March 25, 1958 J. C. HORTH ET AL 2,827,836

PROFILING MACHINE CONTROL MECHANISM

Filed March 4, 1955 2 Sheets-Sheet 1

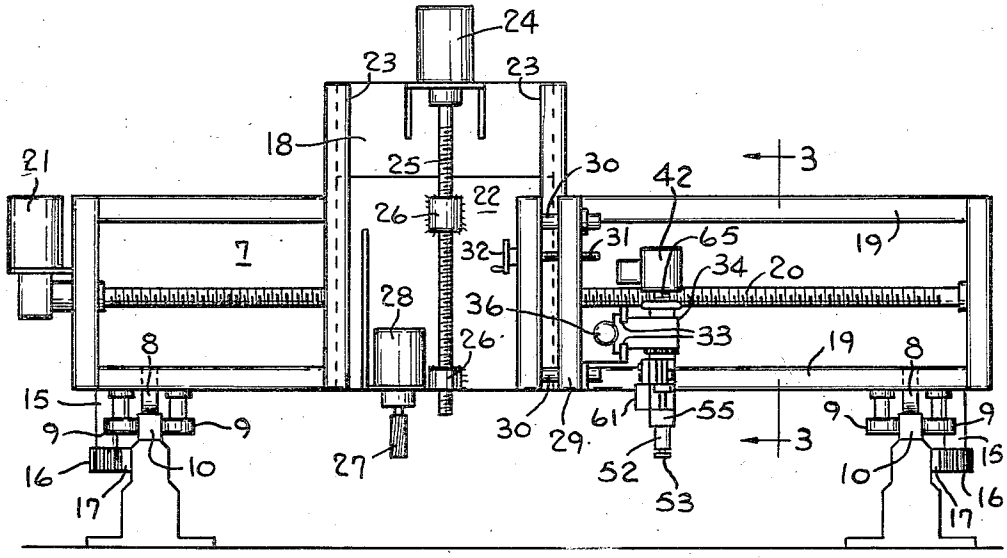


FIG. 1

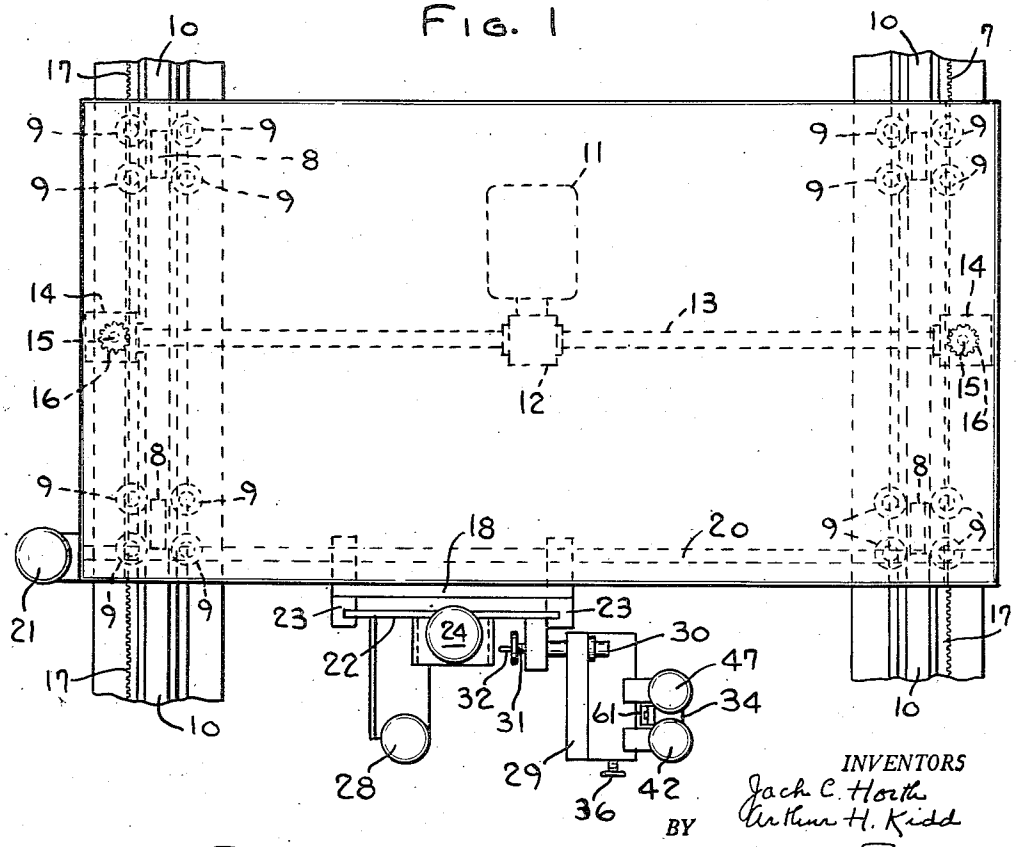


FIG. 2

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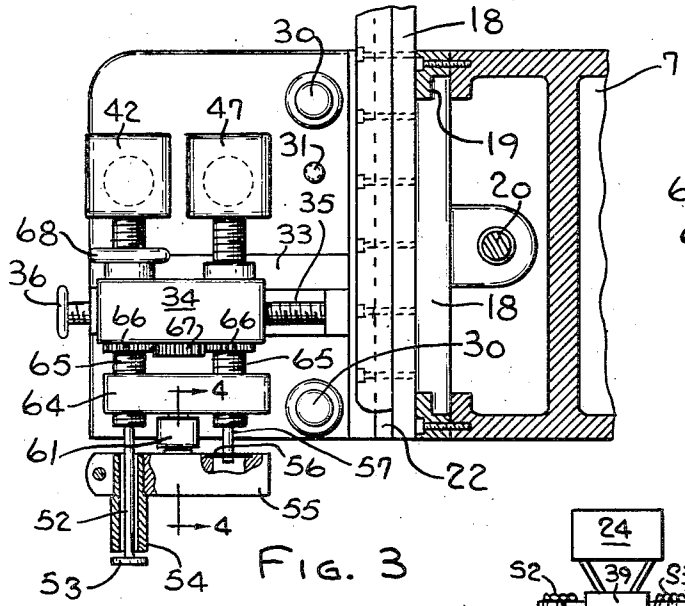


FIG. 3

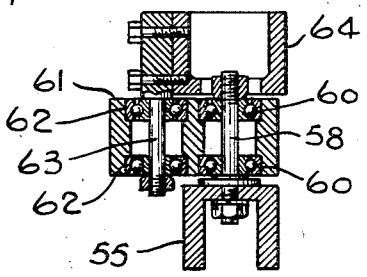


FIG. 4

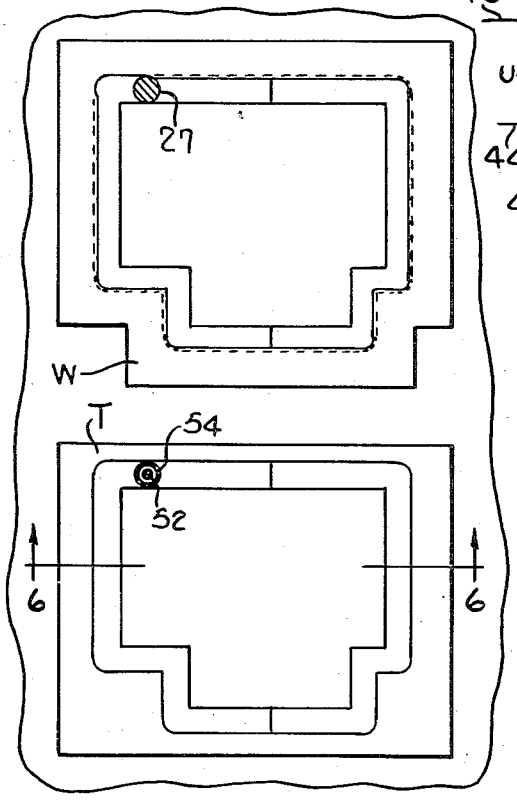


FIG. 5

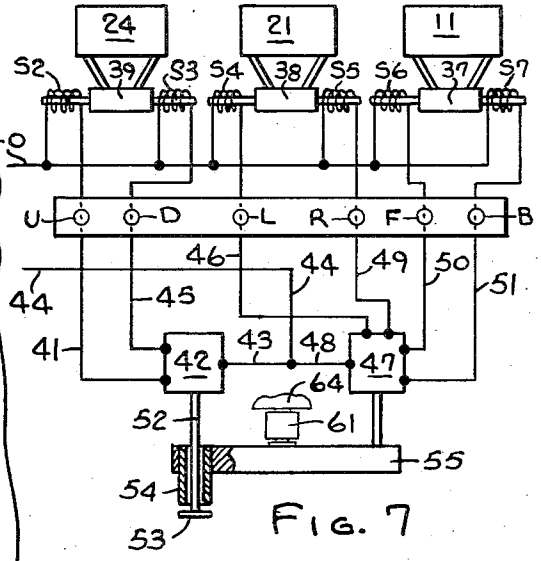


FIG. 7

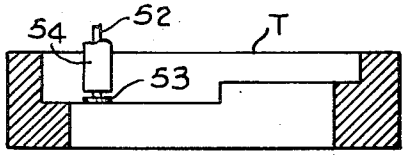


FIG. 6

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PROFILING MACHINE CONTROL MECHANISM

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Application March 4, 1955, Serial No. 492,290

6 Claims. (Cl. 90—13)

The invention relates to profiling machines and more particularly to the mechanism for controlling the cutting tool.

Heretofore, in three dimensional profiling machines it has been the usual practice to provide spaced styli and a separate pattern or template for each stylus. The object of this invention is to simplify the control mechanism by providing concentrically disposed styli and a single three dimensional template, one stylus for sensing or indicating the vertical variations in the depth of the pattern or template and the other for sensing or indicating the horizontal variations in the length and breadth of the pattern to be cut.

This application is a continuation-in-part of our application Serial No. 438,019, filed June 21, 1954, now abandoned, for Profiling Machine Control Mechanism, and includes the concentrically disposed styli and an improved mounting for the stylus used to indicate horizontal variations in the length and breadth of the pattern to be cut. It was found that with the construction of the prior application the lever mounted stylus had a tendency to swing down or twist when moving backward laterally, and also since the control connection was intermediate the ends of the lever, the movement of this connection was half of what it should be. The present invention overcomes the disadvantages above described by a new and improved lever mounting in which the lever is medially pivoted so that the tool control and stylus movements are identical and the pivot for this lever is mounted on a swinging support or link so that the former twisting action is prevented.

The invention further consists in the several features hereinafter set forth and more particularly defined by claims at the conclusion hereof.

In the drawings:

Fig. 1 is a front elevation view of an elementary form of profiling machine equipped with cutter control mechanism embodying the invention;

Fig. 2 is a plan view of the machine;

Fig. 3 is a detailed vertical sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a detailed vertical sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is a diagrammatic view of the template, the work, the styli, and the cutter;

Fig. 6 is a horizontal sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is a schematic arrangement of the cutter drive control mechanism.

Referring to Fig. 1, we have shown a simple form of a three dimensional profiling machine in which a carriage 7 provided with spaced sets of supporting wheels 8 and spaced sets of laterally disposed guide wheels 9 engaging longitudinally disposed spaced rails 10 is adapted to be propelled along said rails by a reversible hydraulic motor 11 connected by gearing 12 wtih a feed screw 13 which at each end has a gearing connection 14 with a shaft 15

carrying a gear 16 meshing with a rack 17 extending parallel to the adjacent rail 10.

The carriage 7 has a tool carrying carriage 18 slidably mounted on horizontally disposed ways 19 and operatively connected to a feed screw 20 on the carriage 7 driven through suitable connections by a reversible hydraulic motor 21.

The carriage 18 has a tool carrying slide 22 mounted for vertical movement in ways 23 thereon and carries a reversible hydraulic motor 24 connected to a feed screw 25 working in feed nuts 26 on the slide. A cutting tool, such as an endmill 27 is coupled to a drive motor 28 mounted on the slide.

The cutter control mechanism includes a frame or carriage 29 movable with the carriage 18 and mounted on vertically spaced guides 30 and manually adjustable toward or away from the carriage 18 by a feed screw 31 and its handwheel 32. Carriage 29 is provided with ways 33 for a stylus carrying carriage 34 and manually adjustable in a plane at right angles to the guides 30 by a feed screw 35 and its handwheel 36.

Referring to Fig. 7, the motor 11 is connected to a source of hydraulic pressure through a solenoid operated control valve 37. Motor 21 is connected to a source of hydraulic pressure through a solenoid operated control valve 38. Motor 24 is connected to a source of hydraulic pressure through a solenoid operated control valve 39.

The valve 39 is moved from a neutral position to a position in which the motor 24 is rotated to move the slide 22 upwardly when the solenoid S2 is energized and to a position in which the motor 24 is rotated to move the slide 22 downwardly when the solenoid S3 is energized.

The valve 38 is moved from its neutral position to a position in which the motor 21 is rotated to move the carriage 18 to the right along the ways 19 when the solenoid S4 is energized and to a position in which said motor is rotated to move said carriage to the left along ways 19 when the solenoid S5 is energized.

The valve 37 is moved from its neutral position to a position in which the motor 11 is rotated to drive the carriage 7 forwardly along the rails 10 when the solenoid S6 is energized and to a position in which said motor is rotated to move said carriage backwardly along the rails 10 when the solenoid S7 is energized.

Solenoids S2 to S7 each have one of their terminals connected to a current supply line 40. The other terminal of solenoid S2 is connected by a conductor 41 including a manual start and stop switch U with a control switch mechanism 42 which is connected by a conductor 43 with the other supply line 44. The other terminal of solenoid S3 is connected by a conductor 45 including a manual start and stop switch D with the switch mechanism 42. The other terminal of solenoid S4 is connected by a conductor 46 including a manual start and stop switch L with a control switch mechanism 47 which is connected by the conductor 48 with supply line 44. The other terminal of solenoid S5 is connected by a conductor 49 including a manual start and stop switch R with the control switch mechanism 47. The other terminals of the solenoids S6 and S7 are respectively connected by conductors 50 and 51 to the switch mechanism 47, conductor 50 including a start and stop switch F and conductor 51 including a start and stop switch B.

Switch U is operated when the operator desires to move or have the motor 24 move the slide 22 and tool 27 upwardly in a vertical plane and the switch D operated to cause motor 24 to move slide 22 and tool 27 downwardly in a vertical plane.

Switch L is operated when the operator desires to

move or have the motor 21 move the carriage 18 toward the left along the carriage 7 to move the tool 27 to the left and the switch R operated when the operator desires to move or have the motor 21 move the carriage 18 toward the right along the carriage 7.

Switch F is operated when the operator desires to move or have the motor 11 move the carriage 7 forwardly along the rails 10 and the switch B operated when the operator desires to move or have said motor 21 move the carriage 7 backwardly along the rails.

Thus the above named switches permit the establishing of control circuits which determine the vertical, lateral, and lengthwise movements of the tool 27 relative to the work W.

All of the above described structure including the switch mechanisms 42 and 47 are old and well known and act through the stylus control of said switch mechanisms when the switches U, D, L, R, F, and B are operated to control the positioning and movement of the cutter 27 relative to the work, the motors 11, 21, and 24 being separately operated so that only one of the three dimensional movements of the cutter is varied at any one time.

As in the prior constructions, the control of the switch mechanisms 42 and 47 is effected by styli which move in response to template variations, but by the present invention the styli are concentrically disposed to be responsive to the variations of a single three dimensional pattern or template instead of being spaced apart and associated with two spaced templates.

Referring to the drawings, a stylus 52 having a head 53 of the same OD as the cutter 27 has its shank operatively connected with the switch mechanism 42 so that the up and down movements of said stylus in response to variations in the depth of the template T will be communicated to said mechanism to in turn control the solenoids S2 and S3 and then control valve 39 to control the motor 24 so that the cutter will be raised or lowered depending upon the bottom contour of the template T.

A hollow or tubular stylus 54 of the same OD as the cutter 27 with the shank of the stylus 52 passing upwardly therethrough in concentric spaced relation therewith is mounted on one end of an intermediately pivoted lever 55 whose other end is connected to a flexible metal diaphragm 56 on the end of a member 57 operatively connected to the switch mechanism 47 so that movements of the lever 55 in a horizontal plane for lateral template variations and lengthwise back and forth movement in this plane for lengthwise template variations will be communicated to member 57. The midpoint of the lever 55 between the stylus 52 and the member 57 is secured to a pivot pin 58 journalled in ball bearing journals 60 in one end of a link 61 whose other end carries ball bearing journals 62 for a pivot pin 63 bolted to a carriage 64. The link 61 permits the lever 55 to swing laterally by the turning of the pin 58 in its bearings, and it also permits the lever 55 to swing about the pivot pin 63 for lengthwise lateral movements and provides a firm mounting for this lever so as to prevent any tendency of it to twist relative to its mounting.

Carriage 64 is suspended from the carriage 34 by vertically disposed feed screws 65 and feed nuts journalled in carriage 34 and carrying gears 66 that are operatively connected by an idler gear 67. Turning of the feed nuts by its associated handwheel 68 acts through the gearing above described to raise or lower the carriage 64 to bring the stylus 52 to the desired operating position relative to the template T. Each feed screw 65 carries its associated switch mechanism 42 or 47.

As previously described, the switch mechanism 42 is responsive to vertical changes in position of the stylus 52 through the connection of its shank with such mechanism. The switch mechanism 47 is made responsive to changes in the position of the stylus 54 by the connection of the diaphragm 56 with the member or rod 57 which

as a consequence moves with the lever 55 and thus transmits changes in the widthwise and lengthwise variations of the template T to control the switch mechanism 47 so that it in turn may control the solenoids S4, S5, S6, and S7 to in turn control the valves 38 and 37 which control the motors 21 and 11 that in turn control the lateral movement of the carriage 18 on the carriage 7 and the lengthwise movement of the carriage 7 along the rails 10.

The general operation of the profiling machine above described and its controls is the same as any three dimensional profiling machine except that the control of the cutter 27 is now from a single master pattern or template T with which the styli 52 and 54 engages subject to the control by the operator through his manipulation of the switches U, D, L, R, F, and B, Fig. 5 showing the styli 52 and 54 in relation to the template T and the cutter 27 making its cut in the work W as indicated by the dotted lines 65 and Fig. 6 showing the stylus 52 in position for controlling the vertical position of the cutter as it makes a portion of its bottom cut in the work W.

As the styli move along the template T from left to right the control switches have been set by the operator so that both styli will move in a horizontal plane with the stylus 53 moving along at a constant depth and the only automatic control then active is that of the stylus 54 engaging the side wall of the template and acting to move the tool 27 laterally to accommodate any variations in contour of the side wall. When, however, the styli reach the vertical wall above referred to, then the operator through his operation of the switches momentarily deactivates lateral or side movement control for stylus 54 and then the side pressure on the stylus 53 acts to move its head upwardly, and the tool is raised accordingly. While the stylus 53 moves up, its side pressure on the vertical wall will cause the whole head to rise with a corresponding movement of the tool. Thereafter, as the stylus 54 reaches the top of the wall, the operator reactivates the lateral control for the stylus 54 so that the styli along the upper level of the pattern move as before. When the styli reach a corner, the operator through his operation of the switches selects the major direction in which the styli and hence the tool are to move. If vertical variations in the pattern are gradual, then the stylus 53 will control the tool to take care of such variations by variations of its end pressure. When during the course of movement of the styli a downward vertical wall is encountered, then the stylus 53 is free to drop, and as it drops off the upper horizontal wall, it is relieved of its pressure and moves down causing its head and consequently the tool head to move down until the lower horizontal wall is reached when the end pressure on the stylus 53 stops further downward movement. With the above construction side pressure as well as end pressure on the stylus 53 will act to raise its head and the tool head while absence of any pressure on stylus 53 will cause it to drop and thus act to lower its head and the tool head. Since the operator only has to watch one pattern instead of the usual two patterns, a further advantage is had by this invention.

We desire it to be understood that this invention is not to be limited to any particular form or arrangement of parts except in so far as such limitations are included in the claims.

What we claim as our invention is:

1. In control mechanism for a profiling machine, the combination of control mechanism for determining the vertical position of the cutting tool relative to the work including a template controlled stylus of the diameter of the cutting tool, and control mechanism for determining the lateral and lengthwise positioning of the cutting tool relative to the work including a stylus concentrically disposed relative to said first named stylus and of substantially the same diameter and sensitive to lateral and lengthwise variations in said template.

2. In control mechanism for a profiling machine, the

combination of control mechanism for determining the vertical position of the cutting tool relative to the work including a template controlled stylus, and control mechanism for determining the lateral and lengthwise positioning of the cutting tool relative to the work including a stylus concentrically disposed relative to said first named stylus and sensitive to lateral and lengthwise variations in said template, said last named stylus including a lever mounted for movement in a horizontal plane both laterally and lengthwise.

3. In control mechanism for a profiling machine, the combination with a single master template having depth, length, and width contours desired to be duplicated in the work, of a tool controlling stylus sensitive to depth contour of said template and a tool controlling stylus sensitive to length and width contours of said template.

4. In a control mechanism for a profiling machine, the combination of control mechanism for determining the vertical position of the cutting tool relative to the work including a template controlled stylus having a template engaging head of the diameter of the cutting tool and a shank of reduced diameter, and control mechanism for determining the lateral and lengthwise position of the cutting tool relative to the work including a stylus having an annular template-engaging head of substantially the same outer diameter as that of the cutting tool and through which the shank of the first named stylus works, and a support for said annular head adapted to move lengthwise and laterally in accordance with the movement of said annular head by the template.

5. Control mechanism as defined in claim 4 wherein

the support for said annular head is a lever having a medially disposed fulcrum, and means supporting said fulcrum for lengthwise lateral movement of said annular head relative to the template.

6. In a control mechanism for a profiling machine, the combination of control mechanism for determining the vertical position of the cutting tool relative to the work including a template controlled stylus having a template engaging head of the diameter of the cutting tool and a shank of reduced diameter, and control mechanism for determining the lateral and lengthwise position of the cutting tool relative to the work including a stylus having an annular template-engaging head of substantially the same outer diameter as that of the cutting tool and through which the shank of the first named stylus works, a relatively fixed support, a lever having said annular template-engaging head at one end and a motion transmitting member at its other end and medially pivoted between its ends, and a link pivotally connected at one end with said relatively fixed support and pivotally connected at its other end with the pivot of said lever.

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