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ARTIFICIAL FILAMENT SPINNING MACHINE

Original Filed Oct. 2, 1943

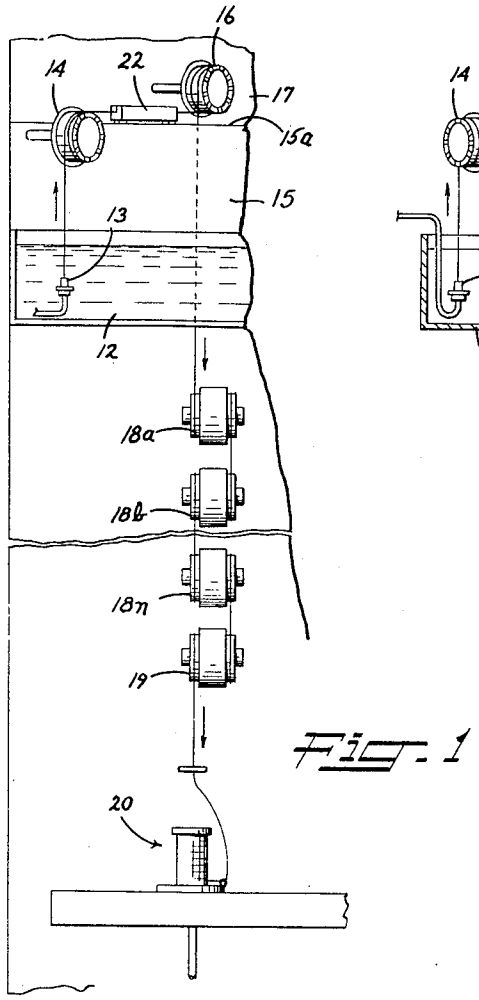


Fig. 1

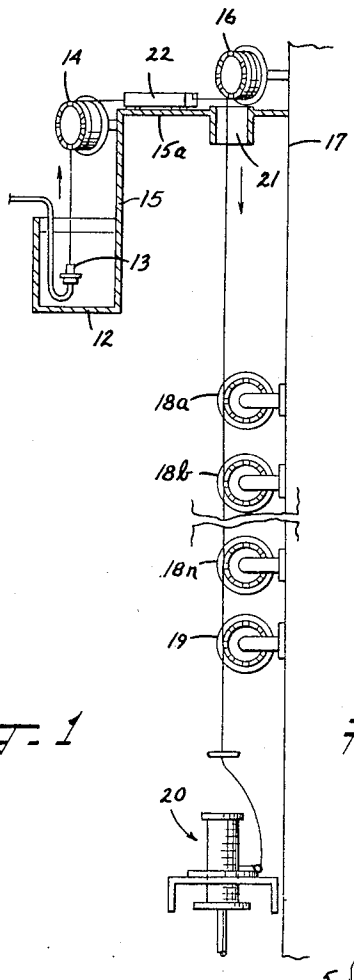


Fig. 2

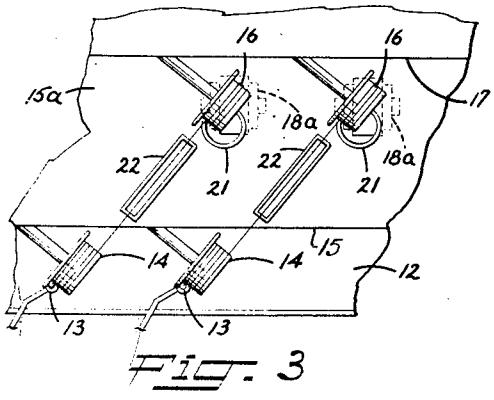


Fig. 3

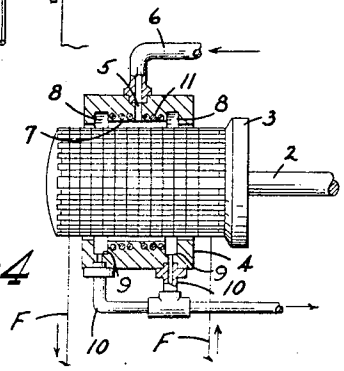


Fig. 4

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ARTIFICIAL FILAMENT SPINNING MACHINE

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12 Claims. Cl. (18—8)

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This invention relates to apparatus for the continuous spinning of artificial filaments which involves the treatment of the continuous filamentary material while continuously advancing through a generally helical path with fluids, such as gases and liquids. The present application is a division of our copending application Serial No. 504,664, filed October 2, 1943.

Many arrangements of the various devices needed for continuously spinning, stretching, treating, drying, and collecting have been heretofore proposed but they are generally characterized by one or more disadvantages, such as requiring an inordinate amount of floor space; inefficient use of treating liquids; inconvenient disposition of the various devices which may need the attention of the operators, and so on.

It is an object of the present invention to provide an improved continuous spinning machine in which the various operations are performed in a highly efficient manner with respect to the utilization of space, liquids and labor. Other objects and advantages will be apparent from the drawing and the description thereof hereinafter.

In the drawing—

Figure 1 is a front elevation of a preferred embodiment of the invention,

Figure 2 is an end elevation, partially in section of the embodiment of Figure 1,

Figure 3 is a plan view of the embodiment of Figure 1, and

Figure 4 is a front elevation of one of the liquid-treating devices, with the deflecting guard sectioned to better illustrate the device.

In accordance with the general aspects of the invention, the spinning machine comprises a spinning section and a liquid-treating or processing section. The spinning section has a front or working face extending throughout its length. In order to economize space and at the same time provide efficient operation and convenience to the operators, each of the multiple-filament threads formed in the spinning bath which extends longitudinally of the machine adjacent its front or working face passes above the bath through one of a plurality of substantially parallel horizontal paths crossing an intermediate vertical plane of the machine at an acute angle, preferably less than 45°, then moves substantially vertically in a zone adjacent the back wall of the machine to the liquid-treating, drying and collecting devices which are arranged in substantially direct vertical super-position. The travel of the filaments is controlled by thread-advancing devices

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disposed at each end of the horizontal path and projecting substantially at right angles to the vertical plane containing the path so that special auxiliary guides are unnecessary to direct the filaments to and from the thread-advancing devices. Advantageously, the filaments may pass through a liquid-treating bath as they travel from front to back of the machine, thereby reducing the number of subsequent treating stages and devices. In the latter case, adequate liquid treatment is obtained even at high speeds because of the long path taken by the thread in its path directed across the machine at an acute angle; thus the machine is adapted to high speed spinning of high tenacity filaments without requiring an increase in machine width beyond that which is convenient and efficient to tend.

Other relationships between the various parts of the machine which co-operate to provide an exceptionally efficient continuous machine will appear in the more specific description hereinafter.

In the preferred embodiment shown, the spinning deck or section has supporting means or framework extending the length of the machine comprising a panel 15 extending upwardly from the back of the trough 12, a ledge, shoulder, or shelf 15a extending back from a position above the back of the trough to the back of the machine, and a back panel or wall 17. The spinning bath is supplied to the trough which extends the length of the machine and is accessible to the operators working along the front of the machine. Spinnerets 13 are arranged in the bath so that the filaments proceed upwardly, preferably vertically, to and around the thread-advancing device 14 carried by the supporting panel 15 extending the length of the machine back of the trough 12. The devices 14 which may comprise simply thread-advancing reels, are disposed above trough 12 in the region extending partially above and partially below the level of the shelf, and they completely overhang the trough 12.

From the devices 14, the threads proceed to similar thread-advancing devices 16 carried on the back wall 17 of the machine at a level just above that of devices 14 and with their axes parallel to those of devices 14 so that a thread passing from the top of the discharge end of one of the devices 14 directly to the bottom of the receiving end of the co-operating device 16 follows a path that is substantially horizontal. The devices 16 are offset longitudinally of the machine from the respective devices 14 from which the

respective threads proceed so that the paths of the threads between devices 14 and 16 make an acute angle to a vertical plane extending longitudinally of the machine.

Each of the devices 14 and 16 is of cantilever construction being supported from one end only, and extend in the same direction from the frame. Since each thereof has its thread-bearing periphery projecting in the same direction from the supported end of the device, a single operator can lace thread upon device 14 and device 16 in rapid succession without having to transfer the thread from one hand to the other as he passes from device 14 to device 16. As shown also, the axes of reels 14 and 16 of a single end spinning unit are at right angles to a vertical plane containing the horizontal course of thread extending between the reels.

Thread-advancing devices 18*a*, 18*b*, and 18*n* are provided for subjecting the threads to the liquids needed to completely process the freshly spun filaments thereof. A similar device 19 is provided for drying the thread, which may be accomplished by hot gases, such as hot air. A take-up 20, which may be any form of winder or twister, such as the ring twister shown, serves to collect the finished thread in the form of a wound package, ready for transport to the point of use or sale.

The devices 16, 18*a*, 18*n*, 19 and even 20 are superposed in substantially vertical alignment and the thread passes vertically between them. Openings 21 in the frame allow the threads to descend to the corresponding reels 18*a*, etc., when the latter are disposed directly beneath the reels 16, but no such openings are needed if the reels 16 were below the reels 18*a*, etc. This results in a substantial saving in floor space.

The disposition of devices 16 at a level immediately above that of devices 14 facilitates lacing-up, inspection, and any other servicing and care by the operators since they are out in the clear and are readily accessible from the front of the machine. It has a fourth advantage in that such attention is not interfered with even when horizontal trough means 22 is used for applying a liquid, such as a stretch-bath, to the courses of the threads passing from devices 14 to devices 16. The location of reels 16 above the level of reels 14 requires the former to rotate in a direction opposite to that of reels 14. When producing high tenacity filaments and threads, the reels 16 are generally driven at a higher peripheral velocity than the corresponding reels 14 to effect longitudinal stretching of the threads extending therebetween.

In the arrangement of Figures 1 to 3, the filamentary material proceeds vertically upwardly from the spinneret 13 through the spinning bath 12 to a thread-storage, thread-advancing device 14, through a stretch-bath 22 to another thread-storage, thread-advancing device 16 from which it descends in succession to a series of superposed single-stage processing devices 18*a* to 18*n*, such as that of Figure 4 hereinafter described. The material passes in zigzag fashion from left to right on the first reel, from right to left on the next and so on alternately through the series on which the sequence of liquid-treating operations may be performed. From 18*n* the material may descend to a thread-storage, thread-advancing device 19 equipped for drying the material from which it descends to a suitable collecting device 20. Thread guides may be placed adjacent the points of approach and departure of the filamentary material with respect to the thread-advancing devices or reels to control any tendency of the material to whip from side to side or to balloon.

The liquid-treating devices 18*a*, 18*b*, and 18*n* may be of any desired type. The forms of such devices described and claimed in our copending application Serial No. 504,664 is particularly suitable and Figure 4 hereof is illustrative of such devices.

In Figure 4, there is shown rotatably mounted on shaft 2, a thread-storage, thread-advancing device in the form of a reel 3 of conventional design and generally comprising two sets of interdigitating spaced, longitudinally extending bar members which form a cage-like drum about the periphery of which the filamentary material F follows a generally helical path. While Figure 4 shows a cantilever form of reel supported at one end only, any form of reel may be used, whether supported at one or both ends. A guard or housing 4 surrounds the thread-advancing reel 3 with sufficient clearance to permit free passage of the filamentary material F riding on reel 3. A portion of the periphery of the device 3 is exposed adjacent each end of the helix of material F carried thereon to permit free passage of such material continuously to and from the device.

A passage 5 connected to a feed pipe 6 permits the delivery of liquids into the housing and to the filamentary material on the reel. The passage 5 may be directed at any desired angle relative to the periphery of the reel, so that the liquid may be flowing in the same or opposite direction relative to the direction of travel of the bars of the reel where contact is first made. As shown, the passage 5 directs the liquid tangentially in the same direction as the direction of rotation of the reel bars. A greater amount of turbulence at the point of entrance may be obtained by directing the liquid at an angle inclined more toward a normal or toward a tangent directed opposite to the direction of rotation of the reel. The inside surface 7 of the housing serves to deflect the liquid thrown outwardly from the helix back upon the filamentary material and may be constituted of either a helically grooved surface, a smooth, polished substantially cylindrical surface as shown or it may be merely roughened. Adjacent each end of the housing there is an annular liquid-collecting groove 8, which may have its lower region more deeply recessed as at 9 to serve as a collecting drain under the influence of gravity. A discharge pipe 10 is connected to the bottom of the collecting system 8 and 9. A pump (not shown) may be provided for recirculating the liquids drained or removed from the system, and such liquids may be refreshed or fortified prior to such recirculation in conventional manner.

As shown, the passage 5 is approximately midway between the grooves 8. This may be varied considerably. Since the advancing action of the filamentary material over the reel 3 tends to favor displacement of the liquid toward the discharge end of the reel, the passage 5 may advantageously be arranged to deliver the liquid to the filamentary material much nearer to the receiving end of the reel than shown.

Instead of introducing the liquid in the fashion shown in Figure 4, it may be introduced to the interior of the reel cage, such as by way of a bore within the axle or shaft by which or on which the reel is supported and rotated.

The clearance between the surface 7 and the filamentary material on the reel may be varied

considerably with good results. The amount of latitude in this respect depends somewhat upon the nature of the surface 7, the character of the liquid being applied, and the speed of operation of the reel which influences the velocity of departure of the liquid from the filamentary material under the action of centrifugal force. Where the surface is rough in character, or a liquid is used which is low in viscosity and is freely broken into a spray, or the centrifugal force is such as to develop a high radial component of velocity of the departing liquid, this clearance may be of the order of one-half to one or two inches or more; whereas if the surface 7 is smooth, or a liquid is used which is viscous, or the departing liquid has a low radial component of velocity, smaller clearances of one-fourth inch or less may be necessary. Where small clearances are used, the action or playing of a liquid upon the filamentary material may involve simply the flow of a sheet or film of liquid filling the annular space between the deflector surface and the external periphery of the reel. Such is the case unless the liquid is introduced in insufficient amount to maintain such as annular sheet, in which event a turbulent wave action may set in as as transition between the simple annular sheet of liquid and the highly turbulent conditions in which the liquid thrown outwardly is splashed and sprayed back by the surrounding deflecting surface. For certain purposes, one type of action may be of more advantage than another. Form the standpoint purely of economy in the use and pumping of liquid, the smaller ranges of clearance are generally preferable, but where less violent action is desirable because of the delicate character of a particular type of filamentary material, the larger clearance which is associated with a corresponding reduction of the force of the rebounding liquid spray on the material may be preferable.

The housing 4 preferably surrounds the desired treating zone of the reel completely. However, for certain purposes it may be desirable or even necessary to restrict the action of the fluid to only a portion of the periphery of a given zone of the reel. In this case, the deflecting means, such as the surface 7, may be provided only about a corresponding portion of the periphery of the reel, and the remaining portion of the periphery may be exposed or provided with a suitable housing or discharge receptacle or channel to catch the liquid thrown off in that region, without deflecting it back to the reel. As an example of this arrangement, the deflecting means 7 of the collecting grooves 8, and the annular housing 4 may extend only 350° about the reel, the liquid being introduced between the surface 7 and the reel at a point adjacent the end of the housing where the reel enters, and a discharge channel may be arranged to receive the liquid from the grooves 8 and the 10° portion of the reel which is free of the deflecting means. By providing a plurality of spaced axial slits, a discharge channel over each of the slits, and a feed pipe at the reel entrance with respect to each deflecting means, it is possible to subject a helical band of the filamentary material to a plurality of different treating liquids spaced peripherally of the helix. The housing 4 may be provided with heating means 11, which is shown as an electrical heating coil embedded therein though the housing 4 may be in the form of a jacket to which either heating or cooling fluids may be applied to control the temperature of the liquid being applied to the filamentary material.

Numerous advantages are obtained by the arrangement constituting the continuous spinning machine of this invention. When it is desired to stretch the filaments shortly after their withdrawal from the spinning bath, this stretching is greatly facilitated by passing the filaments while they are subjected to the stretching tension through a liquid bath, such as a plasticizing bath of hot water, hot dilute acid, or the like, in the horizontal portion of their travel. The use of a horizontal bath at this stage provides efficient use of the treating liquid without sloppiness.

The direction of the filaments as they pass through their horizontal paths at an acute angle to the back of the machine provides a great saving of space and places the various devices within easy reach of the operators. This also makes it possible to use a long immersion stretch bath and still have everything within easy reach of the operators. The machine may be used for wet spinning cuprammonium cellulose, cellulose esters, vinyl resins, and the like but is particularly valuable for the spinning of viscose.

While preferred embodiments of the invention have been disclosed, it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined by the appended claims.

We claim:

1. A machine for the continuous wet spinning of artificial threads comprising a back wall, a spinning section on one level and a processing section on another level in front of the back wall; the spinning section having a front working face, a trough for receiving a coagulating liquid and extending the length of the machine adjacent the working face, a spinneret disposed in the trough, supporting means extending the length of the machine and having a shelf extending from a position above and back of the trough toward the back of the machine, a thread-advancing device carried by the supporting means in the region above the trough and partially above and partially below the shelf for withdrawing the thread from the spinneret, a thread-advancing device carried by the supporting means at the back of the machine at a level just above that of the withdrawing device but offset therefrom longitudinally of the machine for drawing the thread from the first-mentioned device in an approximately horizontal path over the shelf of the supporting means at an acute angle less than 45° to a vertical plane extending longitudinally of the supporting means, said thread-advancing devices being mounted on parallel axes and projecting from the supporting means in the same direction substantially at right angles to a vertical plane containing said horizontal path, said drawing device being arranged to discharge the thread directly vertically therefrom to the processing section.

2. A machine in accordance with claim 1 comprising horizontal trough means on the shelf for receiving a liquid for treating the horizontal courses of the threads thereabove.

3. A machine for the continuous wet spinning of artificial threads comprising a back wall, a spinning section on one level and a processing section on another level in front of the back wall; the spinning section having a front working face, a trough for receiving a coagulating liquid and extending the length of the machine

adjacent the working face, a spinneret disposed in the trough, supporting means extending the length of the machine and having a shelf extending from a position above and back of the trough toward the back of the machine, a thread-advancing device carried by the supporting means in the region above the trough and partially above and partially below the shelf for withdrawing the thread from the spinneret, a thread-advancing device carried by the supporting means at the back of the machine at a level just above that of the withdrawing device but offset therefrom longitudinally of the machine for drawing the thread from the first-mentioned device in an approximately horizontal path over the shelf of the supporting means at an acute angle less than 45° to a vertical plane extending longitudinally of the supporting means, said thread-advancing devices being mounted on parallel axes and projecting from the supporting means in the same direction substantially at right angles to a vertical plane containing said horizontal path, said drawing device being arranged to discharge the thread directly vertically therefrom to the processing section; the processing section comprising a plurality of vertically superposed thread-advancing devices.

4. A machine in accordance with claim 3 in which the thread-advancing device at the back of the spinning section of the machine and a plurality of the thread-advancing devices of the processing section are disposed in substantially vertical superposition with the thread-receiving end of each of the devices in the processing section opposite the thread-discharge end of the preceding device.

5. A machine in accordance with claim 4 in which the devices of the processing section are below the corresponding devices at the back of the spinning section of the machine.

6. A machine for the continuous wet spinning of artificial threads comprising a back wall, a spinning section on one level and a processing section on another level in front of the back wall; the spinning section having a front working face, a trough for receiving a coagulating liquid and extending the length of the machine adjacent the working face, a spinneret disposed in the trough, supporting means extending the length of the machine and having a shelf extending from a position substantially directly above the back of the trough to the back of the machine, a thread-advancing device carried by the supporting means in the region above the trough and partially above and partially below the shelf for withdrawing the thread from the spinneret, a thread-advancing device carried by the supporting means at the back of the machine at a level just above that of the withdrawing device but offset therefrom longitudinally of the machine for drawing the thread from the first-mentioned device in an approximately horizontal path over the shelf of the supporting means at an acute angle less than 45° to a vertical plane extending longitudinally of the supporting means, said thread-advancing device being mounted on parallel axes and projecting from the supporting means in the same direction substantially at right angles to a vertical plane containing said horizontal path, said drawing device being arranged to discharge the thread directly vertically therefrom to the processing section.

7. A machine for the continuous wet spinning of artificial threads comprising a back wall, a spinning section on one level and a processing section on another level in front of the back wall; the spinning section having a front working face, a trough for receiving a coagulating liquid and extending the length of the machine adjacent the working face, a spinneret disposed in the trough, supporting means extending the length of the machine and having a shelf extending from a position substantially directly above the back of the trough to the back of the machine, a thread-advancing device carried by the supporting means in the region above the trough and partially above and partially below the shelf for withdrawing the thread from the spinneret, a thread-advancing device carried by the supporting means at the back of the machine at a level just above that of the withdrawing device but offset therefrom longitudinally of the machine for drawing the thread from the first-mentioned device in an approximately horizontal path over the shelf of the supporting means at an acute angle less than 45° to a vertical plane extending longitudinally of the supporting means, said thread-advancing device being mounted on parallel axes and projecting from the supporting means in the same direction substantially at right angles to a vertical plane containing said horizontal path, said drawing device being arranged to discharge the thread vertically downwardly therefrom to the processing section; the processing section comprising a plurality of superposed thread-advancing devices, means for treating the thread with liquids on the upper of the devices, means for drying the thread on the lower of the devices, and means below the drying devices for collecting the thread by winding.

8. A machine in accordance with claim 7 in which the thread-advancing device at the back of the spinning section of the machine and a plurality of the thread-advancing devices of the processing section are disposed in substantially vertical superposition with the thread-receiving end of each of the devices in the processing section opposite the thread-discharge end of the preceding device.

9. Means for making artificial filaments comprising a spinneret, a thread-advancing device arranged above the spinneret, a second-thread-advancing device arranged with its axis parallel to but laterally and vertically upwardly offset from that of the first so that a filamentary bundle proceeding from the top of the first device follows a substantially horizontal course to the bottom of the second device, a plurality of additional thread-advancing devices arranged in superposition below the second device, said additional devices being disposed with their axes substantially parallel and with their thread-advancing directions alternating to effect a zigzag course of the filamentary bundle thereover, and means on a plurality of the additional devices for treating the filamentary bundle with a plurality of fluids in sequence.

10. Means for making artificial filaments comprising a spinneret, a thread-advancing device arranged above the spinneret, a second thread-advancing device arranged with its axis parallel to but laterally and vertically upwardly offset from that of the first so that a filamentary bundle proceeding from the top of the first device follows a substantially horizontal course to the bottom of the second device, a substantially horizontally disposed stretch-bath receptacle arranged between the two devices, a plurality of additional thread-advancing devices arranged in superposition below the second device, said ad-

ditional devices being disposed with their axes substantially parallel and with their thread-advancing directions alternating to effect a zigzag course of the filamentary bundle thereover, and means on a plurality of the additional devices for treating the filamentary bundle with a plurality of fluids in sequence.

11. Means for making artificial filaments comprising a back wall, a spinneret in front of the back wall, a thread-advancing device arranged above the spinneret, a second-thread-advancing device arranged with its axis parallel to but laterally and vertically upwardly offset from that of the first so that a filamentary bundle proceeding from the top of the first device follows a substantially horizontal course to the bottom of the second device, the axes of said devices extending horizontally at an acute angle of less than 45° to the back wall, a plurality of additional thread-advancing devices arranged in superposition below the second device, said additional devices being disposed with their axes substantially parallel and with their thread-advancing directions alternating to effect a zigzag course of the filamentary bundle thereover, and means on a plurality of the additional devices for treating the filamentary bundle with a plurality of fluids in sequence.

12. Means for making artificial filaments comprising a back wall, a spinneret in front of the back wall, a thread-advancing device arranged

above the spinneret, a second thread-advancing device arranged with its axis parallel to but laterally and vertically upwardly offset from that of the first so that a filamentary bundle proceeding from the top of the first device follows a substantially horizontal course to the bottom of the second device, the axes of said devices extending horizontally at an acute angle of less than 45° to the back wall, a substantially horizontally disposed stretch-bath receptacle arranged between the two devices, a plurality of additional thread-advancing devices arranged in superposition below the second device, said additional devices being disposed with their axes substantially parallel and with their thread-advancing directions alternating to effect a zigzag course of the filamentary bundle thereover, and means on a plurality of the additional devices for treating the filamentary bundle with a plurality of fluids in sequence.

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