DESIGN AND NUMERICAL ANALYSIS OF INNOVATIVE PLOWING MACHINE

[1] *R.Balamurugan,* [2] *Nirmal Kannan.V,* [3] *Rajesh S*

[1] *Assistant Professor, Mechanical Engineering, V.S.B.Engineering College, Karur, India, 639111*

[2] *Professor, Mechanical Engineering, V.S.B.Engineering College, Karur, India, 639111*

[2] *UG scholar, Mechanical Engineering, V.S.B.Engineering College, Karur, India, 639111*

[1] *balaapmech@gmail.com,* [2] *v.nirmalkannan@gmail.com,* [3] *rajeshps44@gmail.com*

Abstract: Ploughs are traditionally drawn by working animals such as horses or cattle, but in modern times may be drawn by tractors. A plough may be made of wood, iron, or steel frame with an attached blade or stick used to cut the earth. The primary purpose of ploughing is to turn over the upper layer of the soil, bringing fresh nutrients to the surface, while burying weeds and the remains of previous crops and allowing them to break down. In our paper a new design and design calculation with fabrication is done where it helps farmers to easily plough the land without strain and cost. Initially the depth of plowing on land should be determined and initial adjustment of height control screw is done. The force is given on handle in such a way that the cutter touches the ground surface and slow frontward movement is given on the plowing machine. When the plowing machine started moving the front two wheels starts its rotation whereby the sprocket attached to the left wheel is also moving. The Sprocket is connected with another sprocket and spur gear assembly by means of chain. When sprocket starts rotates the chain moves and it makes the spur gear to rotate. Now the spur gear is connected with cutter which in turn rotates in backward side and plowing process starts. A third wheel is fixed in the rear side to safeguard the cutter. For effecting plowing we attached two cutters and in future it can be implemented with motor also.

Keywords: Plowing Machine, sprocket, spur gear, cutter, design

1.INTRODUCTION

1.1 PLOWING:

A plough (UK) or plow (US; both /ˈplaʊ/) is a tool or Farm implement used in farming for initial cultivation of soil in preparation for sowing seed or planting to loosen or turn the soil. Ploughs are traditionally drawn by working animals such as horses or cattle, but in modern times may be drawn by tractors. A plough may be made of wood, iron, or steel frame with an attached blade or stick used to cut the earth. It has been a basic instrument for most of recorded history, although written references to the plough do not appear in English until 1100 CE at which point it is referenced frequently. The plough represents one of the major advances in agriculture.

The primary purpose of ploughing is to turn over the upper layer of the soil, bringing fresh nutrients to the surface, while burying weeds and the remains of previous crops and allowing them to break down. As the plough is drawn through the soil it creates long trenches of fertile soil called furrows. In modern use, a ploughed field is typically left to dry out, and is then harrowed before planting. Plowing and cultivating a soil homogenizes and modifies the upper 12 to 25 cm of the soil to form a plow layer. In many soils, the majority of fine plant feeder roots can be found in the topsoil or plow layer.

Ploughs were initially human powered[citation needed], but the process became considerably more efficient once animals were pressed into service. The first animal powered ploughs were undoubtedly pulled by oxen, and later in many areas by horses (generally draft horses) and mules, although various other animals have been used for this purpose. In industrialised countries, the first mechanical means of pulling a plough were steam-powered (ploughing engines or steam tractors), but these were gradually superseded by internal-combustion-powered tractors.

Modern competitions take place for ploughing enthusiasts like the National Ploughing Championships in Ireland. Use of the plough has decreased in some areas, often those significantly threatened by soil damage and erosion, in favour of shallower ploughing and other less invasive conservation tillage techniques.

Natural farming methods are emerging that do not involve any ploughing at all, unless an initial ploughing is necessary to break up hardpan on a new plot to be cultivated, so that the newly introduced soil life can penetrate and develop more quickly and deeply. By not ploughing, beneficial fungi and microbial life can develop that will eventually bring air into the soil, retain water and build up nutrients. A healthy soil full of active fungi and microbial life, combined with a diverse crop

(making use of companion planting), suppresses weeds and pests naturally and retains rainwater.

Thus the intensive use of water-, oil- and energy hungry irrigation, fertilizers and herbicides are avoided. Cultivated land becomes more fertile and productive over time, while tilled land tends to go down in productivity over time due to erosion and the removal of nutrients with every harvest. Proponents of permaculture claim that it is the only way of farming that can be maintained when fossil fuel runs out. On the other hand, the advantage of agricultural methods that require repeated ploughing are that they allow monocropping on a large scale at remote locations, using industrial machinery rather than human labor

2. CONSTRUCTIONAL DETAILS

S.no	Components used	specification
1	Mild steel wheel -2nos	700 mm
2	Sprocket	7”x1/2”
3	Sprocket	2”x1/2”
4	Chain	½”
5	Spur gear	50 dia, No.of teeth:17
6	Cutter	4”dia x1”width
7	Handle	-

2.1 Mild steel wheel

In the States, "mild steel" refers to low carbon steel; typically the AISI grades 1005 through 1025, which are usually used for structural applications.

Carbon steel is steel in which the main interstitial alloying constituent is carbon in the range of 0.12–2.0%. The American Iron and Steel Institute (AISI) definition says:

Steel is considered to be carbon steel when no minimum content is specified or required for chromium, cobalt, molybdenum, nickel, niobium, titanium, tungsten, vanadium or zirconium, or any other element to be added to obtain a desired alloyingeffect;

when the specified minimum for copper does not exceed 0.40 percent;or when the maximum content specified for any of the following elements does not exceed the percentages noted: manganese 1.65, silicon 0.60, copper 0.60.[1]

The term "carbon steel" may also be used in reference to steel which is not stainless steel; in this use carbon steel may include alloy steels.

As the carbon percentage content rises, steel has the ability to become harder and stronger through heat treating; however, it becomes less ductile. Regardless of theheat treatment, a higher carbon content reduces weldability. In carbon steels, the higher carbon content lowers the melting point.

2.2 A sprocket and roller chain

A sprocket[1] or sprocket-wheel[2] is a profiled wheel with teeth, cogs,[3] or even sprockets[4] that mesh with a chain, track or other perforated or indented material.[5][6] The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc. Perhaps the most common form of sprocket may be found in the bicycle, in which the pedal shaft carries a large sprocket-wheel, which drives a chain, which, in turn, drives a small sprocket on the axle of the rear wheel . Early automobiles were also largely driven by sprocket and chain mechanism, a practice largely copied from bicycles.

Sprockets are of various designs, a maximum of efficiency being claimed for each by its originator. Sprockets typically do not have a flange. Some sprockets used with timing belts have flanges to keep the timing belt centered. Sprockets and chains are also used for power transmission from one shaft to another where slippage is not admissible, sprocket chains being used instead of belts or ropes and sprocket-wheels instead of pulleys. They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed.

2.2.1 Transportation

In the case of bicycle chains, it is possible to modify the overall gear ratio of the chain drive by varying the diameter (and therefore, the tooth count) of the sprockets on each side of the chain. This is the basis of derailleur gears. A multi-speed bicycle, by providing two or three different-sized driving sprockets and up to 11 (as of 2014) different-sized driven sprockets, allows up to 33 different gear ratios. The resulting lower gear ratios make the bike easier to pedal up hills while the higher gear ratios make the bike more powerful to pedal on flats and downhills. In a similar way, manually changing the sprockets on a motorcycle can change the characteristics of acceleration and top speed by modifying the final drive gear ratio.

2.2.2 Tracked vehicles

In the case of vehicles with caterpillar tracks the engine-driven toothed-wheel transmitting motion to the tracks is known as the drive sprocket and may be positioned at the front or back of the vehicle, or in some cases both. There may also be a third sprocket, elevated, driving the track.

Tread drive sprocket of the Leclerc main 1

The sprocket wheels a, b, and c engage and transport the film. a and b move with uniform velocity and c indexes each frame of the film into place for projection.
Sprockets are used in the film transport mechanisms of movie projectors and movie cameras.[7] In this case, the sprocket wheels engage film perforations in the film stock. Sprocket feed was also used for punched tape and is used for paper feed to some computer printers.

3. SPROCKET AND CHAIN DRIVE

This is a cycle chain sprocket. The chain sprocket is coupled with another generator shaft.
The chain converts rotational power to pulling power, or pulling power to rotational power, by engaging with the sprocket. The sprocket looks like a gear but differs in three important ways:
1.Sprockets have many engaging teeth; gears usually have only one or two.
2.The teeth of a gear touch and slip against each other; there is basically no slippage in a sprocket.
3.The shape of the teeth is different in gears and sprockets.

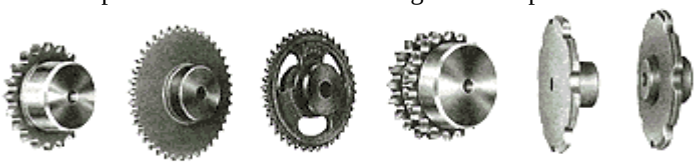
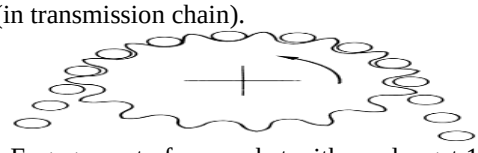


Figure 3.1 sprocket and chain drive

3.1 CHAIN WEAR AND JUMPING SPROCKET TEETH:

The key factor causing chain to jump sprocket teeth is chain wear elongation. Because of wear elongation, the chain creeps up on the sprocket teeth until it starts jumping sprocket teeth and can no longer engage with the sprocket.
Figure 3.1 shows sprocket tooth shape and positions of engagement. Figure 3.2 shows the engagement of a sprocket with an elongated chain.
In Figure 3.1 there are three sections on the sprocket tooth face:
a:Bottom curve of tooth, where the roller falls into place;
b:Working curve, where the roller and the sprocket are working together;
c:Where the tooth can guide the roller but can't transmit tension. If the roller, which should transmit tension, only engages with C, it causes jumped sprocket teeth.
The chain's wear elongation limit varies according to the number of sprocket teeth and their shape, as shown in Figure 3.5.1.2.3. Upon calculation, we see that sprockets with large numbers of teeth are very limited in stretch percentage. Smaller sprockets are limited by other harmful effects, such as high vibration and decreasing strength; therefore, in the case of less than 60 teeth, the stretch limit ratio is limited to 1.5 percent (in transmission chain).



Engagement of a sprocket with an elongat 1

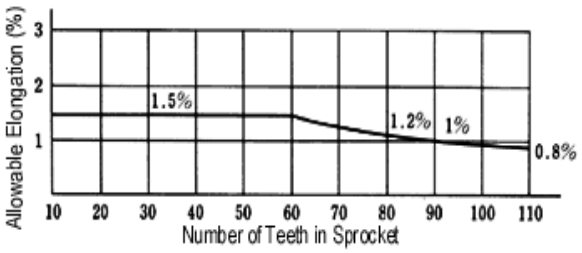


Fig 3.2 Chain's wear elongation limit

In conveyor chains, in which the number of working teeth in sprockets is less than transmission chains, the stretch ratio is limited to 2 percent. Large pitch conveyor chains use a straight line in place of curve B in the sprocket tooth face. A chain is a reliable machine component, which transmits power by means of tensile forces, and is used primarily for power transmission and conveyance systems. The function and uses of chain are similar to a belt. There are many kinds of chain. It is convenient to sort types of chain by either material of composition or method of construction.

D.C MOTOR:

As this project is a automobile vehicle we use dc motor. A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight line.

SPUR GEAR

A gear or cogwheel is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on the two meshing gears all have the same shape. Two or more meshing gears, working in a sequence, are called a gear train or a transmission. A gear can mesh with a linear toothed part, called a rack, thereby producing translation instead of rotation.
The gears in a transmission are analogous to the wheels in a crossed belt pulley system. An advantage of gears is that the teeth of a gear prevent slippage.
When two gears mesh, if one gear is bigger than the other, a mechanical advantage is produced, with the rotational speeds, and the torques, of the two gears differing in proportion to their diameters.
In transmissions with multiple gear ratios—such as bicycles, motorcycles, and cars—the term "gear" as in "first gear" refers to a gear ratio rather than an actual physical gear. The term describes similar devices, even when the gear ratio is continuous rather than discrete, or when the device does not actually contain gears, as in a continuously variable transmission.

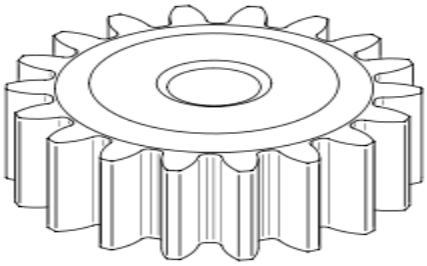
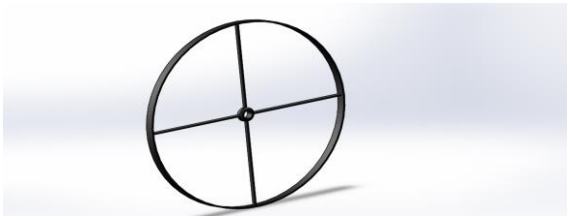


Fig 3.3 Spur Gear

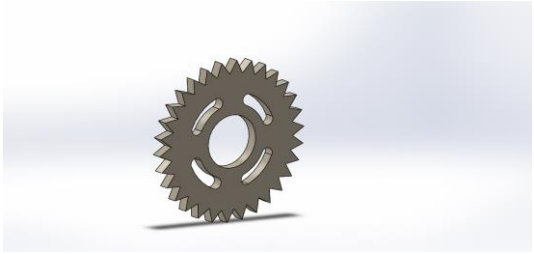
4.DESIGN OF PLOWING MACHINE

4.1 FRONT WHEEL:

4.2 BACK WHEEL:

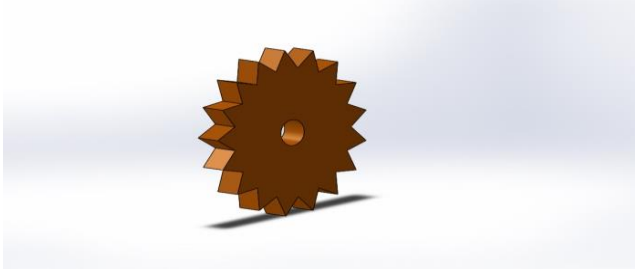


4.3 SPROCKETS:

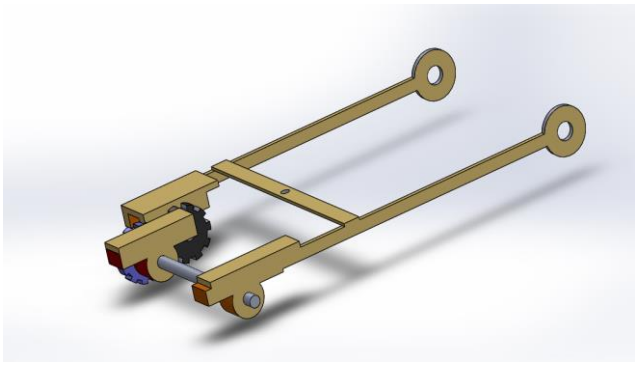


4.4 CHASIS:

4.5 GEAR:



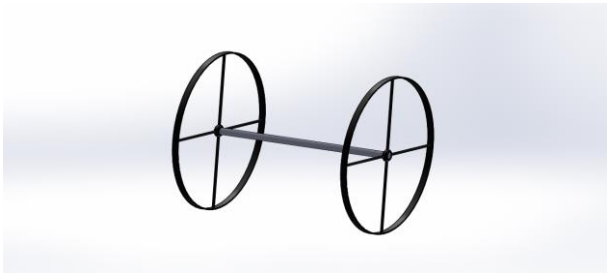
4.6 GEAR SETUP:



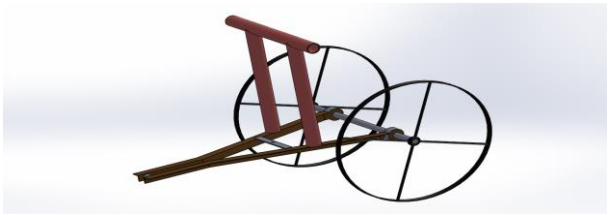
4.7 HEIGHT CONTROL SCREW:

5.ASSEMBLY STEPS:

STEP 1:



STEP 2:



STEP 3:

STEP 4:

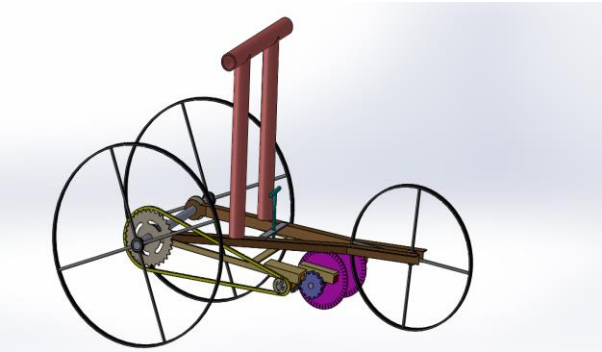


FIg 5.1 Working Model

6. WORKING PRINCIPLE

•In Plowing machine, initially the depth of plowing on land should be determined and initial adjustment of height control screw is done.
•The force is given on handle in such a way that the cutter touches the ground surface and slow frontward movement is given on the plowing machine.
•When the plowing machine started moving the front two wheels starts its rotation whereby the sprocket attached to the left wheel is also moving.
•The Sprocket is connected with another sprocket and spur gear assembly by means of chain. When sprocket starts rotates the chain moves and it makes the spur gear to rotate.
•Now the spur gear is connected with cutter which in turn rotates in backward side and plowing process starts. A third wheel is fixed in the rear side to safeguard the cutter.
•For effecting plowing we attached two cutters and in future it can be implemented with motor also.

7. ADVANTAGES AND APPLICATION

7.1 ADVANTAGES

- Portable and easy to transport one place to another.
- Maintenance cost is low
- Low cost machine used for plowing small agriculture land.
- No need of power supply when connected to battery
- Working is easy and human friendly

7.2 APPLICATION

Plowing small agriculture land.
Study model for agriculture and engineering students.

CONCLUSION

In this project we have successfully fabricated a Plowing machine. Thus a low cost machine for Plowing small agriculture land. The main advantage is that the maintenance cost is very low and renting of tractors is avoided and it helps farmers in great extend. Design of innovative plowing machine is done using solid works software and fabricated successfully.

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