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Fabrication of Multi-Purpose Operation Machine

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ABSTRACT

This paper presents about fabrication of multi-purpose operation machine for an industry. Different types of mechanical industries are producing useful goods and services at low cost and maximum efficiency. In order to produce these useful products many mechanical operations like drilling, cutting, grinding, milling, sawing, riveting, etc. are done on different components. Even though mechanical works are modernized but still we are using separate machines to do all mechanical operations. It will result in time consumption, more power usage, more space required and maintenance.

This paper deals with reducing of all above problems by fabricating a "MULTI-PURPOSE OPERATION MACHINE". This machine is designed for the purpose of multi operations i.e. drilling, cutting and grinding of a thin metals as well as wooden blocks. And can perfume multi operations at the same time with required electricity as it is pedaled. This machine is based on the mechanism of power transmission through bevel gears, chain drives. This multi operation machine is used in small scale industries and domestic operations.

***Keywords*—** Drilling, Cutting, Grinding

I. INTRODUCTION

Industries are basically meant for production of useful products and services at low cost of production, machinery cost and inventory cost. Today in this world every task is quick and fast because of technology advancement but this technology advancement demands huge investments and expenditure for industries, As every industry desires to make high productivity rate by maintaining the quality and standards of the product at low cost. The small scale industries make a considerable portion of investment for machinery installation. So in this paper we have a proposed a machine which is used to produce the product with accuracy and produce the goods in an economical manner. It makes the inventory cost less. The multi-purpose operation machine can perform operations like drilling, cutting, grinding, at different working centers simultaneously by which the industrialist have not to pay for individual machines as three operations are performed in one machine.

According to some economists, for an economy the term manufacturing is a wealth-producing sector the manufacturing is a wealth-consuming. That emerging the technologies which provided some new growth in advanced manufacturing employment opportunities. Manufacturing provides important material support for national infrastructure and for national defense.

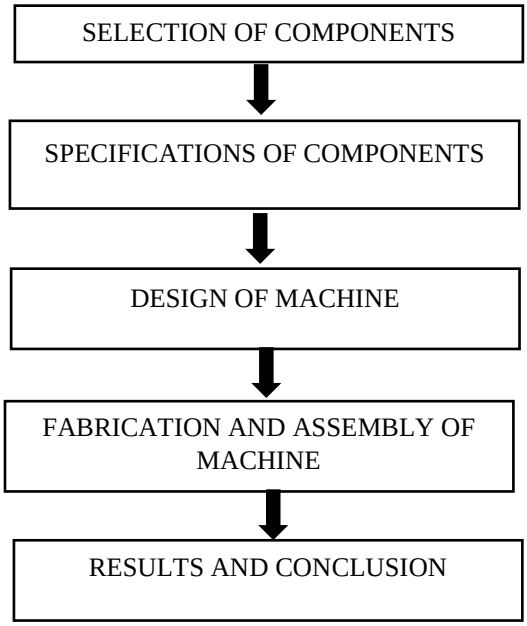
Before starting our work we have undergone through many research papers which indicates that for a small scale industries the machine installation is a difficult task because many factors are being associated with it such as power consumption, maintenance cost, number of units produced per machine i.e. capacity of machine, time consumption and many more. To reduce this problems we have fabricated a multi-purpose operation machine.

II. LITERATURE REVIEW

M.Prathyusha et al [1] developed a multiple operating Machine by using the scotch yoke mechanism, to measure process performance, and parameters of tooling and machining that includes cutting speed, material removal rate, depth of cut and machine which can perform operations like drilling, sawing, shaping, (grinding) and some lathe operations at different working centers simultaneously. Rakesh Ambade et al [2] designed and fabricated a human Powered multipurpose machine. The main purpose to fabricate this machine is to perform operation without electricity. In rural areas there is a problem of electricity shortage or no electricity, it is a very stressful and laborious job to perform machining operation in those areas. By this human powered multipurpose machine the need of rural people can be satisfied by giving them an alternative way of performing machining

operation like drilling and grinding. Sharad Srivastava et al [3] have fabricated a conceptual machine which can perform different operation like drilling, sawing, grinding, simultaneously at different working centers using scotch yoke mechanism, belt drive and gears. Industries make an affordable portion of investment for machinery installation. Which implies that industrialists not have pay for machine performing above tasks individually. Dharwa Chaitanya Kirtikumar [4] designed and fabricated a multipurpose machine which does not require electricity to perform several operation like cutting, grinding etc. and this is a human powered machine works on chain drives with human effort. And this machine can be modified by attaching a motor it can be operated through electricity. This machine have some special attachment by which both human power as well as electric power.

III. METHODOLOGY



IV. SELECTION OF COMPONETS

The following components are used for fabrication of multi- purpose operation machine:

- Frame
- Shafts
- Journal bearings
- Cycle chain
- Cycle body
- Big sprocket
- Small sprocket
- Bolts
- Nuts
- Drill chuck
- Drill bit
- Cutter
- Grinding wheel

V. SPECIFICATIONS OF COMPONENTS

Frame: Frame is a basic part of the machine it is used to support the assembly of the machine and for absorption of all shock and vibrations during of operation. In this machine the frame is made by Zinc metal square bar.
Material: Zinc Metal
Width: 450mm
Length: 750mm
Height: 600mm

Shaft: A shaft is a rotating element, usually circular in cross section, a shaft is used to transmit power from one element to another element. The various members such as sprockets, chain are mounted on it. The material used for the shaft is mild steel.
Material: MILD STEEL
Diameter: 20mm
Length: 600mm

Bearing: Bearing is used to support the shaft as the axle & holds it in correct position with respect to frame. Bearing ensures free rotation of the shaft with minimum friction. In this we have used journal bearing.
Pillow Block Bearing
Diameter: 20mm

Sprockets: Sprockets are used in bicycle to transmit rotary motion between two shafts. The most common form of sprocket may be found in the bicycle, in which a pedal shaft carries a large sprocket-wheel, which drives a chain, and a small sprocket which is placed on the shaft.

Big Sprocket:
No of Teeth: 56
Diameter: 85mm
Width: 12mm

Small Sprocket:
No of Teeth: 18
Diameter: 38mm

Bevel Gear: Bevel gears are the gears where axes of the two shafts intersect and the tooth-bearing faces of gears themselves are conically shaped. Bevel gars are most often mounted on shafts that are 90 degrees apart. The bevel gear pitch surface is cone in shape, known as a pitch cone. Bevel gear transfers the power from shaft to drill cuck.
No of Teeth: 32

Cycle Chain: A bicycle chain is a roller chain that transmit the power from the large sprocket to small sprocket. Most bicycle chains are made up of alloy-steel but some are nickel plate to prevent rust, or simply for aesthetic.
Length of Chain: 750mm
Center Distance: 300mm
Material: Alloy steel

Drill Chuck: A drill chuck is a specialized self-centering, with capacity of 0.5in 13mm and used to hold drill bits or other rotary tools. This type of chuck is used on tools ranging from professional equipment to in expensive hand for domestic use.
Diameter: 1-15mm

Drill Bits: Drill bits are cutting tools used to remove material to create holed, drill bits are of circular cross section. They are in many sizes and shapes and can create different kinds of holes on various materials. In order to create holes drill bits are usually fixed in a drill chuck, which rotate the drill it to cut the work piece. The upper end of a drill bit is called the shank and fixed in the drill.
Diameter: 10mm

Cutter: Cutters are cutting tools and used in cutting machines to perform cutting operations cutters remove material within the machine or directly from the cutter's shape movement.
No of teeth: 30
Diameter: 110mm

Grinding Wheel: Grinding wheels consists of abrasive compounds for grinding operations. This consists of coarse-particle aggregate pressed and bonded together by a cementing matrix to form a circular shape. It is mainly used for surface finishing of work-piece.
Diameter: 102mm

Design of Machine:
Design of Shaft:
Length = 600mm
Applied Force= 250N
Torque = Force× Perpendicular distance
= 250× 300
Torque = 75000 N-mm

$$T = \frac{\pi}{16} \times d^3 \times \tau$$

$$d^3 = \frac{T \times 16}{\pi \times \tau}$$

(Allowable shear stress for Mild steel $\tau = 40 - 60$MPA)

$$d^3 = \frac{75000 \times 16}{\pi \times 47}$$

Diameter of shaft = 20mm.

Stresses Induced in Shaft:

When shaft is subjected to Twisting Moment:

Diameter=20mm
Length=600mm
Force=250N
Torque=Force×perpendicular distance
= 250×300
Torque = 75000N-mm

$$T = \frac{\pi}{16} \times d^3 \times \tau$$

$$\tau = \frac{T \times 16}{\pi \times d^3}$$

$$\tau = \frac{75000 \times 16}{\pi \times 20^3}$$

$\tau = 47.746 {}^{N}/_{mm^2}$

For mild steel allowable shear stress is $345 {}^{N}/_{mm^2}$

∴ The design is safe

Power = $\frac{2\pi NT}{60}$

$= \frac{2 \times \pi \times 30 \times 75000}{60}$

P = 235W

When shaft is subjected to Bending Moment:

Diameter=20mm
Length=600mm
Load=250N

$$\text{Moment} = \frac{\pi}{32} \times \sigma_b \times d^3$$

$$M = \frac{WL}{4}$$

$$M = \frac{250 \times 600}{4}$$

M=37500N-mm

$$\sigma_b = \frac{M \times 32}{\pi \times d^3}$$

$$\sigma_b = \frac{37500 \times 32}{\pi \times 20^3}$$

$$\sigma_b = 47.746 {}^{N}/_{mm^2}$$

$\therefore$ *Allowable Bending stress for Mild Steel is* $364 {}^{N}/_{mm^2}$

∴ The design is safe

When shaft is subject to Bending + Twisting:

Torque =75000N-mm
Moment=37500N-mm

$$\sqrt{m^2 + T^2} = \frac{\pi}{16} \times \tau \times d^3$$

$$\sqrt{(37500)^2 + (75000)^2} = \frac{\pi}{16} \times \tau \times (20)^3$$

$$\tau = 53.38 {}^{N}/_{mm^2}$$

∴ For Mild Steel the Max Allowable Shear Stress is

$$345 {}^{N}/_{mm^2}$$

∴The Design is safe.

Chain length:

No. of teeth on Big Sprocket (T1) = 56
No. of teeth on Small Sprocket (T2) =18
Diameter of Big Sprocket = 85mm
Diameter of Small Sprocket = 38mm
Center distance (x) = 300mm

$$r_2 = \frac{p}{2} \cos\left(\frac{180}{T_2}\right)$$

$$19 = \frac{p}{2} \cos\left(\frac{180}{18}\right)$$

$$p = 6.5mm$$

$x = m \times p$

$m = \frac{x}{p}$

$m = \frac{300}{6.5}$

m = 45.5mm

$$K = \frac{(t_1 + t_2)}{2} + 2m + \left[\frac{\text{cosec}\left[\frac{180}{t_1}\right] - \text{cosec}\left[\frac{180}{t_2}\right]}{4m}\right]$$

$$K = \frac{(56+18)}{2} + 2 \times 45.5 + \left[\frac{\text{cosec}\left[\frac{180}{56}\right] - \text{cosec}\left[\frac{180}{18}\right]}{4 \times 45.5}\right]$$

K = 128.02mm

Length of chain L = $K \times P$

$= 128.02 \times 6.5$

L = 750mm

(This design calculations for shaft where taken from machine design text book).

Assembly And Fabrication Machine:

VI. RESULTS

By fabricating multi-purpose operation machine the following results can be drawn:

- ✓ Particularly this machine is useful for small scale industries.
- ✓ Movement of workers can be minimized.
- ✓ Number of operations can be performed on the single machine.
- ✓ Consumption of power is reduced.
- ✓ Area required for floor is reduced.
- ✓ Manufacturing cost can also been reduced.

VII. CONCLUSION

The "MULTI PURPOSE OPERATION MACHINE" is fabricated and it is working with satisfactory condition. We are able to understand the difficulties in maintaining the tolerances and also difficulties in maintaining the tolerances and also quality. We utilized our ability and skill for making this machine with the use of available resources. With this fabricated "MULTI PURPOSE OPERATION MACHINE" we gain the knowledge that how machining is done on work pieces with low cost. This machine is operated without electricity. With the help of technical knowledge we can modify the above fabricated machine and can develop a new one according to the applications.

This work has provided us an excellent opportunity and experience, to use our limited knowledge. We gain a lot of practical knowledge regarding, planning, purchasing, assembling and machining. We feel that the work is good solution to bridge the gate between institutions and industries. We are proud that we have completed the work with the limited time successfully.

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