May 9, 1967 O. L. BIHLMIRE 3,318,388

MARINE PROPELLER

Filed Jan. 21, 1966 2 Sheets-Sheet 1

Fig. 1

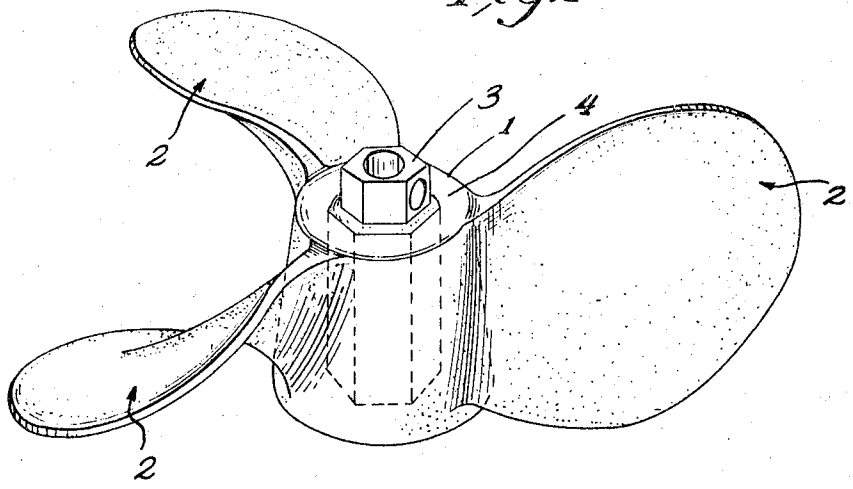



Fig. 2

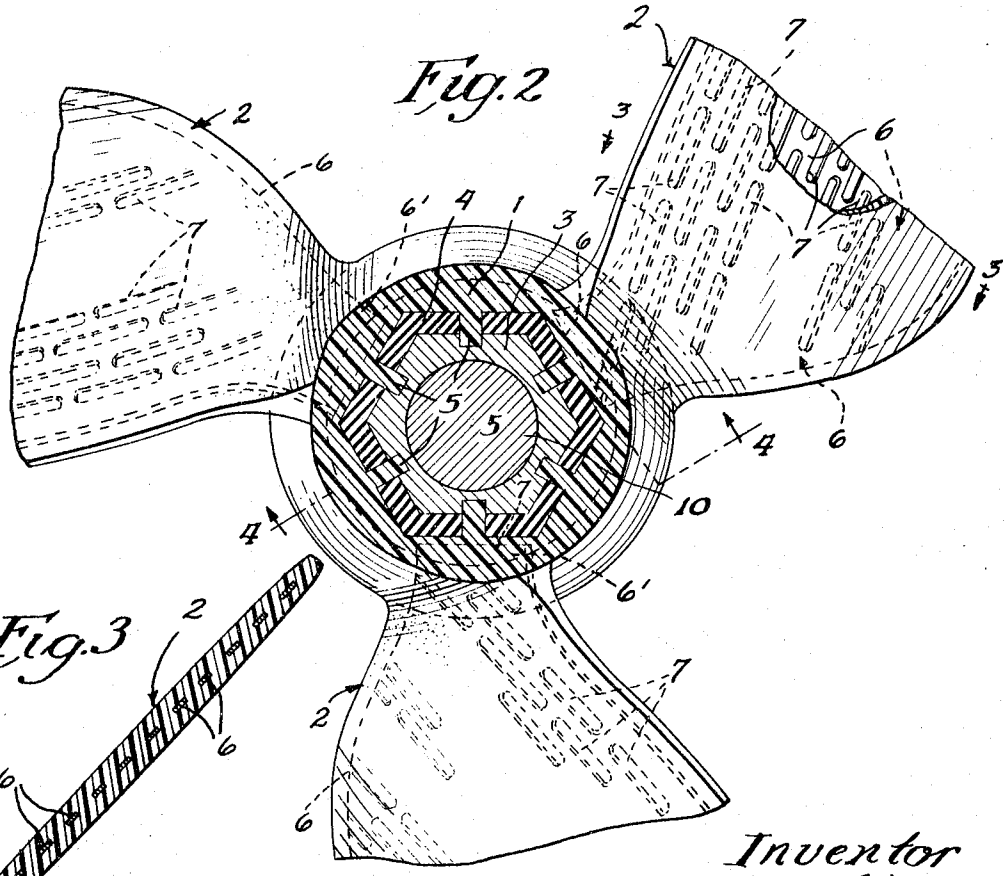



Fig. 3




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May 9, 1967 O. L. BIHLMIRE 3,318,388

MARINE PROPELLER

Filed Jan. 21, 1966 2 Sheets-Sheet 2

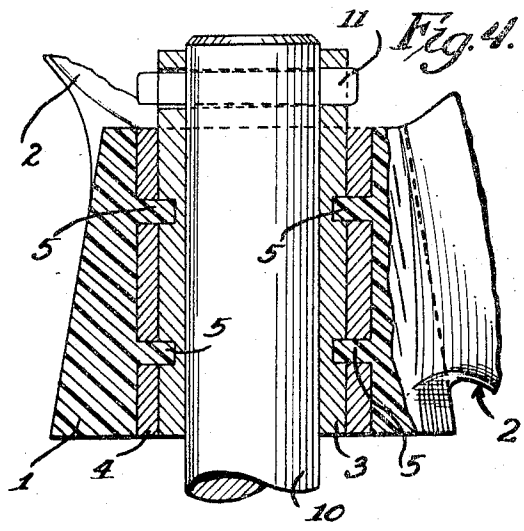



Fig. 4.

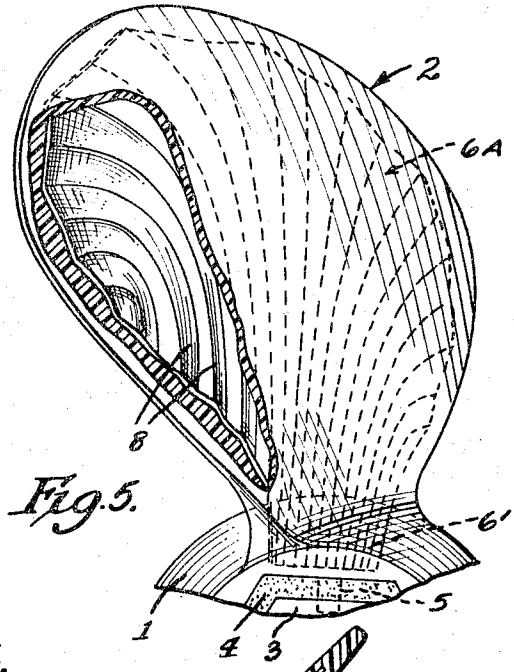



Fig. 5.

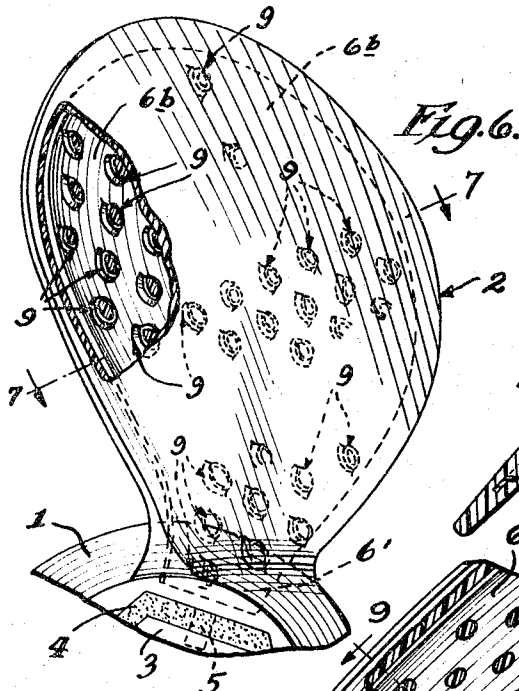



Fig. 6.

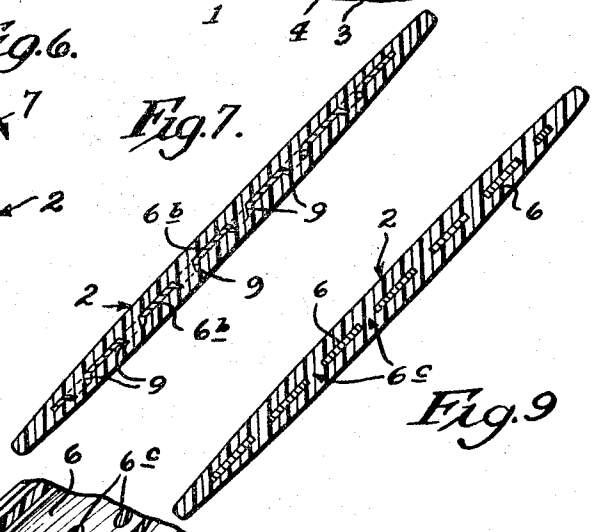



Fig. 7.

Fig. 9

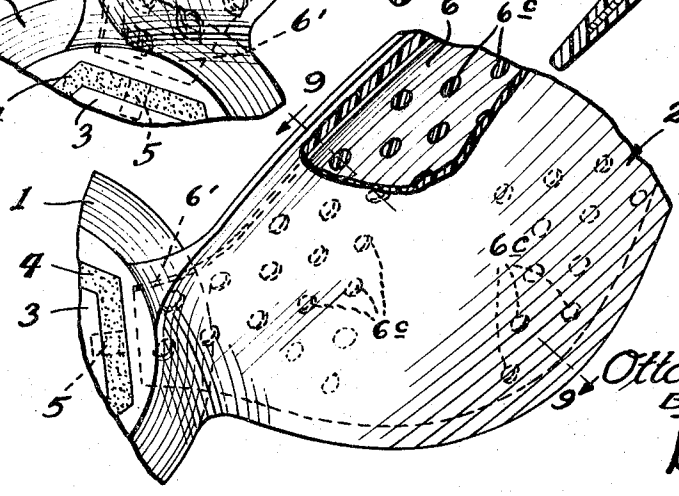



Fig. 8

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3,318,388

# MARINE PROPELLER

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4 Claims. (Cl. 170—160.5)

This invention relates to marine propellers, especially to propellers of the rotary blade type of the kind described and claimed in my abandoned application for patent, Ser. No. 298,841, filed July 31, 1963.

A principal object of the invention resides in the provision of a plastic material constituted propeller for marine craft in which the blades thereof are so constructed as to possess an indwelling permanent elasticity or spring, permitting them to automatically yield in their respective pitches under certain applied stresses or impact, such for example as torque loads thereupon, and with reduction of these loads, return to their exact and original pitches or positions whereby to improve their propulsion efficiencies, hence, improving its overall propulsion performance as (1) a speed propeller and (2) a power propeller.

An equally important object of the invention is to provide a marine propeller wherein the aforesaid yieldable or load responsively adjustable spring blades thereof will be evenly and uniformly reinforced throughout their respective areas, this in order that their inherent spring properties will be increased, stabilized and controlled uniformly therethroughout, in contradistinction to being irregularly or unevenly reinforced or otherwise strengthened by the incorporation and dispersion of certain matters or materials in and substantially throughout the same.

It is also an object of the invention to provide a propeller of the stated character, having a metal drive or power shaft receiving bushing or sleeve mounted in the hub portion thereof and permanently and securely connected thereto in a manner and by means which will be shock absorbing; will prevent relative longitudinal or rotative shifting or slippage movement between the propeller and the drive or power shaft, and will insure positive and stress resistance and enduring connection between the propeller and the shaft.

It is a further object of the invention to provide a marine propeller of such construction and form as will be resistant to breakage, chipping, deformation or deterioration during conditions or times of normal and/or abnormal operation and usage in either fresh or salt water.

Yet another object of the invention resides in providing a marine propeller wherein the spring properties and degrees of flexibility of the blades thereof can and will be accurately and beneficially automatically controlled by and with the character, form and gauge of reinforcement supplied thereto, thus assuring their maximum performance as to propulsion efficiencies, impact absorption and resistance to breaking, chipping, denting or similar deformation or distortion.

I am aware that heretofore developments and experimentation have been effected for the production of plastic marine propellers including both reinforced and non-reinforced materials. Such developments and productions, while being durable to limited degrees, have proved to be unsatisfactory and undependable insofar as performance is concerned, due in part to the low moduli of elasticity of the employed plastic materials and resultant large elastic blade deformations when used. To overcome such deficiencies, various efforts and expedients have been resorted to, including (1) thickening the propeller blades to an extent which would or will equate the stiffness of an equivalent metal propeller, resulting in large performance losses; and (2) the dispersing or disseminating different characters of reinforcing fibers in and throughout the base



plastic material forming the propeller, which has failed to satisfactorily overcome said deficiencies.

The above stated deficiencies and difficulties, plus others, have been corrected by my present invention, the aim and object of which is to produce a marine propeller which will and does eliminate these more or less chronic troubles common to heretofore existent plastic marine propellers by (1) providing the art with a propeller which will and does afford a twofold insurance against impact damage thereto, or to the power source, and power transmitting gearing (when such is used), by accurately and beneficially controlling the flexibility of the propeller blades; (2) by providing the propeller with plastic blades whose thicknesses correspond to that of prevalent types of metal propellers, hence, affording comparable and even greater propulsion efficiencies; (3) by assuring certain protection against slippage or other movement of the propeller hub bushing with relation to its receiving hub without sacrificing or lessening cushioning effect; (4) by providing a marine propeller which will be immune to and hence, resistant to the deleterious effects thereon of salt water, corrosion and electrolysis; (5) by providing a propeller whose blades are so constructed as to render the same elastic and flexible to an extent which will permit them to automatically springingly yield and adjust in their respective pitches under applied loads and stresses whereby to increase and improve their propulsion efficiencies, and with reduction of such loads and stresses, to automatically return to their exact original pitches, thus, producing a propeller possessed of twofold character, to-wit, a power propeller and a speed propeller; and (6) by embodying in the propeller the aforementioned features whose end results will assure greater durability and usage life span.

The foregoing, as well as other objects, advantages and meritorious teachings of my invention, will be in part obvious and in part pointed out in the following described disclosure thereof, when taken in conjunction with the accompanying drawings, it being understood that the forms of invention presented herein are precise and what are now considered to be the better modes of embodying its principles, but that other and further modifications and changes may be made in specific embodiment without departing from its essential features.

In the drawings:

FIGURE 1 is a perspective view of a marine propeller constructed in accordance with my invention showing, in particular, one form of cross-sectionally polygonally shaped bushing and shock cushioning and absorbing sleeve in the hub thereof.

FIGURE 2 is a fragmentary front view of the same with the outer end portions of the propeller blades broken away and the propeller hub shown in partial transverse section; the reinforcing bodies which are embedded in each of the blades being shown in dotted lines.

FIGURE 3 is a transverse section through one of the propeller blades taken on the line 3—3 of FIGURE 2, looking in the direction in which the arrows point.

FIGURE 4 is a fragmentary longitudinal section through the propeller hub taken on the line 4—4 of FIGURE 2, looking in the direction in which the arrows point.

FIGURE 5 is a side elevation of one of the propeller blades, partly in section, and a portion of the hub showing a modified form of blade reinforcing body embedded in the blade in full and dotted lines.

FIGURE 6 is a view similar to FIGURE 5, showing another modified form of blade reinforcing body embedded in the blade.

FIGURE 7 is a transverse section taken on the line 7—7 of FIGURE 6, looking in the direction in which the arrows point.

FIGURE 8 is a view similar to FIGURE 6, but with the outer portion of the blade broken away, illustrating another modified form of blade reinforcing body embedded in a propeller blade, and

FIGURE 9 is a transverse section taken on the line 9—9 of FIGURE 8, looking in the direction in which the arrows point.

Referring in detail to the drawings, particularly to the form of my invention shown in the FIGURES 1, 2, 3 and 4, the same comprises a hub **1** and a plurality of properly pitched blades **2** integral therewith and extended radially therefrom. Said hub and blades are formed of a suitable molded flexible plastic material which is possessed of original form regaining, spring, usage enduring, and wear resistant properties, as well as being effectively resistant or immune to the deleterious effects of salt water, corrosion and electrolysis, being capable of production, especially, by the existing methods of injection molding.

The hub is formed with a central opening of polygonal cross-sectional shape (hexagonal in the present embodiment) throughout its length, axially receiving therein a bushing **3**, preferably, but not necessarily, made of bronze. Said bushings is of a cross-sectional shape corresponding to that of the hub central opening and as indicated, is of a lesser cross-sectional size. A sleeve **4** of rubber or similar and satisfactory shock cushioning and absorbing material is snugly and conformingly engaged over and about the bushing. Its thickness is such that its outer side walls engage with the multi-sided walls of said hub opening. Relatively outwardly opening and spaced pockets are formed in the peripheral portion of the bushing and register with openings in adjacent portions of the sleeve **4**. Hence, with the molding of the hub, portions of the flowing plastic material will pass through the sleeve openings and into the adjacent or communicating bushing pockets, as indicated at **5**, forming interconnecting pins, shearable with the application of predetermined stress or shock thereto. When set, a positive bonding or coupling will be effected between the hub, sleeve and bushing assembly in the manner illustrated by FIGURES 2 and 4 of the drawings. Furthermore, a bond will be established between the molded hub and the sleeve, as hereinafter more fully described.

The blades **2**, integral with the hub, are arranged or disposed with relation thereto at pitches or degrees of pitches effective for producing propulsion forces when rotated. Being basically constructed of flexible plastic material, they are capable of retaining their original form and relationship to the hub as and when they are relieved of those pressures or stresses causing flexing thereof.

To control the degree or extent of flexing of the blades and to ensure their return to original or preflexed form and pitch relationship to the hub **1**, each thereof is provided with a positive reinforce and spring influence.

Each blade being of like construction, the following is descriptive of but one thereof, it being understood that such description will suffice for all thereof.

Embedded within the blade **2** is a spring metal sheet-like body **6**, of suitable gauge, the shape of which corresponds to that of said blade, while its size or area is slightly less than the blade. The body is so positioned in the blade as to be substantially medial of its thickness, as shown in FIGURE 3 of the drawings. The perimetric portions thereof, generally, are substantially parallel to and in close spaced relation to those of the blade, as shown in FIGURES 2 and 3, except that the width reduced inner end portion **6'** thereof is extended into and embedded in the hub **1**, i.e, securely rooted therein (see FIGURE 2), but spaced from the sleeve **4**. Relatively staggered slots **7** are formed in and over the body area, being of a number such as will control the flexure abilities or property of the same to a predetermined degree or extent, this according to load or stress to be applied, or expected to be applied thereto, during its operation. Being so areally reinforced, it will be understood and appreciated that the flexure and original form regaining properties of the blade will be controlled to the required accuracy and nicety. Furthermore, the blade will be bodily strengthened, particularly, to the extent that it will be assured of a materially longer operational efficiency and life and will be effectively resistant to denting or other malforming if subjected to abnormal operating conditions, such, for example, as contacting matters other than water or striking floating or submerged or partially submerged foreign objects.



The reinforcing bodies, such as shown in the immediately preceding embodiment of my invention, may be modified in the manners shown in the drawing FIGURES 5, 6 and 8.

In FIGURE 5, the sheet-like spring body **6*a*** is of shape, size and placement as described hereinbefore. Instead of being formed with the slots **7**, it is formed with substantially longitudinally disposed and curved corrugations or ripples which extend from the reduced inner end portion **6'** thereof to its outer end and its opposite sides. The depths of the corrugations adjacent the reduced inner end portion are greater. As the progress over the body, they gradually become less deep or shallow, so that at the body outer end and sides where they terminate, they are of minimum depths whereby due to the marginal tapering of the blade, the body will be enclosed or embedded within the blade and at the same time, reinforce it.

In FIGURES 6 and 7, the body **6*b*** is of shape, size and placement, as above. It is formed with a plurality of relatively staggered tapered teats **9** or apertured dimples (see FIGURE 7) over its area. Thus, this provided reinforcement to the blade is accentuated or increased by the side walls of the teats, while the apertures at their tips permit the plastic material (during molding) to be flowed through the body and thereby effect a firm and secure bonding between the blade and the reinforcing body.

In the FIGURES 8 and 9, the propeller blade reinforcing sheet-like spring body is formed with a plurality of relatively staggered perforations **6*c*** (circular or otherwise) in and throughout its area, serving a purpose like that served by the slots **7** of the first described embodiment.

Whereas I have hereinbefore described certain forms of slots, corrugations, teats and perforations as being provided to their respective sheet-like reinforcing spring bodies, it will be understood that other and different means for controlling the flexibilities of said bodies may be employed; moreover, that the area placement thereof may be lessened or varied as required.

In production of a marine propeller embodying my invention, a suitable mold (not shown) preferably one of the injection type, is employed—this according to the character or form of propeller to be produced. The hub bushing **3** and sleeve **4** assembly and the blade reinforcing body assembly is effected in the mold in that relation illustrated in FIGURE 2 of the drawings. Thereupon, a suitable plastic material is injected into the mold, forming the hub **1** about the bushing **3** and sleeve **4** assembly and the blades **2** with the sheet-like reinforcing spring bodies embedded therein. When set, the product is removed from the mold.

From the foregoing, it will be understood that a marine propeller constructed in accordance with my invention will afford multifold advantages and benefits. The reinforced and flexure controlled blades **2** thereof will automatically vary in their respective pitch or pitches according to the load and/or stress applied thereto during operation. Thereby, the propeller will serve effectually as a speed propeller and as a power propeller. Obviously, as and when loads applied to the propeller blades are lessened, they will partially or fully return to their original pitch relationships to the propeller hub **1**, conversely,

when loads and stresses are applied thereto, they will flex and so be positioned in manners whereby to attain and provide a maximum of propulsion efficiencies.

Should the propeller, during its operation, engage with matter or objects tending to interrupt or stay its rotary motion, the shock or shocks incident to such engagement will be cushioned and absorbed by reason of the intermediately positioned shock cushioning and absorbing sleeve **4**; moreover, by reason of the polygonal cross-sectional shape of the bushing **3** and its bonded engagement via the sleeve **4** with the hub **1**, a positive and enduring driving connection will be effected and maintained between the propeller and the engine drive shaft **10** of an equipped boat. However, should the degree of shock or stress transmitted to the propeller, or to which it may be subjected, exceed that which can or will be successfully cushioned or absorbed by the sleeve **4**, the pins **5** will be sheared. Thereby, protection in addition to that afforded by the usual shearing pin connection, hereinafter described, between the propeller and power transmission, will be assured.

As a safety precaution, it will, of course, be understood that the bushing **3**, particularly, that portion thereof extended outwardly and beyond one end of the propeller hub **1**, as shown in FIGURE 1 of the drawings, is formed with a diametrically disposed shearing pin receiving opening registering with a like opening in the drive shaft **10** and into and through which a conventional form of shearing pin **11** is engaged. Such construction is conventional.

As hereinbefore stated, the type of marine propeller constructed in accordance with my invention shown in the present and elected embodiment of the invention is not to be considered as limitative to its range of adaptation or usage. Propellers of different sizes and propellers employing a different number of blades may, of course, be constructed according to and by the teachings of my invention.

I claim:

**1.** A marine propeller, comprising:

(a) a hub and integral blades radiating therefrom, each made of moldable yieldable and original form-regaining plastic material;

(b) the hub having a co-axially disposed multi-sided opening therethrough;



(c) a metal bushing of cross-sectional external shape corresponding to and of less cross-sectional size than, that of said multi-sided opening and engaged therein;

(d) the bushing having a plurality of relatively spaced pockets in its outer periphery;

(e) a sleeve made of shock cushioning resilient material snugly engaged over and about said bushing and within said coaxially disposed hub opening, portions of which are formed with openings therethrough aligned with said pockets; and

(f) portions of the hub plastic material constituting shearable pins engaged through said sleeve openings and in the aligned bushing pockets.

**2.** The marine propeller as set forth in claim **1**, further characterized in that sheet-like spring metal reinforcing bodies are embedded in said blades and each thereof corresponds to the shape and curvature of the blade in which it is embedded.

**3.** The marine propeller as set forth in claim **1**, further characterized in that a sheet-like spring metal reinforcing body is embedded in each of said blades and corresponds in shape and curvature thereto, and further in that each of said reinforcing bodies have corrugations of curvilinear form therein.

**4.** The marine propeller as set forth in claim **1**, further characterized firstly that a sheet-like spring metal reinforcing body is embedded in each of said blades and is of a shape and curvature corresponding to the blade in which it is embedded, and, secondly, that each of said bodies are formed with substantially parallel corrugations of curvilinear form therein.

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