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Fabrication of Dual Side Shaper Machine using Scotch Yoke Mechanism

Veldi Kanakaraju,
Assistant Professor in dept. of Mechanical Engineering,
Warangal institute of technology and science, Warangal,
Telangana. India.

Manga Hymanjali
Assistant Professor in dept. of Mechanical Engineering,
Warangal institute of technology and science, Warangal,
Telangana. India.

Boda Ramesh
Assistant Professor in dept. of Mechanical Engineering,
Warangal institute of technology and science, Warangal,
Telangana. India.

Kanjarla Shyam Kumar
Assistant Professor in dept. of Mechanical Engineering,
Warangal institute of technology and science, Warangal,
Telangana. India.

***Abstract*:- A shaper is used to machine a single job by using a single point cutting tool and hence it cannot be used for high production rate. A small Scotch yoke mechanism has been thus devised to demonstrate the dual side machining time reduction in shaping machines. This shaping machine has an idle stroke during its return motion. This project uses the idle stroke as cutting stroke and hence increases the production rate. This can be achieved by an addition of clapper box with a tool such that the arrangement on tool and the arrangement on tool holder has one tool clamped on the clapper box individually. The motor source of power with switch accessories is used to drive the ram on the guide plate to obtain the forward and return strokes. By this arrangement the machining time of a work piece is reduced by the half the time**

INTRODUCTION

Usually a single point cutting 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 utilize the idling time and increase the productivity, and decrease the cost and production time a small Scotch Yoke mechanism has been thus devised to demonstrate. Due to this mechanism both sides of shaper machine shaping operations are possible.

LITERATURE REVIEW

[1]R M Lathe et.al., Investigated that conventional machining process consumes very high time and increases the labour cost, to overcome these problems and difficulties he used automated electric pneumatic devices and PLCs in shaper machine. He developed electro pneumatic circuit for performing shaping operations, which makes the operation semi-automatic by using a single point cutting tool. Automation of the machines are made with the help of pneumatic device, sensors, mechatronics and PLCs etc. [2] M.V.N Srujan Manohar: Studied that pneumatic shaper is used for high production of automatic gear cutting with auto indexing work piece. A small ratchet gear structure has been thus devised to demonstrate the gear cutting attachments in shaping machines. The pneumatic source of power with control accessories is used to drive the ram or the cylinder piston to obtain the forward and return strokes. [3] S. Ravindran: Studied to improve the productivity and energy conservation of shaper and planer with modified tool heads. The quick return mechanism of shaper and planer machines, reduce the ineffective time and wastage of energy. Further reduction of the idling time, modified tool post with two clapper boxes and with two tools was designed, fabricated and tested. Size of the clappers were made small, crushing strength. [4] Anand Shukla: Investigated that optimizing of the cutting force and power consumption of shaper machine by varying different parameters during cutting operation using computer interface. He developed a methodology to find out cutting force and power required by the tool to perform shaping operation on work piece [5] Dharwa Chaitanya Kirtikumar: Investigated that energy is the most vital aspect in the development of modern technological civilization. The conventional energy sources are being scarce, so alternative energy sources are found which must be cheap, easily available and must satisfy the technical requirements. Power required for pedalling is well below the capacity of an average healthy human being. [6] R.Maguteeswaran: Investigated that the various machining process in manufacturing industries are carried out by separate machining machine. It need more space requirement and time with high expenses. But the fabrication of multi operation machine, which contains three operations in a single machine. The operations are namely drilling, slotting and shaping [7] Devanand R. Tayade: Investigated that evaluation of cutting and geometric parameter is one of the most important elements for quality and productivity which play significant role in today's manufacturing market. From customers view point quality is very important because the extent of quality of the procured item (or product) influences the degree of satisfaction of the consumers during usage of the procured goods. [8] Deepak Lathwal: Investigated that the finite element method is used to study the effects of different of rake angles on the force exerted on the tool during cutting. This method is attracting the researches for better

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understanding the chip formation mechanisms, heat generation in cutting zone, tool chip interfacial friction characteristics and integrity on the machined surfaces. [9]

S. Sundaram: Investigated that wear of cutting tool in a machining operation is highly undesirable because it severely degrades the quality of machined surfaces and causes undesirable and unpredictable changes in the work geometry. From a process automation point of view, it is therefore necessary that an intelligent sensing system be devised to detect the progress of tool wear during cutting operations so that worn tools can be identified and replaced in tune, As a 'non-destructive' sensing methodology,

DUAL SIDE SHAPER MACHINE

WORKING PRINCIPLE

The job is rigidly fixed on the machine table. The single point cutting tool held properly in the tool post is mounted on a reciprocating ram. The reciprocating motion of the ram is obtained by a scotch yoke mechanism. As the ram reciprocates, the tool cuts the material during its forward stroke. During return stroke there is no cutting action and this stroke is called idle stroke. The forward stroke of the one side of the machine is the return stroke of another side of the machine. One half cycle gives the forward stroke to one work and the return stroke to another work. The another half cycle gives the return stroke of the first work and the forward stroke of the next work. Thus, the machining takes place on both works in one complete cycle.

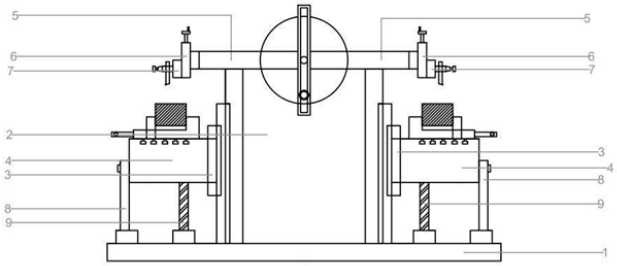


Fig.3.1 Line diagram of dual side shaper machine

1. Base, 2. Column, 3. Cross-rail, 4. Table, 5. Ram, 6. Tool head,
Clapper box, 8. Table support, 9. Elevating Screw

SCOTCH YOKE MECHANISM

The scotch yoke mechanism (also known as slotted link mechanism) is a reciprocating motion mechanism, converting the linear motion of a slider into rotational motion, or vice versa. The reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. The location of the reciprocating part verses time is a sine wave of constant amplitude, and constant frequency given a constant rotational speed.

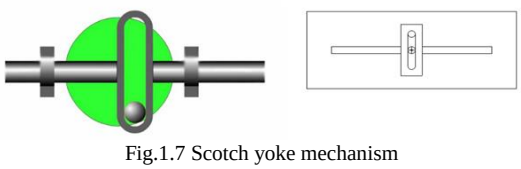


Fig.1.7 Scotch yoke mechanism

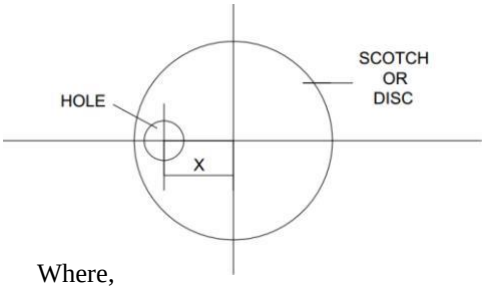
APPLICATIONS OF SCOTCH YOKE MECHANISM:

1. Piston water pump
2. Can crusher machine
3. Double acting hacksaw
4. Multipurpose machines

DESIGN AND SPECIFICATIONS

5.1 STROKE LENGTH:

Stroke length, (L) = 2 × X



Where,

X is the distance between the centre of scotch or disc to the centre of hole located on periphery of scotch.

NO. OF WORKING STROKES:

SPECIFICATIONS OF DUAL SIDE SHAPER MACHINE:

Height of the machine	1310mm
Length of the machine	1500mm
Width of the machine	650mm
Stroke length	105-285mm
Type of power transmission	Pulley transmission
Type of drive	Belt drive
Motor capacity	1 H.P.
Motor speed	1440 rpm

FABRICATION PROCESS

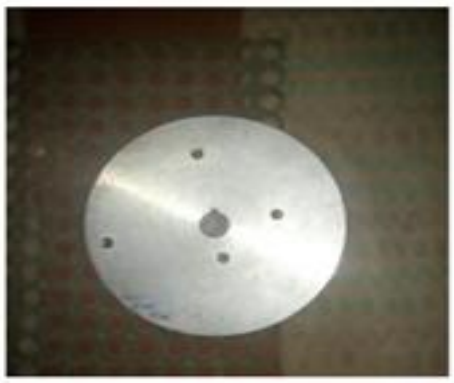


Fig:- Scotch or Disc

Fig:- yoke

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Fig:- Tool heads

Fig:- Pulleys

Fig:- Table support and Ram support

Fig:- Table

Fig. Flywheel, Hand wheels and Helical gears

Fig.:- Elevating Screws

MACHINES	OPERATIONS
Metal cutting machine	Cutting
Milling machine	Side milling, End milling
Welding machine	Welding (Metal Arc Welding)
Drilling machine	Drilling, Boring
Grinding machine	Surface grinding

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Fig:- Proto type of dual side shaper machine

CALCULATIONS:

Find out the total machining time for complete the two similar jobs of width 20mm, depth of the job to be cut is 10mm, stroke length 225mm, no. of full strokes (forward stroke and return stroke) are 218 and feed is 0.2mm and depth of cut is 0.5mm.

Cutting speed, Vc = 2LN/1000 = = 98.1 m/min

Time taken to complete one double stroke = (2×L×60)/(1000×Vc) = 0.275 sec

Total no. of double strokes required to complete the job = W/f = 100

Total time taken to complete the one cut = Total no. of double strokes × Time taken to complete one double stroke = 0.275×100 = 27.5 sec

Total no. of cuts required to complete the job n = 20

Total machining time for complete the job, T = Tc×n = 9.166 min

But in dual side shaper machine two jobs are machined at a time

∴ The total machining time for complete one job is equal to total machining time of two jobs is 9.166 min.

EXISTING SHAPER MACHINE:

Machining time for existing shaper machine for complete same jobs at a same cutting speed is:

No. of double strokes per minute or r.p.m. of the bull wheel N = (1000×Vc)/(L (1+K)) = 262

Cutting time = (L×60)/(1000×Vc) = 0.137 sec

Return stroke time = 0.0917 sec

Total time for one complete double stroke = 0.137+0.0917 = 0.2287 sec

Total time taken to complete the one cut = 0.2287×100 = 22.87 sec

Total machining time to complete one job, T = Tc×n = 22.87×20 = 457.4 sec = 7.623 min

Total machining time to complete two jobs = 2×T = 2×7.62 = 15.246 min

% Of time reducing to complete the jobs = 40%

∴ The dual side shaper machine is reducing the machining time by 40% as compare to existing shaper machines.

RESULTS AND DISCUSSIONS

The dual side shaper machine resembles like assembling of two existing shaper machines. Hence, the machine occupies less space, number of equipment's are reduced. For the same amount of work produced by the existing shapers the labor cost and power consumption are decreased and also the overall machining time is reduced to 40% compared to the existing shapers.

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