

March 22, 1955

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2,704,782

RETRACTILE CORDS AND METHODS OF MAKING THE SAME

Filed Aug. 30, 1950

2 Sheets-Sheet 1

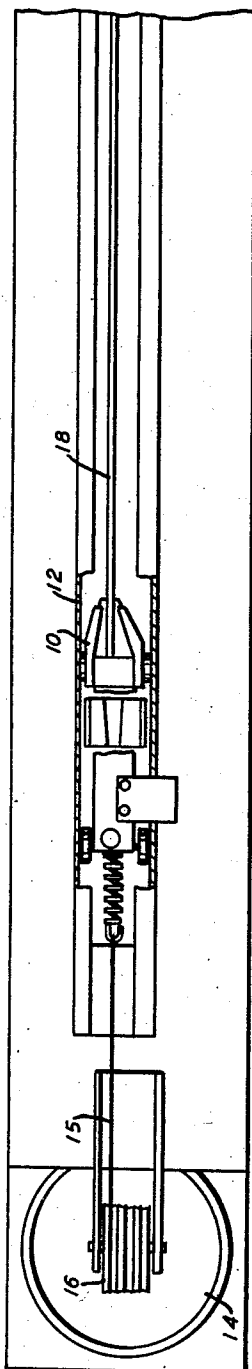


FIG. 1

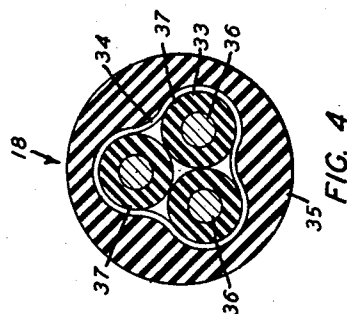


FIG. 4

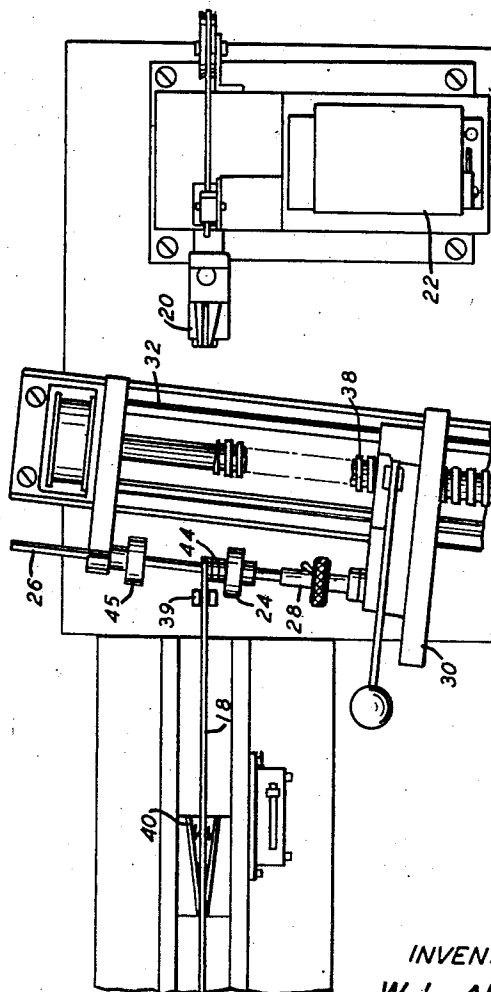


FIG. 2

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2 Sheets-Sheet 2

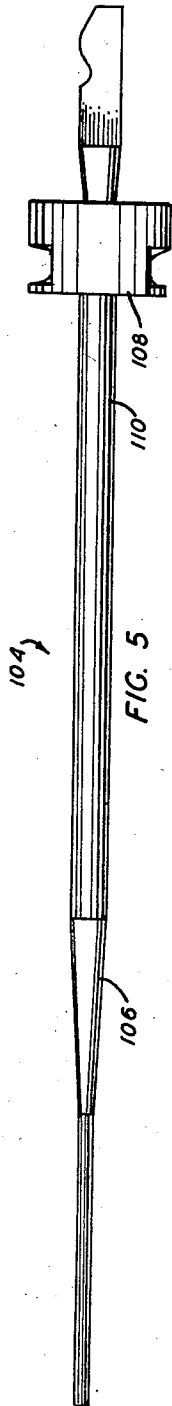


FIG. 5

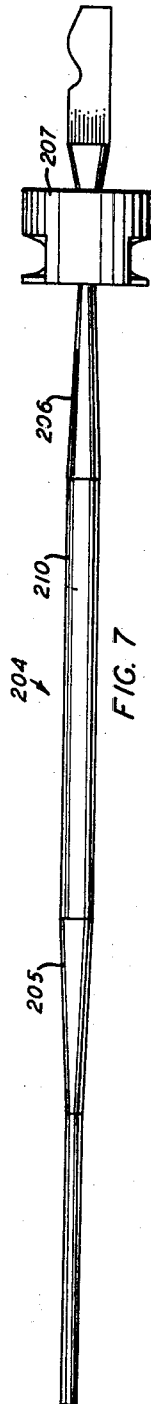


FIG. 7

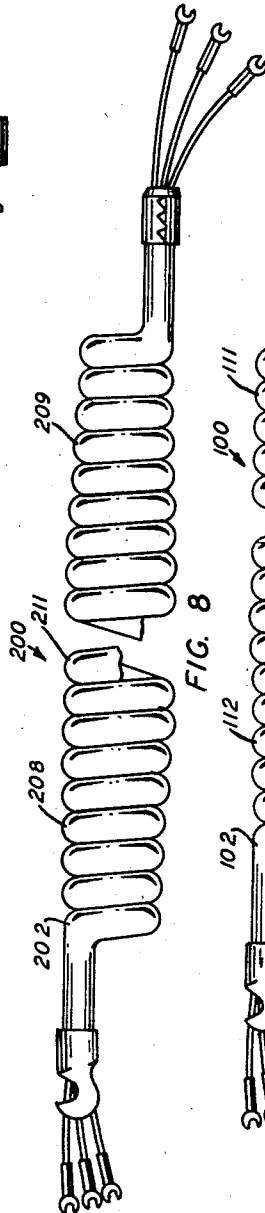


FIG. 8

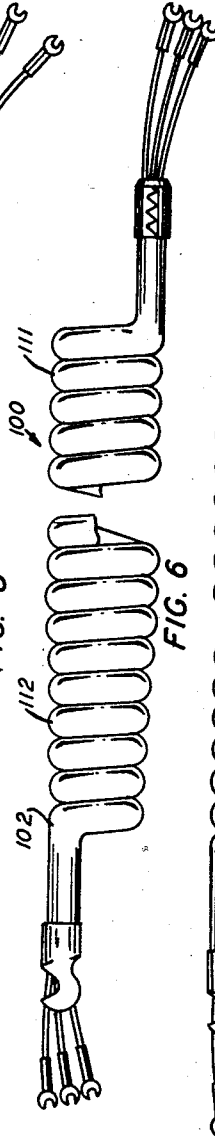


FIG. 6

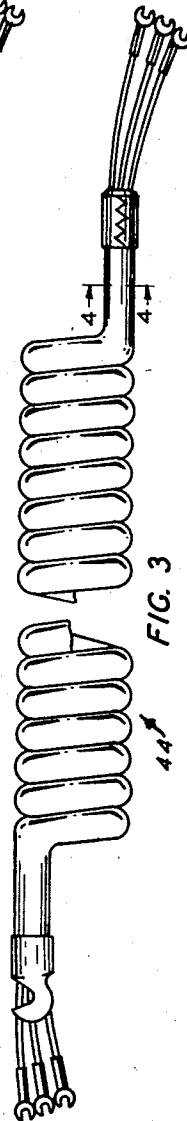


FIG. 3

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RETRACTILE CORDS AND METHODS OF MAKING THE SAME

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Application August 30, 1950, Serial No. 182,260

11 Claims. (Cl. 174—69)

This invention relates to retractile cords and methods of making the same, and more particularly to retractile cords having differential retractility along different portions thereof and methods of making the same.

In the use of retractile cords on telephones and other electrical apparatus, it is sometimes desirable to have retractile cords having different retractility along different portions thereof. This desirability has not been recognized in the past, and no method of making such cords has been known.

An object of the invention is to provide new and improved retractile cords and methods of making the same.

Another object of the invention is to provide retractile cords having differential retractility along different portions thereof and methods of making the same.

A further object of the invention is to provide retractile cords having high retractility near at least one end thereof and a lower retractility in other portions thereof.

A retractile cord illustrating certain features of the invention may include cordage including a plurality of conductors and a jacket composed of a cured elastomer compound. The cordage is coiled into a spiral and is set in that shape by heating and cooling. At least one portion of the cordage has a higher retractility than does another portion of the cordage.

A method illustrating certain features of the invention may include coiling into a spiral cordage including a cured elastomer compound capable of being set by heating and cooling, which comprises coiling such cordage into a spiral, twisting the cordage axially as it is coiled with a varying degree of twist per unit length of the cordage, holding the cordage in the spiral and twisted form, and sequentially heating and cooling the cordage to set it in the spiral and twisted form.

A complete understanding of the invention may be obtained from the following detailed description of retractile cords and methods of making them forming specific embodiments thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a fragmentary, top plan view of a portion of an apparatus for practicing a method forming one embodiment of the invention;

Fig. 2 is a fragmentary, top plan view of another portion of the apparatus shown in Fig. 1;

Fig. 3 is a fragmentary side view of a retractile cord forming one embodiment of the invention;

Fig. 4 is a transverse section taken along line 4—4 of Fig. 3;

Fig. 5 is a side view of a portion of an apparatus for practicing another method embodying the invention;

Fig. 6 is a side view of a retractile cord forming another embodiment of the invention;

Fig. 7 is a fragmentary side view of a portion of an apparatus for practicing still another method embodying the invention, and

Fig. 8 is a fragmentary side view of a retractile cord forming an additional embodiment of the invention.

Referring now in detail to the drawings, there is shown in Figs. 1 and 2 an apparatus for forming retractile cords, certain features of which apparatus are described and claimed in my copending application Serial No. 91,749, filed May 6, 1949, for "Apparatus for Manufacturing Retractable Cords," now Patent No. 2,565,465, granted August 28, 1951. This apparatus includes a gripper 10 slidably mounted in a guideway 12 and biased toward the left, as viewed in Fig. 1, by a weight 14 and a strand 15 going over a sheave 16. The gripper 10 serves to grip

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a length of cordage 18 at one end and hold that end of the cordage against axial movement relative thereto and against axial turning relative thereto. The other end of the cordage is inserted in a chuck 20 and the chuck is rotated a predetermined number of times under the control of an adjustable counter 22. After the rotation of the chuck stops, the length of cordage 18 has a predetermined number of turns around its longitudinal axis, which is in the direction in which the cordage is to be formed into a helix and is termed "overtwist" inasmuch as the twist is additive to the twist imparted inherently to the cordage by coiling the cordage into a helix. The end of the cordage held in the chuck 20 is removed manually therefrom, and the free end of cordage is secured to a clamp 24 fixed to the starting end of a mandrel 26. During this transfer the cordage is held manually against unwinding and axial rotation so that the overtwist is maintained therein. The clamp 24 secures the cordage to the mandrel, and holds the cordage against turning movement. One end of the mandrel 26 is held interlockably by a chuck 28 carried by a distributor carriage 30. The carriage is mounted for movement along a guideway 32, which extends almost transversely to the cordage 18 and the guideway 12, but slightly obliquely with respect thereto.

The cordage 18 includes parallel, individually insulated conductors 33—33 (Fig. 4) enclosed in a thin paper sheath 34. A jacket 35, which encloses the paper sheath, is composed of a tough, highly elastic, cured elastomer compound, such as, for example, a compound including polymerized chloroprene (neoprene), natural rubber, a copolymer of butadiene and styrene (Buna-S), or another tough elastomer as the essential ingredient thereof. The cured jacket compound is one which may be set permanently by heating and cooling it. The individually insulated conductors 33—33 include highly flexible conductive cores 36—36 and insulating coverings 37—37, which may be composed of a cured compound including as the essential ingredient thereof a cured elastomer, such as, for example, a copolymer of butadiene and styrene (Buna-S), natural rubber, or other suitable insulating material.

The chuck 28 is caused to rotate, and it, in turn, rotates the mandrel 26 to wind the cordage 18 thereon. A distributor screw 38 moves the carriage 30 continuously past a U-shaped guide 39 so as to wind the cordage into a helix on the mandrel as the rotation of the mandrel proceeds. The U-shaped guide 39 guides the cordage to a fixed spot with respect thereto so that, as the cordage is wound on the mandrel, the cordage advancing to the mandrel rubs against the turn thereof that has just been wound on the mandrel, which rubbing removes some of the overtwist from the portion of the cordage going onto the mandrel. The thus removed twist accumulates in the portion of the cordage not yet wound on the mandrel and extending between the mandrel and the gripper 10. As the cordage is taken up on the mandrel 26, the gripper 10 is moved along the guideway against the force of the weight 14, which tensions the cordage.

As the rubbing of the cordage on the adjacent turn of the cordage on the mandrel continues, the build-up in the twist in the uncoiled portion of the cordage continues and the overtwist on the portion of the cordage going on the mandrel gradually increases. During the winding of about the last quarter of cordage, a wedge 40 applies a heavy braking force to the gripper 10 to tension the cordage more than it was tensioned theretofore to apply the cordage tightly on the mandrel.

After the cordage 18 has been wound on the mandrel to form a cord 44, a clamp 45 placed on the mandrel is secured thereto against rotation. The end of the cordage held by the gripper 10 then is removed manually therefrom, and is fastened to the clamp 45, which holds the cordage against uncoiling on the mandrel and against axially untwisting. The cordage then is heated to such an extent that substantially all the strain in the jacket, except some of that from the axial twisting thereof, is removed so that, upon cooling, the jacket 35 holds the cordage in the form in which it is wound on the mandrel. The cordage then is cooled, while held on the mandrel.

The resulting retractile cord 44 has a gradually increasing retractility and pull from the first wound portion thereof to the last wound portion thereof.

The cord 44 also may be made by winding the cordage manually on the mandrel, overtwisting it severely on one end portion and then overtwisting it lightly and uniformly along the remainder of the spiral. The resulting cord has substantially more retractility and harder pull in the highly overtwisted portion. Thus, when the cord is pulled from both ends, the less retractile portion thereof opens much more easily and sooner than does the higher retractility portion. Consequently, the higher retractile portion may withstand a much higher force without sagging than the portion of less retractility can. Thus, if the main weight of cord would be supported by the more retractile end there would be no tendency for the cord to be extended, and the less retractile portion imparts a soft pull to the cord.

The above-described retractile cord may also be wound into a uniform diameter helix, and twisted axially differentially and tensioned differentially manually to apply to both end portions of the cordage heavier overtwist and tension than to the central portion to cause both end portions of the helix to be highly retractile and the central portion less retractile. The overtwist and tension of the uniform helix may be so regulated that the retractility of the spiral portion of the cord decreases uniformly from the ends of the spiral to the center thereof.

Embodiment shown in Figs. 5 and 6

A retractile cord 100 (Fig. 6) may be made by winding a length of cordage 102 identical with the cordage 18 on a mandrel 104 (Fig. 5), which is provided with a tapered portion 106 and a portion 110 of uniform diameter. In forming the cord 100, one end of the cordage is clamped to a clamp 108, which holds the cordage on the mandrel and prevents axial turning of the cordage. The cordage is wound on the mandrel 104 into a helical portion 111 having a uniform diameter and uniform overtwisting per unit of length and a tapered portion 112 having a greater overtwist per unit of length. The portion of the cord wound on the tapered portion 106 of the mandrel decreases continuously and forms a tapered spiral. The free end of the cordage is clamped to the mandrel 104 by another clamp similar to the clamp 108 and the cordage is heated and cooled to set it in the form it occupies on the mandrel with substantially all strains in the jacket of the cordage, except part of the strain from twisting, removed. The cord then is removed from the mandrel 104, and the ends thereof are finished and tipped. This cord 100 is highly retractile in the tapered portion thereof inasmuch as each coil of successively smaller diameter has greater axial twist therein and has higher retractility than has the preceding coil. The helical portion of the cord extending from the tapered portion has a lesser and uniform retractility throughout the length thereof.

The cordage 102 may be overtwisted either before it is wound on the mandrel 104, during the winding thereof, or the overtwist may be omitted entirely. If desired, a differential overtwist may be formed in the wound portion of the cordage with the greater overtwist per unit of length of the cordage being in the tapered portion. Also, the tapered portion may be wound while under a higher tension than that in the portion having a uniform diameter.

Embodiment shown in Figs. 7 and 8

A retractile cord 200 (Fig. 8) may be made from cordage 202 by winding the cordage upon a mandrel 204 (Fig. 7), which has tapered end portions 205 and 206 at the ends thereof and an intermediate portion 210 of uniform diameter. The cordage 202 is identical with the cordage 18. The cord 200 has tapered end portions 208 and 209, which have progressively less retractility from the ends of the wound portion toward the center of the cord. A portion 211 of the cord between the tapered portion is substantially uniform in diameter.

One end of the cordage 202 is secured to a clamp 207 fixed to the mandrel 204, and the cordage is overtwisted and wound on the mandrel in a tight spiral from the clamp 207 to the left hand end of the tapered portion 205, as viewed in Fig. 7. A second clamp (not shown) then is fastened to the mandrel and the free

end of the cordage is secured thereto to prevent unwinding of the cordage and untwisting thereof. The cord then is heated sufficiently to relieve substantially all strains in the jacket except part of the strain from the overtwisting, and then is coiled to set the cordage in the form it occupies on the mandrel. The set cord then is released from the clamps and is removed from the mandrel.

If desired, greater tension and overtwist may be applied to the portions of the cordage formed into the tapered portions 208 and 209 than to the intermediate portion 111 of the cord to make the differential retractility between the tapered portions and the intermediate portion even higher. Also, the overtwist itself may be varied between the tapered end portions of the cord and the intermediate portion to provide the desired difference in retractility without the application of differential tension as the cordage is wound on the mandrel. Furthermore, a cord may be coiled into a spiral tapering from the center thereof to both ends thereof.

The cords 44, 100 and 200 may be made by winding them manually on the mandrels and applying manually to each portion of the cord that is to have a high degree of retractility a higher degree of overtwist than is applied to the portions to have a low degree of retractility. The cord 44 may be formed into a helix having a uniform diameter throughout, but with less overtwist in the portion between the end portions thereof so that the end portions have higher retractility than do the intermediate portion thereof. Thus, the end portions are able to stand higher tensile loads without elongation than can the intermediate portion.

In the use of the term "cured elastomer" in describing compounds and the like, in this specification and claims, it is intended to include highly elastic materials which are capable of being set by heating and cooling such, as for example, copolymers of butadiene and styrene, natural rubber of polychloroprene.

What is claimed is:

1. A retractile cord, which comprises a plurality of conductors, insulating compound enclosing the conductors to form a core therewith, and a jacket of a cured elastomer compound enclosing the core to form cordage therewith, a portion of said cordage having been formed and set in a spiral and at least one part of the spiral portion of the cordage having a greater axial twist than another part of the spiral portion of the cordage, whereby said part of greater axial twist has a greater retractility than said other part of the cord.

2. A retractile cord, which comprises a plurality of conductors, electrical insulating material enclosing the conductors to form a core therewith, and a jacket composed of a cured elastomer compound capable of being set by heating and cooling enclosing the core to form a cord therewith, a portion of the cord being coiled into a spiral, twisted axially more than necessary to form the spiral and set in that form, a part of said spiral portion of the cordage being twisted axially to a greater extent than other portions of the spiral portion to impart increased retractility to that part of the cord.

3. A retractile cord, which comprises a plurality of conductors, electrical insulating material enclosing the conductors, spacing them apart and electrically insulating them from one another to form a core therewith, and a jacket composed of polymerized chloroprene compound capable of being set by heating and cooling enclosing the core to form cordage therewith, a portion of the cordage being coiled into a spiral, twisted axially more than necessary to form the spiral and set in that form, a part of said spiral portion of the cordage being twisted axially to a greater extent than other portions of the spiral portion to impart increased retractility to that part of the cord.

4. A retractile cord, which comprises a plurality of conductors, electrical insulating material enclosing the conductors, spacing them apart and electrically insulating them from one another to form a core therewith, and a jacket composed of rubber compound capable of being set by heating and cooling enclosing the core to form cordage therewith, a portion of the cordage being coiled into a spiral twisted axially more than necessary to form the spiral and set in that form, a part of said spiral portion of the cordage being twisted axially to a greater extent than other parts of the spiral por-

tion to impart higher retractility to that part of the cord.

5. A retractile cord, which comprises a plurality of conductors, electrical insulating material enclosing the conductors, spacing them apart and electrically insulating them from one another to form a core therewith, and a jacket composed of a cured elastomer compound capable of being set by heating and cooling enclosing the core to form a cord therewith, a portion of the cord being coiled into a spiral and being set in that form, the central part of the spiral being cylindrical and at least one of the end portions of the spiral being tapered, the tapered portion of the cord being twisted axially to a greater extent than the remainder thereof to impart increased retractility to that portion of the cord.

6. The method of making retractile cords from cordage having a jacket composed of a cured elastomer compound capable of being set by heating and cooling, which comprises coiling a length of such cordage in the form of a spiral, simultaneously twisting the cordage axially, varying the degree of such twist per unit length of the cordage sufficiently to impart corresponding variations in the retractility along the finished cord, holding the cordage in the resulting spiral form, and heating and cooling the cordage to set it in said spiral form.

7. The method of making retractile cords from cordage having a jacket composed of a cured elastomer compound capable of being set by heating and cooling, which comprises coiling such cordage into a spiral, said spiral having a portion thereof of a uniform diameter and another portion thereof tapered from said first-mentioned diameter to a smaller diameter, simultaneously twisting the cordage axially with a predetermined degree of twist per unit length as it is coiled into the portion of the spiral having the uniform diameter, twisting the cordage axially with a substantially greater degree of twist per unit length as it is coiled to form the tapered portion of the spiral, said greater degree of twist being sufficient to cause a corresponding increase in the retractility of the tapered portion of the finished cord, holding the cordage in the resulting spiral form, and heating and cooling the cordage to set it in said spiral form.

8. The method of making retractile cords from cordage having a jacket composed of a cured elastomer compound capable of being set by heating and cooling, which comprises coiling a length of such cordage into a spiral form on a mandrel, twisting the cordage axially with a predetermined degree of twist per unit length as it is coiled upon a portion of the mandrel, twisting the cordage axially with a substantially greater degree of twist per unit length as it is coiled upon another portion of the mandrel which twist is sufficient to cause a corresponding increase in the retractility in this portion of the finished cord, holding the cordage in the resulting spiral form, and heating and cooling the cordage to set it in said spiral form.

9. The method of making retractile cords from cordage having a flexible conductor, a flexible insulating covering enclosing the conductor and a jacket composed of a cured, flexible elastomer compound capable of being set by heating and cooling enclosing the insulating covering, which comprises coiling a length of such cordage into a spiral, simultaneously applying an axial overtwist to the cordage, varying the degree of overtwist applied to the cordage so that the twist per unit length of the cordage increases from the center portion to the ends of the spiral sufficiently to impart corresponding variations in the retractility along the finished cord, holding the cordage in the resulting spiral form, and heating and cooling the cordage to set it in said spiral form.

10. The method of making retractile cords from cordage having flexible cores and coverings composed of a cured, flexible elastomer compound capable of being set in a distorted shape by heating and cooling it while in such shape, which comprises winding such cordage on a mandrel to form a helix, simultaneously twisting the cordage axially, uniformly increasing the degree of twist per unit length of the cordage sufficiently to impart a corresponding uniform increase in the retractility along the finished cord, holding the cordage in the resulting helical form, heating the cordage as it is so held, and cooling the cordage to set it in said helical form.

11. A retractile cord, which comprises a plurality of conductors, insulating compound individually enclosing the conductors to form a core therewith, and a jacket of a cured elastomer compound enclosing the core to form cordage therewith, a portion of said cordage having been formed and set in a spiral form, said portion of the cordage forming the spiral having an axial overtwist varying uniformly from a minimum at one end thereof to a maximum at the other end thereof, whereby the retractility of the spiral portion of the cord increases substantially and uniformly therealong.

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