

Development of Winch Machine For Erection of Transmission Tower –A Review

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Abstract - Winch machine is arrangement of tools and tackle for lifting and lowering the objects and widely used in the field of engineering mechanisms. It is designed as pulling devices, consisting of rope winding around a horizontal drum turned typically by motor. It is classified into seven major types depending on drive system, such as electrical winch, mechanical drum-style winch, mechanical capstan-style winch, hydraulic winch, mechanical hand-operated winch, mechanical portable winch and hybrid winch.

A winch is made up of many components like drum, shaft, rope, winch gearbox and drive system etc. In recent trend to fulfil the shortfall of energy throughout the country and under developed countries business of construction of EHV Transmission line is undergoing on war foot basis & its required an specially designed winch machine to achieve the great result with proper safety in work. . This review is conducted to study the areas of improvement in the design of winch system to develop the high performance winch for the building/construction of EHV transmission tower

Key Words: Winch Drum, Rope, Tower, lifting & lowering device

1.INTRODUCTION

Tower erection is the process of lifting the tower parts sections and assembled as per the drawing specifications. It is majorly consist three process of tower building (a) Manual method (b) Motorised winch (c) Helicopter method. All these three method having limitations as mentioned below

Manual method: - In this method erection work done with the help of manpower and moving tractor (partially). Basic loophole & limitations are skilled manpower, unsafe working and right of way (ROW) required for tractor moving.

Motorised winch: - This is compact size model of winch, It have a one or two small size pulley arrangement to pass over the cable smoothly. As there doesn't have any drum arrangement the cable life reduces in high extent. The arrangement is also more complicated to make the winch in

steady position. These complications make its unsafe as well as less progressive.

Helicopter method: - This is one of the most expensive methods used for the erection of the tower in section wise. In this method helicopter is used for lifting the section wise tower portion and directly installed on the main body with the help of highly skilled manpower. But due to cost factor it not much popular in Indian business.

To overcome the all drawbacks we are developing the winch machine based on the principle of the conventional practices with increased outcome & safe working condition. This winch will be driven by the tractor power through P.T.O

2. LITERATURE REVIEW

P.F. Cabral developed the Electrically driven traction winch of Maximum pulling capacity of a 10 tonne load over inflatable tires in a 15° inclined plan having the range of 50 m and nominal traction speed of 0.5m/s at full load. He described the ideation, design, conventional sizing calculation based on expedite realistic equations and validation of the results by the use of finite elements analyses of the critical components in a traction winch intended for use in marine environment. Their purpose is to provide a reliable and safe means of pulling boats over wheeled dollies out of the water up an inclined plan. The author's experience in boating has contributed for the initial empirical ideation of the mechanism and concluded that the process of conception and calculation of mechanical systems is one of heavily iterative nature, experience being a very important factor in allowing the designer to approach the design with empirical initial sizing close to those that [1]

Lim Buan Teck analysed stress loading on the drum subjected to multilayer of rope and improved design of an anchor handling and towing winch. He studied the relation between multi-layering and generated stress on drum, therefore determine the critical thickness to balance the manufacturing cost and safety of operation. Two experiments were conducted on the prototype to simulate the actual loading on drum under shaft. The experimental result proved

that generated hoop stress depends largely on the loading conditions. As the winding continues to load on another layer of rope on the wound layer of rope, the inner wound rope will experience lesser pulling force from the load. The inner layer of rope acts to be part of or additional thickness to the cylinder, and therefore, the hoop stress generated is much lower.[2]

Joey McKee proposed the design, construction and evaluation of hydraulic powered power take off or PTO winch for M37 cargo truck, produced by the United States in 1952. He replaced the factory mechanical drive system with the complete hydraulic system. This winch is rated at 7500 lbs. receives its input power via a driveshaft connected to the transmission power take off gearbox capable of bidirectional operation. When the winch is operated the PTO hydraulic pump is engaged providing hydraulic pressure controlled by a 4 way valve delivering flow to a hydraulic motor. The hydraulic motor turns a small driveshaft directly coupled to the back of the factory winch. Author concluded that the size of the hydraulic pump in this system is larger than necessary to run the one hydraulic motor. The largest problem with outfitting a vehicle with a hydraulic system is acquiring enough room to fit the various components while retaining functionality and ease of maintenance[3]

Moses F. Oduoria, Enoch K. Musyoka, Thomas O. Mbuya had demonstrated application of analytical decision making during mechanical design and, particularly, in selecting a suitable material for a given application. Equations for the mechanical design of a manual winch rope drum are used to derive quantitative material performance indicators, which are then used in a multiple attribute decision making (MADM) model to rank the candidate materials. Thus, the processing of mechanical design considerations and material properties data into information that is suitable for use in a quantitative materials selection process is demonstrated for the case of a rope drum design [4]

M. Matejic, M. Blagojevic, V. Marjanovic, R. Vujanac, B. Simic had investigated the tribological aspects of process of winding the steel rope around the winch drum. They focused on the analysis of friction between the steel rope and winch drum during the process of winding and unwinding of rope around the winch drum. As the result of the research, certain mechanisms of winding of the rope from the aspects of the friction force were obtained, and the effects of the forces on the sides of the drum were analysed. They proposed the Mathematical model of steel rope winding around the winch drum, which is used to define the single layered and multi-layered winding. This mathematical model has been developed, which for given initial parameters of winding of the rope gives the friction forces diagrams, perpendicular forces, as well as the comparative friction forces diagram for different coefficients of friction. Using the mathematical model and friction force calculation, it has been shown that the friction force in the rope spooling onto the winch drum process does not depend only on the friction coefficient, but also in the position of the rope during the process. It has been shown that the greatest friction forces occur during the

crossing of the rope from one layer to another. With the increase of the friction coefficient, the time needed for the pulling to friction force transfer shortens. [5]

Vladimir Solovyov and Alexandr Cherniavsky did the Computational and experimental analysis of trawl winches barrels deformations. The necessary use of heavy duty trawl winches can cause plastic deformation of winch barrels, known as rolling and main reason for such deformation are evenly distributed pressure of wound rope and the "Running spots" of contact stresses near the point of contact between the rope and barrel. As the strain increases with number of cycles and strain accumulation rate depends on the barrel size, material, rope tension and rope stiffness. Therefore a special combination of hardware and software developed, which informs the trawler master about the possibility of plastic deformation and helps him to predict situation that can lead to barrel plastic deformation [6]

3. CONCLUSIONS

Winches are the more efficient tool widely used in the various engineering applications it available in different types based on drive system. They are driven by using hydraulic system, pneumatic system, electrical system and mechanical system. So depending on the drive source they are named as hydraulic winches, pneumatic winches, electrical winches and mechanical winches. The above literature review helps to understand the development of special purpose tractor P.T.O driven winch system. It also helps to understand the analyses of winch components like winch drum, rope. Etc. These all reviews support to find out the causes of poor performance and corrective solution to developed cost effective and compact size winch machine along with the proper safety parameters.

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