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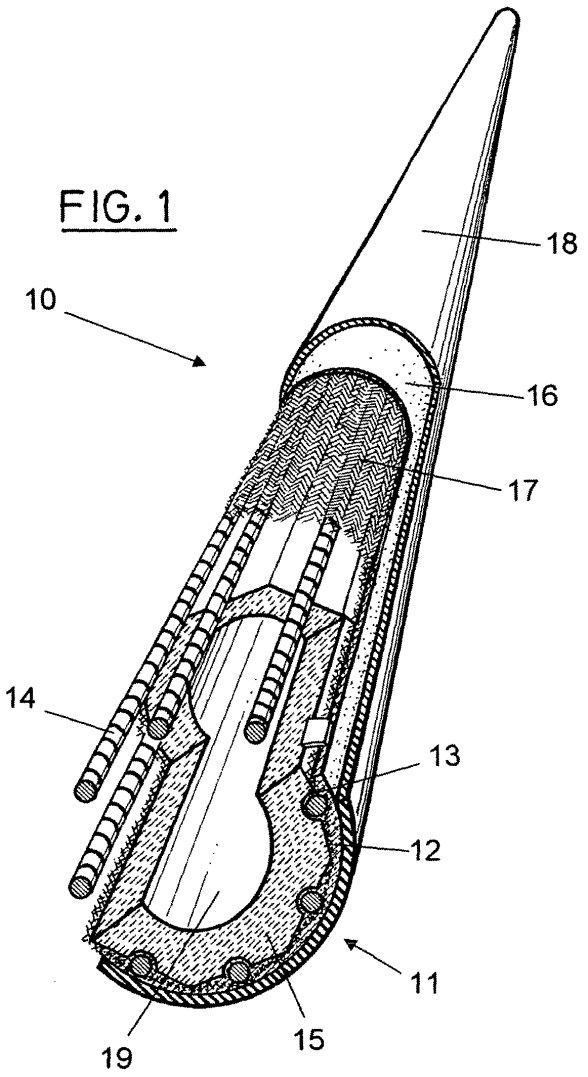
(54) Post with ceramic core and method to obtain ceramic pieces to form said core

(57) The invention relates to a post with a ceramic core and to a process for obtaining ceramic parts forming said core, the post comprising a core (15) of ceramic material which integrates in its composition amorphous silica, added during the formation of a homogeneous mixture of clays used to obtain the parts of ceramic material by injection or extrusion in a step prior to the definitive consolidation thereof. The mentioned amorphous silica can have a mineral origin or a biological origin and in particular it is a byproduct of the processing and refining of rice grains of different rice plant species.

FIG. 1



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Description

Field of the Art

[0001] The present invention relates to a frustoconical post the purpose of which is holding cables for medium- and low-voltage electric power transmission, in train catenaries, as vertical supports for holding fixed or rotating photovoltaic solar panels, for supports of electric wind generators and in multiple and various applications in lighting, architecture and advertising.

[0002] The post object of the invention is distinguished by its insulating and recyclable plastic frustoconical outer cover of various colors which does not corrode with environmental conditions. The post object of the invention is furthermore distinguished by its high mechanical strength as a result of a special ceramic core, a lightweight electrowelded metal framework designed by computation, as well as by the slenderness of its shape and structure and by its ecological design which gives precedence to the reduction of the use of natural resources and energy.

[0003] The invention provides a slender post with a variable height with its lower part inserted and duly connected in the ground or floor, whereas at its upper or top part, it is used to place at different heights elements as different as power supply cables, solar panels, solar trackers, wind generators, lightning arresters, spotlights, flags, signs, sails, video cameras and many other products, apparatuses and elements. With this variety of applications, the slender structures obtainable by applying the principles of this invention can have names such as posts, masts, poles, staffs, antennas, fences, supports, columns, pilasters, street lamps, towers, etc.

Background of the Invention

[0004] In the manufacture of vibrated reinforced concrete posts and columns one of the main elements are the steel rods joined by stirrups ensuring their position, once they are introduced in the mortar based on cement and aggregates, the post is vibrated before the setting to expel the air pockets or bubbles that may remain in the mortar. Many hours are needed in the manufacture of these types of posts for their pre-setting, at the end of this phase each unit can be extracted from the mold and there can be a wait of between 10 and 15 more days to obtain the maximum nominal strength. One of the most important problems of these posts is that the steel rods are located at the outer part of the post in the area of the tensioning stresses, this area subjected to bending and compression suffers from cracks over time, leaving the rod exposed to the oxidation processes which are the cause of the start of the destruction of the post. Other drawbacks of the use of reinforced concrete in the manufacture of posts subjected to bending are: their elevated weight which involves high transport costs and makes it difficult to handle them in the installations, the risk of violent fracture at limit strains due to the low homogeneity of concrete, as well as their nil aesthetic attraction and high impact on the landscape in certain urban areas, large infrastructures, industrial and rural areas, etc... It should also be stated that in this type of post the changes of power line from the overhead phase to the land phase are performed on the outside with the hazard of accidental discharges and sabotage that this represents.

[0005] Industrial techniques requiring large infrastructures and expensive installations, as well as machinery with powers in the order of 100 hp for each production unit, are used in the use of centrifuged and pretensed reinforced concrete in the manufacture of posts. Although the product obtained has a better mechanical quality than the previous one (without pretensing and vibrating), it has the enormous drawback that due to the centrifugation a distribution of the aggregates is carried out according to their density in the section of the post, which effect considerably reduces the technical performance thereof. Other drawbacks of this type of manufactured products are: the manual preparation of the frameworks, the presetting time must be shortened as much as possible in order to be able to pretense and demold, the need to heat the assembly as well as add chemical accelerants for the setting of the cement which reduce its quality. The pretensed structure obtained furthermore generates small cracks produced by its bending and, although they are smaller in the bottom part since the deflection with respect to the upper end decreases, such cracks continue to exist, therefore in order to prevent water and air infiltrations which can trigger irreversible oxidation processes, they normally have to be painted or primed to protect them from external agents.

[0006] In short, the production cost of this type of post is high, since the production is complex and the waiting times until the complete setting are long, it must be very carefully handled and the transport is expensive due to its elevated weight.

[0007] The use of polyester and fiberglass in the manufacture of these slender structures has been the object of considerable investment and attention in the last 25 years in industrialized countries such as Germany, Spain and Italy, mainly. The objective has been to search for an insulating product which is resistant to atmospheric agents, competitive in price and which does not require preservation. This material has considerable drawbacks such as: the lack of rigidity which prevents applications requiring high bending strength; its high combustibility; the low impact strength, thus the collision of a vehicle can break the post; it is cut easily, the manufacturing cost is very high; the difficult stabilization to sunlight; the complex adjustment of its resistant section according to each bending moment, since the fiberglass and polyester post are manufactured by centrifugation. They are furthermore products that are completely derived from petroleum which are increasingly expensive and highly polluting.

[0008] Patent ES-B1-2012688 describes a post especially for holding power supply cables comprising a hol-

low ceramic core surrounded by a resistant framework of iron rods embedded in a mass of settable polymeric material, the entire assembly being surrounded by an envelopment of rigid polymeric material.

[0009] Patent ES-B1-2228277 describes a process, an apparatus and a mold for heat molding hollow parts with a variable section from a tube with a constant section by means of which slender hollow parts with a variable section and a relatively large length suitable, for example, as a protective outer layer in street lamp bases, flagpoles, posts for supporting posters or signs, electric wiring posts, etc., can be obtained from cylindrical tube sections obtained, for example, by extrusion.

[0010] The objective of the present application is to improve the features of the posts according to the structure described in the two previous patents, increasing their strength with a lower weight and allowing a substantially lower cost for obtaining them.

Brief Description of the Invention

[0011] The post of this invention consists of an elongated and slender body, defined by a hollow core of special ceramic material, surrounded by a resistant metal framework formed by specific steel rods encircled at least in part of its section by a special fiber mesh, and the assembly of which is embedded in a mass of settable polymeric material, with a high compressive strength, this body being enveloped and protected by an enveloping cover of rigid polymeric material, stable to light and to atmospheric agents.

[0012] According to a preferred embodiment the post with a ceramic core of this invention comprises:

- a slender and elongated body constructed in one or more portions with a hollow core of ceramic material constructed with high strength, preferably constructed by a series of ceramic parts facing one another at their bases and longitudinally placed against one another with cylindrical or conical shapes;
- a metal reinforcement framework integrating a plurality of rods surrounding said ceramic core, said plurality of rods being embedded in a settable material with high compressive strength; and
- a smooth outer cover of rigid polymeric material, which can have various colors and different shapes, stable to light and highly resistant to atmospheric agents and with nil electrical conductivity.

[0013] All of this is according to the features of the post already described in the mentioned patent documents ES-B1-2012688 and ES-B1-2228277, being characterized by the fact that the mentioned ceramic material integrates in its composition amorphous (i.e., non-crystalline) silica added during the formation of a homogeneous mixture of clays used to obtain the parts of ceramic material by injection or extrusion in a step prior to the definitive consolidation thereof.

[0014] The mentioned silica can have a mineral origin or a biological origin, particularly a plant origin.

[0015] The amorphous silica used is included in the composition of the mixture of clays in a percentage between 15 and 35% of the total weight of said mixture of clays and particularly between 20% - 30%.

[0016] The metal framework is designed by computation by means of special adapted software (CAD-CAM structural software calculation) using MEF technology which also integrates structure calculation and design software capable of performing strength calculations in two and three dimensions with a wide range of materials, mainly steel and concrete. The calculation system enables a wide variety of static and dynamic (modal, seismic, p-delta...) analyses integrating factors such as height, section, necessary bending strength, weight, materials used, etc.

[0017] The framework of the proposed post is manufactured by means of using 2 to 10 iron crowns which are arranged transversely to the section of the column, and are provided with grooves or notches in which the rods are supported. Said crowns comprise two main crowns next to each end of the framework and other equidistant crowns along the structure, depending on the necessary strength variables and qualities of the end product. The crowns are different in terms of composition, diameter, thickness and number of grooves, etc., a condition which is defined for each type of framework.

[0018] Once the material required to manufacture the framework, crowns, number of rods and strength (5,800 kg/cm^2), length and diameter have been determined, the two ends of the rods are assembled with support in the periphery of the end metal crowns corresponding to the larger and smaller bases of the metal structure. The assembly is assembled on a resistant steel center with a frustoconical shape which allows providing a suitable permanent strain to the assembly of the framework as a result of a special computerized hydraulic system. Once the ends with all the rods are fixed and the suitable strain has been exerted, the assembly is welded, initially at least to the end crowns at the two ends of the post, at the contact points defined by the calculation program. The necessary welding is performed in the intersections between the rods and the grooves of the crowns. To reinforce the strength of the metal assembly subjected to regulated strain, the metal framework is enveloped by a special synthetic fiber mesh which is sheathed and tensed perimetrically to the framework. The post is now ready for the placement of the outer RTP (Recyclable Thermoplastic Polymer) cover and subsequent filling of the special polymer by injection.

[0019] To considerably increase the bending strength of the posts having heights greater than 9 meters, special ceramic parts are integrated in the assembly. Thus, high-strength hollow ceramic parts which have been manufactured to reach compressive strengths in a range between 1200 kg/cm^2 to 6000 kg/cm^2 or more (concrete reaches 700 kg/cm^2 at most) are superimposed above

the steel core and under the specific steel rods. This ceramic frame externally reinforced with steel rods secured to the plates at each end and to the intermediate stirrups, is strapped with a double helix-shaped special steel wire so that the compact assembly is rigid by itself and works optimally from the first strain exerted.

[0020] The ceramic parts have a conical or cylindrical shape, variable lengths and thickness depending on their position along the post and on the required strength demand. The chemical composition of the ceramic parts is special and integrates, as has been indicated, components derived from silica, the material is thus specifically formulated to ensure homogeneous and strain-free drying of the part for the purpose of preventing malformations in the firing process at high temperatures, uniform straight parts ensuring a high compressive strength are finally obtained.

[0021] The post which is obtained has a very high bending strength compared to its dimensions and lightness: both the compressive strength and bending strength of this compact technological structure are high. The zero need for maintenance and its complete electrical insulation makes it a suitable product for any of the industrial, architectural and technological applications mentioned above.

[0022] The assembly is introduced in a RTP plastic sheath and special fast-setting cement with a high compressive strength (850 kg/cm^2) is injected, which covers the ceramic, embeds the rods and the strap, fixing them, and is adhered and fixed to the RTP, forming a whole compact assembly.

[0023] If the steel rods used have small diameters (5 - 8 mm), the strength calculations are between 16 to 36 in number according to heights and stresses, which represents greater axial strength homogeneity. If the rods have greater diameters, between 10 - 16 mm, the structures obtained are more rigid and their manufacturing process is more complex and requires the automation of the processes and their robotization. The low labor intervention therefore leads to a lower production cost.

[0024] The post according to invention has the following differential properties compared to the known posts of the state of the art:

- Homogeneity in terms of structural behavior and composition of the materials used.
- Perfect finish.
- Insulation.
- Rigidity.
- Competitive cost as a result of a comfortable and economic manufacturing process.
- Durability.
- Safety.
- Ease in obtaining the raw materials used, which are abundant on the market.
- Resistance to atmospheric agents and to corrosive and chemically aggressive environments.

Brief Description of the Drawings

[0025] The previous and other advantages and features will be more fully understood from the following detailed description of an embodiment with reference to the attached drawing, which shows, in an indicative and non-limiting manner, a perspective and partially sectioned view of a post constructed according to the principles of the invention.

Detailed Description of an Embodiment

[0026] The post 10 according to the invention illustrated in Figure 1 consists of a body with a vertical slender frustoconical configuration wherein its section increases progressively according to its resistant moment.

[0027] The base 11, which is wider, is formed by a metal plate 12 provided with notches 13 or holes for the insertion of the equidistant and uniformly distributed longitudinal rods 14 in circumference, which will form the resistant framework. This framework is calculated by computer by means of a CAD-CAM (structural software calculation) calculation program. As observed in the figure, the constitution of the post comprises a core 15 of ceramic material integrating in its composition amorphous silica with a plant origin providing it with exceptional strength properties. The rods 14 are embedded in a peripheral mass 16 of high-strength polymeric cement surrounding the core, a material which has a high compressive strength after its hardening. For certain heights this assembly is sheathed in a special fiber mesh 17 providing the post with exceptional elastic-strength properties.

[0028] Said mesh 17 is a tubular mesh of resistant synthetic material forming an envelopment surrounding the entire structure of the metal rods 14, being located between such structure and the polymeric cover and embedded in the assembly once the settable cement 16 is injected.

[0029] According to an embodiment, the mentioned height at which the tubular fiber mesh 17 is located is from 5 meters to 12 meters from the base of the post 10.

[0030] In addition, the ceramic core 15 comprises a plurality of ceramic parts with cylindrical or conical shapes facing one another at their bases and longitudinally placed against one another.

[0031] According to an implementation of this invention, each ceramic part for obtaining the core 15 is obtained by the coupling of two half-parts coupled along edges including at least one inflection.

[0032] The outer area forming the visible envelopment of the post is formed by a coating 18 made of RTP (recyclable thermoplastic polymer) or another rigid polymer, stable to light and resistant to outdoor agents, which can be prepared separately in the form of a tubular component, and receive in another phase the reinforcement framework and the ceramic material and polymer material which will form the resistant part of the structure, the

latter applied in a fluid state and under pressure in an operation of casting by injection. In the center of the structure there is a hollow area 19 coinciding with the neutral line, the existence of which provides the assembly with rigidity, saving in material and dead weight for the post, and serving for the passage of the cables. This hollow area can be covered with a RTP plastic type tube.

[0033] As has been indicated above, according to this invention the mentioned ceramic material 15 integrates in its composition amorphous silica added during the formation of a homogeneous mixture of clays used to obtain the parts of ceramic material by injection or extrusion in a step prior to the definitive consolidation thereof, in a percentage between 15 and 35% of the total weight of said mixture of clays.

[0034] Although the mentioned amorphous silica can have a mineral origin, in a preferred embodiment the invention proposes using amorphous silica with a biological origin and particularly with a plant origin.

[0035] According to an embodiment, it has been provided that said amorphous silica be obtained from the plant covers or endocarps protecting the seeds of cultivated plants of the gramineae family in a controlled combustion process, operating under 700-800°C to obtain a deformed microporous structure.

[0036] It has particularly been provided that said endocarp be an endocarp of a rice plant which is furthermore a by-product of the processing and refining of rice grains of different species.

[0037] In addition, the mentioned settable material 16 is high-strength lightweight cement integrating in its composition a percentage of amorphous silica according to the previously indicated range of values, where said cement can be a Portland type cement in which the percentage of silica integrated is comprised between 10% to 50% by weight.

[0038] As can be seen in Figure 1, the post 10 according to the invention is narrowed from the base to the upper end according to a slender frustoconical section which is functional for each needed moment of inertia and resistant moment and the mentioned rods 14 are welded in recesses of the annular metal plates 12, arranged transversely to the section of the post 10 and distributed along said post.

[0039] The invention also relates to a process for obtaining ceramic parts forming the mentioned ceramic core 15 for a post 10, which ceramic parts are obtained by injection or extrusion, and is **characterized in that** said parts are subjected to drying prior to their firing process in a laminar hot air system.

[0040] The mentioned prior drying process comprises placing the ceramic parts in stacks of assemblies of between 4, 8, and 16 in open carriages allowing a homogeneous drying of the parts as a result of a laminar hot air flow for at least 48 hours before introducing them in an oven for their correct firing at stable temperatures.

Claims

1. A post with a ceramic core and for holding power lines and cables, equipment and/or devices for solar energy, wind energy or lighting devices, comprising:

   - a slender and elongated body of one or two parts with a hollow core (15) of high-strength ceramic material;
   - a metal reinforcement framework integrating a plurality of rods (14) surrounding said ceramic core (15), said plurality of rods (14) being embedded in a settable material with high compressive strength; and
   - an outer cover (16) of rigid polymeric material, of various colors and different shapes, stable to light and very resistant to atmospheric agents and with nil electrical conductivity;

   characterized in that said ceramic material integrates in its composition amorphous silica, added during the formation of a homogeneous mixture of clays used to obtain the parts of ceramic material by injection or extrusion in a step prior to the definitive consolidation thereof.

2. The post according to claim 1, **characterized in that** said amorphous silica has a biological origin and is included in the composition of the mixture of clays in a percentage between 15 and 35% of the total weight of said mixture of clays.

3. The post according to claim 2, wherein said percentage is 20% - 30%.

4. The post according to claim 1 or 2, **characterized in that** said amorphous silica has a plant origin.

5. The post according to claim 2, **characterized in that** said amorphous silica has been obtained from the plant covers or endocarps protecting the seeds of cultivated plants of the gramineae family in a controlled combustion process, operating under 700-800°C to obtain a deformed microporous structure.

6. The post according to claim 5, **characterized in that** said endocarp is a rice endocarp.

7. The post according to claim 6, wherein said rice endocarp is a by-product of the processing and refining of rice grains of different species.

8. The post according to claim 1, **characterized in that** the mentioned settable material is a high-strength lightweight cement integrating in its composition a percentage of amorphous silica according to one of claims 4-6.

9. The post according to claim 8, **characterized in that** said cement is a Portland type cement and **in that** the percentage of silica in said cement is comprised between 10% to 50% by weight.

10. The post according to claim 1, **characterized in that** it integrates in at least one section of the post, and from a certain height, a tubular mesh (17) of resistant synthetic material forming an envelopment surrounding the entire structure of the metal rods (14) and being located between such structure and the polymeric cover (16) and embedded in the assembly once the settable cement is injected.

11. The post according to claim 10, **characterized in that** said certain height at which the tubular fiber mesh (17) is located is from 5 meters to 12 meters from the base.

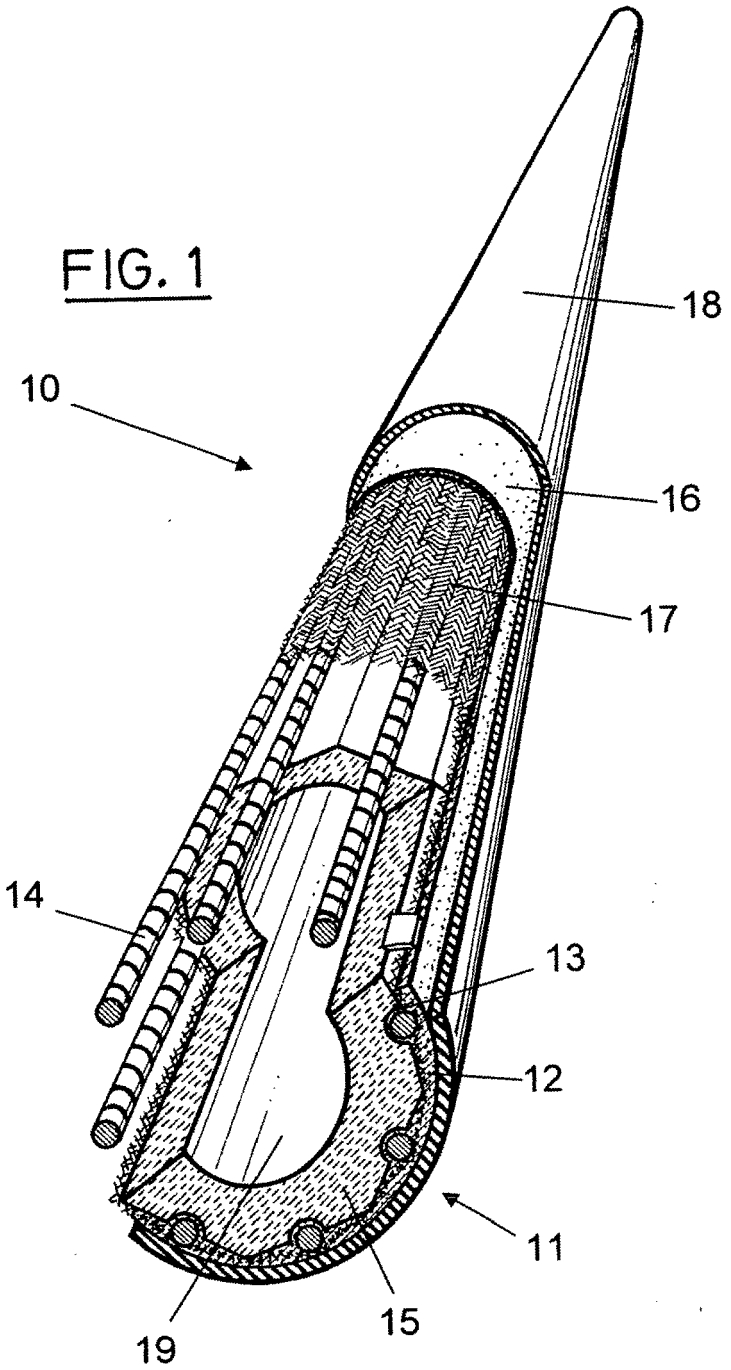
12. The post according to claim 1, **characterized in that** said ceramic core (15) comprises a plurality of ceramic parts with cylindrical or conical shapes facing one another at their bases and longitudinally placed against one another.

13. The post according to claim 12, wherein each ceramic part is obtained by the coupling of two half-parts coupled along edges including at least one inflection.

14. A process for obtaining ceramic parts forming a ceramic core for a post, which ceramic parts are obtained by injection or extrusion, **characterized in that** said parts are subjected to drying prior to their firing process in a laminar hot air system.

15. The process according to claim 14, **characterized in that** said prior drying process comprises placing the ceramic parts in stacks of assemblies of between 4, 8, and 16 in open carriages allowing a homogeneous drying of the parts as a result of a laminar hot air flow for at least 48 hours before introducing them in an oven for their correct firing at stable temperatures.

FIG. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 09 38 0123

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 December 2009	Delzor, François

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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