ME3200 Machine Design Project

Semester 5

Name of your project/application

Initial Design

By

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Prime mover

To pick the prime mover for this application, we need to consider about parameters involve in the machine such as power requirement for our all type of load, time and conditions we needed to operate.

For power sources there are few options mainly we can consider fuel type engine and electric motor. In this machine I would like to go with electric motor because this is an domestic type. We use this application indoor so if gases emitted during operation it will stuck in it or we need system to remove the gases. Hence better to pick one emit less gases.

Fuel engines emit gases and electric motor will not emit and since this machine is fixed, we don't need to carry and power supply can be got continuously so using electric motor won't be problem

Electric motors have high efficiency compared to fuel engine.

Things we need to look into when selecting electric motor,

- Required RPM
- Power supply type
- Bearing and belt types

Wood hardness factor

- This is the property rely on material of the wood for hardness of wood.
  It given by
  HF=specific gravity*2.20

Type	Specific gravity Value
Softwood	0.35
Cedar-Western	0.31
Red	0.45
Douglas Fir-Coast	0.38
Pine-Ponderosa	0.37
Spruce-White	0.65
Hardwood	0.55
Birch-Yellow	0.56
Maple	0.60
Oak-White	

Type of wood	Hardness factor	Gear used for this wood
Soft wood	0.0– 0.5	3rd gear
Engineering wood	0.5 – 1.0	2nd gear
Hard wood	1.0 – 1.5	1st gear

Examples of tress of soft wood

- Pine
- Cedar
- Redwood
- Douglas fir

Examples of Engineering wood

- Plywood
- Particle board
- Blockboard
- Medium Density fiber board

Examples of tress of hard wood

- Maple
- Oak
- Walnut
- Hickory

Parameters of bench saw	dimension
Our maximum cutting depth of the woodcutter is	
Number of Teeth. (T)	120
Diameter (D)	10inch
Saw Thickness (t)	1.5mm
Kerf with (K)	3mm/0.11inch
Gullet Area(G)	2 inch square

Gullet area

It is the space between teeth of saw, to carry away waste such as saw dust and wood particles.

Kerf width

Width of the cut by saw or in other words width of the teeth

Finding Maximum Horsepower required for the saw?

Horsepower = Gullet Area(G) x Number of teeth(T) x Saw Speed(V) x Bite Factor(B) x Kerf Factor (KF) X Wood Hardness Factor (HF) x Face Width Factor (FF) x 0.003

Feed per tooth = (Carriage speed*12) / (saw rpm*number of teeth)

carriage speed in feet per min, this speed we move the saw, Let carriage speed 250ft/min

= (250*12)/(3200RPM*120)

=0.007

Bite Factor = 0.5 + 4x Feed per tooth(in)

= 0.5+(4*0.007)

= 0.528

Kerf Width Factor = 0.11 x 2.91

= 0.3201

Maximum Cant face width = ((Gullet Area/Feed per tooth) x 0.70)+ 3

= (2*0.70/0.007)+3

= 203

Face Width Factor = 12/max cant face width

(12/203) = 0.0591

Our maximum Saw RPM is 3200.

Where we operate at third gear for soft hard wood with highest Carriage Speed.

H.P = G x T x V x BF x KF x HF x 0.6741 x 0.003

= 2*120*3200*0.528*0.3201*0.5*(0.0591) *0.003

=11.63HP

We must select the motor higher power than the required since there will be loss, let motor has efficiency of 85%.

So power input will be = 11.63*(100/85)

=13.67HP

Therefore, my selection for the power mover is 14Hp squirrel cage electric motor.

Power transmission

If we kept the motor near by cutting saw, there can be wood particles will go to motor and I also felt motor makes unnecessary sound and vibrations near you so if make a power transmission system it will be better. there are different kind of power transmission

I am going to select v-type belt it is common available belt drive. And also, with increased torque will be useful in smooth cutting. Belt drive will be connected to input shaft of motor and input shaft of gear box.

My required rpm will be 3200 rpm, so ratio of "V" Belt drive is 3500/3200 = 1.094

Gear ratio Selection

Since I am connecting third gear with input shaft it has same rpm as input shaft

- Angular velocity of 3rd gear is 3200 RPM
- Angular velocity of 2nd year is (HF=1.0)

  Let other parameters does not change,

  H.P = 2*120*W2*0.528*0.3201*1.0*(0.059)*0.003

  W2 will be 1917.45 RPM

- Angular velocity of 3rd Gear is when HF=1.5

  H.P =2*120*W2*0.528*0.3201*1.0*(0.059) *0.003

  So W3 will be = 1278.32RPM

Gear ratio

For the 3rd gear is 3500/3500 = 1

For the 2nd gear is 3500/1917.5=2

For the 3rd gear is 3500/1278.31= 3

For reverse gear is 3500/800 = 5

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Selecting suitable gear box type

There are three varieties available

- Constant mesh gear box
- Sliding mesh gear box
- synchromesh gearbox

comparison between them was provided below

Parameter	Sliding Mesh Gear Box	Constant Mesh Gear Box
Construction	It consists of spur gear	It consists of helical gear
	The main shaft gears are not in mesh constantly with the countershaft gears, which can slide and mesh.	All the gears on the main shaft are in constant mesh with the corresponding gears on the countershaft

	Selector fork unit is used in this gearbox for engaging the gear	A dog clutch unit is used in this gearbox for engaging the gears
Torque Transmission	Low	High
Size	The size of the gearbox is large	The size of the gearbox is small compared to the sliding mesh gearbox.
Application	It is the oldest type of gearbox used in motor vehicles.	Constant-mesh gearbox has been used in 2&3-wheelers.

I have decided to go with constant mesh type, and manual transmission system, since we operate this equipment at high rpm we need smooth and easy gear transmission for that constant mesh type will suit.

Gear type

There two varieties of gear type we can consider for this purpose namely spur gear and helical gear.
Spur gear in high-speed application it will be noisy and create vibrations, but helical gear has better effect.

In this case if we get vibrations occur it will become difficult to handle the machine, so it's better to choose helical gear for this purpose and constant mesh gear box type generally use helical gears.
So my selection for gear type is helical gear

Layout

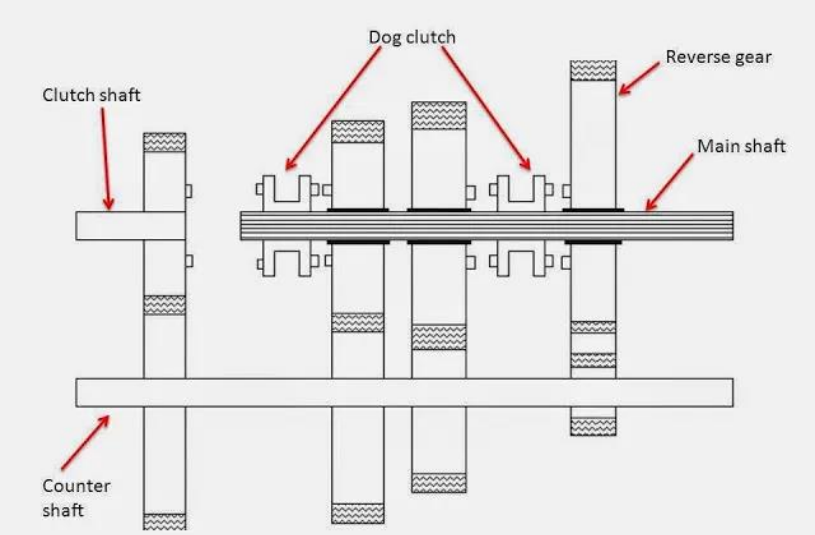
Constant mesh gearbox generally consists of 3 shafts such as input shaft, the layshaft, and Main Shaft.
Other than that, there will be two dog clutch and gear lever will be available.
Input shaft
This is the shaft that get that power from v belt drive to gear box.

- Lay shaft
  In this shaft where all constant mesh gears are in fixed in the shaft

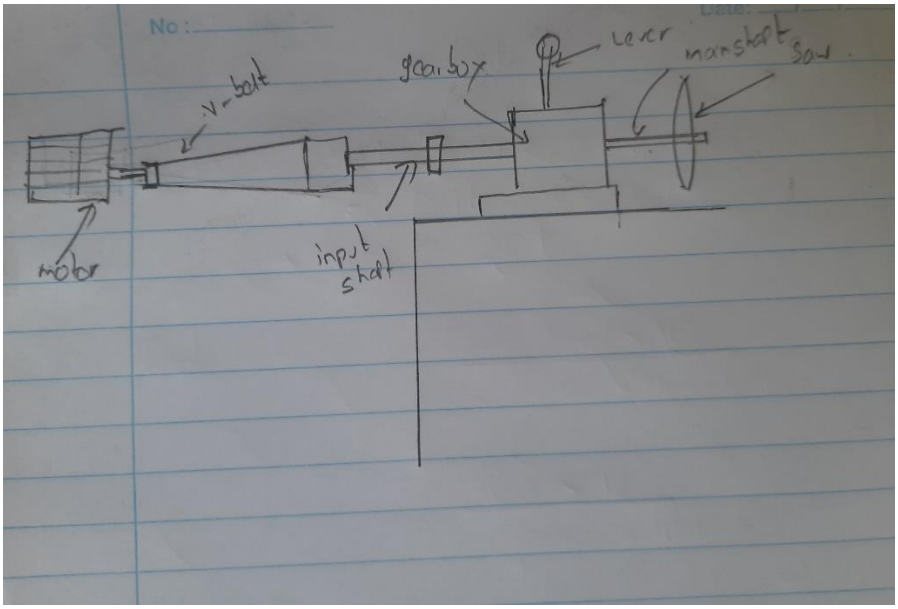
- Main shaft
  This shaft will provide output power to saw.

- Dog clutch
  this is used to reduce speed or changing Gear, gear which relates to dog clutch will Be the one drive the main shaft, this done by engaging and disengaging of gears on the main shaft

- Gear lever
  This lever will be used by operator to change gear manually.



Constant mesh gear box



Lubrication

It will help to reduce friction between metals and enable smooth transmission
can reduce heat dissipation
Factors needed to consider is

- ✓ Speed
- ✓ Materials used
- ✓ Temperature
- ✓ Load
- ✓ vibration
- ✓ Type of motion

Lubrication can be applied by several types.

- Drip oil feed
  Where the system operated on low speed and low load and low to moderate speed have bearings where small quantity of oil at regular intervals is expected.

- Splash oil feed
  Splash oil feed is a term applied to a variety of conducting lubricated bushings or pistons. Oil is splashed on bearings or pistons from the action of various moving parts regularly dipped in lubricating oil.

- Force oil feed
  High speed or high load equipment can develop high temperature from friction. To protect equipment from such high temperature from friction. To protect equipment from such high temperatures, a high flow of oil is needed. In force oil feed lubrication system, the pressurized oil from oil pump is directed to the rotating component.

- Grease lubrication
  Grease are semi solid lubricants. They are used instead of oil when lubricant must stay in one place or stay adhered to the part. Greases do not leak out as easily as oils. Greases are also used when the component cannot be lubricated often and are not accessible during operation.

  In this we do not need lubrication continuously, this machine is not high load and high speed so lubricant can be applied at regular intervals and this machine won't make high heat and not operated for long time also. So for

this purpose I felt drip oil feed will be better as it applied for low load and oil will feed to machine in regular intervals.

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