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Design and Analysis of Advanced Rope Making Machine

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Abstract—Wire ropes have been continuously using in elevators, cranes and many heavy mechanical machines. In this paper, we are proposing a modified design which deals with the solution of space and power consumption problem in the wire-rope manufacturing industries. After applying our proposed modified design of wire rope making machine, it can save the space which is a major problem of any manufacturing industry and also saves some amount power consumption due to the use of only one DC motor. Now, continuous research is going on the improvement of wire rope physical characteristics. This paper presents Solidwork simulation which represents efficient axial strain at rope as well as tension in the rope.

Keywords— Wire Rope, Steel Cord, Torsion, Axial Strain, Tension.

I. INTRODUCTION

Today various transportation facilities are available such as buses, trains, airplanes, ships, boats etc. In nature, these all facilities are unique and appropriate for specific condition and environment. For traveling from one mountain to another mountain we have to climb down and travel from one moun-tain to the bottom of Second Mountain and then climb up. This takes large amount of time and it is to be performed without electrical power, it is very exhaustive and everybody cannot go to Second Mountain from First Mountain [1].

There is one method through ropeway we can go from one mountain to another mountain. We can use in the ropeway transportation. It can be used in industries also like gravies etc. Generally ropes are made by wire (aluminum, steel) [2]. We are trying to design a model of rope making as project and study on this working. We are trying to make a simple technology based model in this paper as rope making.

A. Problems in Conventional Rope Making Machine

Rope making is a very complex job comprising of twisting of wires in to a single incorporating a very complex mech-anism involving a huge number of gears, space and capital for maintenance. Due to this reason only it prevails in large industries [3]. We are trying to simplify this design and make it smaller in size and easy to operate.

B. Factors on Which Modification is Done

For this we concentrated on two things mainly:

1) Length of machine.

2) Number of gears used.

Controlling these two aspects may fulfill our interest of making it less complex.

II. LITERATURE REVIEW

A. Arrangement of Strand Twisting Apparatuses

Herein disclosed is an arrangement of strand twisting appa-ratuses, comprising a plurality of strand twisting apparatuses which are side-by-side and vertically installed in a row on floor, and each of which comprises a fore portion of a frame including a flyer unit vertically disposed for supplying and twisting strands into a cable, a take-up unit disposed in side-by-side relation with the flyer unit to wind the cable, a direction change roll unit disposed immediately above the flyer unit for changing the cable vertically fed from the flyer unit to a horizontal direction, a capstan roll unit disposed immediately above the take-up unit for smooth feed of the cable fed from the direction change roll unit to the take-up unit, and an over-twister unit disposed between the direction change roll unit and the capstan roll unit to stabilize twisting of the cable during traveling between the direction change roll unit and the capstan roll unit; and a rear portion of the frame including a driving the flyer unit, the take-up unit, the direction change roll unit, the capstan roll unit and the over-twister unit [4].

B. Method and Device for Over Twisting and Under Twisting a Steel Cord.

A steel cord, having steel filaments twisted so as to have a final twist pitch, is manufactured by plastically deforming the steel filaments by over twisting the steel cord to a twist pitch which is smaller than the final twist pitch, untwisting the steel cord to the final twist pitch, further untwisting the steel cord to a twist pitch which is greater than the final twist pitch, and twisting the steel cord again to the final twist pitch. The first two steps (i.e., over twisting and untwisting) are done under a first tension and the third and fourth steps (i.e., further untwisting and twisting) are done under a second tension which is lower than half of the first tension [5].

C. Steel Cord Construction

A steel cord (10) adapted for the reinforcement of elastomers, comprises individual steel filaments (12, 14). Some of these steel filaments (12) have a difference in torsion saturation level in comparison with other steel filaments (14). All of the individual steel filaments have a predeterminednumber of residual torsions and are preferably free of residual torsions. Such a steel cord is manufactured by making use of two false twisters [6].

D. Method and Apparatus for Making a Bundle of Wires or a Cable

The invention relates to a method and an apparatus for mak-ing a bundle of a plurality of individual metal wires (strands) or a cable composed of a plurality of strands [7]. To obtain strands of substantially improved quality, it is proposed to give the strand a low constant tensile stress during production, continuously to measure the torsion value of the strand or cable in the region of this low constant tensile stress during the entire production operation, and, in the event of deviations of the measured torsion value from the predetermined torsion value, to generate a control signal, by means of which the rotational speed of the over-winding device is varied in such a way that the strand or cable assumes the set torsion value again [8].

E. Method and Device for Producing High–Strength Steel Cord

The invention is based on the problem of developing a high-productivity double-twist stranding machine on the in-out principle, by means of which machine steel cords having a core wire can also be produced in the appropriate quality and the requirement of the user industry to accomplish multi-machine operation is satisfied [9]. The said problem is solved in that the run-off bobbins (3) are each assigned a specially designed wire-pull brake (2), a conically shaped deflecting roller (6) is arranged in the region of the first deflection point, and the common stranding point (8) for the first and second stranding twist is arranged between the run-off bobbins (3) and deflecting roller (6). The sector of use of the invention is primarily in the field of stranding-out double-twist stranding machines (in-out) [10].

F. Treatment of Steel Cord

A steel cord (12) having steel filaments (2) twisted so as to have a final twist pitch, is subjected toa step

(i) Of plastically deforming the steel filaments (2) by over twisting the steel cord (12) until a twist pitch which is smaller than the final twist pitch, a step

(ii) Of untwisting the steel cord (12) until the final twist pitch,

a step

(iii) Of further untwisting the steel cord (12) until a twist pitch which is greater than the final twist pitch, a step

(iv) Of twisting the steel cord (12) again to its finaltwist pitch.

Steps (i) and (ii) are done under a first tension and steps (iii) and (iv) are done under a second tension; the second tension is lower than half the first tension. [6]

G. Steel Cord Construction

A steel cord (10) adapted for the reinforcement of elastomers, comprises individual steel filaments (12, 14). Some of these steel filaments (12) have a difference in torsion saturation level in comparison with other steel filaments (14). All of the individual steel filaments have a predetermined number of residual torsions and are preferably free of residual torsions.

H. Cable Twist Setting Method and Apparatus

A twist setting unit (10) wherein a twisted cable (46) is guided around spaced pulleys (16, 18) mounted in an opening

(14) in the twist setting unit (10) and titled at an angle to the axis of rotation (C-C) of the unit (10) to prevent contact of the overlapping sections of cable (46) while setting the twist in the cable (46) [12].

I. Steel Cord with Reduced Residual Torsions

A steel cord (132) adapted to reinforce a breaker or belt ply in a rubber tire comprises a core group and a sheath group. The core group consists of two to four core steel filaments (102) with a first diameter d_c and the sheath group consists of one to six sheath steel filaments (116) with a second diameter d_s. The ratio d_c=d_s of the first diameter d_c to the second diameter ds ranges from 1.10 to 1.70. The two core steel filaments (102) are untwisted or have a twisting step greater than 300 mm. The sheath group is twisted around the core group with a cord twisting step in a cord twisting direction [13]. The ratio of the difference in residual torsions of the core group and the sheath group to the difference in saturation level between the core group and the sheath group ranges from 0.10 to 0.65, preferably from 0.10 to 0.60. The steel cord (132) has no flare and plastic deformation of the steel filaments (102, 116) can be reduced while still obtaining a steel cord (132) without flare. A twisting equipment (100) comprising a buncher (106) and a method of manufacturing said steel cord (132) is disclosed, too [14].

J. A Method of SZ Stranding Flexible Micro–Modules

The invention concerns a method of SZ stranding into one strand a bundle of two or more flexible micro-modules, each micro-module comprising one or more optical fibers. A first pulley is located with its winding surface adjacent to a longitudinal axis of a cabling line. The bundle of micro-modules is guided over the winding surface of the first pulley, the first pulley being rotating around the longitudinal axis of the cabling line. The rotational speed, or the rotational direction of the first pulley, is alternating [15].

K. Method and Apparatus for Making Wire Strand

A method of making compacted steel wire strand having a central core wire and at least one layer of wires wound around the core wire in which non-compacted strand is made by pulling the wires through a closing die and the wire is then compacted in not more than two reducing dies the dies being arranged so that the wires forming the strand are free to move relative to one another to prevent birdcaging during the reduction in area of the strand to compact it [16].

L. Method of Making Sealed Wire Rope

A corrosion resistant rope in which the individual strands are sealed with a plastic foam impregnant and surrounded with a dense unfoamed plastic material is made by applying a foamable plastic to the individual wires of a series of wire strands, or, alternatively, to the individual strands as a whole, and closing the strands into a rope in a closing die while passing a nonfoamable plastic material into the closing die. Sealed plastic foam impregnated wire strands can be made in the same manner by passing nonfoamable plastic material into the stranding die during fabrication of the strand [17].

M. Problem Identification

Conventional wire rope machine driven by spur gearing, are three revolving carriages or creels, each containing six bobbins. Each group revolves as the yarns are drawn off the bobbins, and thus the threads are formed into three strands. As the strands emerge from the guides, they converge towards three other guides, are laid together, and finally the finished rope is wound on to the reel.

In Conventional wire rope machine the galvanized wire is wound on bobbins of suitable size, a definite number of which are mounted on the forks or frames of the stranding machine. These forks are swung or pivoted between disks, which are keyed on a hollow main shaft, through which the wires or other material intended for the core pass. This core is of such a size that the aggregate numbers of wires that are mounted in the machine exactly cover it in a spiral direction.

All the wires, including the center core, are passed through their individual hollow spindles, then led to the nose or head of the machine, and finally passed through a stationary compression block to draw off wheels. The speed of these wheels is regulated in proportion to the speed of the machine by means of suitable gearing. During the revolutions of the machine each bobbin and for-k is kept in a vertical position, and floats thus, by means of an eccentric ring behind the back disk. This ring is connected to the spindles of the bobbin forks by means of small cranks, thus preventing any torsional movement that would otherwise be imparted to the individual wires.

Each bobbin is controlled by a brake, which acts as a tensioning device so that equal strain can be applied to each, allowing the wires to unwind uniformly. The finished strands are wound in turn upon large bobbins, and mounted in the disks of the rope-closing machine.The speed of the machines varies according to the weight of material, the size of the strands and the construction of the finished rope.

Drawbacks of Conventional Version of Wire Rope Making Machine:

1) It is practically noisy.
2) It occupies more space than belt driving, and the slip is so great.
3) The turning movement is more; machines therefore it is not run steadily
4) Greater range of drives; anything from 10 ft. to over 80 ft., and much greater distances when carrier pulleys are used which results in increase in cost.
5) Machine is very complex hence tough to operate and maintain.

III. PROPOSED METHOD AND RESULT

In our proposed design, we have used some basic components of rope making machine i.e. Pulleys, Gears, Power motor, Bobbins etc to perform the desired function. Only change which we have made in our design is the change of the position of these entire components and made a new design of Wire-Rope making machine, which is less complex & having simple mechanism to perform its desired function.

Our modified design required less manpower as compare to conventional machine because length of our machine is small and as the length is small so we need a one control point of machine from where a worker can control a whole machine easily. Due to its simple design & use of less no. of parts like by using less no. of Gears (as compared to conventional machine) the machine require a very less maintenance.

So in this way, our new modified machine is very econom-ical, less complex, less power consuming, require less space, require less maintenance as compared to Conventional ma-chine. Figure 3.1, 3.2, 3.3 and 3.4 represents simulation of proposed work in Solidwork. Figure 3.5 represents axial strain at rope; Figure 3.6 represents tension in the rope.

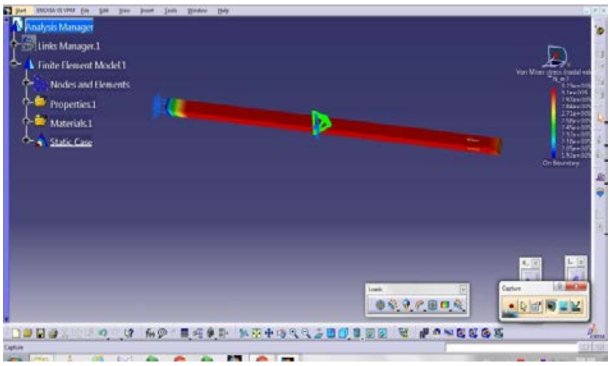

Fig. 3.1 Result 1

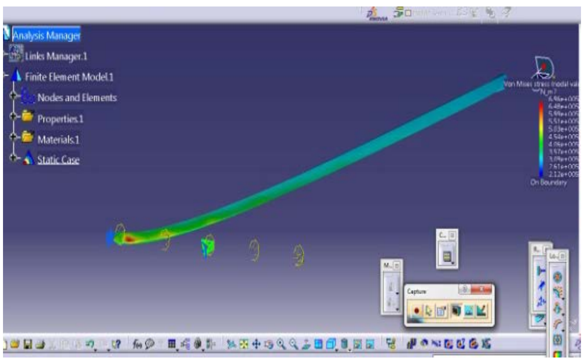

Fig3.2 Result 2

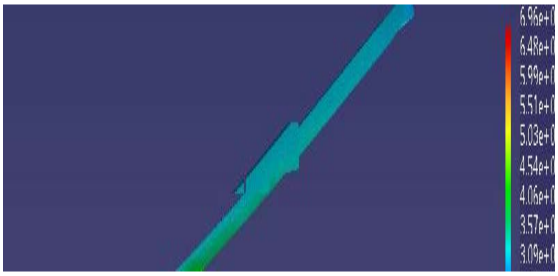

Fig. 3.3 Result 3

Fig.3.4. Result 4

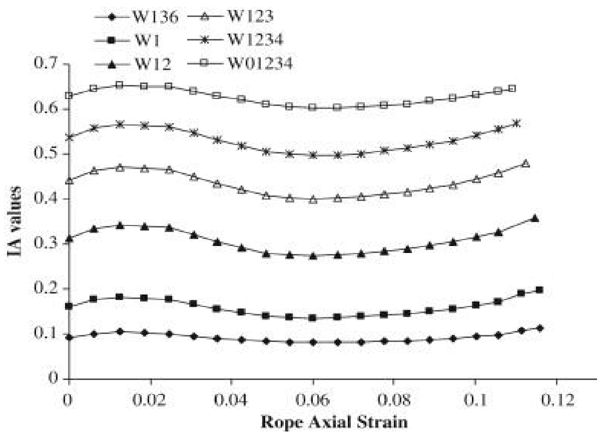

Fig. 3.5 Rope Axial Strain

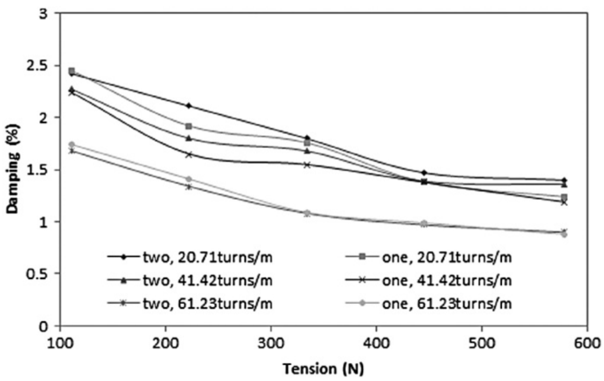

Figure 3.6 Tension in Rope

1) Size: Size of the modified machine is very less as compared to conventional one thereby facilitating its use in small scale industries also.

2) Simplified Mechanism: The number of gears in our modified design is very less in number as compared to conventional machine. We are just using only five- six

gears while conventional machine uses over 16 gears, thus making our design simpler and easy to operate.

3) Less Maintenance: Since we are using fewer gears, and our mechanism is much simpler so it doesnt require any extra maintenance job, thus making profits in the context of maintenance.

4) Power Consumption: Our proposed design, consumed a very low Electric power (as compared to Conventional wire-rope making machine.) because in our design twist-ing & winding action is perform at one point so that only one power motor is sufficient for the motion of both the assembly.

IV. CONCLUSION

The roposed design of wire-rope manufacturing machine has a lot of applications, It can use for making the accelerator wire, clutch wire, high tension electric wire etc. According to the winded wire application, with making slight changes in our machine component (according to the design formulas) we can make winded wire of any size. In our modified design we mainly concentrate on the Space and Power consumption problem and we have succeeded to get our target. We have saved the space and also the power consumption but apart from the saving of space and power consumption, the less complexity and the less maintenance for the wire-rope manu-facturing machine are like an icing on a cake.

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