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Design of Grass Cutter

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Abstract: In my seminar I design the grass cutting machine for the use of agricultural field, to cut the crops in the field. This is a new innovative concept mainly used in agricultural field. It is simple in construction and its working is easy. The components that are used are engine, gear, cam, chain and sprocket, lead screw, wheel, control unit. Below the gear arrangement cutting blade is fixed. When the engine starts running the shaft also rotates and that rotates the gear arrangement which is coupled with the motor. As the gear arrangement rotates the cam arrangement, it operates the sickle bar which tends to cut the grass or crops. The sickle bar has one is fixed cutter and another one is movable cutter which is placed on it. The whole set up is placed on a movable base which has a wheel arrangement.
Keywords: Grass Cutting Machine, Components, Power Supply, Sickle Bar.

I. INTRODUCTION

Grass cutter machines have become very popular today. Most common machines are used for soft grass furnishing. In our project Grass cutter machine we are aimed to develop for operation and construction. Agriculture is the most important sector in the Indian economy. In India there is a great scope of grass cutter machine. In our country as well as other countries has also it is used in various fields for cutting the grass. The machine may consist of two, three or four blades depending upon the machine. The grass cutting machine is known as lawn mower. The grass cutting machine is available in the various types like reel (cylinder) mower, rotary and mulching mower, hover mower, riding mower, professional mower etc. but these are very costly and unaffordable also. Also, it requires a skilled person to operate it. Hence, it was found necessary to have a grass cutter with minimum initial cost and can be operated by unskilled labor [7].

Figure1.1: our Model of the grass cutter [7].

The machines required for manufacturing includes welding machine, grinding machine etc. Working principle of the grass cutter is providing a high speed rotation to the blade, which helps to cut the grass. The blade will get kinetic energy while increasing the rpm. The cutting edges are very smooth and accurate. Also Electric Grass Cutting Machines are much easier to be used in garden, lawn and grass fields. In order to enhance the beauty of home-lawns and gardens, Grass cutting machines are the best available option in the industry.

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With the help of a lawn mower which is a machine with revolving blades to help us cutting lawns at even length, people can easily maintain and beautify their lawns and gardens without any hassle. Now-a-days, there are plenty of options starting from the simplest push along mower to the most advanced electric grass cutting machine [7].

A vertical mounted electrical motor operated grass cutter was found to be an alternative to common rotor mower (Chancellor, 1958). The grass cutters do the better job of cutting grass or lawn grass. The vertical rotor shaft has many pairs of swinging knives that cut the grass at equal height. If the blade cannot cut the grass by the first blade, then it can be cut by the other three remaining blades. The commercially available units for mowing or grass cutting are casting heavily. The grass was cut above the ground surface without damaging the blades when it strikes on immovable object such as rock, stone. The grass cutting takes place due to impact and shearing action also [7].

A. Parts Of Machine

Shaft : it is an rigid component which transfer power from one end to another
Bevel gear : it is an type of gear which is used as a differentional
Chain sprocket : it is used to supply power one flywheel to another
Blades : it is used to cut the grass

Design Procedure:

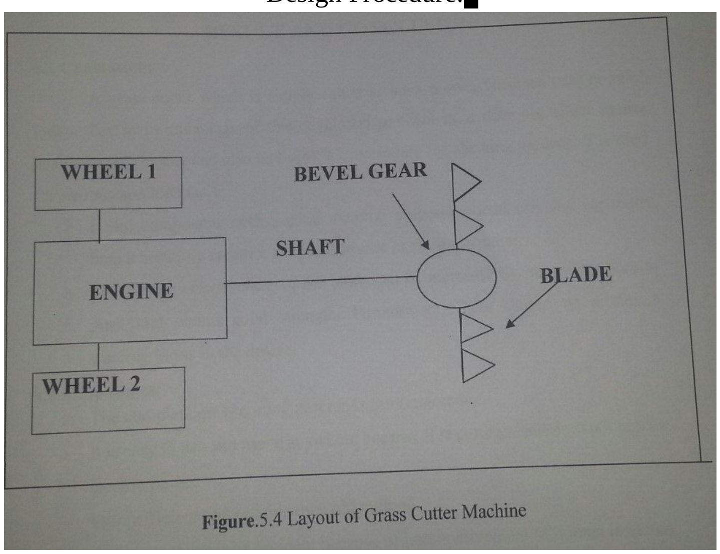

Figure: layout of grass cutter machine

The various types of design procedure for Shaft, Gear, Bearing and Drive design are mention below:

B. Design Procedure of Shaft

A shaft is a rotating member, in general has a circular cross section and is use to transmit power. The power is delivered to the shaft by some tangential force and the resultant torque. In order to transfer the power from one shaft to another, the various members such as pulleys, gears etc., are mounted on it. These members along with the forces exerted upon them causes the shaft to bending. In other words, we may say that a shaft is used for the transmission of torque and bending moment.The shafts may be designed on the basis of:

C. Strength

D. Rigidity and Stiffness

In designing shafts on the basis of strength, the following cases may be considered:

1) Shafts subjected to twisting moment or torque only,
2) (b) Shafts subjected to bending moment only,
3) (c) Shafts subjected to combined twisting and bending moments, and
4) (d) Shafts subjected to axial loads in addition to combined torsion and bending loads.

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E. Shaft Design Based on Strength

Design is carried out so that stress at any location of the shaft should not exceed material yielding.

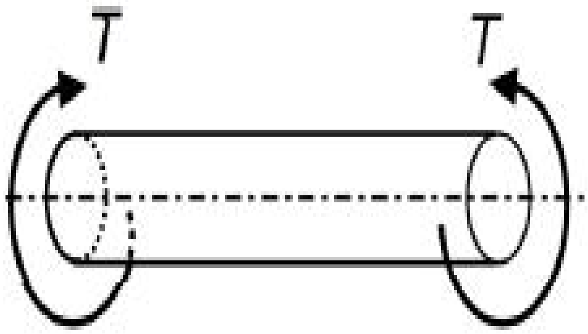

Figure 3.1: Shaft [8].

F. Stress due to torsion

$$\tau_{xy} = \frac{T \times r}{J} = \frac{16T}{\pi d_o^3 \left(1 - c^4\right)}$$

τ_{xy} = Shear stress due to torsion

T =Torque on the shaft

G. Shaft Design Based on Rigidity

$$\frac{T}{J} = \frac{G.\theta}{L} \quad \text{or} \quad \theta = \frac{T.L}{J.G}$$

Where,

θ= Torsion deflection or angle of twist in radians,

T = Twisting moment or torque on the shaft,

J = Polar moment of inertia of the cross-sectional area about the axis of rotation,

G = Modulus of rigidity for the shaft material,

L = Length of the shaft.

$$= \frac{\pi}{32} \times d^4 \qquad \text{...(For solid shaft)}$$

$$= \frac{\pi}{32}\left[(d_o)^4 - (d_i)^4\right] \qquad \text{...(For hollow shaft)}$$

F. Design Procedure of Gear

Bevel gears are gears where the axes of the two shafts intersect and the tooth-bearing faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. The pitch surface of bevel gears is a cone. The bevel gears are used for transmitting power at a constant velocity ratio between two shafts whose axes intersect at a certain angle [8].

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Figure 3.2: Bevel Gear [8].

The strength of a bevel gear tooth is obtained in a similar way as discussed in the previous articles. The modified form of the Lewis equation for the tangential tooth load is given as follows:

$$W_T = (\sigma_o \times C_v)\, b.\pi\, m.y' \left(\frac{L-b}{L}\right)$$

Where,

σ_0= Allowable static stress,

Cv= Velocity factor,

v = Peripheral speed in m / s,

b = Face width,

m = Module,

y' = Tooth form factor (or Lewis factor) for the equivalent number of teeth,

L = Slant height of pitch cone (or cone distance).

The static tooth load or endurance strength of the tooth for bevel gears is given by

$$W_S = \sigma_e . b.\pi\, m.y' \left(\frac{L-b}{L}\right)$$

F. Design Procedure of Bearing

A bearing is a machine element which supports another moving machine element. It permits a relative motion between the contact surfaces of the members, while carrying the load. A little consideration will show that due to the relative motion between the contact surfaces, a certain amount of power is wasted in overcoming frictional resistance. In order to reduce frictional resistance and wear and a layer of fluid (known as lubricant) may be provided [8].

Figure3.3**:** Bearing [8].

The following procedure may be adopted in designing journal bearings, when the bearing load, the diameter and the speed of the shaft are known.

1) Determine the bearing length by choosing a ratio of l / d.
2) Check the bearing pressure, p = W / l.d for probable satisfactory value.
3) Assume a lubricant and its operating temperature (t_0). This temperature should be between 26.5°C and 60°C with 82°C as a maximum for high temperature installations such as steam turbines.
4) Determine the operating value of ZN / p for the assumed bearing temperature and check this value with corresponding values, to determine the possibility of maintaining fluid film operation.
5) Assume a clearance ratio c / d.
6) Determine the coefficient of friction (μ) by using the relation. Determine the heat generated by using the relation.
7) Determine the heat dissipated by using the relation.
8) Determine the thermal equilibrium to see that the heat dissipated becomes at least equal to the heat generated. In case the heat generated is more than the heat dissipated then either the bearing is redesigned or it is artificially cooled by water.

G. Design Procedure of Chain Drives

The chains are made up of number of rigid links which are hinged together by pin joints. These wheels have projecting teeth of special profile and fit into the corresponding recesses in the links of the chain as shown in Fig.3.4 the toothed wheels are known as sprocket wheels or simply sprockets. The chains are mostly used to transmit motion and power from one shaft to another. The chains are used for velocities up to 25 m / s and for power up to 110 kW. In some cases, higher power transmission is also possible [8].

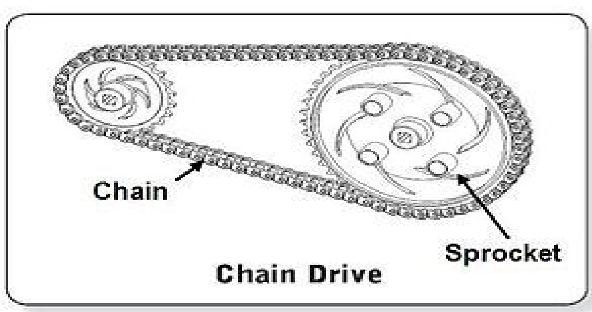

Figure 3.4: Chain [8].

The chain drive is designed as discussed below:

1) First of all, determine the velocity ratio of the chain drive.
2) Select the minimum number of teeth on the smaller sprocket or pinion.
3) Find the number of teeth on the larger sprocket.
4) Determine the design power by using the service factor, such that Design power = Rated power × Service factor
5) Note down the parameters of the chain, such as pitch, roller diameter, minimum width of roller etc.
6) Find pitch circle diameters and pitch line velocity of the smaller sprocket.
7) Determine the load (W) on the chain by using the following relation, i.e.W=Rated power/Pitch line velocity

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8) Calculate the factor of safety by dividing the breaking load (WB) to the load on the chain (W). This value of factor of safety should be greater than the value.
9) Fix the center distance between the sprockets.
10) Determine the length of the chain.

H. Design Procedure of Frame
This is the first and very important part of this arrangement. It consists of a simple structure like shown in above fig.3.2.2. This arrangement of structure is fitted on the span of base at both end having two wheels and at front end with a wheel.

Figure3.5**:** Frame [8].

I. There are Three Types of Frames
1) Conventional frame
2) Integral frame
3) Semi-integral frame

J. Conventional Frame
It has two long side members and 5 to 6 cross members joined together with the help of rivets and bolts. The frame sections are used generally.
1) Channel Section – Good resistance to bending
2) Tabular Section – Good resistance to Torsion
3) Box Section – Good resistance to both bending and Torsion

K. Integral Frame
This frame is used now days in most of the cars. There is no frame and all the assembly units are attached to the body. All the functions of the frame carried out by the body itself. Due to elimination of long frame it is cheaper and due to less weight most economical also. Only disadvantage is repairing is difficult.

L. Semi – Integral Frame
In some vehicles half frame is fixed in the front end on which engine gear box and front suspension is mounted. It has the advantage when the vehicle is met with accident the front frame can be taken easily to replace the damaged chassis frame. This type of frame is used in some of the European and American cars.

M. Selection of Engine Capacity
There are a variety of ways to make starting easier and they will vary by the engine you select. To be sure you find the combination of features and power that's right for you, look for an engine brand that offers a wide selection of easy-starting options. All Briggs & Stratton engines offer various easy starting features. One of the easiest starting is with the feature no choking, no priming, just pull for power [8].

N. Power
Engine power is the single biggest difference from one piece of power equipment to the next. For instance, the more cutting power a lawnmower has the more easily it will maintain the speed of the blade and delivers a consistent, quality cut, even under tough conditions.

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O. Engine Size

In combination with engine configuration, engine size is the most important factor in a lawnmower's ability to handle tough, demanding jobs. The higher the displacement, torque or horsepower rating, the more power the machine has to get the job done. For walk-behind mowers, Briggs & Stratton engine sizes typically range from 148cc to 190cc. For riding mowers the sizes typically range from 10.5 to 24.0 gross horsepower. CC's (Cubic Centimeters) is a measure of size and indicates an engine's volume or capacity

P. Torque

It is defined as the twisting force that tends to cause

II. CONCLUSIONS

A grass cutter which is simply called as lawn mower becomes very popular today. The main advantage of this developed protocol is, it does not affect farmer health by any means and also and now it is necessary for cleaning gardens. It is used for various applications. If the component having good material properties, load carrying capability then it certainly enhance the performance of the grass cutter. The cutting effectiveness of the blade can be increased by improving slice to push and obtain good strength. Furthermore, there should be minimum welding joints in the design

III. ACKNOWLEDGMENT

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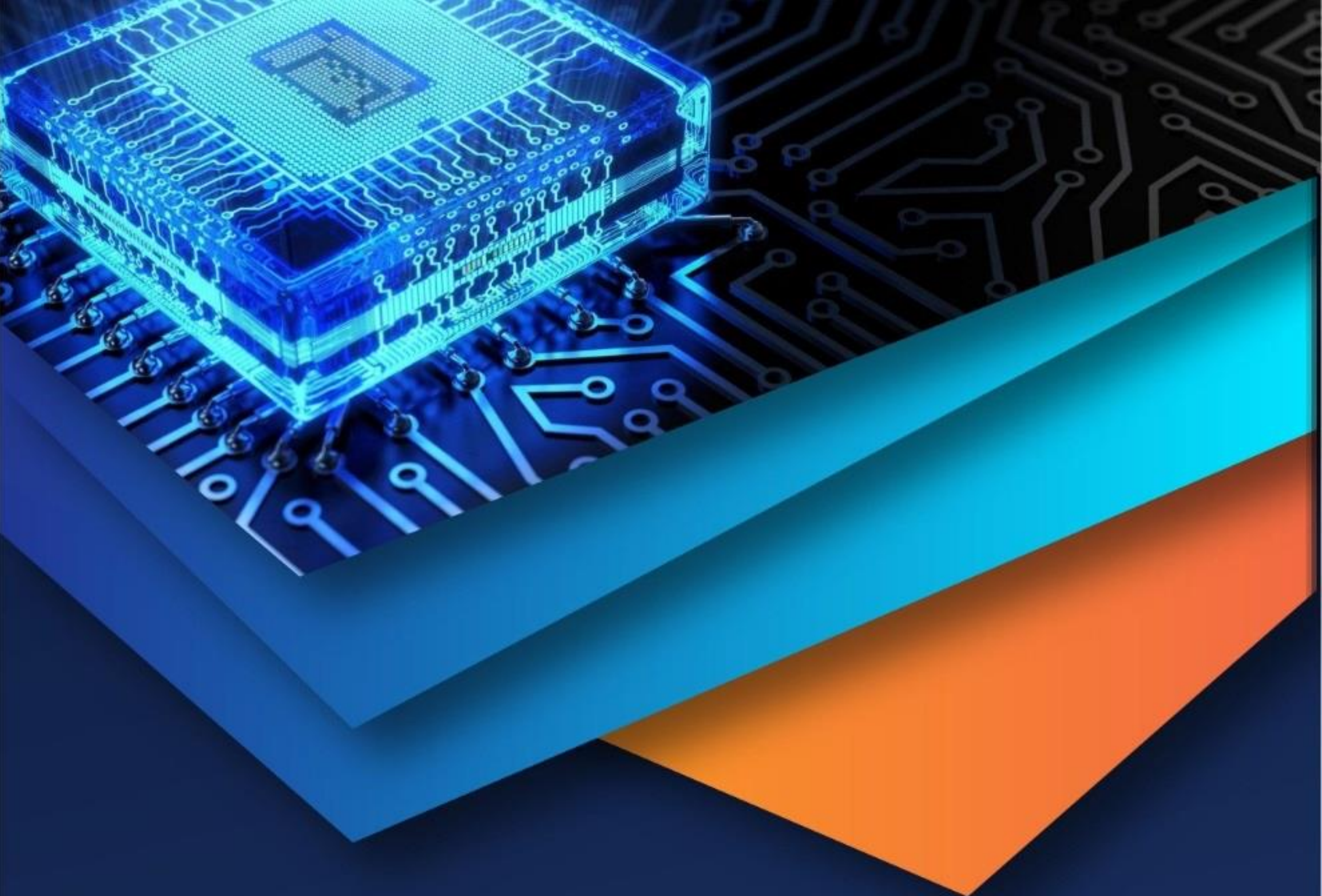

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