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Advanced Automatic Feed Mechanism in Shapers Using Microcontrollers

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Abstract: **In recent generations, significant development in manufacturing processes has led to large advancements in the process of machining. . However, for converting the raw material into the given desired part, one of the most important processes is called as shaping. In the case of a normal existing shaper, the tool feed to cut the work piece will be given manually. However, in certain cases, there is also automatic feed control. In the case of our method, we propose an automatic feed control by integrated works of mechanical, electrical and coding software. In this method, the tool slide which is kept normal top the work piece or swiveled at an angle, initially moves over the work piece. The entire unit is connected to the internally connected microcontroller circuit. Once the first action of the work piece removal is done, the microcontroller is automatically coded to stimulate mechanical action, by means of which the dial indicator moves to check the flatness of the already cut work piece. Indicators may be used to check the variation in tolerance during the inspection process of a machined part, measure the deflection of a beam or ring under laboratory conditions, as well as many other situations where a small measurement needs to be registered or indicated. [5] Once the secondary action is completed, the deflection detected by the microcontroller is detected in the case of the work piece being uneven and the tool slide is instructed by the microcontroller to move to the deflected point by stimulated mechanical action. Again the dial indicator is moved to check flatness; until the deflection is not detected the above process continuous to occur and finally stop when no deflection is detected. One of the major advantages of using this method of automatic feed is that it is fully automated. Since a dial indicator is also used to check the flatness, the accuracy obtained in the flatness of the work piece will be maximum. It also eliminates the human operator thus diminishing human error.**

Index Terms**—Dial indicator, microcontroller, tool feed, work piece**

I. INTRODUCTION

In recent generations, significant development in manufacturing processes has led to large advancements in the process of machining. Machining is any of various processes in which a piece of raw material is cut into a desired final shape and size by a controlled material-removal process. Machining is part of the manufacture of many metal products, but it can also be used on materials like wood, plastic, ceramic, and composites.[1]

In the context of machining, a cutting tool or cutter is any tool that is used to remove material from the work piece by means of shear deformation. Cutting may be accomplished by single-point or multipoint tools. Single-point tools are used in turning, shaping, planing and similar operations, and remove material by means of one cutting edge. However, for converting the raw material into the given desired part, one of the most important processes is called as shaping. A shaping machine is used to machine surfaces. It can cut curves, angles and many other shapes. It is a popular machine in a workshop because its movement is very simple although it can produce a variety of work. Shapers are mainly classified as standard, draw-cut, horizontal, universal, vertical, geared, crank, hydraulic, contour and traveling head.[2]

II. SHAPER RELATED TERMINOLOGIES

Generally, shaper is an assembly of many individual parts. The parts of a shaping machine are

1. Base- The base of the shaper supports the column or pillar which supports all the working parts such as ram, work table, drive mechanism etc. Base is a heavy cast iron body.

2. Column - Pillar or Body- Frame-The shaper has a column which is a ribbed casting of cellular construction. The top of the column carries the ram sideways, while the table sideways is machined on the front of the casting. The crank and slotted link mechanism that drives the ram is contained within the column. The driving motor, the variable speed gearbox, levers, handles and other controls of shaper are also contained in the column.

3. Cross rail- The cross rail carries the horizontal table sideways and is mounted on the vertical sideways of the column. The cross rail can be raised or lowered by means of an elevating screw in order to compensate for different thicknesses of work. The cross rail is a, heavy casting and it also carries the table cross feed screw together with the pawl and ratchet intermittent drive mechanism.

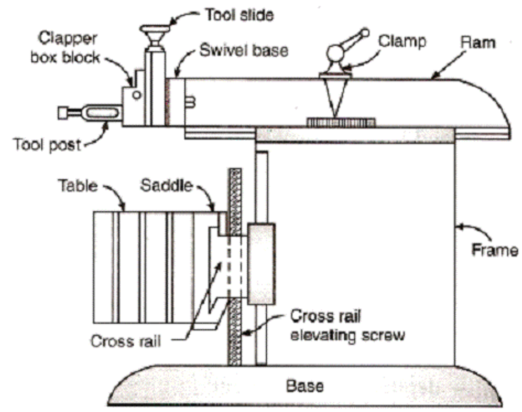
4. Saddle- Saddle is gibbed to the cross rail and supports the table. If the table is removed, the work can be bolted or clamped to the T-slots in front of the saddle. Crosswise movement of the saddle causes the work table to move sideways.

5. Table- The work table is a box shaped casting with T-slots in its upper surface and down one side. It also has a vee machined in the vertical side to carry cylindrical work.
The upper surface of the work table is machined in situ after assembly to ensure that the working surface of the table is a true datum for work setting. The work table is bolted to the saddle and can be moved vertically and crosswise with the help of saddle and cross rail.

6. Ram- Ram is a rigidly braced casting and is located on the top of column. The ram is driven back and forth in its slides by the slotted link mechanism. The ram contains a stroke positioning mechanism and the down feed mechanism.

7. Tool post and tool slide - The tool head slides in a dovetail at the front of the ram by means of T-bolts. It can swivel from 0° to 90° in a vertical plane: The tool head can be raised or lowered by hand feed for vertical cuts on the work piece.
The tool head holds the tool.

The tool head imparts the tool, the necessary vertical and angular feed movements. The tool slide controls the in feed of the cutting tool into the work piece. In other words, it controls the depth of cut and is adjusted by a lead screw. The clapper box allows the cutting tool to lift on the return or idle stroke so that the tool is not dragged back through the uncut work piece and gets damaged. The tool post carries the cutting tool. [3]



III. MECHANISM OF SHAPER

The work piece mounts on a rigid, box-shaped table in front of the machine. The height of the table can be adjusted to suit this work piece, and the table can traverse sideways underneath the reciprocating tool, which is mounted on the ram. Table motion may be controlled manually, but is usually advanced by automatic feed mechanism acting on the feed screw. The ram slides back and forth above the work. At the front end of the ram is a vertical tool slide that may be adjusted to either side of the vertical plane along the stroke axis. This tool-slide holds the clapper box and tool post, from which the tool can be positioned to cut a straight, flat surface on the top of the work piece. The tool-slide permits feeding the tool downwards to deepen a cut. This adjustability, coupled with the use of specialized cutters and tool holders, enable the operator to cut internal and external gear tooth profiles, splines, dovetails, and keyways. The ram is adjustable for stroke and, due to the geometry of the linkage, it moves faster on the return (non-cutting) stroke than on the forward, cutting stroke. This action is via a slotted link or Whitworth link. [4]

IV. ADVANCED AUTOMATIC FEED MECHANISM

In the case of a normal existing shaper, the tool feed to cut the work piece will be given manually. However, in certain cases, there is also automatic feed control. In the case of our method, we propose an automatic feed control by integrated works of mechanical, electrical and coding software.

In this method, the tool slide which is kept normal top the work piece or swiveled at an angle, initially moves over the work piece. The entire unit is connected to the internally connected microcontroller circuit. Once the first action of the work piece removal is done, the microcontroller is automatically coded to stimulate mechanical action, by means of which the dial indicator moves to check the flatness of the already cut work piece. Indicators may be used to check the variation in tolerance during the inspection process of a machined part, measure the deflection of a beam or ring under laboratory conditions, as well as many other situations where a small measurement needs to be registered or indicated. [5] Once the secondary action is completed, the deflection detected by the microcontroller is detected in the case of the work piece being uneven and the tool slide is instructed by the microcontroller to move to the deflected point by stimulated mechanical action. Again the dial indicator is moved to check flatness; until the deflection is not detected the above process continuous to occur and finally stop when no deflection is detected.

V. ALGORITHM STORED IN THE MICROCONTROLLER

A. In a single cycle, the feed value is initially set and the tool is moved over the work piece and chips the material.

B. Microcontroller is coded such that dial indicator is moved over the work piece to check the flatness.

C. Once the deflection is detected (indicating unevenness of the work piece); the point at which deflection occurs is stored in the memory unit of the microcontroller.

D. Now, the tool is instructed to move to the deflected point wherein the initially set designated amount of feed is supplied to remove the excess material.

E. Again, the dial is automatically moved to check the flatness.

F. The above processes repeat until there is no deflection in the dial indicator.

G. Once there is no deflection detected, the tool again moves to the dead end of the work piece.

H. This completes one single cycle.

VI. ADVANTAGES

A. One of the major advantages of using this method of automatic feed is that it is fully automated.

B. Since a dial indicator is also used to check the flatness, the accuracy obtained in the flatness of the work piece will be maximum.

C. It also eliminates the human operator thus diminishing human error.

D. Also, this method is less time consuming and finished materials are obtained with a very high amount of accuracy and precision.

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