MODERN MULTIPURPOSE PLANT AND GRASS CUTTING MACHINE

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Abstract

The objective 'modern multipurpose plant cutting machine'is a machine that uses rotating blades to cut a lawn at an even length by changing the blades on the plate having bolt and nut arrangement. Even more convenient devices are there in each field. Power consumption becomes essential for future. Modern plant cutting machine is a very useful device which is very simple in construction and easy for operation. It is used to maintain and upkeep lawns in gardens, schools, college's, road dividers, public parks etc. We have done many modifications in the existing machine to make its application simple and easier at reduced cost. It has no requirement of skilled operator for the operation as it can operate easily and maintain the lawn very fine and uniform surface look. In our project circular disc cutter is used for the cutting of plants in vertical direction and we can also use blades for horizontal grass cutting also we can replace this blades by using nut and bolt arrangement for the cultivation of soilin agricultural field. It comprises of a system of speed variation by using pulleys which drive the cutting blades and lift mechanism meant to adjust the height of the cut. This is achieved by means of a system of chain and pulley by using v-belt arrangement having minimum slip effect also we can used as collapsible blades to reduce the wear of blade teeth. The prime mover is used as tractor having high efficiency and high power with small amount of human effort. Thus, the machine having high efficiency and is readily adaptable to different cutting conditions.Now, in India the plant cutting is done by manually i.e. by the application of human effort. So on behalf of these types of plant cutting we have to made 'modern plant cutting machine' which is efficient, less noisy, portable and less time consuming.

Key words: *Plant cutting machine, Prime mover, Cutting blades, Less human efforts, Horizontal grass cutting, cultivation of soil, Cheaper, Reduced road accident, etc.*

1. INTRODUCTION

The aesthetic value of his environment is as important as food and shelter to the modern man. In general, gases are found to survive in a variety of conditions and thus the need to curtail their growth in order to enhance the beauty of our habitant environment. So, we can make plant cutting machine that employs rotating blades, for cutting a garden land spaces, with an even length and height. A grass cutting machine used for cutting grass or lawns. The conventional grass cutting machines produces number of unpleasant effect on human as well as environment. That grass cutting machine having high running and maintenance cost. Looking into all this problem it was decided to develop a good machine with eases operation and with low cost.

The first lawn mower was invented in 1830 by Edwin Beard Budding (www.altavista.com/history). The idea given for machine after watching a machine in a local cloth mill having application cutting cylinder mounted on a bench to trim clothes for a smooth finish after weaving. Budding realized that a similar concept could be used to cut grass if the mechanism is mounted in a wheel frame to enable the blades rotate close to the lawns surface. These early machines were made of cast iron and featured a large rear roller with a cutting cylinder (reel) in the front. Cast iron gear wheel transmitted power from the rear roller to the cutting cylinder. In early years, sheep and other animals were used to keep the lawn or yard trimmed. The animal used to gaze however in today's modern time a machine with rotating blades is used for cutting grass or lawns. This machines are called as lawn movers and they can be manual or motor driven. Some mower blades may be

pushed forward and some may cut the grass to an even height with spinning of blades. So we can make modern machine which is driven from a Mahindra tractor having capacity of 15 HP. This power transmission take in which another gear in backward side of the tractor having six splines on that shaft. This machine is operated by using a universal joint which is coupled to the splined shaft and the gearbox of the machine. The power transmission takes place by using chain drive having two sprockets for speed variation between input shaft driven by gearbox of the machine and the output shaft.

2. PROBLEM DEFINITION

In Early days, most of the activities like screen outing of plants are done by manually. In the course of time, so many big and small equipment have been developed to sooth human activities, thereby to reduce the human efforts to do the things. Now a day's most of the activities which includes human efforts are not only replaced but also automated by the help of machines or other types of equipment. Skilled workmanship is necessary for conventional type of grass cutters. Why because here we employ animals like bulls. Now a days, the technology is developing, in other hands, skilled people with conventional grass cutters had potential to meet basic energy needs of teeming millions who reside in rural India. Now we must have to depend upon the technology.

Because of the risk involved in a conventional grass cutters, now a days, very few individuals are coming forward to grass cutting by conventional grass cutter. Moreover, Indian youth's educational background is improving day by day. So most of people avoid or hesitate to deal with conventional grass cutters. The modern multipurpose plant cutter exists in Japan but is not available in our country and this machine is driven with the help of hydraulic power obtained from a prime mover. The machine is very expensive i.e. up to 20 lakh. So this machine is expensive for purchasing this equipment for human or PWD.

3.COMPONENTS OF PLANT CUTTING MACHINE

3.1 PRIME MOVER (TRACTOR)

Mahindra Yuvraj is a compact tractor with the capacity of 15 HP having variety of styles and the efficient performance. The Yuvraj 215NXT becomes an ideal tractor for land holding and inter-culture operations because of ease of operation and its fuel efficiency.

3.2 BEARINGS

High capacity Timken and self- aligning ball bearing are a grease type bearing with seal incorporated. The bearing is locked to the shaft with cam lock collars.

Fig-1 Bearing

3.3 ROTORS

The rotor consists of series of uniformly positioned flanges and fixed with four blades for each and every flange. Four bolts for each flanges with self- locking nut,are required to hold the blades in placed.

The desired and recommended working rotor speed is 240 RPM. The formula which is used to calculate the speed obtained with your tractor is;
P.T.O rpm + 2*0.59= Rotor speed

However, a lower 160 rpm may be used and can be achieved by using tractor P.T.O. speed of 540 RPM. Remember that the speed of tractor P. T. O. is achieved at a certain engine RPM.

3.4 POWER TACK OF SHAFT

Fig.2 power tack of shaft

3.5 UNIVERSAL JOINT

We the universal joint as one of the oldest among the all flexible couplings. It is commonly well known for its use on four wheelers and heavy motor vehicles like trucks, buses, etc. A universal joint is made up of two right angled (90 degree) shaft yokes to each other and a Yoke joining four-point cross. The cross fits inside the bearing cap assemblies, which are pressed into the eyes of yokes. Industrial applications runs without stopping.

Fig-3: Universal joint

3.6 GEAR HOUSING

It is employed for transitions of power from the PTO shaft to the plant cutting machine through universal joint. The analysis was done for the housing without the any revolving parts (such as gears, shafts, and bearings). Rigid and flexible mounting conditions for the gear housing are taken into consideration in this analysis. The simulation of realistic mounting condition is obtained on a rotorcraft with the flexuous support, and for comparison purposes, the rigid one is analyzed.

Fig-4: Gear housing

3.7CHAIN DRIVE

A chain drive consist of an endless chain running around two sprocket wheels as shown in fig-6. The chain drive possess specificationswhich are common to both the V-belt drives and the gear drives. There is no slippage in chain drive. Compared to belt drive, it is a positive drive. The power can be transmitted by the chain drive from input shaft to output shaft.

Fig-5: Chain drive

3.8CUTTERS (BLADES)

A circular saw is a power saw having a toothed or abrasive disc or blade for cutting different leaves using a rotary motion spinning around a arbor's hole saw and a ring cutter also uses a rotary motion but is different from a circular saws and may also be loosely used for the blade itself. Circular saws where invented in the late 18th century.
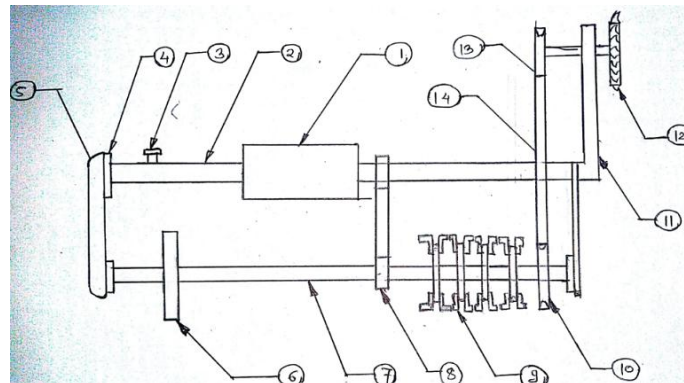

Fig-6: Cutting blades

3.9 balancing wheel

Balancing wheel is a mechanical comp that is used for the application of balancing weight or stable the plant cutting machine.it is used only when the cultivation of soil is tacks place or in the application of grass

Fig.7 balancing wheel

4. Assembly view of plant cutting machine

Fig.8 assembly view of plant cutting machine

S/N	Item	Quantity
1	Gear housing	1
2	Input shaft	1
3	Oil drain plug	1
4	Bearing	4
5	Chain drive	1
6	Balance wheel	1
7	Output shaft	1
8	Supported member	2
9	Blades	24
10	Input pulley	1
11	Vertical bar	1
12	Cutter	2
13	Output pulley	1
14	V belt	1

5. DESIGN ANALYSIS

5.1 Theory

The shearing force of most annual and perennial grasses found on most lawns is usually between 9.2N ~ 11.51N (Yong and Chow, 1991). Force required by cutting blade to shear the grass is given by;

$$F = T/R \qquad \text{… (1) (Khurmi, 2003)}$$

Where T = Shaft torque; R = Radius of cutting blade
But shaft torque is given by;

$$T = P/2\pi N \qquad \text{… (2) (Khurmi, 2003)}$$

Where P = Power developed by shaft; T = Torque required; and N = Shaft speed in Rev/min

5.2 Selection of prime mover

For smooth grass cutting, a prime mover power of not less than 628.3W (0.84hp) having a rotational speed of not less than 3,000 rev/min and producing a shear force of about 10.5 N is recommended (www.lawnmowerguie.com). Though this gives a sufficient torque with a high cutting force, using an average blade radius, the speed is still not sufficient enough for easy grass cutting. Hence a speed multiplication pulley system is used.

5.3 Design of the Pulley System

The mower is made of a speed multiplication v-grooved pulley system
D_1 = Diameter of motor pulley, D_2 = Diameter of blade shaft pulley
D_4 = Diameter of alternator shaft pulley; $D_2 = D_3 = D_4$
$\pi D_1 N_1 = \pi D_2 N_2$ (Khurmi, 1997)
$D_1/D_2 = N_2/N_1$
Where N_1 = Speed of drive pulley
N_2 = Desired blade shaft speed,
$D_2 = D_1 N_1 / N_2$

5.4 Length of Drive Belts

$L_1 = \pi/2 (D_1 + D_2) + 2C + (D_1 - D_2)2 /4C$ (Khurmi, 2003)
Where L_1 = Length of drive belt for pulleys 1 and 2
C = Centre distance between the two pulleys

5.5 Power Transmission

Power transmitted from the motor to the blade is given by;
$P = (T_1 - T_2) v$ (Khurmi, 2003)
Where T_1 = Tension on tight side of belt
T_2 = Tension on slack side of belt, and P =power developed by shaft
Use was made of group A, v-belt design having a power transmission range of 0.7 ~ 3.5 kW.
$2.3 \log (T_1/T_2) = \mu\theta\mathrm{cosec}\beta$ (Khurmi, 2003)
$\sin\alpha = (R_1 - R_2) /C$
Where R_1 and R_2 are radii of pulleys 1 and 2 respectively.
Angle of contact, $\theta = 180^o - 2\alpha$ 24°
$2.3 \log (T_1/T_2) = \mu\theta\mathrm{cosec}\beta$; where $\mu = 0.2$
$P = (T_1 - T_2) v$; where P and v are transmitted power and peripheral velocity respectively.
Centrifugal tension in the belt is given by;
$T_c = mv^2$
Where m = mass of belt per meter, and v = peripheral velocity.

5.6 Cutting Blades and Shaft Design
Speed of blades and shaft in rev/min
Power transmitted in kW
Torque transmitted, $T = P/2\pi N$, N-m
But $T = F.r$ $F = T/r$

5.7 PERFORMANCE TEST
Area of grass cut
Desired height of cut
Time taken
Area of grass cut to desired height
Cutting Efficiency of the plant cutting machine

6. WORKING PRINCIPLE
The modern multipurpose plant cutting machine is driven by using a prime mover as tractor. The power transmission takes place by using gearbox through splined shaft at backward side. The power from splined shaft is transferred to the gear housing of plant cutting machine by the application of universal joint. The power from the gearbox is transferred to the chain drive. The speed increase takes place in the chain drive. The balance wheel is provided at the output shaft of the plant cutting machine. There are four rotating flanges which are bolted on the output shaft. The rotor blades are bolted on that flanges which is used for the cultivation in agriculture. Also, by changing the blades the grass cutting is also done on this machine. Out of the four flanges, one flange is used for carrying the pulley which is bolted on it. From that flange, the power transmission takes place by using a V-belt drive. For that purpose, we can make another assemblies for vertical plant cutting machine. In that, we can use vertical bar for its supports. On that we can attach two pulleys for rotating a saw

circular blades. The pulley on output shaft have bigger diameter than the diameter of small pulley which is located on vertical bar. The vertical bar is required only when the vertical cutting is to be done. Otherwise, at the time of grass cutting or cultivation of soil, there is no necessity to drive the vertical cutters. At that time we can remove the V-belt drive. This machine is used in cultivation in the wine yardsurrounding. Also, it is used for the screening out of pomegranate plant. It is used in rural area as well.

The speed variation or speed ratio can be altered by varying the sprocket diameter. When chain drive becomes active, this motion is transferred in vertical direction to the saw cutter. The cutting action will take place by change of the spindle speed. The cutter motion can be obtained with the help of the hydraulic lifter.

7. FUTURE WORK

Our project entitled Modern multipurpose plant cutting machine is successfully completed and the results obtained are satisfactory. It will be easier for the people who are going to take the project for the further modifications.

This project is more suitable for a common man as it is having much more advantages i.e. no fuel cost, no pollution and no fuel residue, less wear and tear because of less number of moving components and this can be operated by using solar energy. This will give much more physical exercise to the people and can be easily handled.

8.CONCLUSION

The modern multipurpose plant cutting machine is cheap and easy to handle for user. The machine is used for various application of agriculture such as cutting of pomegranate, cultivation of soil in wine yard. This machine is used for the cutting on road divider plant in vertical direction and grass cutting of garden in horizontal direction and cultivation of garden. This Machine is very cheap and easy to operate.

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