

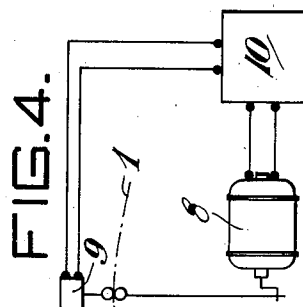
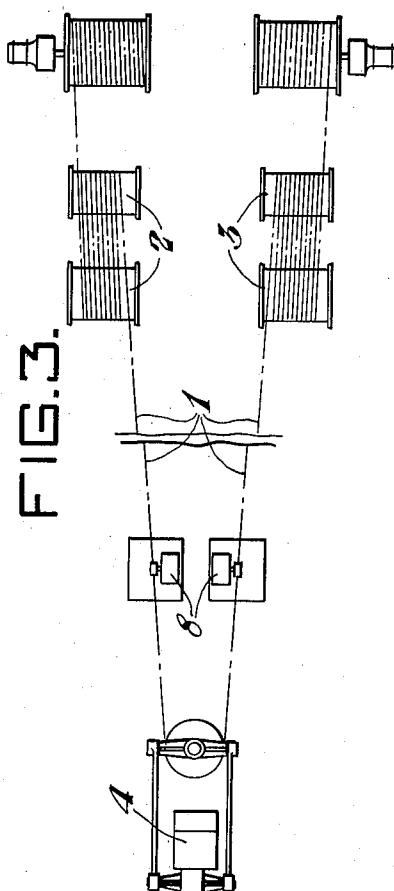
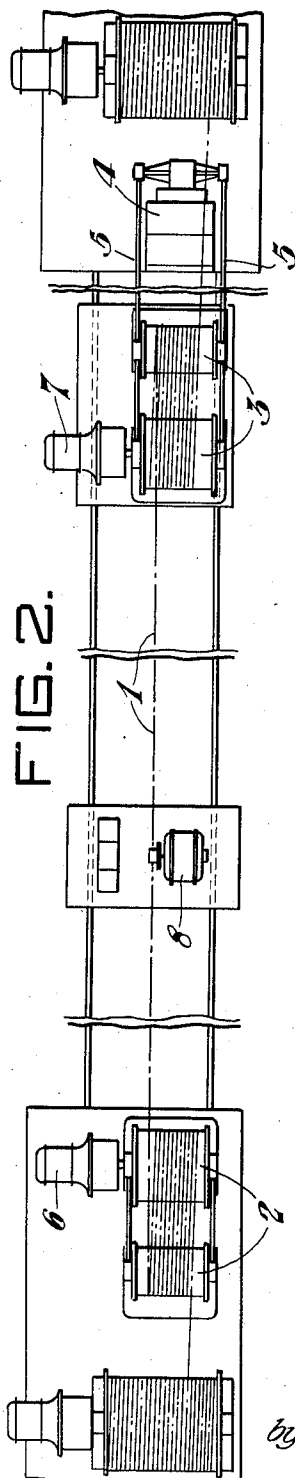
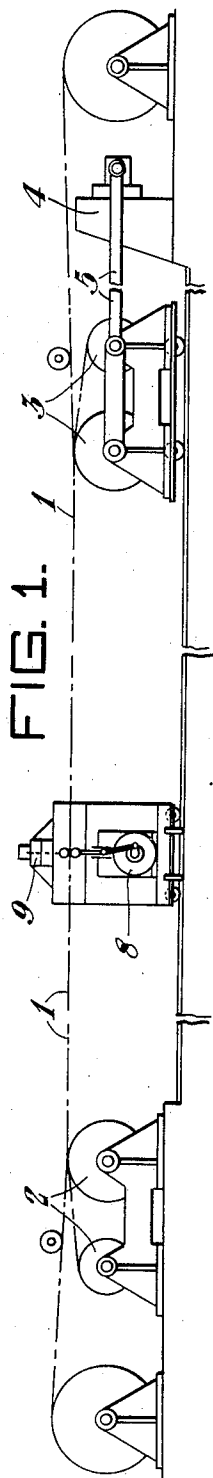
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PRESTRETCHING OF WIRE ROPES AND THE LIKE

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PRESTRETCHING OF WIRE ROPES AND
THE LIKE

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9 Claims. (Cl. 57—55.5)

My invention relates to the prestretching of wire ropes or other structures formed of assembled wires or strands, for the purpose of retarding or preventing the structure from unduly stretching when placed in service.

As a result of investigations into the vibration fatigue characteristics of various wire ropes, conductors, etc., I noticed the remarkable accelerating effect the presence of vibration has on the stretching characteristics of such composite structures as ropes, conductors, cables, etc. Upon conceiving the possibilities of applying vibration to the prestretching of ropes, etc., I conducted a series of tests on the effects of applying various combinations of tensions and vibration frequencies to wire center and hemp center wire ropes. These few tests revealed the following significant facts:

a. Vibration combined with tension can effect a greater prestretching or consolidation of the structure in a matter of minutes (10 or less) than tension alone can in many hours (24 or more).

b. The tension needed for effecting the prestretching under vibration can be considerably smaller than the tensions (50 per cent or more of the ultimate strength) commonly used for static stretching of like structures.

c. Both increase in amplitude or frequency of vibration accelerate the stretching effect, the frequency being considerably more effective in its action than the amplitude.

d. The vibration stretching establishes a condition of equilibrium and stability in the rope against further stretching or creep due to mechanical set.

e. The modulus of elasticity of the rope or strand structure can be raised as much as 40 per cent by the vibration stretching treatment.

As a result of these few observations, I have developed certain worthwhile ideas with regard to the application of vibration stretching, as follows:

a. The prestretching of ropes has long been recognized as desirable for stabilizing and balancing rope constructions, but the present static methods of loading individual lengths has necessitated using large loads and considerable space for the equipment. As a result, very heavy and spacious equipment is used for the few ropes that are prestretched. Furthermore, the length of time involved in stretching by the static method makes the treatment very costly. However, vibration applied to the stretching operation makes it possible to greatly reduce both the tension and

time necessary for stabilizing, consolidating, or balancing the rope or strand structure. Furthermore, the lighter loads and shorter time make it possible to apply the vibration stretching treatment to long continuous lengths of rope either in a separate machine as a separate treatment or continuously as the rope comes from the stranding machine. The mechanism for providing this treatment will be explained later.

b. By applying this vibration stretching to ropes in general, I would be in a position to produce a rope having superior characteristics to those of ropes not prestretched. For one thing, I could largely remove the creep characteristics of ropes commonly applied to elevators, shovels, etc. I also have reason to believe, from other tests I have made, that these prestretched ropes have superior impact or shock resisting ability as compared to nonstretched ropes. Incidentally, tests show these improvements to persist even if the ropes are considerably handled after being prestretched and before being put into operation.

c. Perhaps the most immediate important application of vibration stretching is that of prestressing rural transmission lines. Three-wire conductors are of such an unbalanced construction that variations in modulus of elasticity can be very pronounced. Also, the stretch characteristics of this type of conductor leave much to be desired. By subjecting this conductor to vibration stretching, I can not only establish a uniform modulus in the conductor, but I can also stabilize it against further creep and thus do away with the necessity of resagging lines strung with this conductor.

d. Other important applications of the vibration stretching treatment can be made to such special cables as are used for oil well exploration and well shooting. Cables supplied for this purpose must now be prestretched by running them either into old wells or pulling them with trucks. These cables are very long, running from 10,000 to 15,000 feet. This vibration stretching treatment can be continuously applied to these cables in the manner to be described.

With respect to applying the vibration stretching treatment to ropes, cables, conductors, etc., the apparatus consists essentially of a means for applying a controlled tension to every part of the structure being treated, and a means for simultaneously applying a controlled vibration to those parts being stretched.

An example of such apparatus is illustrated by the accompanying drawing, in which:

Figure 1 is an elevation;

Figure 2 is a plan;

Figure 3 is a plan of a modification; and

Figure 4 is a diagram of how the vibration may be controlled.

- 5 The device for continuously applying tension to long lengths of rope, etc., can take a variety of forms. It may be either a separate machine or part of a stranding machine. Two schemes are shown on the accompanying drawing. The rope 1 passes continuously from a set of station-
10 ary haul-off sheaves 2 to a similar set 3 whose distance from the first set can be adjusted to any desired length. Tension is applied to the rope through a hydraulic ram 4 linked by cable ties 5 to the adjustable position haul-off 3. The pressure in the hydraulic ram 4 can be adjusted to give any desired tension on the moving cable.
15 This pressure is coupled through an electric valve and relay to the haul-off motors 6 and 7 in such a manner as to maintain a difference in speed on the two haul-off motors which will automatically create the tension in the rope originally set on the hydraulic ram 4. The arrangement is reversible so that the rope can pass back and forth
20 as many times as desired.

- In operation, the ram is adjusted to give a certain definite tension to the rope. The span and haul-off motor speeds are adjusted to give a short or long time treatment to the rope. From
30 that time on the electric valve and relay would automatically control the difference in motor speeds so as to maintain continuously the desired tension. Without such tension controls the rope, etc., could be seriously overstressed when sub-
35 ject to the differential haul-off speeds if it happened to have a tight section, and considerably understressed if the rope construction became relatively loose in another part while passing between the sheaves.

- 40 The haul-off sheaves and loading ram can be placed in line, as shown in Figure 1, or arranged as shown in the alternate layout of Figure 3, if found more convenient. Other schemes for applying tension can be used, as for example, pull-
45 ing against dies or snubbing sheaves, etc. In all cases a mechanism as described for controlling the tension is a necessary part of the equipment to insure uniformity of product and avoid over-
50 stressing the structure.

- Without vibration the elements of the rope structure can get into such positions that the mere application of tension will fail to properly consolidate the structure. The application of
55 high frequency vibration causes the inertia of the individual wires and strands to come into play, causing an internal manipulation of the rope so that under a relatively small tension the individual components quickly fall into their most stable position.

- 60 The vibration applied to the rope should be of sufficient amplitude and frequency to call into play the inertia of the individual components. These amplitudes and frequencies will depend upon the structure being tested, as well as the
65 tension applied. Although lateral vibration is most easily applied, the effect can be achieved by the use of torsional vibration or longitudinal vibration, as well as any combination of lateral, torsional, and longitudinal vibration.

- 70 A number of means for applying vibration to a continuously moving rope, etc., under tension are possible, as for example:

- a. A variable or fixed speed motor can be connected through a variable throw crank and suit-
75 able pulley guides to the structure being tested,

and the latter vibrated by forced vibrations. Due to poor coupling conditions at forced vibration, this will require a motor of large horsepower.

b. A variable speed motor 8 can be made to vibrate the rope 1, as shown in Figure 4, at any
5 natural frequency of the rope by means of a suitable frequency pick-up 9 with a filter and speed control 10. At natural frequency operation, a low horsepower motor is sufficient.

c. A special electromagnetic vibrator motor as
10 used in certain vibration fatigue equipment can be applied to the rope and the latter vibrated at any natural frequency. This motor acts magnetically like a loud speaker in which the rope takes the place of the diaphragm.

d. Alternating current can be passed through the rope while it passes between the poles of a
15 D. C. magnet. The interaction of the magnetic fields will cause the rope to vibrate.

e. Other means, electrical or mechanical, in-
20 volving resonant or forced vibration of the rope can be applied.

I claim:

1. A method of prestretching wire ropes or other structures formed of assembled wires or
25 strands, including vibrating successive lengths of the structure while it is under prestretching tension, the frequency at which the structure is vibrated being sufficiently high to impart a suf-
30 ficiently great force to the vibrating components of the structure to cause these components to adjust themselves to positions best adapted to withstand the tension applied the structure when
it is in service.

2. A method of prestretching wire ropes or
35 other structures formed of assembled wires or strands, including vibrating successive lengths of the structure while it is under prestretching tension, the frequency at which the structure is
40 vibrated being sufficiently high to impart a sufficiently great force to the vibrating components of the structure to cause these components to adjust themselves to positions best adapted to
45 withstand the tension applied the structure when it is in service, the prestretching tension used being substantially less than is necessary when
a similar structure is prestretched under static tension to accomplish comparable results.

3. A method of prestretching wire ropes or
50 other structures formed of assembled wires or strands, including coiling and uncoiling the structure so as to provide a continuously moving span of the same, controlling the rate of the coiling and uncoiling so as to tension the structure in this span and vibrating the tensioned
55 portion of the structure.

4. A method of prestretching wire ropes or other structures formed of assembled wires or
60 strands, including coiling and uncoiling the structure so as to provide a continuously moving span of the same, controlling the rate of the coiling and uncoiling so as to tension the structure in this span and vibrating the tensioned
65 portion of the structure, the frequency at which the structure is vibrated being sufficiently high to impart a sufficiently great force to the vibrating components of the structure to cause these components to adjust themselves to positions best adapted to withstand the tension applied
70 the structure when it is in service.

5. A method of prestretching wire ropes or other structures formed of assembled wires or
75 strands, including coiling and uncoiling the structure so as to provide a continuously moving span of the same, controlling the rate of the

coiling and uncoiling so as to tension the structure in this span and vibrating the tensioned portion of the structure, the frequency at which the structure is vibrated being sufficiently high to impart a sufficiently great force to the vibrating components of the structure to cause these components to adjust themselves to positions best adapted to withstand the tension applied the structure when it is in service, the prestretching tension used being substantially less than is necessary when a similar structure is prestretched under static tension to accomplish comparable results.

6. A method of prestretching wire ropes or other structures formed of assembled wires or strands, including coiling and uncoiling the structure so as to provide a continuously moving span of the same, controlling the rate of the coiling and uncoiling so as to tension the structure in this span and vibrating the tensioned portion of the structure at the natural vibration frequency of the structure.

7. A method of prestretching wire ropes or other structures formed of assembled wires or

strands, including vibrating the structure while it is under prestretching tension by contacting it with an element oscillated by a powered crank actuator, the rotary speed of the crank actuator being adjusted to vibrate the structure at its inherent or natural vibration frequency.

8. Apparatus for prestretching wire ropes or other structures formed of assembled wires or strands, comprising spaced coiling and uncoiling devices for handling the structure and providing a span of the same, means for controlling these devices to cause tensioning of the structure spanned therebetween and means between these devices for vibrating the structure spanned and tensioned therebetween.

9. Means for vibrating a tensioned wire rope or similar structure, comprising a rotary motor, a crank powered by this motor, an element for engaging the tensioned structure, a connecting rod between the crank and element and means responsive to the vibration frequency of the structure for varying the speed of said motor.

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