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(54) Title: METHOD OF MAKING A STEEL CABLE REINFORCED CONVEYOR BELT

(57) Abstract

This invention relates to a method of making a steel cable reinforced conveyor belt while monitoring the tensions of all the cables.

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METHOD OF MAKING A STEEL CABLE REINFORCED CONVEYOR BELT

Background

When making steel cable reinforced conveyor belts, it is desirable to maintain the tensions on each cable at a predetermined level. This invention provides a method of making a steel cable reinforced conveyor belt while monitoring the tension of each of the cables going into the construction.

Methods and apparatuses for measuring the tension in wires and cables have been known for some time. Most are based on determining the natural frequency of vibration of a known length of cable between two fixed points and calculating the tension according to the following formula:

$$T=4L^2F^2M$$

where T is tension, L is the length between the two fixed points, F is the natural frequency of vibration and M is the mass per unit of length of the cable. See e.g. U.S. Patent Nos. 3,871,217; 3,540,271; 3,394,587; 2,618,970 and 3,889,525.

In accordance with the practice of the present invention, there is provided a method of making a steel cable reinforced conveyor belt comprising the steps of encapsulating a plurality of steel cables between two layers of rubber while monitoring the tensions of all the cables by exciting a known length of each cable between a pair of clamps and measuring their natural frequencies by means of a combination of a permanent magnet and a linear Hall effect sensor in close proximity to each of the cables, sending the output signals from the sensors to a signal converter to convert the signal from analog to digital then to a digital signal processor to generate a signal for the period of each cable and sending the period data to a host computer to calculate the tension of each cable. The data from the last computer can then be fed back to adjust the tension of each cable.

The excitation of the cables is brought about by moving the cables away from their rest position and then allowing them to vibrate. As the cables vibrate near the permanent magnet/linear Hall effect sensor combinations which are in a non-contact proximity to each cable, the sensors sense the changes in the magnetic flux and their output signals vary as the positions of the cables change. The periods of the sensors' outputs are detected and converted from analog to digital by means of a comparator circuit. Sets of thirty-two digital signals are read in parallel by a digital signal processor (DSP) at a regular rate prescribed by an internal DSP timer and interrupt.

A time counter is incremented by one with each interrupt. A time stamp (value of the counter) is saved in the DSP memory for each channel each time the digital signal for that

channel transitions low to high. Time stamps are collected in the DSP memory under interrupts long enough for at least one cable cycle to be detected. The time stamps are converted to periods.

The integer period values are sent to the host computer. The host knows the time interval for each time counter increment so that the period in seconds can be determined and the tensions are then calculated.

CLAIMS

1. A method of making a steel cable reinforced conveyor belt comprising the steps of encapsulating a plurality of steel cables between two layers of rubber while monitoring the tensions of all the cables by exciting a known length of each cable between a pair of clamps and measuring their natural frequencies by means of a combination of a permanent magnet and a linear Hall effect sensor in close proximity to each of the cables, sending the output signals from the sensors to a signal converter to convert the signal from analog to digital then to a digital signal processor to generate a signal for the period of each cable and sending the period data to a host computer to calculate the tension of each cable.

2. The method of claim 1 further including the step of adjusting the tension of each cable.

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B29D29/06 //G01L1/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G01L B29D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 785 420 A (ALSTHOM CGE ALCATEL) 23 July 1997 see column 1, line 13 - line 20 see column 11, line 34 - line 40	1,2
A	US 3 862 559 A (RICHTER HEINZ ET AL) 28 January 1975 see the whole document	1,2
A	DE 20 55 456 A (CONTINENTAL GUMMI-WERKE) 18 May 1972 see the whole document	1,2
A	US 3 871 217 A (MILEY DAVID C) 18 March 1975 cited in the application see the whole document	1,2

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
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Int. ional Application No
PCT/US 98/01932

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 394 587 A (FREEMAN JOHN THOMAS) 30 July 1968 cited in the application see the whole document -----	1,2

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