STUDY OF DIFFERENT TYPES OF SPROCKETS AND ITS USES

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Abstract - Sprockets are most widely used in automobile sector and in machinery. These are used in two wheelers and four wheelers such as bikes, cycles, cars and other mechanism either to transmit revolving motion between two shafts wherever gears are incompatible or to communicate undeviating motion to a pathway etc. They exist in various dimensions, teeth number and are made of different materials. Sometimes faulty chains quickly wear the sprocket. Possible causes of this problem are significant overload, breakage, high impact pressure, excessive chain wear far beyond replacement level, combination of worn chain with new sprockets etc. To ensure efficient power transmission chain sprocket should be properly designed and manufactured. There is a possibility of weight reduction in chain drive sprocket**.**

Mostly researchers have used different grades of steel as their base material and redesigned the sprocket by using different CAD software, few have used composite materials like Carbon Fiber or Nylon66GF30 also as an alternative to steel and compared to earlier research. Some has given heat treatment and other types of chemical treatment to the sprocket to enhance its mechanical properties. From the review, it is concluded that no workis done in redesigning of chain sprocket and optimizing its weight and performance using different alternative materials like Metal Matrix Composite**.**

Key Words: essentials, sprocket, design, wheel, tooth**,**

1.INTRODUCTION

History:

The term 'sprocket' originally applied to the projection from the wheel that caught on the chain and provided the drive to it. The overall wheel was then termed a 'sprocket wheel'. With time and common use of these devices, the overall wheel became known as a sprocket. The earlier uses would now be seen as archaic.It is driven by a toothed wheel called a sprocket. It is a simple, reliable, and efficient means of power transmission. Though Hans Renold is credited with inventing the roller chain in 1880, sketches by Leonardo da Vinci in the 16th century show a chain with a roller bearing

Objective of Study:

- To classify different types of sprockets.
- To understand the working of all types of sprockets
- .To explain various parts and functions of it..
- To study sprocket mechanism

Scope of Study :

- it has scope intextiles machinery industry and instrument industry.
- It can be used in manufacturing of bicycles and automobiles.
- It has a scope in defense, industries and in transportation sector

- it has a scope in film transport mechanism of movie projectors and movie cameras

Benefit of study:

- You can make awesomeprojects.
- Sprockets are used to modify the overall gear ratio of the chain drive by varying the diameter.
- It is easy to study chain sprocket mechanism.
- We found various types of sprockets which can be used in number of machines

2. LITERATURE REVIEW

Historical Background:

The term 'sprocket' originally applied to the projection from the wheel that caught on the chain and provided the drive to it. The overall wheel was then termed a 'sprocket wheel'. With time and common use of these devices, the overall wheel became known as a sprocket. The earlier uses would now be seen as archaic.It is driven by a toothed wheel called a sprocket. It is a simple, reliable, and efficient means of power transmission. Though Hans Renold is credited with inventing the roller chain in 1880, sketches by Leonardo da Vinci in the 16th century show a chain with a roller bearing

Literature Survey:

S. Thipprakmas: A sprocket is a toothed wheel, commonly used in drive systems, to which the strength and wear resistance of the teeth are important. Sprockets are conventionally fashioned by hobbing, followed by heat treatment. However, the fine-blanking process has recently seen increasing use by sprocket manufacturers. The process of fine-blanking has the possibility of reducing the number of process operations, thus reducing production time and cost, as well as improving part quality and process repeatability. Because of the severe plastic deformation in fine-blanking process, the strength, hardness and wear resistance of parts can be improved. In this work, the surface hardness and wear resistance of a fine-blanked sprocket are compared with those of a sprocket made using the hobbing process. The source of the wear resistance improvement was identified via examination of the microstructure. The microstructure of the fine-blanked sprocket revealed an increasingly compressed and elongated grain structure, in which grain flow and orientation resulted in pronounced hardening across the tooth width. The wear resistance of the fine-blanked sprocket, as measured by the distance between the teeth and the radius at the tooth bottom, was greater than that of the hobbed and heat-treated sprocket. Based on the results, the material cost of the sprocket could be reduced by using low carbon steel (SS400) instead of medium carbon steel (S50C), and further savings in production time would be realized by eliminating the need for subsequentheat treatment

Yong Wang:Roller chain drive is widely used in timing mechanism of gasoline engine. However, its polygonal action and meshing impact effect resulted from the non-conjugated meshing feature may damage the synchronization and uniformity of transmission. In this paper, new sprocket tooth profile is developed to reduce polygonal action and meshing impact under high speed. A new conjugated profile is derived by modifying involute profile to guarantee that the moving distance of chain is equal to the arc length of pitch circle that a sprocket rotates at the same time and the center line of chain at tight side is always tangent to the pitch circle. An asymmetrical modification method for sprocket tooth profile is also proposed. A multi-body dynamic model of the timing mechanism of a gasoline engine with the intake and exhaust sprockets is developed. The fluctuation and meshing impact of the chain are analyzed under different rotational speeds. The results show thatnewly developed sprocket profile can efficiently reduce meshing impact and friction of chain. The stability of chain transmission under high speed can be improved

Bahir H Eldiwany: An experimental study was conducted to measure the load distribution in steel roller chains on polymer sprockets and determine the effect of material modulus of elasticity, tight-side load, slack-side load and pitch difference. A chain load distribution test machine and a single sprocket tooth test machine were designed and constructed to conduct this investigation. Theoretical results obtained from a geometric progression load distribution model and a spring model load distribution analysis were compared to the experimental results.

Mohammad R Nazi:A study was made to determine the load distribution for an elastic roller chain on an elastic sprocket. The equations developed for the distribution include, as a subset, those for a rigid roller chain on a stationary rigid sprocket. The effect of friction and sprocket rotation on load distribution is discussed. Results are presented for a 20-tooth sprocket with a 180° angle of roller chain wrap, for various tight-to-slack side tension ratios of both driver and driven sprockets, with various spring constant ratios.

Bahir H. Eldiwany: An experimental study was conducted to measure the load distribution in steel roller chains on steel sprockets and determine the effect of lubrication, misalignment, sprocket speed of rotation at low speeds, and slack-side load. A chain load distribution test machine was designed and constructed to conduct this investigation. Theoretical results obtained from a geometric progression load distribution model were compared to the experimental results

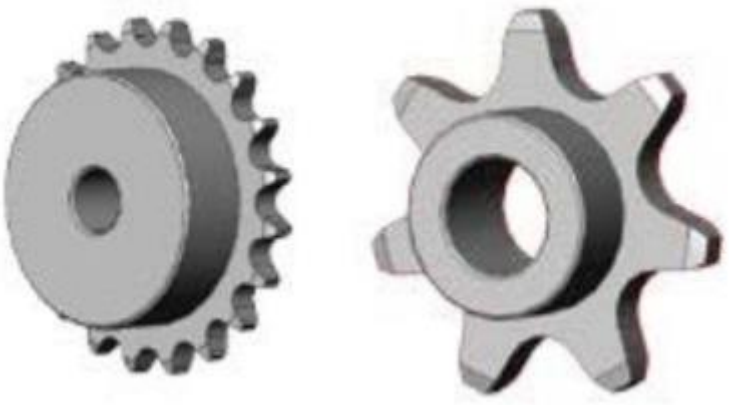
What is Sprockets ?

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.

Types of Sprockets :

1) Small and Large Roller Pitch Sprockets Double : Used with double pitch conveyor series roller chains. These chains are available with either the standard small roller diameter (i.e.: 2040, 2050, 2060, 2080, 2100) or a larger diameter chain roller style
(i.e.: 2042, 2052, 2062, 2082, 2102). Sprockets are available from stock to accommodate either style. This type of sprocket is primarily used in conveying applications where torque requirements are lower, and long service life is critical. Please refer to Figure 3.1 for an illustration of a standard and double pitch sprocket for comparison purposes



- Fig 3.1 Small and Large Roller Pitch Sprockets Double

Mechanism of sprockets

Working of sprockets:

chain or belt is used to connect two sprockets, with one being the 'driver' and the other being 'driven'. Motion or force then drives them, which transmits power or changes the torque or speed of a mechanical system.Sprockets with more teeth are able to move heavier amounts of weight, however they produce more friction, which reduces operating speed.As a chain passesover, it wears away the notches, so if they've become sharpened or hooked at the tip instead of being blunt they need to be replaced.

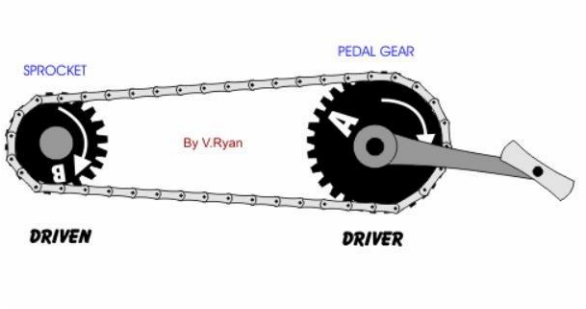


Fig.3.1 working of sprockets

Sprocket Dimensions:

- Number of teeth **:** This is the amount of teeth located on the sprocket**.**
- Outside diameter (O.D.): The measurement from the tip of the sprocket tooth across to the corresponding point directly opposite the sprocket.
- Hub diameter (H.D.): Hub In sprockets utilizing an integral hub, this is the distance through the hub's center bore.
- Pitch diameter (P.D.): A measurement across the sprocket from tooth center to corresponding tooth center. In instances where there is no direct opposite, the nearest tooth center dictates measurement.
- Face width (F.W.): This is the value of the distance across the thinnest part of the sprocket. This is kept from its maximum to allow low-friction chain engagement, but also from its minimum to ensure proper working load.
- Sprocket bore (S.B.): For hubbed sprockets, this is the width across the shaft hole of the hub.
- Length through bore (L.T.B.): This is the distance within the bored hole on hubbed sprockets. This will be of larger value than the face width, and must be long enough to withstand torque from the shaft.
- Inside diameter (I.D.): In sprockets that do not utilize a hub, this is the distance across the inner edge

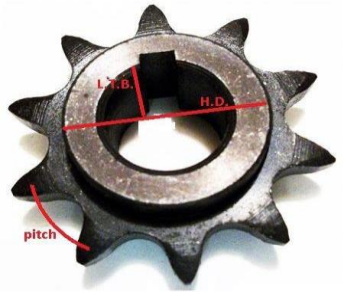


Fig .3.1 sprocket Dimensions-1

Fig.3.2 sprocket Dimensions-2

4. Difference between gear and sprockets :

Gears	Sprocket
Teeth of two gears interlock with each other	Their teeth do not interlock, they fit into the slots of a chain or belt.
The gear transmit motion in any axis	The sprocket transmits motion only in a parallel axis.
The transmitted torque is opposite in direction	It transmits torque is in the same direction.
If one of its teeth is damaged	Damage to one or more than one of

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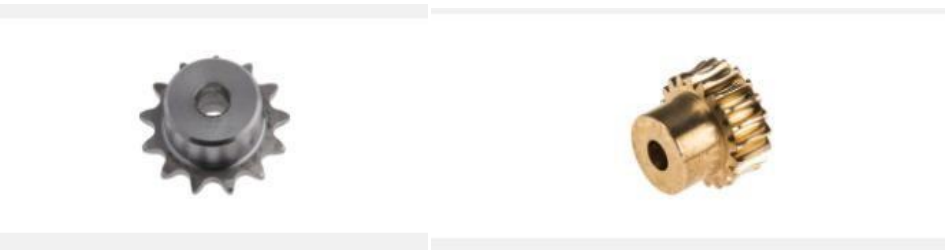

- Fig .4.1 gear and sprockets

- They're both used to transmit power in machines or move other items by interlocking with them, but the main difference between a sprocket and a gear is how they work on a practical level. Both tend to be wheels with notches for use in machinery, meaning they look very similar, but the way they operate and what they do is different.

- Usually gears are designed to link together to transmit movement to them, which then causes movement elsewhere. So sprockets normally work directly with some part of the machinery, and gears often push against each other and use their collective movement to cause larger mechanical movement.

- This means sprockets are designed to directly move something such as a chain or belt, so they work more independently, whereas gears create a network to increase strength and cause movement.

- The differences can also be seen when inspecting the grooves of both devices. As gears mesh directly together, the notches could be on the outside of the wheel as well as the inside circumference

CONCLUSION

It is interesting to observe that mostly researchers have chosen Finite Element Analysis to optimize the sprocket. Mostly they have chosen different grades of steel as their base material. Few have tried to substitute the steel with composite material also. As compared to steel, composites are not so easy to be machined using traditional machining processes. Few of the researchers have optimized the sprocket using FEA software without performing the experiment validation. Hence, it can be concluded that more weight reduction can be achieved by re- designing the sprocket geometry like teeth profile, hub, bolt holes, pockets etc. and more torque can be achieved. Since metals will be going to deplete someday, researchers are searching for more alternative materials. Polymer composites are slowly finding its place as a replacement to steel. Re-designing of sprocket can be done by using the different compositions of polymer matrix composites and more weight can be optimized without reducing the power transmission. Metal-Matrix composite can be also used as a substitute to steel for manufacturing of sprocket. Cost of material is an another factor which restricts the use of alternate materials in place of existing materials for sprocket manufacturing for automobiles and machineries. New manufacturing techniques can also be introduced or the existing methods can also be optimized for fast and precision manufacturing of the sprockets. So the above techniques can be used for further development of chain sprocket and more efficiency can be achieved during power transmission

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