Jan. 16, 1968 W. C. LINGERFELT 3,363,850

CONSTANT PRESSURE DRIVE USED IN THE FORMATION OF YARN PACKAGES

Filed Sept. 20, 1965 3 Sheets-Sheet 1

FIG. 1

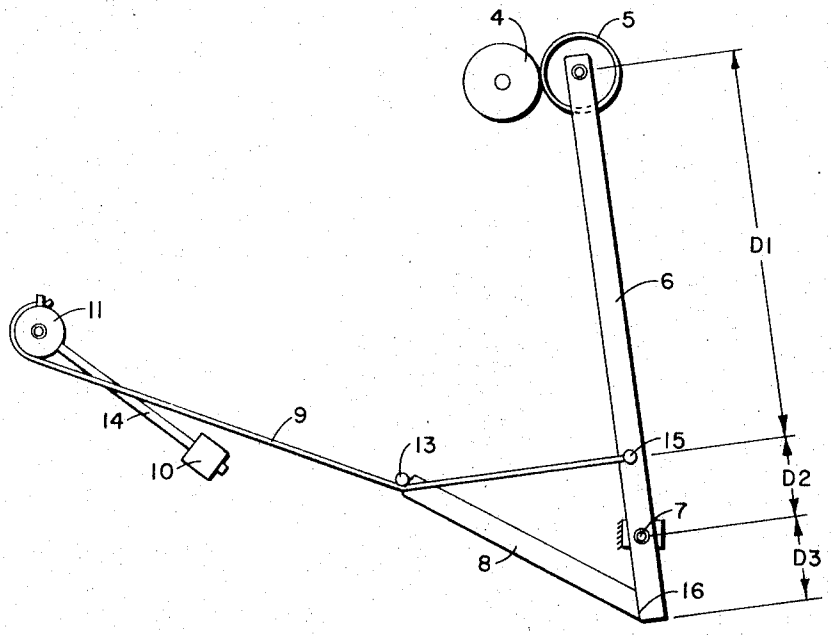
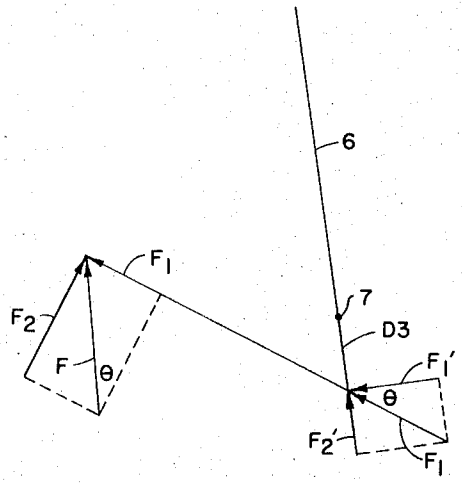


FIG. 2



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FIG. 3

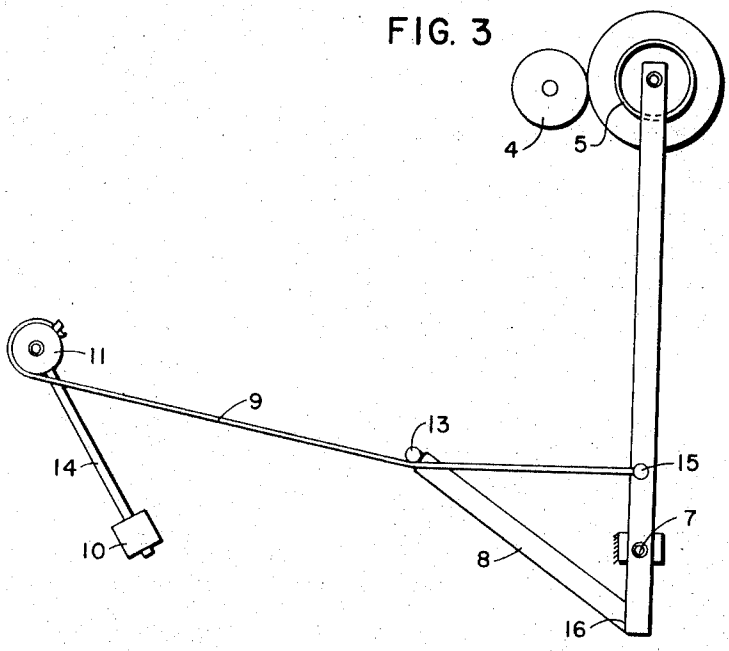
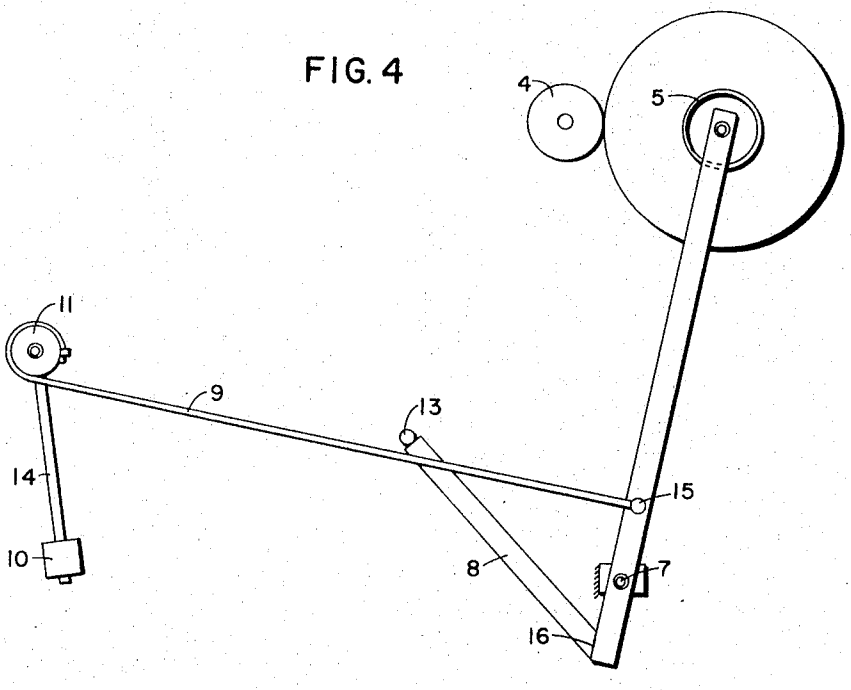


FIG. 4



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FIG. 5

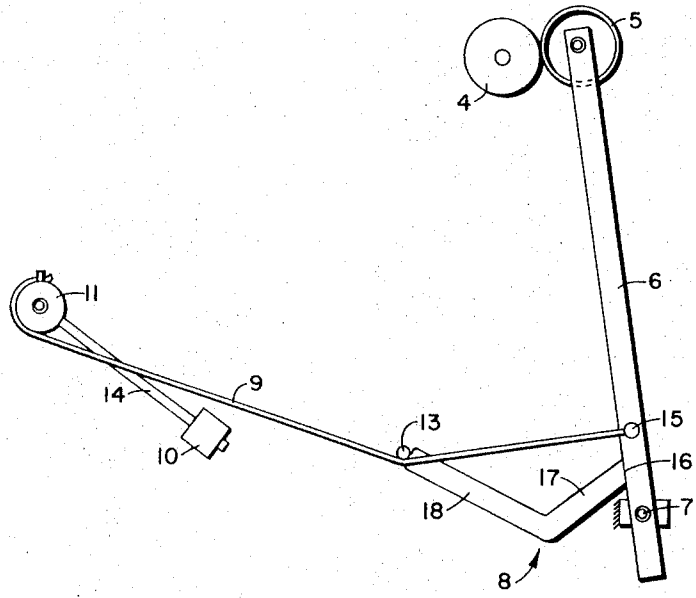
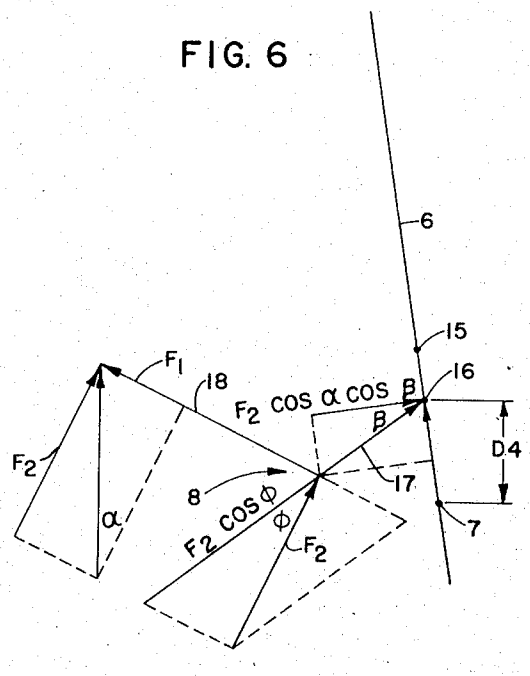


FIG. 6



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ABSTRACT OF THE DISCLOSURE

A support arm rotatably engaging a yarn package at one end and rotatably mounted on a fixed axis for enabling the arm to move away from a drive roller as the yarn package builds. A cable means is connected to the support arm and a counter torque arm, rigidly joined to the support arm and extending outwardly therefrom, acts to bias the cable means and thereby maintains a substantially constant pressure between the yarn package and the drive roller during buildup of the package.

The present invention relates generally to rotary drive mechanisms for winding yarn onto a tube and more particularly to a yarn package drive mechanism for providing a substantially constant pressure between a drive roller and a yarn package during buildup of said yarn package.

Prior art mechanisms for winding yarn onto a tube include various apparatuses for bringing the yarn package into forced contact with a drive roller during yarn package buildup in order to prevent slippage between the drive roller and the yarn package. One way to accomplish this is to mount the tube for rotation on one end of a yarn package support arm which is rotatably mounted on a fixed axis. This enables the support arm to move away from the drive roller during yarn package buildup. In addition to the yarn package supporting members, it is necessary to provide means connected to the yarn package support arm for biasing the yarn package against the drive roller at all times during yarn package buildup. The latter function has often been provided by a fixed spring or satellite counterweight system connected to the yarn package support arm to bias the support arm in the direction of said drive roller, thus producing the necessary friction between the yarn package and drive roller during yarn package buildup.

These types of constant biasing rotational drive systems are disadvantageous in that the pressure changes between the yarn package and the drive roller due to the change in position of the center of gravity of said yarn package during buildup go uncompensated for. The reasons for these pressure changes may be readily understood by considering the rotation of the yarn package support arm during package buildup. During the initial stages of yarn winding, the support arm is often leaning toward the drive roller whereas during the latter stages of yarn package buildup, the support arm is likely to be leaning away from said drive roller due to the increased diameter of the yarn package resulting from package buildup. Thus in the aforedescribed prior art mechanisms for creating friction between the drive roller and the yarn package, there is no compensation for the pressure reduction between said yarn package and drive roller due to a "falling away" of the yarn package from the drive roller during rotation of the yarn package support arm.

Accordingly, it is an object of the present invention to provide an improved yarn package drive mechanism wherein the drive roller may be maintained in contact with the yarn package at a substantially constant pressure during package buildup thereby forming a yarn package of extremely high quality.

It is another object of the invention to provide a yarn package drive mechanism of the type described which is easy to manufacture and which exhibits a substantial operational improvement over similar prior art drive mechanisms.

These and other objects of the invention will become more fully apparent in the following description of the drawings wherein:

FIGURE 1 is an elevation view of one embodiment of the constant pressure drive system of the invention showing the positions of the biasing and support members thereof when the tube carrying the yarn has few or no yarn windings thereon;

FIGURE 2 shows a diagram of the force vectors exerted on the counter-torque arm of the embodiment of FIGURES 1, 3, and 4 by the cable extending from the yarn package support arm to a counterweight system to be described hereinafter;

FIGURE 3 illustrates the positions of the yarn package support members in FIGURE 1 when the yarn package has reached an intermediate size;

FIGURE 4 illustrates the positions of the support members of FIGURES 1 and 3 when the yarn package has reached full size;

FIGURE 5 is an elevation view of another embodiment of the invention illustrating a change in configuration and position of the counter-torque arm; and

FIGURE 6 shows a diagram of the force vectors exerted by the counterweight system on the counter-torque arm and yarn package support arm in FIGURE 5.

Briefly described, the present invention comprises a support arm rotatably engaging a yarn package at one end and rotatably mounted on a fixed axis for enabling the support arm to move away from a drive roller as the yarn package builds up. A cable means is connected to the support arm at a point on the arm between the fixed axis and the yarn package, and means are coupled to said cable means for creating tension therein and for forcing the yarn package against the drive roller.

A counter-torque arm is rigidly joined to the support arm and extends outwardly therefrom to bias the cable means out of a natural straight position between the support arm and the tension creating means prior to package buildup. Due to the upward lift exerted on said counter-torque arm by said cable means, a force is translated via said counter-torque arm to said support arm and produces a torque thereon about the fixed axis. This torque tends to force the yarn package away from the drive roller prior to yarn package buildup. As a result of this counter-torqueing action, the resultant torque on said support arm in a direction of said drive roller is less than that produced without the counter-torque arm.

However, as the support arm begins to rotate away from the drive roller and as the pressure between the drive roller and yarn package resulting from the yarn package "leaning against" the drive roller is reduced, the counter-torque arm moves upwardly in an arc allowing the cable means to gradually assume a straight position between the support arm and the tension creating means. During this upward movement of the counter-torque arm the force on the support arm in the direction of the drive roller is gradually increased to compensate for any reduction in pressure between drive roller and yarn package caused by a shift in the center of gravity of the yarn package.

Referring now in more detail to the drawings, there is shown in FIGURE 1 a drive roller **4** in frictional contact with a tube **5** which has a few or no turns of yarn wound thereon. Yarn package support arm **6** is tilted slightly in the direction of the drive roller **4** prior to yarn package buildup and the pressure between members **4** and **5** at their point of mutual engagement is due in part to the yarn

package tube 5 and support arm 6 "leaning against" the drive roller 4.

The yarn package support arm 6 is rotatably mounted on a fixed axis 7 and is biased in the direction of the drive roller 4 by means of a cable 9 which is secured to disc 11 and support arm 6 at point 15. The disc 11 has a shaft 14 extending as shown with weight 10 attached thereto for creating tension in the cable 9.

A counter-torque arm 8 is rigidly joined to the end of the support arm 6 opposite the yarn package tube 5 and has a portion 13 protruding therefrom into engagement with said cable 9 for biasing the cable out of the natural straight position between the support arm 6 and the disc 11. As a yarn package builds up on tube 5 there is a clockwise rotation of support arm 6 which causes the portion 13 of counter-torque arm 8 to move upwardly in an arc and enable cable 9 to gradually return to a straight position between disc 11 and arm 8. This gradual movement of cable 9 tends to gradually diminish the torque on the support arm 6 in a direction tending to bias support arm 6 away from said drive roller 4. Thus, as the pressure between members 4 and 5 resulting from the support arm 6 "leaning against" roller 4 decreases, the torque produced by the counter-torque arm tending to force members 4 and 5 apart likewise decreases. As a result of the latter, the pressure between members 4 and 5 during yarn package buildup remains substantially constant.

FIGURE 2 illustrates a vector diagram of the forces produced by cable 9 acting on counter-torque arm 8. The uplifting effect on the counter-torque arm 8 and caused by cable 9 may be considered a substantially vertical force F as shown in FIGURE 2. This force may be resolved into two components F_1 and F_2, with the latter component F_2 being ineffective to contribute to the moment of forces about axis 7. Component F_1 acts through point 16 as shown in FIGURE 2 and may be resolved into two more components F_1' and F_2'. Since F_1 is equal to $F \sin \theta$ and since F_1' is equal to $F_1 \cos \theta$, then F_1' is equal to $F \sin \theta \cos \theta$. The moment of forces at point 16 about the axis of rotation 7 which provides the counter-torqueing action is equal to F_1' multiplied by the distance D_3. It is obvious that force vector F_2' acting upwardly of support arm 6 toward the axis of rotation 7 does not contribute to the moment about the axis of rotation 7. Thus, during the initial stages of package buildup there is a moment M approximately equal to F_1' multiplied by distance D_3 which acts on support arm 6 in a direction tending to separate the yarn package 5 from the drive roller 4.

As the yarn package 5 continues to build up however, the rotation of the support arm 6 in a clockwise direction tends to produce an arcuate movement of the counter-torque arm 8, thus enabling cable 9 to gradually return to a straight position between disc 11 and support arm 6. This gradual movement of cable 9 causes a reduction in the force F exerted in a substantially vertical direction on the counter-torque arm 8. A reduction in the force F will consequently result in both a reduction in the horizontal force F_1' acting at point 16 and a reduction in the torque produced on support arm 6 equal to $F_1' \times D_3$.

FIGURES 3 and 4 illustrate the complete return of cable 9 to a straight position as support arm 6 rotates in a clockwise direction about axis 7 during the buildup of a yarn package on tube 5.

In FIGURE 3 the cable 9 has almost returned to a straight position with support arm 8 having crossed over a vertical line through the fixed axis 7. There remains very little counter-torqueing action via arm 8 since cable 9 provides only a slight upward lift in this position.

FIGURE 4 shows the positions of cable 9 and counter-torque arm 8 when the yarn package has reached full size. All of the force pulling the yarn package into contact with the drive roller 4 is translated via cable 9 directly to support arm 6 at point 15.

During the initial stages of package buildup it was observed that the weight 10 moved slightly clockwise. This was because the initial upward movement of arm 8 caused a slackening of cable 9 which was not immediately taken up by the clockwise rotation of support arm 6. However, as the support arm 6 rotated further in the clockwise direction with further package buildup, cable 9 eventually became taut upon disengagement thereof with counter-torque arm 8 and moved weight 10 slightly in a counter-clockwise direction. The distance that the weight 10 will move in a counterclockwise direction will depend upon the size of the yarn package to be built and how much clockwise rotation support arm 6 will undergo. Thus, with counter-torque arm 8 out of engagement with cable 9, the entire torque (counterclockwise) is exerted via cable 9 directly to support arm 6.

It will be noted that the cable 9 will move upwardly with the rotation of support arm 6 and will tend to maintain the angle at which the cable 9 meets arm 6 substantially constant throughout package buildup. However, any small variation in said angle will be inconsequential as affecting the torque of the pulling force of cable 9 acting through a distance D_2.

FIGURES 5 and 6 illustrate an alternative embodiment of the invention wherein the counter-torque arm 8 has a pair of integral sections 17 and 18 and is joined to the support member 6 at a point 16 above the axis 7. The force of the cable 9 acting in an upward direction against protrusion 13 on the end of section 18 of the counter-torque arm 8 produces a force on support arm 6 tending to "push" the tube 5 away from drive roller 4 during the initial stages of package buildup. This force, like that produced by the counter-torque arm 8 in FIGURE 1, counteracts the added pressure between drive roller 4 and tube 5 due to the support arm 6 "leaning against" the drive roller 4 during the initial stages of package buildup.

The force vector diagram shown in FIGURE 6 resolves force F exerted by cable 9 on the counter-torque arm into components to illustrate the torqueing action on support arm 6. Vector F_2 which is equal to $F \cos \alpha$ acts against section 17 of the counter-torque arm 8 and tends to force arm 6 in a clockwise direction. However, since the vector F_2 is not necessarily aligned with section 17 of the counter-torque arm 8, the force acting longitudinally of section 17 may be expressed as $F_2 \cos \phi$, where ϕ is the angle between the direction of force F_2 and an extension of section 17. If the sections 17 and 18 of the counter-torque arm 8 were joined at right angles, ϕ would be zero.

The torque producing component of $F_2 \cos \phi$ may be expressed as $F_2 \cos \phi \cos \beta$, where β is the angle at which section 17 meets support arm 6. Thus, the moment of forces acting at point 16 through a distance D_4 may be expressed as $F \cos \alpha \cos \phi \cos \beta \times D_4$.

Obviously many structural modifications may be made in the above described embodiments without departing from the spirit and scope of the invention. The position and configuration of the counter-torque arm 8 could be widely varied to produce more or less counter-torqueing action without the exercise of invention. Similarly the overall dimensions of the above described embodiments are not critical and may also be widely varied by one skilled in the art. Therefore, it should be understood that the invention is limited only by the scope of the following appended claims.

What is claimed is:

1. Apparatus for maintaining a substantially constant pressure between a yarn package and a drive roller comprising

(a) a support arm adapted to rotatably engage a yarn package at one end thereof and rotatably mounted on a fixed axis to enable said support arm to move away from said drive roller as said yarn package builds up,

(b) cable means connected to said support arm for forcing said yarn package into contact with said drive roller during yarn package buildup, and

(c) means engaging said cable means and said support arm for producing a gradually increasing torque on said support arm during yarn package buildup in a direction tending to force said yarn package against said drive roller.

2. Apparatus for maintaining a substantially constant pressure between a yarn package and a drive roller in contact therewith, said apparatus comprising

(a) a support arm rotatably engaging a yarn package at one end thereof and rotatably mounted on a fixed axis for enabling said support arm to move away from said drive roller as said yarn package builds up,

(b) cable means connected to said support arm at a point on said arm between said fixed axis and said yarn package,

(c) means coupled to said cable means for creating tension therein and for producing a torque on said support arm tending to force said yarn package against said drive roller, and

(d) means engaging said cable means and said support arm for producing a gradually diminishing torque on said support arm during package buildup in a direction tending to force said yarn package away from said drive roller whereby the resultant increasing torque in a direction tending to force said yarn package against said drive roller compensates for a loss in pressure between said yarn package and said drive roller due to a shift in the center of gravity of said yarn package during package buildup.

3. Apparatus of claim 1 wherein said means for maintaining a substantially constant pressure between said drive roller and said yarn package includes

(a) a counter-torque arm having first and second sections joined together, said first section rigidly joined to said support arm between said fixed axis and said yarn package, and

(b) cable means connected to said support arm and engaging said second section of said counter-torque arm for producing a torque on said support arm in a direction tending to force said yarn package away from said drive roller during initial stages of yarn package buildup.

4. Apparatus of claim 3 wherein

(a) said first section extends outwardly from said support arm and away from said cable means, and

(b) said second section extends in the direction of said cable means whereby a force is translated via said second section to said first section for producing said torque on said support arm.

5. Apparatus for maintaining a substantially constant pressure in the area of mutual engagement between a yarn package and a drive roller, said apparatus comprising

(a) a support arm rotatably engaging said yarn package at one end thereof and rotatably mounted on a fixed axis for enabling said support arm to move away from said drive roller as said yarn package builds up,

(b) cable means connected to said support arm at a point on said arm between said fixed axis and said yarn package,

(c) means coupled to said cable means for creating tension therein and for producing a torque on said support arm about said fixed axis tending to force said yarn package against said drive roller, and

(d) a counter-torque arm rigidly joined to said support arm and engaging said cable means for biasing said cable means out of a natural straight position between said support arm and said torque producing means prior to package buildup, said cable means translating a force via said counter-torque arm to said support arm for producing a torque thereon about said fixed axis tending to force said yarn package away from said drive roller prior to yarn package buildup whereby as said yarn package builds up and as said support arm rotates about said fixed axis, said cable is gradually returned to a straight position and said torque produced by the force translated via said counter-torque arm is gradually diminished.

6. Apparatus of claim 5 wherein said counter-torque arm is straight and is joined to said support arm between the end of said support arm opposite said yarn package and said fixed axis.

7. Apparatus of claim 5 wherein said torque producing means includes

(a) a rotatable disc being secured to said cable means, and

(b) a weighted shaft extending therefrom for creating tension in said cable means.

8. Apparatus of claim 7 wherein said shaft has a weight at one end thereof which moves in a clockwise direction during the initial stage of package buildup due to the initial movement of said counter-torque arm away from said cable means and thereafter moves counterclockwise during the latter stages of yarn package buildup due to the straightening out of said cable means.

9. Apparatus for maintaining a substantially constant pressure in the area of mutual engagement between a yarn package and a drive roller, said apparatus comprising

(a) a support arm adapted to engage a yarn package at one end and rotatably mounted on a fixed axis for enabling said support arm to move away from said drive roller as said yarn package builds up,

(b) cable means connected to said support arm,

(c) means coupled to said cable means for creating tension therein and for producing a torque on said support arm in a direction tending to force said yarn package against said drive roller,

(d) said support arm being tilted slightly in the direction of said drive roller prior to yarn package buildup and being tilted away from said drive roller after said yarn package buildup due to the rotation of said support member, and

(e) means rigidly joined to said support arm for compensating for the pressure change between said yarn package and said drive roller during yarn package buildup due to the tilt variation of said support member.

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