

DEVELOPMENT AND FABRICATION OF PEDAL OPERATED MULTI-OPERATIONAL MACHINE

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Abstract: This task presents the idea of Human Powered Multi-Operational Mechanical Machine for the most part completed for production based enterprises. Enterprises are fundamentally implied for Production of helpful merchandise and ventures at low production cost, apparatus cost and low stock expense. Today in this world each assignment have been made snappier and quick because of innovation headway yet this progression additionally requests tremendous ventures and use, each industry wants to make high profitability rate keeping up the quality and standard of the item at low normal expense. We have built up an applied model of a machine which would be equipped for performing diverse activity at the same time, and it ought to be monetarily productive. This machine can be utilized in remote spots where power is unpredictable or lacking. It is planned as a versatile one which can be utilized for cutting in different spots. It tends to be utilized for working on materials like meager metals, wood and PVC pipes. The material can be cut with no outside vitality like fuel or current. Since machine utilizes no electric force and fuel, this is modest. Vitality is the most fundamental perspective in the advancement of present day mechanical human progress. In the current work, a human fueled multipurpose machine is created which can perform four sorts of activities boring, sawing, cutting and grinding. Force required for accelerating is well underneath the limit of a normal solid person. The framework is additionally helpful for the work out reason on the grounds that accelerating will go about as a well-being exercise and furthermore accomplishing a valuable work.

Index Terms - Pedal Operated, Multi-Operational, Zero Electricity.

I. INTRODUCTION

HISTORY

Pedal force is the trading of imperativeness from a human source utilizing a foot pedal. This procedure is most commonly utilized for transportation for a long time. Pedal controlled machines resurged during the 1970s, along with the bicycle. Since the further improvement of fixed pedal-controlled machines had been halted for more than 5 decades, there was an extensive proportion of work ahead remembering the ultimate objective to modernize the development. Additionally, it tends to be used to deliver power by partner it to dynamo, diode, and battery. In this examination work, a pedal-worked hacksaw machine is planned and developed using the pedal force for cutting applications. Vibration is produced while slicing wood because of the huge cutting power of the sharp edge. Hence, it is important to hold the wood piece firmly while slicing due to maintain a strategic distance from the surprising development from the specific area. In the proposed gadget, the edge is intended to get the wood piece appropriately. It likewise makes the gadget condition well-disposed by diminishing contamination or soil.

GENERAL OUTLINE

Vitality is the unbreakable piece of our living, with the in any event, expanding the expense and diminishing wellsprings of customary vitality like petroleum products, finding the option non-regular vitality sources is the need of present time. Separated of other sustainable power source assets human force is one of the compelling and elective assets accessible since antiquated time. The individual conveyed their vitality from calorific contains of nourishments they eat.

The designer continually adjusted with the difficulties of getting thoughts and structure to reality new machine and methods are being grown consistently to fabricate different items at less expensive rates and high caliber. It is a reduced, versatile unit fit for doing numerous activities that typically require costly single reason machines. With various connections that are accessible with the unit, cutting, penetrating, molding, polishing and crushing can be performed rapidly and modestly. Assembling enterprises are essentially implied for creation of helpful merchandise and ventures requiring little to no effort. All the assignments in regular daily existences have been made speedier because of innovative progressions. Be that as it may, this headway likewise requests enormous ventures and consumption. Considering this, each industry wants to accomplish a high efficiency rate while keeping up the quality and standard of the item with ease. The thought behind this undertaking is to build up a reasonable machine which would be fit for performing various activities at the same time while additionally being monetarily productive.

Human has applied vitality using arms, hands and back. With the creation of bike and accelerating, legs additionally started to be considered as a way to create power from human muscles. An individual can create multiple times more force by accelerating than by hand turning. At the pace of 1/4hp, persistent accelerating should be possible for just brief periods, around 10 minutes. In any case, accelerating at a large portion of this force (1/8hp) can be continued for around an hour. It is imperative to envision better approaches to carry capacity to the individuals as populace keeps on developing and force deficiencies keep on happening. A great part of the force that is given to individuals today is done in very un-practical ways; new thoughts are expected to progress in to a post modest oil period. Pedal force empowers an individual to drive gadgets at a similar rate as that accomplished by hand wrenching, yet with far less exertion and exhaustion. Pedal force likewise lets one drive gadgets at a quicker rate than previously, or works gadgets that require a lot of intensity for hand turning. Throughout the hundreds of years,

the treadle has been the most widely recognized strategy for utilizing the legs to deliver power. Treadles are as yet normal in the low-power run, particularly for sewing machines. The most extreme force yield from treadles is exceptionally little; maybe just 0-15 percent of what an individual utilizing pedal worked wrenches can create under ideal conditions. The force levels that an individual can deliver through accelerating rely upon how solid the accelerating individual is and on to what extent the person in question needs to pedal. On the off chance that the assignment to be fueled will proceed for quite a long time at once, 75 watts mechanical force is commonly viewed as the cutoff for a bigger sound non-competitor. A sound athletic individual of a similar develop may create to twice this sum. An individual who is littler and less very much fed, however not sick, would deliver less; the gauge for such an individual ought to most likely be 50 watts.

A sound male can just dependably keep up the powerful scope of around (250 watts or more of mechanical force). The connection of human pedal force delivered regarding time is introduced in Table-1.

Table 1: Human power by Duration of effort

Age (Year)	Human force by Duration of exertion (watt)					
	Time Duration					
	5 min	10 min	15 min	30 min	60 min	180 min
20	220	210	200	180	160	90
35	210	200	180	160	135	75
60	180	160	150	130	110	60

II. LITERATURE REVIEW

Basaveshwar Engineering College, Bagalkot Karnataka, India (2015) ^[1]

This inquires about have done the Design and Fabrication of Multi-Purpose Wood Working Machine. Carpentry is whatever playing out any procedure on wood in any capacity for some valuable work. This multipurpose carpentry machine has capacity to perform four tasks such has Planing, Edge shaping, Cutting, and Drilling on a solitary machine. All the four apparatuses driven by single engine. The belt drives are utilized can be locked in and separated at whatever point important. In this serious world individuals are exceptionally enthusiastic for their home inside plan.

Akshay N. Shirbhate, Alok S. Sharma (2016) ^[2]

This undertaking speaks to the idea of Human Powered Multi-Operational Machine principally did for creation based ventures. Enterprises are fundamentally implied for Production of helpful merchandise and ventures at low creation cost, hardware cost and low stock expense. This multi-operational machine can perform activities all the while or separately like machining activity cutting, crushing, power age and water lifting for farming and residential reason.

J Sreedhar, B Sanjanna, K. (2017) ^[3]

Obviously all the businesses that depend on creation, require a lower efficiency cost and high work rate which are feasible by utilizing multi-work working gadget that utilization lesser force and time. As this machine offers functionalities at different focuses, it was seen as viable in lessening time that was devoured up-to an impressive breaking point. With regards to an industry, a significant piece of the speculation is spent for the establishment motivation behind the gadget.

Jyoti, Surendra Gupta (2018) ^[4]

In this paper presents the idea of Multi-Purpose Machine which is principally done for creation based ventures. We have built up an applied model of a machine which would be equipped for performing various activities all the while like boring, cutting and granulating and it ought to be monetarily proficient. It is planned as a versatile one which can be utilized for cutting in different spots.

III. DESIGN AND WORKING

WORKING

At the point when the administrator begin accelerating the shaft which is associated with accelerating plan will pivot at a similar speed of the accelerating. Shaft-1 is associated with the accelerating plan by methods of chain sprocket system. The shaper and Grinder are connected to the shaft-1 so both are running on a similar speed as shaft is turn and give the yield at the same time.

Presently the shaft-2 is likewise associated with shaft-1 by methods for chain sprocket instrument, in this the huge rigging of shaft-1 is associated with the sprocket of shaft-2 so the speed of the shaft-2 will be duplicated by this system from shaft-1. The hacksaw and drill are joined to the shaft-2 which can proceed as the speed as shaft-2 turns. The tight clamp is required to fix or move the work piece for both hacksaw and drill activity. The jack will also be given for the work piece's upward and downward movement to the drilling structure.



Figure 1. Isometric View of Model

IV. EXPERIMENTAL SETUP

The General structure of the Design and Fabrication of Pedal Operated Multi-Operational machine is surrendered. In this course of action we are utilizing two stages. In this initial one is from pedal to shaft-1 and afterward shaft-1 to shaft-2 is fixed on the edge. We are utilizing accelerating gear plan for drive the shafting which is fitted on the casing. In the accelerating course of action, the bigger rigging is associated with the littler apparatus which is fixed on the shaft-1 to transmit the movement from accelerating gear plan to shaft-1.

In the subsequent advance, the Shaft-1 is associated with the Shaft-2 which are fitted both side with the assistance of the platform bearing and the platform bearing is fixed on the gentle steel outline. These riggings are mounted on shafts which are associated with one another by methods for chain. The chain is additionally interfacing the accelerating course of action to littler rigging of shaft-1. The bigger apparatus on shaft-1 is associated with the littler rigging of shaft-2 by methods of chain.

The cutter and grinder are joined to the each side of Shaft-1 and the penetrating course of action and hacksaw shaper are appended to the each side of shaft-2. In this the Hacksaw takes a shot at responding movement while shaft giving turning movement so we need to change over the rotating movement into the responding movement, so the hacksaw is associated with the shaft by implies of scotch-yoke instrument.

This machine performs multipurpose activities simultaneously with required speed and this machine is pedal worked. This model of the multipurpose machine might be utilized in little scope ventures and residential tasks, which can perform mechanical activities like Drilling, cutting and grinding of a slender metallic just as wooden model.

Table 2: Material Specification

Component Name	Specification
Frame	Iron Mild Steel(S275)
Shafts	Mild Steel(C1045)
Pedestal Bearing	Cast Iron
Chain	Alloy Steel
Chain Wheel	Corrosion Resistant Steel

V. ANALYSIS ON BASIS OF TIME

MANUALLY

Cutting	= 2 min 30 sec (*4)
Grinding	= 1 min 30 sec (*4)
Drill	= 40 sec
Cutting of base	= 2 min
Total time	= 18 min 40 sec

ON MULTI OPERATIONAL MECHANICAL MACHINE

Cutting	= 50 sec (*4)
Grinding	= 30 sec (*4)
Drill	= 20 sec
Cutting of base	= 30 sec
Total time	= 6 min 16 sec

- Time manual/Time machine = 18 min 40sec/6min 16 sec
= 3:1
- Time required manually is 3 times the time required by operation mechanical machine = 270/90 machine.
=3:1
- All machines occupy 3 times the space occupied by multi operational mechanical machine.

VI. CALCULATION

Consider mass of operator (m) = 60 kg

Therefore,

- Force = mass \times acceleration
= m \times g
= 60 \times 9.81
= 588.6 N

- Torque = Force × radius (front sprocket wheel)
 - = 588.6 × 152.4
 - = 89702.64 N-mm
 - = 89.70 N-m

Here assumed that N=60 rpm,

- Power = $2\pi NT / 60$
 - = $2 \times 3.14 \times 60 \times 89.70 / 60$
 - = 563.33 Watt
- Speed of rear wheel sprocket (speed of primary shaft)
 - = Teeth ratio × Speed of front sprocket wheel (measured)
 - = 3.14×60
 - = 185 rpm
- Speed of secondary shaft = Teeth ratio × Speed of front sprocket wheel (measured)
 - = 2.92×185
 - = 540 rpm

RPM	MASS (KG)	FORCE (N)	TORQUE (N-M)	POWER (WATT)	SHAFT-1 (RPM)	SHAFT-2 (RPM)
60	60	588	89.70	563.3	185	540
65	70	686	404.6	711.9	204	596
70	75	735	112.1	821.8	220	642
75	80	734	119.6	939.3	236	686
80	Above 80	804	122.5	1027	251	734

CALCULATION FOR GRINDING AND CUTTING ASSEMBLY

We know that in our model the Grinding and Cutting assembly is attached to the primary shaft so the speed of the primary shaft is same as the speed of the Grinding as well as the Cutting assembly.

Speed of primary shaft = Teeth ratio × Speed of front sprocket wheel (measured)

$$= 3.14 \times 60$$

$$= 185 \text{ rpm}$$

CALCULATION FOR HACKSAW ASSEMBLY

In hacksaw assembly after testing result found that Hacksaw = 60 strokes / minute. This Hacksaw assembly can cut up to 30-40 mm diameter work piece.

Calculation of Cutting Speed of Hacksaw

$$V = L * N (1+m) / 1000 \text{ m/min}$$

V= cutting speed, m/min,

N= no. of complete strokes per min,

L= length of stroke, m,

M= ratio of time taken in return stroke to the time taken in cutting stroke.

$$V = 90 * 60 (1 + 0.45) / 1000 \text{ m/min}$$

$$V = 7.83 \text{ m/min}$$

For Example,

The length of a bike pedal arm is r = 0.152 m, and a descending power of F = 111 N is applied by the foot. What is the size of torque about the rotate moment that the point θ between the arm and vertical is?

- (a) 30.0°
- (b) 90.0°
- (c) 180.0°

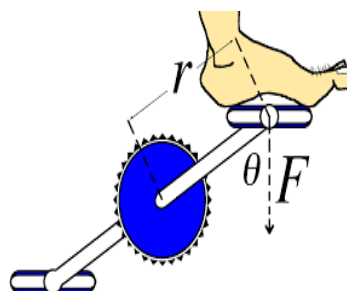


Figure 2. Torque at different angles

Solution:

At the point when the edge θ between the arm and the vertical is 30.0°, the torque τ will be $\tau = r F \sin 30^\circ$

$$= 0.152 \times 111 \times 0.5$$

$$= 8.44 \text{ Nm}$$

When $\theta = 90^\circ$, $\sin \theta = 1$,
 So $\tau = r F \sin \theta$
 $= 0.152 \times 111 \times 1$
 $= 16.9 \text{ Nm}$

When $\theta = 180^\circ$, $\sin \theta = 0$,
 So the power applies no torque on the pedal. This is the circumstance when the pedal is at the base; no measure of pushing down now can deliver any torque on the pedal.

POWER PRODUCE BY OPERATOR:

Power is the best indicator of how well an operator will perform in terms of maximizing their speed. An elite operator can produce about 5 watts (5W) of power for every kilogram of bodyweight for a 1-hour event. For example, a 70 kg operator who is able to maintain a power output of 350W for 1 hour would be considered to be in the elite category.

A very powerful operator might be able to produce 1200W or more for a few seconds. This is useful to make sure they reach maximum speed as soon as possible

HOW PEDALING POWER RELATES TO FORCE AND SPEED

The power of a cyclist depends on:

- How much force the pedals are being pushed with
- The speed at which the pedals are being turned around.

The most extreme force happens when the power pushing on the pedals increased by the speed of the pedals is most noteworthy.

For example,

If the cyclist applies a force of 150 newton to the pedals (150N is the force needed to lift a 15kg mass) and the speed of the pedals in a circle is 2 meters per second (2m/s), the pedaling power output of the cyclist is:

$$\text{Pedaling power} = \text{force on pedals} \times \text{speed of pedals}$$

$$= 150\text{N} \times 2\text{m/s}$$

$$= 300\text{W}$$

This is the same power as lifting a 30kg mass upwards a height of 1 meter every second.

Power is a proportion of how rapidly vitality is being changed into different structures. To comprehend why power will be force duplicated by speed.

There are two main ideas:

- Change in energy is equal to the work done, which is force applied multiplied by distance moved.
- Speed equals distance moved divided by time taken.

$$\text{Power} = \text{change in energy}/\text{time taken}$$

$$= \text{work done}/\text{time}$$

$$= \text{force} \times \text{distance}/\text{time}$$

$$= \text{force} \times \text{speed}$$

RELATED CONCEPTS: FORCE AND TORQUE

The total force F_{total} applied to the pedal is the sum of all vector forces, see Figure 4, produced by the contractions and extensions of the leg and hip muscles which can be decomposed into tangential and radial forces, F_{tan} and F_{rad} , respectively. The force F_{tan} is tangential to the crank rotation and the radial force F_{rad} is parallel to the crank. Only F_{tan} contributes to the crank rotation,

$$F_{\text{total}} = F_{\text{tan}} + F_{\text{rad}}$$

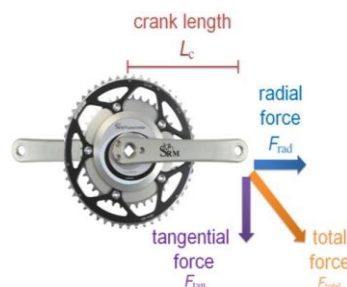


Figure 3. The total force applied to the pedal, F_{total} , is the sum of two perpendicular forces: the tangential F_{tan} and the radial force F_{rad}

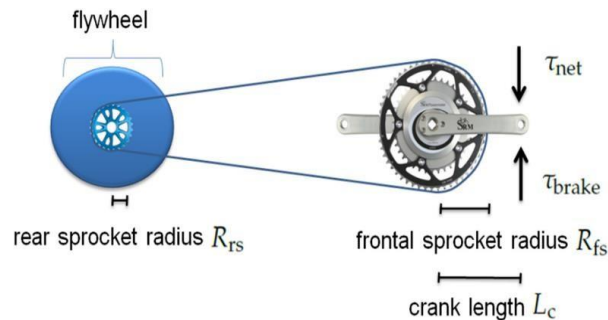
GEAR RATIO

Figure 4. Figure for find out gear ratio

Diameter of the pedal gear = 152.4mm

Diameter of the shaft gear = 56.89mm

Now Circumference of the gears = $2\pi D$

So for the Circumference Of pedal Gear = $2*(3.14)*(152.4)$
= 957.072mm

And circumference of shaft gear = $2*(3.14)*(56.89)$
= 357.269mm

Now,

Gear ratio = Circumference Of pedal Gear / circumference of shaft gear
= $957.072/357.269$
= 2.67



Figure 5. Actual View of Model

VII. CONCLUSION AND REMARKS

By utilizing this machine we can perform multiple tasks at the same time which spare the creation time just as cost. For working this machine there is no need of high skilled laborer. This machine is valuable in rustic region since standard force cut-off is happens in provincial zone. In the perspective on current rural electrification program of government, a thought to build and create pedal worked multi-operational machine will do many procedure without utilization of power.

This machine is perform grinding and cutting procedure on materials like wood, aluminum and steel which having less hardness and thickness. This machine is tough, movable, easy to save and can be utilized in remote or country places. This machine is cost efficient. This machine likewise advances physical wellness of human body.

We realize that aim of each production based industry is to limit the production cost and increment the production rate which can be accomplished by use of multi-functional mechanical machine. In an industry a lot of venture is required for hardware establishment. Additionally, floor required to arrangement this machine is exceptionally less as compared to floor compulsory for setting up isolated machines.

VIII. FUTURE SCOPE

- We can perform many processes like cutting, drilling, or grinding separately by introducing coupling (engagement & disengagement) between them.

- We can do boring operation by introducing a boring tool by replacing drilling tool.
- We can use this multipurpose machine for large scale application instead individual machines
- We can further replace the pedal by motor.
- Other operations can also be incorporated in to the machine.
- The Machine can be made more portable.
- Cost can likewise be diminished somewhat by assembling it on a mass scale.
- Other operations can also be incorporated in to the machine
- Regulator can also be incorporated onto the AC motor to regulate the speed of moving motor (varying speed of motor).

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