Study of Comparison between shaper & Planer with Modified tool head for the enhancement in productivity & energy conservation

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Abstract: *Tools are the essential part of a manufacturing workshop. Shaper & planer are one of them which utilize these tools to develop different magical jobs. Flat surfaces are machined by these machine tools.. They have reciprocating motion for a single point tool and the job. During the forward stroke of the tool, machining will take place while in the return stoke, the tool will be idling. These two strokes are known as forward stroke & idle stroke respectively. The quick return mechanism of these machines; reduce the ineffective time (i.e. the idle stroke time when no machining takes place) and wastage of energy. An idea has been suggested on reducing the idle stroke time, with modified tool post, two clapper boxes and with two tools. This arrangement ensures material removal during the return stroke also. In this paper, special care is taken to save energy, machining time and improve the productivity.*

Key words: Productivity Improvement, Tool, Shaper, Planer, Energy Conservation

INTRODUCTION

Electricity & Heat are the two major source and forms of energy that are used in industries for wide range of applications. Some applications where they are relevantly used in the form of heat are in boilers in order to produce steam , metals that are melted in furnaces, shaft power developed in I.C Engine, Sterilization in hospitals etc.. Whereas another form of energy i.e. electricity finds its use in producing light (electricity) through electric bulb , in a motor to produce shaft power of different capacities to meet different applications like a motors coupled with pumps, washing machines, fans and several other electrical appliances.

In a manufacturing shop different types of machine tools are being used. Few of them are rotary type of machines and many others are reciprocating type. Typical examples are laths, cylindrical grinders, cam manufacturing machine tools. In these machines, the work pieces

are made to rotate while the tools are mounted on a stationary tool posts. Shapers and planners are the machine tools used to machine flat surfaces. These machines have reciprocating movement for the tool or the job. Usually a single point tool will be used in these machine tools. During the forward stroke of the tool, job will be machined and during the backward stroke of the Tool, the tool will be idling. To achieve this, the cutting tools are mounted over an arrangement called clapper box. In other words the return strokes are ineffective and non- machining strokes.

In order to reduce the idling time, a new tool post with a second clapper box was provided in a shaper and a planner machine. In this paper, results of the experiments conducted on a shaper and a planning machine, in terms of conservation of energy, machining time and productivity improvement are reported.

Shaper Machine: Shaper is a reciprocating machine tool, which is used to machine a flat surface. They can be classified as follows:

- Standard type or universal shaper,
- Crank type,
- Geared type,
- Hydraulic type,
- Horizontal type,
- Push type,
- Draw type
- Vertical type and
- Gear cutting - gear shapers

The tool head is attached to a ram, which can reciprocate. Movement of the ram and tool is imparted by a mechanism driven by a motor or hydraulic circuit. A quick return mechanism is used to make the return stroke quicker than the forward cutting stroke. The ratio of the return to the cutting time is in the range of 0.3 to 0.5. Machining takes place during the forward stroke of the ram. In the return stroke, with the help of the clapper box arrangement, the tool tilts a little and idles. Tilting of the tool post helps us with the return stroke, which does not damage the machined surface.

The work piece gets machined, which is clamped over a table. It can be moved vertically or sidewise to provide the required depth of cut and feed. Machining can be done in four steps:

1. The job is mounted suitably on the table and a rough cutting tool is set in the tool post.

2. The stroke length of the ram is set in such a way that the tool will have little over shoot from either sides of the job.

3. The depth of cut and cross feed is set and a rough cutting is done.

4. Using finishing tool the machining is completed. For the finishing cuts, depth of cut may be small in comparison to the rough cut.

Planner Machine

Planner Machine: Planning machines are used in machining large flat surfaces. In these machines, tool is mounted on tool post, which will be attached to a fixed frame and the job shall be mounted on a reciprocating table. The table of the planning machines is reciprocated with a job mounted on it. Usually a single point tool is mounted on the tool post and held at a stationary position, while the table is made to reciprocate by mechanical, hydraulic or electric device. During the forward stroke of the table, job is cut and in the return stroke tool idles.

Planning machines are classified as follows:

- Double column type,
- Single column type or open side type,
- Pit planners,
- Edge on plate planner and
- Divided table planner.

Special designs of planner machines are available like plano-grinders and plano-milling machines. Few designs have provisions for more than one tool post and each tool post can accommodate one single point cutter. This enables the machine to be more productive. Special tools are available with stroke lengths of the table ranges from 1 to 12 meters.

Tool Heads of a Shaper and Planer

Traditional Tool Head

Similar arrangements are used in the shaper and planer to hold the tool and job. Main parts of the head of the shaper or planner are saddle, swivel base, cross feed arrangement, vertical feed arrangement, apron, clapper box, clapper and the tool post. The tool heads support the tool post in which a single point cutting tool may be mounted. The clapper box and tool post are supported with webs on either side. In certain designs, up to 60° swivel on either side is possible. Hand wheels are provided to move the table. During the forward stroke of the tool, job will be machined and during the backward stroke of the tool, the tool will be idling. To achieve this, the cutting tools are mounted over arrangement called clapper box. In other words the return strokes are ineffective and non-machining strokes.

Modified Tool Head

Similar modifications were made, in the tool posts of the shaper and planer. The modified tool head was designed and fabricated to accommodate two clapper blocks.

Accordingly, size of the clappers were made small, crushing strength was taken in to account. Both the clapper blocks were placed at a phase shift of 180° and with suitable supports. Two left hand tools with carbide tool bits were proposed for the tests. Working of the tools are the same as that of the normal tool of a shaper or planer i.e. cutting during the forward stroke and idling during the return stroke. In the modified tool post, as the two tool posts are at 180° phase shift, during the forward stroke there will be a rough cut and during the return stroke, there will be a finishing cut. The design procedures for modified tool post for the shaper as well as the planer were the same. Care was taken in designing the back support of the second tool post /5-11/. Mounting arrangement of the tool post on the machine was matched as that of the original system. The arrangement is shown in Fig. 1.

Tool holder was made up of EN-8 steel and clapper block with mild steel plates. Bolts for gripping the tools were made of C45 steel.

Scope for Improvement: As the working principles of the shaping and planning machines are the same, the following arguments on scope of Energy Conservation, Time Saving and Productivity Improvement would be holding good for both the machines. Along with the improvement in productivity & energy conservation there are lot more things to be taken into consideration while experimenting it on the machine.

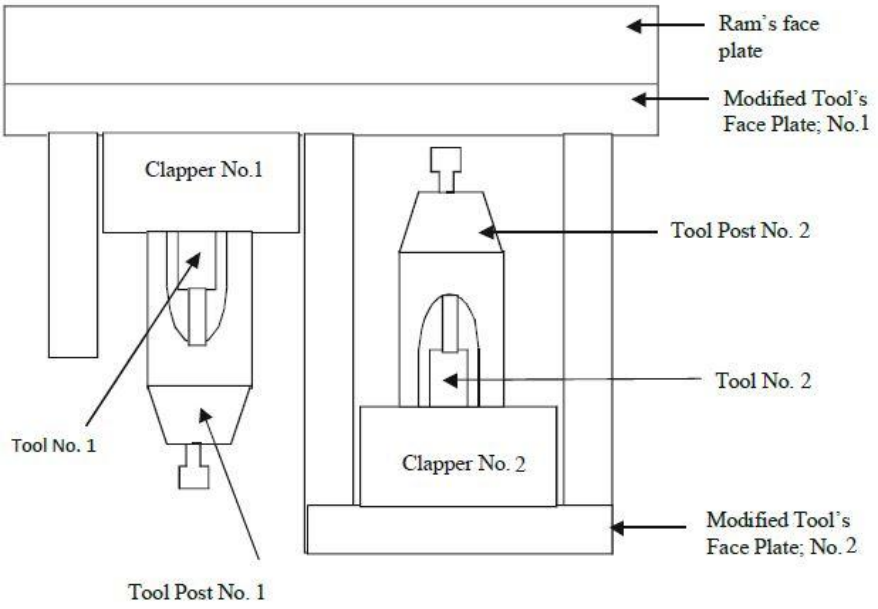

Fig. 1: Schematic Diagram of Modified Tool Heads of Shaper

Energy Conservation: During the forward stroke, the energy supplied is used for the machining and to overcome the friction. In the return stroke, it is used only to overcome friction between the moving parts. Attempt may be made to reduce this difference in level of energy utilization. After the first rough cut, entire surface will have to be machined again

with a finishing tool. If both these cutting processes take place one after the other, the energy needed to machine the surface may be reduced nearly to half.

Productivity Improvement: It is possible to achieve a significant improvement in productivity because of the reductions in machining time, alternate tool mounting time and elimination of the time requirement to finish the surface.

Estimate of Energy Conservation: With a conventional machine, let the energy consumptions be A1 and A2 respectively for the rough and finishing cuts. With a modified tool head, the energy supplied may be classified in three parts namely (1) rough forward cuts with idling return strokes until the finishing tool comes in contact with the job, (2) rough forward cut with return finishing cuts and (3) forward idling strokes with return finishing cuts until the finishing tool disengages with the job. Let the energy supplied be B1, B2 and B3 respectively.

Percentage of energy conservation:

$$=(A - B) * 100 / A \quad (1)$$

where, A = A1 + A2

and B = B1 + B2 + B3

Estimate of Improvement in Productivity: Let the time of machining a job with a conventional tool post be 't' and that with a modified tool post be 'T', then we have,

Percentage of time saving = $(t - T) * 100 / t$ (2)

and

Machine productivity improvement = $(t - T) * 100 / T$ (3)

Other Advantages: The modified tool post will have other advantages as listed below:

- Better uniformity in usage of energy supplied.
- As rough and finishing cuts are made in every cycle a separate finishing process gets eliminated totally.
- For a wide job, a significant improvement will be seen.
- Alternate tool changing time will be reduced in the case of mass production.

Limitations: The modified tool post will have other limitations listed below:

- Suitable for flat surfaces only.
- V – slots and dovetails can't be machined.
- Overall machining area of the machine gets reduced a little.
- Tool movement is possible in one direction only.

Future Scope

If the results are encouraging, further work is recommend to pursue in measuring the energy utilized to machine the surface with more accuracy, for better exactness in energy saving calculations. Tool fixing time, job fixing time may also be taken into account in the calculations of productivity improvement..

CONCLUSIONS

In this paper idea has been suggested for reducing the idle stroke time by the use of two clapper boxes in shaper as well as planer machine with a modified tool head. This will obviously give a fruitful result in the energy conservation & improvement of the productivity. If the results are encouraging, further work is recommend to pursue in measuring the energy utilized to machine the surface with more accuracy, for better exactness in energy saving calculations. Tool fixing time, job fixing time may also be taken into account in the calculations of productivity improvement..

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