the degrees of rotation of face plate 18 when the shaft 38 is employed to rotate same.

Journalled in the table 11 in a bearing sleeve 44' secured to wall 12 below bearing sleeve 29 is a transverse shaft 45 extending through wall 12. At its outer portion shaft 45 carries a gear 46 which meshes with a smaller gear 47 carried by shaft 33. Shaft 45 is connected through a reversing clutch 48 to a shaft 49 journaled in a bearing bracket 50 secured to the transverse plate member 25. Shaft 49 carries a worm 51 which meshes with a worm gear 52 carried on a vertical shaft 53 suitably journaled in bearing bracket 50. The bottom end of shaft 53 is journaled in a bearing 54 suitably secured to the rear table wall 13 by means of a bracket member 55. The bottom end portion of shaft 53 carries a gear 56. Bracket member 55 is formed with a longitudinally extending horizontal guideway in which is slidably positioned a rack member 57 which is in mesh with the gear 56. Rack member 57 carries a pair of opposed upwardly projecting slotted arcuate arms 58, 58 and adjustably secured in the arcuate slots 59, 59 thereof is an inclined follower guide 60, pivotally connected at its mid-portion,

as shown at 61 to an upstanding lug 62 carried by rack member 57.

Secured to the mid-portion of follower guide 60 is a bracket member 63 formed with a central bearing aperture 64 and with longitudinal inner grooves 65, 65. Slidable in said grooves are respective rack members 66, 66.

Threaded into the ends of follower guide 60 and passing through the slots 59, 59 are bolts 67, 67 and secured to the ends of the follower guide are guide brackets 68, 68 slidably receiving the respective racks 66, 66. Secured to each bolt 67 inside a guide bracket 68 is a gear 69 meshing with the adjacent rack 66. The inner ends of the racks mesh with a gear 70 integrally secured on a shaft 71 extending through bearing aperture 64 in bracket member 63. Shaft 71 is journaled in a suitable bearing sleeve, shown at 72, secured to bracket member 63. Said sleeve and shaft project through front wall 12 and the shaft is provided with a squared outer end 73 which is provided with a crank 74. Front wall 12 is horizontally slotted, as shown at 75 to permit horizontal movement of the sleeve 72 as the follower guide moves horizontally during the cam forming process. Front wall 12 is calibrated with an arcuate scale 76 concentric with the mid-point of slot 75. Secured to sleeve 72 by a collar member 72' is a pointer arm 77 which indicates the angle of adjustment of the follower guide on scale 76 when said follower guide is positioned so that shaft 71 is concentric with the arcuate scale 76. Arm 77 is also employed as a handle to vary the angle of the follower guide when the clamping bolts 67 are loosened.

By rotating handle 74 in one direction the racks 66, 66 loosen the gear bolts 67, 67 so that the follower guide 60 may be set in a desired position of inclination. By rotating handle 74 in the opposite direction the racks 66, 66 tighten the gear bolts to secure the follower guide 60 in its adjusted position in the arcuate slots 59, 59 of the arms 58, 58.

Secured to the rear wall 13 of the table 11 is a vertical column member 78 and interlocked therewith for sliding movement in a vertical direction is a block member 79. Block member 79 has secured thereto a forwardly projecting horizontal shaft 80 on which is journaled a follower roller 81 having a peripheral flange 82. Roller 81 overlies the top surface of follower guide 60, said follower guide top surface being formed with a groove 83 adapted to receive the flange 82 to maintain the roller in tracking engagement with the follower guide top surface at all times. When the rack 57 is moved to the left, as viewed in Figure 1, block 79 therefore rises and when the rack 57 is moved to the right, block 79 is allowed to drop. The degree and direction of vertical movement of block 79 for a given motion of rack 57 is of course governed by the angular position of adjustment of the follower guide 60.

The sliding engagement of block 79 with column member 78 is in a vertical groove 84 formed in said column member, as shown in Figure 6. The column member 78 is formed with dovetailed vertical surfaces 85, 85 and slidably interlocked with said column member at said dovetailed surfaces for vertical movement with respect thereto is a knee member 86. Knee member 86 carries a horizontal forwardly extending support member 87 which is formed with a longitudinal dovetail guide track 88. Slidably engaged with guide track 88 is a support member 89 which extends transversely with respect to table 11 and is longitudi-

5

nally adjustable thereon. Support member 89 is formed with a transverse dovetail guide track 90. Slidably engaged with guide track 90 is a tool support 91 which is adjustable along the length of guide track 90. By moving support member 89 along guide track 88 and by moving tool support 91 along guide track 90, said tool support may be adjusted to any position in a horizontal plane in an area defined by the length of longitudinal track 88 and transverse track 90.

Tool support 91 may be manually adjusted on guide track 90 by means of an adjusting screw 92 journaled in the forward portion of support member 89 and threadedly engaging a nut 93 carried by the tool support and depending therefrom into a transversely extending slot 94 formed in the support member 89. An operating handle 95 is secured to the outer end of screw 92.

The guide track 88 is formed with a longitudinal groove 96 and slidably positioned therein at the left end of the track 88 is a block member 97. Journaled in block member 97 is a screw member 98 which threadedly engages a nut 99 carried by support member 89 and depending therefrom into groove 96. An operating handle 100 is secured to the outer end of screw member 98, whereby support member 89 may be manually adjusted longitudinally with respect to the block member 97. Block member 97 may be locked to track 88 in a desired position of adjustment thereof relative to the support member 89 by a locking pin 101. Secured to block member 97 by bolts 102 is a longitudinally extending bar member or rack 103 carried in groove 96 and formed at its bottom surface with rack teeth. Extending through an opening 113' formed in the bottom wall of the inner portion of groove 96 and meshing with said rack teeth is a gear 104 freely rotatable on a transverse shaft 105 journaled to the bottom of support member 87. Shaft 105 carries at its rear end a gear 106 which is received in a vertical groove 107 formed in the column member 78. Positioned vertically and slidably in said groove 107 is a rack bar 108 meshing with gear 106. The bottom end of rack bar 108 is adapted to engage the top surface of block 79, whereby vertical movement of said block will be transmitted to said rack bar, causing gear 106 and shaft 105 to rotate. A sleeve member 110 is slidably mounted on shaft 105 so as to be movable axially thereon but is keyed to said shaft so as to rotate therewith. Sleeve member 110 carries a clutch collar 111 having projections 112 adapted to be engaged in openings 113 formed in gear 104. At its outer end, sleeve member 110 is provided with a squared stud 114 which may be engaged by a suitable wrench or crank.

When sleeve member 110 is in an inwardly adjusted position so that projections 112 are seated in the gear openings 113, rotation of shaft 105 will be transmitted to gear 104 to thereby cause rack bar member 103 to move longitudinally in groove 96. This in turn moves support member 89 longitudinally on track 88 due to the connection of rack bar member 103 with said support member 89 through block 97, screw 98 and nut 99.

Vertical rack bar 108 may be raised to a position wherein its lower end will not engage the block 79 during the movement of said block and may be locked in said inoperative position by a suitable nut, such as is shown at 109. The elevation or adjustment of rack bar 108 is accomplished by disengaging the sleeve projections 112 from the gear 104, engaging the stud 114 by a suitable wrench or crank and thereby manually rotating the sleeve

6

member 110 and shaft 105 to raise the rack bar 108 to its desired position. When a radial cam is to be formed the projections 112 are engaged in the gear openings 113, thus coupling the longitudinal rack bar member 103 to the vertical rack bar 108 in the manner above described. When an axial cam is to be formed, vertical rack bar 108 is locked in an elevated inoperative position.

In its upper portion, column member 78 is formed with a vertical rectangular groove 115 in which is slidably positioned a rectangular collar member 116 secured to knee member 86. Slidably received in collar member 116 and non-rotatively keyed thereto is a vertical screw 117 whose bottom end is adapted to engage the block 79, whereby vertical movement of said block 79 may be transmitted to the knee member 86. Rotatably engaging the bottom portion of collar member 116 is a nut member 118 threadedly engaged with screw 117 and having a bottom flange underlying collar member 116 and formed with bevel gear teeth. Thus, as screw 117 is raised by block 79, the nut 118 is raised carrying with it collar 116, knee member 86 and support 87. Likewise, as the nut 118 is lowered, collar 116 and the related parts ride downwardly with it. The bevel gear portion of nut member 118 is meshed with a bevel gear 119 carried at the end of a horizontal shaft 120 extending transversely of and journaled to the bottom of knee member 86. A hand wheel 121 is secured to the forward end of shaft 120. By rotating hand wheel 121 the knee member 86 may be manually raised or lowered with respect to screw member 117.

Supported on the top of column member 78 is a shouldered collar 122 through which the vertical screw 117 passes. A nut 123 is threaded on screw 117 above said collar by means of which the screw 117 may at times be lifted so that its lower end is above the range of vertical movement of block 79 and may be thus locked in an inoperative position, as when radial cams are to be formed. When axial cams are to be formed, the screw member 117 is in a lowered position so that its bottom end engages the block 79 and the knee member 86 follows the vertical movements of said block.

Any suitable cam forming tool may be secured to the tool support 91. Figure 2 shows a motor-driven grinder 124 mounted on said tool support. The tool support is provided with a collar portion 125 in which a depending stud 126 carried by the tool may be received and secured by suitable clamping screws 127. Figures 11 and 12 show a bracket 128 which may be secured to collar portion 125 in the same manner as the grinding tool of Figures 2 and 10, said bracket being adapted to clampingly receive the shank portion 129 of a holder 130 for a cutting torch.

Figures 14 and 15 illustrate the details of the reversing clutch 48 employed for reversing the shaft 49 with respect to shaft 45 when it is desired to obtain a reversal of the direction of movement of the follower guide 60 with respect to the direction of rotation of the face plate 18. Clutch 48 comprises a bottom supporting plate 131 having vertical arms 132, 132 which are secured to the transverse vertical plate 25 of the table 11 to thereby support plate 131 in a horizontal position. Secured to bottom plate 131 are opposed upstanding bearing brackets 133 and 134. Shaft 45 is journaled in bracket 133 and carries at its inner end a gear 135 formed with a toothed clutch face 136. Shaft 49 is journaled in bracket 134 and terminates adjacent the toothed clutch face

136 but is spaced therefrom. Keyed to but axially slidable on the end of shaft 49 is a sleeve member 137 having a first toothed clutch face 138 opposing clutch face 136 and an opposite toothed clutch face 139. Rotatably mounted on shaft 49 adjacent the bearing bracket 134 is a gear 140 having a toothed clutch face 141 opposing clutch face 139. Journalled in bearing brackets 133 and 134 is a first countershaft 142 carrying a gear 143 meshing with gear 135 and journalled in said bearing brackets is a second countershaft 144 carrying a gear 145 meshing with both gear 143 and gear 140. A suitable shifter rod, not shown, is employed to shift sleeve member 137 axially, so that in one position of said sleeve member the clutch faces 136 and 138 are inter-locked and in an opposite position of said sleeve member the clutch faces 139 and 141 are interlocked. In the first position above described, shaft 45 transmits torque directly to shaft 49 through clutch face 136 and the sleeve member 137. In the second position of said sleeve member, shaft 45 transmits torque through gears 135, 143, 145 and 140 and the interlocking clutch faces 141 and 139 to shaft 49, causing shaft 49 to rotate in a direction opposite to the direction of rotation of shaft 45.

In operation of the machine, the cam blank is centered on the face plate 18 and secured thereby by suitable clamps. If a radial cam is to be formed, the screw 117 is elevated to an inoperative position as above described. The cam forming tool is mounted on the tool support 91 and the inclination of the follower guide 60 is adjusted in accordance with the peripheral shape required for the finished cam. The tool is adjusted to its starting position at the surface of the blank. Crank 44 is then rotated causing simultaneous rotation of the face plate 18 and longitudinal movement of the rack bar 57 which carries the follower guide 60. Follower 81 is moved vertically by the action of the moving follower guide and transmits its vertical movement through block 79 to rack bar 108. Rack bar 108 rotates gear 104 through gear 106 shaft 105 and clutch sleeve 110, producing longitudinal movement of rack bar 103, which is transmitted to support member 89 through block 97, screw 98 and nut 99. The cam forming tool is moved longitudinally along with support member 89.

When an axial cam is to be formed, the rack bar 108 is elevated to an inoperative position and locked therein as above described. Longitudinal movement of the follower guide 60 then produces vertical movement of the block 79, which is transmitted to the screw member 117. The vertical movement of screw member 117 is transmitted to the knee member 86 through the nut member 118 and collar member 116. The cam forming tool, is moved vertically along with the knee member 86. As in the case of the radial cam, the face plate 18 revolves simultaneously with the movement of the cam forming tool so that the shape of the cut made in the cylindrical cam blank is determined by the shape and angle of adjustment of the follower guide 60.

The follower guide 60 may have any desired shape, determined by the path of motion which the intended cam follower for the finished cam must assume.

An important feature of the present invention is the separation of the rotational and translational motions involved in forming the cam so that the shape thereof may be modified by modifying the translational motion. The translational motion involved in forming the cam is derived

from a comparatively simple shape (of follower guide) in most cases, and by having that motion under separate control it becomes much easier to produce or modify a cam than in the conventional method of combining the two components of motion by the use of a master cam as the tool guiding means.

In one method of producing cams, use is made of a dividing head with change gears, but in such method the lead cannot be so conveniently varied by large or small differences, as by the means herein disclosed. In using the master cam method, any variation of lead or other important feature of the work, requires a new and different master cam, which because of the delay and expense involved in producing same, cannot be justified for other than large quantities of identical production. In view of the above, cams are made, in many instances, by indirect and laborious methods, resulting in much hand work and non-uniformity of product. The machine herein disclosed provides a direct and easily controlled method of performing such work, and at a much lower requirement of skill and a much higher standard of quality.

The machine herein disclosed has various other possible uses. By mounting suitable tools in the tool carrier, the machine may be employed for such uses as drilling to a pattern, milling, flame cutting profiles, flame hardening profiled surfaces, laying out lines, making angular measurements, and the like.

The profile defining member 60, as above mentioned, may have any desired shape, governed by the path of motion which the intended cam follower must assume and can be adjusted at various angles, depending upon the range of movement required for the intended cam follower.

While a specific embodiment of a cam generating machine for the forming of axial and radial cams has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention other than as defined by the scope of the appended claims:

What is claimed is:

1. A surface generating machine comprising a support, a face plate rotatively mounted on said support, means for securing a cam blank to said face plate, a carriage on said support, means for adjusting said carriage horizontally on said support, means for securing a tool to said carriage, a profile defining member on said support, means for adjusting the angle of inclination of said profile defining member, means for simultaneously rotating said face plate and moving said profile defining member longitudinally, a follower engaging the profiled surface of said profile defining member, a first vertically movable member engageable with the top surface of said follower, means for moving the carriage longitudinally responsive to vertical movement of said first member, a second vertically movable member engageable with the top surface of said follower, means for moving the carriage vertically responsive to vertical movement of said second member, and individual means for elevating said vertically movable members independently with respect to said follower and said carriage.

2. In a profile-generating machine including a support mounting a rotatable face plate adapted to support a work piece thereon and a carriage movable on said support axially and

9

radially of said face plate and adapted to mount a profile-forming tool thereon, the improvement comprising a profile-defining member, means mounting said member for reciprocable movement on said support, means for simultaneously rotating said face plate and reciprocating said member, said member including a follower surface, said surface being angularly adjustable to define a plurality of profiles, a follower linearly movable on said support and operatively engaging said follower surface, and separate means engageable with said follower and operatively connected to said carriage for selectively moving the latter axially and radially of said face plate responsive to linear movement of said follower.

3. In a profile-generating machine including a support mounting a rotatable face plate adapted to support a work piece thereon and a carriage movable on said support axially and radially of said face plate and adapted to mount a profile-forming tool thereon, the improvement comprising a profile-defining member, means mounting said member for reciprocable movement on said support radially of the axis of said face plate, means for simultaneously rotating said face plate and reciprocating said member, said member including a follower surface, said surface being angularly adjustable to define a plurality of profiles, a follower, means mounting said follower on said support for reciprocal movement substantially at right angles to the movement of said member, said follower surface operatively engaging said follower whereby to reciprocate said follower upon reciprocation of said member, and separate means engageable with said follower and operatively connected to said carriage for selectively moving the latter axially and radially of said face plate responsive to reciprocating movement of said follower.

4. In a profile-generating machine including a support mounting a rotatable face plate adapted to support a work piece thereon and a carriage movable on said support axially and radially of said face plate and adapted to mount a profile-forming tool thereon, the improvement comprising a profile-defining member, means mounting said member for reciprocable movement on said support radially of the axis of said face plate, means for simultaneously rotating said face plate and reciprocating said member, said member including a follower surface, said surface being angularly adjustable to define a plurality of profiles, a follower, means mounting said follower on said support for reciprocal movement substantially parallel to the axis of said face plate, said follower surface operatively engaging said follower whereby to reciprocate said follower upon reciprocation of said member, and separate means engageable with said follower and operatively connected to said carriage for selectively moving the latter axially and radially of said face plate responsive to reciprocating movement of said follower.

5. In a profile-generating machine including a support, a mount for a work piece blank rotatable on said support on a vertical axis, and a profile-forming tool carriage mounted on said support for movement vertically and horizontally, the improvement comprising a profile-defining member, means mounting said member on said support for horizontal reciprocating movement, means for simultaneously rotating said mount and reciprocating said member, said member including an upwardly-directed follower surface, said surface being angularly adjustable on a

10

horizontal transverse axis to define a plurality of profiles, a follower vertically reciprocable on said support, said follower surface operatively engaging said follower so as to reciprocate said follower upon reciprocation of said member, a rack vertically slidable on said support and including a lower end engageable with said follower whereby said rack is vertically reciprocable with said follower, a horizontal rack carried by said carriage, gear means carried by said carriage and operatively engaging both racks, and clutch means operatively associated with said gear means for selectively coupling and uncoupling said racks, whereby at times said racks are operatively coupled together so as to reciprocate said carriage horizontally upon reciprocation of said follower.

6. In a profile-generating machine including a support, a mount for a work piece blank rotatable on said support on a vertical axis, and a profile-forming tool carriage mounted on said support for movement vertically and horizontally, the improvement comprising a profile-defining member, means mounting said member on said support for horizontal reciprocating movement, means for simultaneously rotating said mount and reciprocating said member, said member including an upwardly-directed follower surface, said surface being angularly adjustable on a horizontal transverse axis to define a plurality of profiles, a follower vertically reciprocable on said support, said follower surface operatively engaging said follower so as to reciprocate said follower upon reciprocation of said member, a vertical screw vertically slidable on said support and including a lower end engageable with said follower whereby said screw is vertically reciprocable with said follower, a collar mounting said carriage on said screw for vertical sliding movement relative thereto, a nut on said screw below said collar and providing a seat for said collar whereby said carriage is vertically reciprocable with said screw, and means for elevating said screw relative to said carriage whereby to disengage said lower end of said screw from said follower.

7. In a profile-generating machine including a support, a mount for a work piece blank rotatable on said support on a vertical axis, and a profile-forming tool carriage mounted on said support for movement vertically and horizontally, the improvement comprising a profile-defining member, means mounting said member on said support for horizontal reciprocating movement, means for simultaneously rotating said mount and reciprocating said member, said member including an upwardly-directed follower surface, said surface being angularly adjustable on a horizontal transverse axis to define a plurality of profiles, a follower vertically reciprocable on said support, said follower surface operatively engaging said follower so as to reciprocate said follower upon reciprocation of said member, a rack vertically slidable on said support and including a lower end engageable with said follower whereby said rack is vertically reciprocable with said follower, a horizontal rack carried by said carriage, gear means carried by said carriage and operatively engaging both racks, clutch means operatively associated with said gear means for selectively coupling and uncoupling said racks, whereby at times said racks are operatively coupled together so as to reciprocate said carriage horizontally upon reciprocation of said follower, a

11

vertical screw vertically slidable on said support and including a lower end engageable with said follower whereby said screw is vertically reciprocable with said follower, a collar mounting said carriage on said screw for vertical sliding movement relative thereto, a nut on said screw below said collar and providing a seat for said collar whereby said carriage is vertically reciprocable with said screw, and means for elevating said screw relative to said carriage whereby to disengage said lower end of said screw from said follower.

8. In a profile-generating machine including a support, a mount for a work piece rotatable on said support, and a tool carriage movable on said support in planes parallel to the axis of said mount and in planes normal to the axis of said mount, the improvement comprising a profile-defining guide, means mounting said guide on said support for reciprocating movement in a plane normal to the axis of said mount, said guide including a guide member pivoted thereon for angular adjustment relative thereto, a pair of opposed arcuate extensions of said guides, means slidably connecting opposite portions of said guide member to said extensions, a pair of clamps for clamping such portions to said extensions for locking said guide member in angularly-adjusted relation to said guide, and rack and pinion means operatively associated with said guide member for simultaneously actuating both of said clamps.

9. A surface-generating machine, comprising a support, a face plate rotatably mounted on said support, means for clamping a work piece to said face plate, a carriage on said support, a tool, means for securing said tool to said carriage, a profiling follower guide reciprocable on said support, means for adjusting said guide for defining a plurality of profiles, means for simultaneously rotating said plate and reciprocating said follower guide, a follower engageable with said guide and reciprocable thereby, and settable means operatively associated with said follower for moving said carriage in axial and normal planes relative to the axis of said face plate in response to reciprocating movement of said follower.

10. A surface-generating machine, comprising a support, a face plate rotatably mounted on said support, means for securing a work piece to said face plate, a carriage on said support, a forming tool, means for securing said forming tool to said

12

carriage, an angularly-adjustable profiling guide longitudinally reciprocable on said support, means for simultaneously rotating said face plate and reciprocating said guide longitudinally, a follower engaging said guide and reciprocated thereby at an angle thereto, a first movable member engaging said follower, means for moving said carriage in one direction responsive to movement of said first member, a second movable member engaging said follower, means for moving the carriage in another direction responsive to movement of said second member, and separate means for selectively securing one of said first and second members in an inoperative position out of engagement with said follower.

11. A surface-generating machine, comprising a support, a face plate rotatably mounted on said support, means for clamping a work piece to said face plate, a carriage on said support, a tool, means for securing said tool to said carriage, an angularly-adjustable profiling guide reciprocable on said support, means for simultaneously rotating said face plate and reciprocating said guide, a single follower engaging said guide and reciprocated thereby, a pair of separate settable means engageable with said follower and reciprocated thereby and therewith, said means being operatively coupled to said carriage for moving the same axially and radially relative to an axis parallel to the axis of said face plate in response to reciprocating movement of said guide and follower, means for varying the angular position of said guide, and means for selectively inactivating one of said settable means.

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