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"Fabrication of A Dual Side Shaping Machine for Industrial Applications"

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ABSTRACT: Most of the industries are having various types of reciprocating machines for performing machine operations on the small size of work. Usually, the shaper, broaching machine, and planner are used for machining a small area of work with less quantity. These machines are used for machining very small areas of a plain surface, vertical surface, angular surface, grooving, etc.

It removes the materials from the job only at forward stroke. So it takes more machining time to complete the product. To overcome this problem, a small dual shaper machine is developed for machining two workpieces at the same time. This machine has both the direction of ram movement and removes material from two workpieces simultaneously.

So, the machining time will be reduced and the production rate will be increased.

Keywords:
reciprocating,machine,operation,materials,stroke,dual,shaper,ram,workpieces,simultaneousl

I. INTRODUCTION

In a dual shaper machine, materials are shaped from both sides, which makes it more advantageous than the usual shaper. In this project, a dual side shaper machine is designed with the help of quick return mechanism, the rotary motion of the motor is converted into linear motion of the tool which shapes the material mounted on the vice from both the side. The quick return mechanism converts rotary motion into reciprocating motion, but unlike the crank and slider, the forward reciprocating motion is at a slower rate than the return stroke. DC motor is connected with the mechanism with the help of a chain and sprocket. The whole mechanism is built on a rugged metal frame.

A shaper is a machine that is used for forming (metal evacuation) procedures on the workpiece.Thesedays,Industries attempt to accomplish a high creation rate at a negligible hindrance looked by a solitary side shaper. The fundamental position of a double-side shaper is that it diminishes time as well as creation cost. In this manner, it expands profitability. A shaper is a kind of machine apparatus that utilizes direct relative movement between the workpiece and a solitary point cutting measures of time,cost, and so on. The use of a double-side shaper machine wipes out the most device-to-machine a direct device way. Its slice is comparable to that of a machine. This experiment can be easily carried out in Solidworks.

Project Advantages

- In this machine, materials are shaped from both sides, which is more advantageous than the usual shaper.
- Dual Shaper machine helps industries to achieve high production rates at a minimal amount of time and cost.
- Increase the work efficiency.
- It is designed with the help of quick return mechanism, the rotary motion of the motor is converted into linear motion of the tool which shapes the material mounted on the vice from both the side.
- It gives forward reciprocating motion at a slower rate than the return stroke.DC motor is connected with the mechanism with the help of a chain and sprocket. The whole mechanism is built on the rugged metal frame

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II. LITERATURE SURVEY

1.R M Lathe Investigated that the conventional machining process consumes very high time and increases the labor cost, to overcome these problems and difficulties he used automated electric pneumatic devices and PLCs in shaper machines. He developed an electro-pneumatic circuit for performing shaping operations, which makes the operation semi-automatic by using a single-point cutting tool. Automation of the machines is made with the help of pneumatic devices, sensors, mechatronics and PLCs, etc.

2.M.V.NSrujanManohar presented in his paper that pneumatic shaper is used for high production of automatic gear cutting with the auto-indexing workpiece. 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 presented to improve the productivity and energy conservation of shapers and planers with modified tool heads. The quick return mechanism of shaper and planer machines reduces 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. The size of the clappers was made small, crushing strength.

4.AnandShukla investigated that optimizing the cutting force and power consumption of shaper machines by varying different parameters during cutting operation using a computer interface. He developed a methodology to find out the cutting force and power required by the tool to perform shaping operations on the workpiece.

5.R.Maguteeswaran: Investigated that the various machining process in manufacturing industries are carried out by separate machining machines. It needs more space requirements and time with high expenses. But the fabrication of a multi-operation machine, which contains three operations in a single machine. The operations are namely drilling, slotting, and shaping.

Component used

Frame
Crank (Mild steel)
Shaft (Steel)
Connecting Rod (Mild steel)
Slotted Bar (Mild steel)
Shaper tool**(**High-Speed steel (HSS))

- **FRAME:**

The components are mounted on the frame, which is made up of Mild steel. Some of the components are assembled on the frame by using Arc welding. Mild steel tubes- rectangular Cross-section Base 450mm X 300mm.

- **PULLEY :**

A pulley is a wheel on the axle that is designed to support movement and changes of direction of a taut cable or transfer of power between the shaft and cable. The pulley is supported by a frame that does not transfer power to the shaft but is used to guide the cable and transfer power to the shaft. Internal diameter 30mm External diameter 150mm
Pully is a fixed type moving by Vbelt.

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- **SHAFT:**

A shaft is a circular section solid or hollow bar used for the transmission of motion or power. The shaft coupling is a solid or flexible device to causes adjacent parts of a body to slide relative to one another in the direction of the force. Mild Steel Ø30 mm and 200 mm length.

- **CRANK:**

The crank is an element attached directly to a rotating shaft by which linear motion is received from the shaft. It is used to convert circular motion into linear motion. Mild steel Ø210mm Crankpin is welded on a crank at a pitch circle diameter (PCD)of 130 mm. Mild steel Ø25 mm and 70mm length.

- **V-BELT:**

The v-belts are made of rubber with fabric cords to transmit power and it's covered with a protective layer. the wedge shape of the belt increases the area of contact with the pulley thereby increasing more friction which makes it carry more power without slip.

(TOOL)

- **HIGH-SPEED STEEL:**

High-speed steel is a single-point cutting tool is used to remove metal from the workpieceand having high wear resistance.

We are buying two tools from Amazon at a price of Rs500.
Width (W) = 8mm
Length (L) = 3inch

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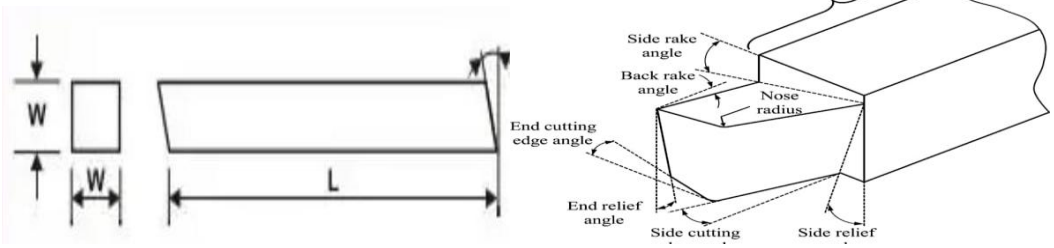

The nut is a hollow material where bolts are inserted. Mild steel Ø6 mm. Bolt is moved inside the nut. It has a head, shank, thread portion. Mild steel Ø10 mm

METHOD:
Scotch Yoke Mechanism:

The scotch yoke mechanism is a reciprocating motion mechanism, is converting the rotational motion of the shaft into linear motion. The reciprocating part is directly coupled to a slotted bar yoke with a slot that engages a pin on the rotating part.

CALCULATION

Name of material	**Type of material**	
Frame	450mm×300mm	Metal
Crank	ø210mm	Mild steel
Shaft	ø30mm &200mm(length)	Steel
Connecting Rod	ø15mm & 450mm	Mild steel
Slotted Bar	ø25 &70mm(length)	Mild steel

Shaper tool **High-Speed steel (HSS)**

Preferring of Pulley diameter:
For power given selected small pulley dia (d) from the v-belt table in pg. No. 7.58 then used speed ratio to calculate large pulley dia. (D)

$$\text{speed ratio} = \frac{D}{d} = \frac{N_1}{N_2}$$

D = speed ratio × d

For power = 736 watts

Small pulley dia (d) = 5cm = 50 mm

Motor speed = 200 rpm, $N_2 = 100$ rpm

$$\text{Speed ratio} = \frac{D}{d} = \frac{200}{100}$$

D= 2×5 = 10cm

large pulley dia (D) = 100mm

Design Parameters

Diameter of crank = 0.21m
Length of slotted bar = 0.185m
Length of connecting rod = 0.45m

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Calculation of Cutting Forces

Assume,

Power = 736 watts

Speed = 200rpm

(Power) $Q = \frac{2\pi NT}{60}$

(Torque) T = 35.159Nm

Torque = force × Radious of Crank

T=F×r

$F=\frac{T}{r}$

F= 296.75N

Design of shaft

Diameter of Shaft = 0.3m

Permissible shear stress for mild steel = 34 $^{N}/_{mm^2}$

Shear Stress,$\tau = \frac{16T}{\pi d^3}$

τ = 6.635 $^{N}/_{mm^2}$< τ Permissible

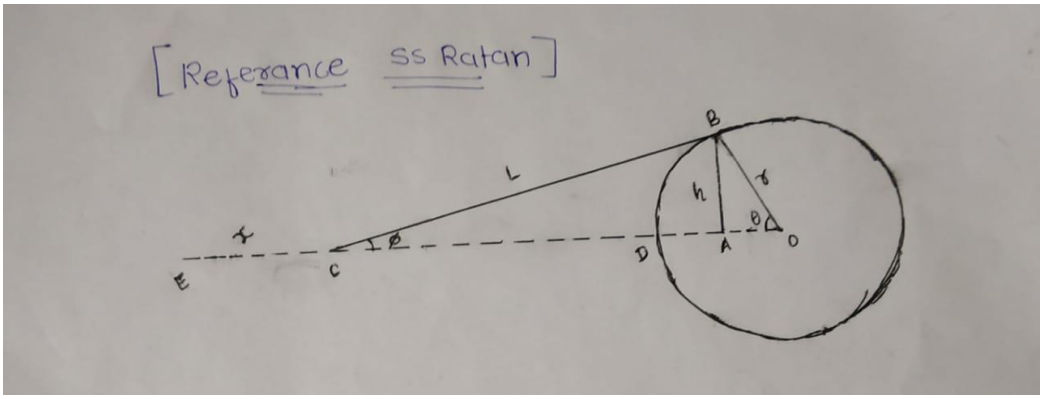
Therefore design is safe.

Considering the factor of safety

Fos = $\frac{34}{6.635}$ = 5.1243

Calculation of Cutting Stroke

Scotch Yoke mechanis



Let 'x' is length of cutting stroke

r = radius of crank

L = Length of BC

Angle AOB =θ

Angle ACB = ∅

In triangle ABC

cosø = $\frac{AC}{L}$ sinø = $\frac{h}{L}$

AC = LcosøsinΘ = $\frac{h}{r}$

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In triangle OAB

$\cos\Theta = \frac{OA}{r}$

$OA = r\cos\Theta$

$\sin^2\emptyset + \cos^2\emptyset = 1$

$\cos\emptyset = \sqrt{1 - \sin^2\emptyset}$

$= \sqrt{1 - \sin\frac{h^2}{L}}$ $= \sqrt{1 - \frac{r^2\sin^2\theta}{L^2}}$

$n = \frac{L}{r} = \frac{\text{connectingrodlength}}{\text{crankradius}}$

(obliquity ratio)

$\cos\emptyset = [1 - \frac{\sin^2\theta}{h^2}]^{1/2}$

$x = r(1-\cos\theta) + \frac{r^2}{4L}$ (1-cosine2θ)

Velocity Calculation

$\mathbf{v = \frac{dx}{dt} = \omega r\sin\theta + \frac{r}{4l}\cos 2\theta}$

acceleration,

$a = \frac{dv}{dt} = r\omega^2(\cos\theta + {}^{r}/_{L}\cos 2\theta)$

we assume,

Radius of crank, r = 105mm

L = 450mm

At, ∅ = 0 &θ = 0

x = 450+105=555mm

At, ∅ = 0 &θ = 180

x = 450+105+0-100cos(180)= 555mm

Length of cutting stroke = 555-450

= 105mm = 10.5cm

Calculation of Cutting Speed

Cutting speed, $v = \frac{NL(1+m)}{1000}\,{}^{m}/_{min}$

N= no. of dubble strokes (take N = 100)

L = length of ran stroke in mm

$m = \frac{\text{returnstroketime}}{\text{cuttingstroketime}} = 1$

$v = 0.021\,{}^{m}/_{min}$

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LAYOUT OF THE MACHINE AND MECHANISMS USED

The components (or) parts are assembled and the machining process is carried out. The fabrication of dual side shaper machine is clearly shown in figure

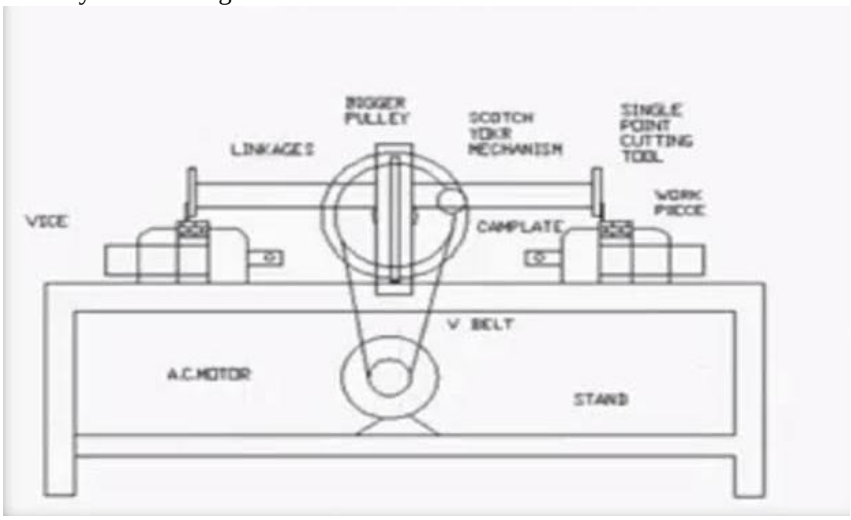

Figure1. The layout of the dual side shaper machine

Mechanisms Used in Dual Shaper

The mechanism used in the dual shaper is explained below.

Scotch Yoke Mechanism. The Scotch yoke (also known as the slotted link mechanism) is a reciprocating motion mechanism, converting the linear motion of a slider into rotational motion or vice versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. The location of the piston versus time is a sine wave of constant amplitude, and constant Frequency is given a constant rotational speed. This mechanism is generally found on shaping machines where a single point cutting tool is mounted on the front of the slider or ram, in a hinged tool post. The tool cuts on the slow forward stroke and lifts over the workpiece on the quick return stroke. The slotted link rocks from side to side, driven by the sliding block on the bull wheel.

DESCRIPTION OF PROPOSED WORK

A shaping machine will mainly be used for shaping the tools, which may be horizontal, vertical, or inclined. In a dual shaper machine, materials are shaped from both sides, which makesit more advantageous than the usual shaper.

MODELING OF MACHINE AND MACHINE COMPONENTS

The 3-D modeling of the machine and the components is carried out in Solid Works software. The modeling application also provides "features-based" solid bodies by directing editing capabilities, which allow changing and updating solid bodies by directing editing the dimensions of a solid feature or by other geometric construction techniques.

Parts to be design

The various parts to be designed in solid works software are :

Shaft
Pulley Frame
Ram
Workpiece

Isometric View of Dual Shaper

The isometric view of the dual shaper machine is illustrated in Figure 2

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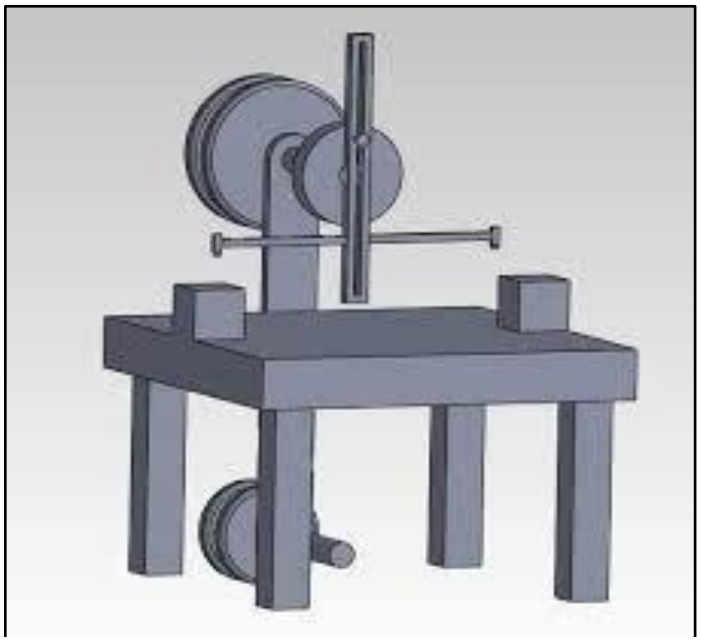

Figure2. Isometric View of Dual Shaper

Pulley

The modeling of the pulley is depicted in Figure3.

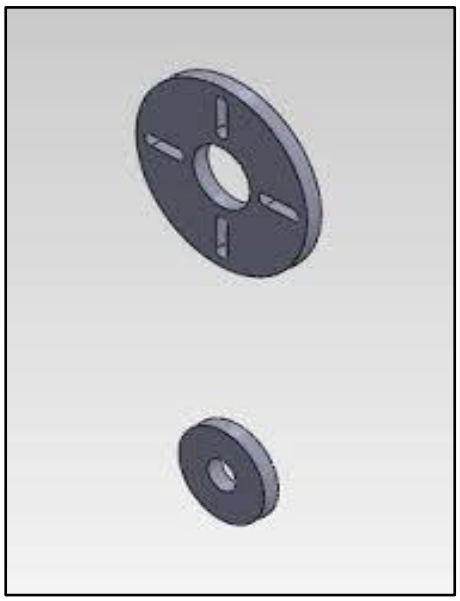

Figure3. Isometric View of Pulley

Frame

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The isometric view of the table is depicted in Figure.4

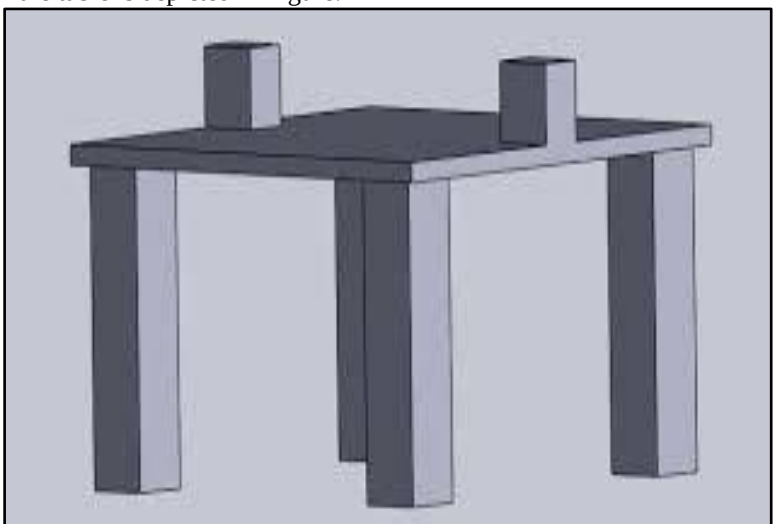

Figure4. Isometric View of the frame

Shaft

The isometric view of the shaft is shown in Figure.5.

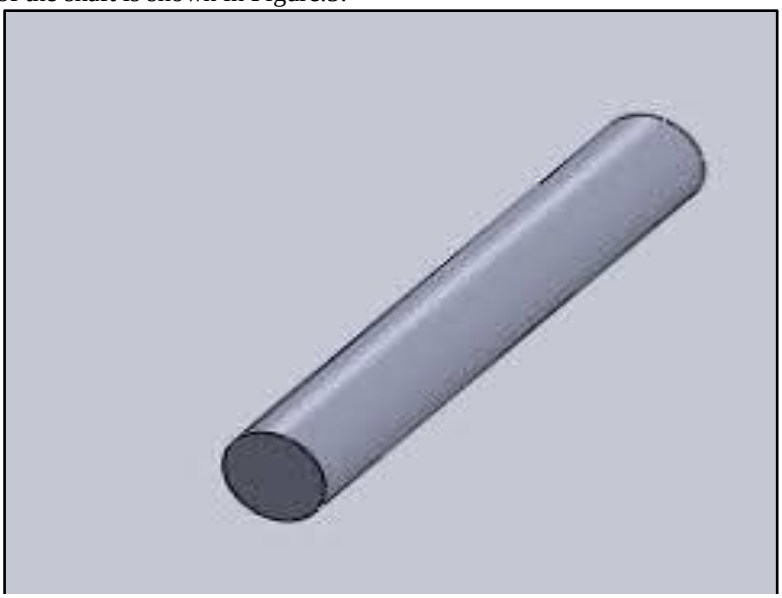

Figure5. Isometric View of Shaft

Wheel

The isometric view of the wheel is shown in Figure.6

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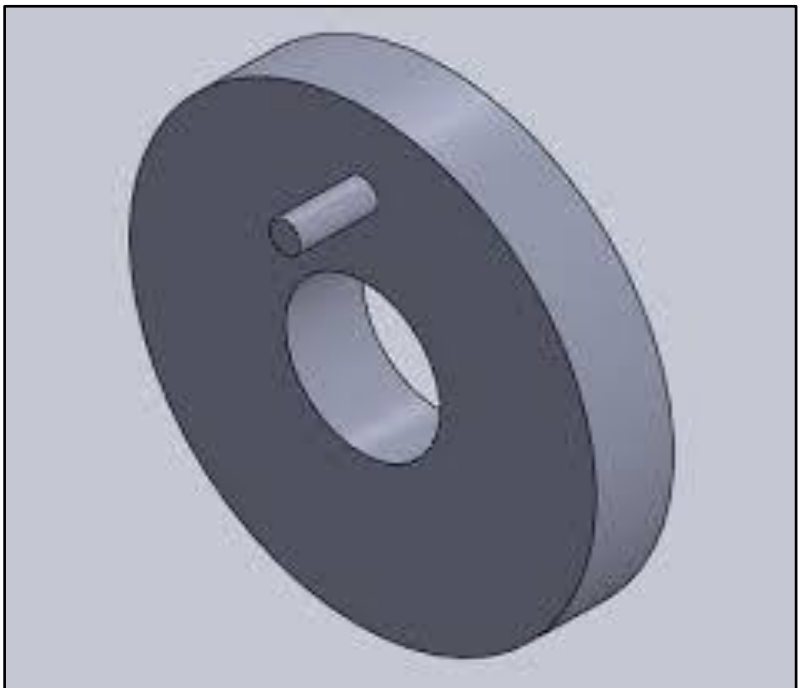


Figure.6 Isometric View of Wheel

Ram

The isometric view of the ram is depicted in Figure.7.

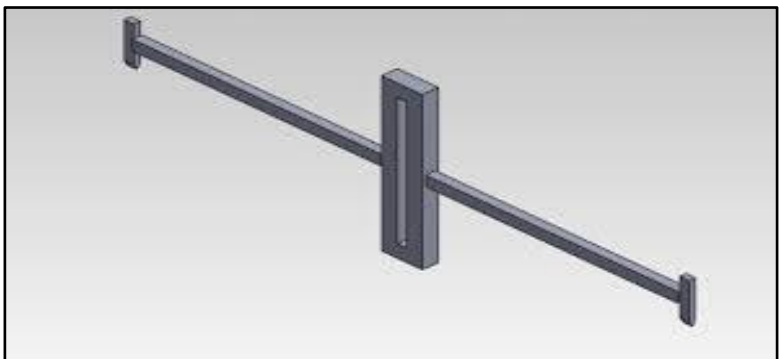
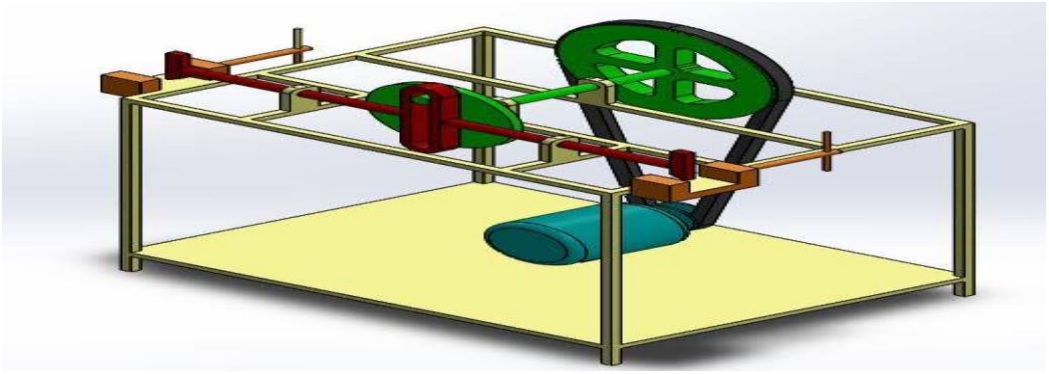


Figure7. Isometric View of Ram

FINAL DIAGRAM OF WORK:



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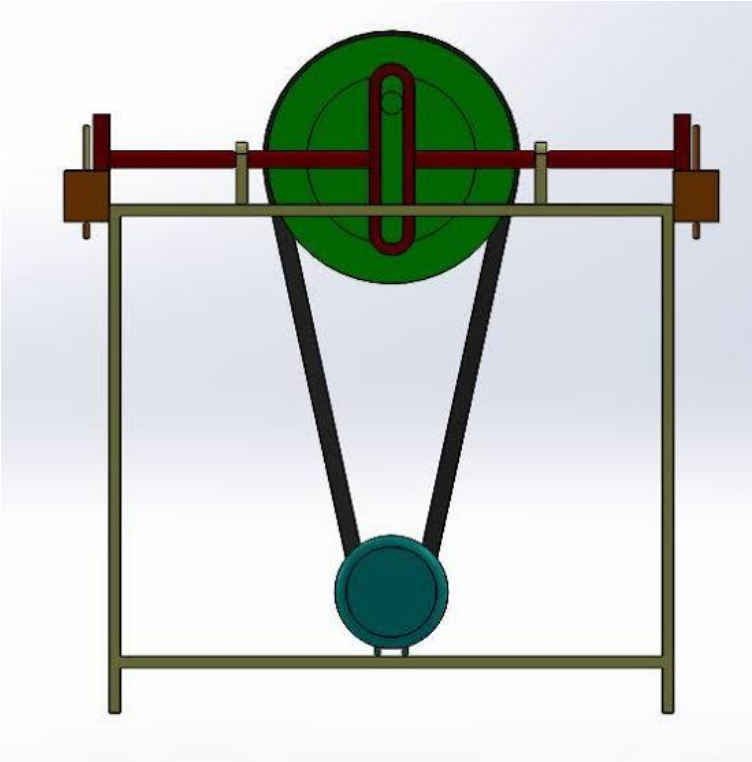

III. CONCLUSIONS

In this paper, a dual side shaper is designed and fabricated.

The dual side shaper machine is used to manufacture components similar to a standard shaper machine. The machining time required for this dual shaper is less as compared to the normal shaper. Hence, the production rate is increased. The designed dual shaper has been used for only trial production. In the future, it would be used for commercial production in industries. The double side shaper apparatus looks like amassing of two existing shaper machines. Subsequently, the machine consumes less space, the number of gears is diminished.

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