8. Masts, sails and rigging

University of Murcia

Objective

At the end of this module, the student will be able to recognise each of the parts of the ship that are connected with the hull and that are used to sail. For that, the student will recognise the different kind of masts, their uses and their relationship with the diverse sails that can be used, and the rigging needed to manage them. Once this is known, the student will have a basic knowledge on how to create and join each of them.

Duration

25 hours.

Outcomes

1. Understand and manage the terms associated with the construction and repair of masts, sails and rigging
2. Manage the following tools
3. Know the materials used
4. Determine the number and dimensions of masts
5. Perform the joints between helmet, fixed rigging and mobile rigging
6. Till the masts
7. Establish the velic surface and design it
8. Establish the mobile rigging and design it

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1. The masts in classic sailing

Since the origin of the boats, basically two means of propulsion have been used for the boat, the oar and the sail. During the evolution of ships, an improvement in propulsion is produced, adapting to the size of the ships and needs, both military and commercial, producing during this time the combination of sailing with rowing and the inclusion of more and more masts with their increase in power. thickness and length, the latter even in several sections.

The evolution of the rigging has been in accordance with the needs and modifications suffered by vessels and other elements during the 16th, 17th, 18th and 19th centuries. 400 years of constant changes in its proportions and sails, contributing to all these modifications years of crossing the Atlantic and sailing along the coasts of the Americas, creating new designs that will change the silhouette of ships for centuries, until the arrival of the use of iron in the construction of ships.

The use of ferrous material will even influence the rigging which allows the masts to be made entirely of iron. In our case we will mast to the use of wood as raw material in the elaboration of the rigging, focusing on the typology of various ships, such as the frigate and the ship of the eighteenth century to describe the masts, sails, rigging and other elements of a generic form, since the purpose is to briefly know these great riggings.

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2. Raw material

The tree is the element that supplies raw material as the main element in shipbuilding, but this does not mean that all trees are suitable, choosing only the species that meet certain characteristics in relation to the role they play in the ship's anatomy. . The wood used for the rigging must be, like the rest of the pieces of the ship, of quality, eliminating the pieces with defects or many knots, preferably using a wood that is characterized by its flexibility.

The organic element such as wood will eventually give way to iron rigging in many of its elements, without being completely eliminated in many cases. Not only in elements of the rigging or rigging, it will also continue to be used for some small rigging, small parts, different parts of the deck or interior decoration, among other functions.

As wood was the main material for many centuries, the necessary quantity and supply was not always easy to maintain, in Europe, as in many places in America, obtaining and transporting this material to the arsenals, dry docks or shipyards carries a cost, Several options were used, such as boats, ox carts and rivers that served as roads for the trunks to slide through their waters, taking advantage of their buoyancy.
In the Spanish peninsula, the best areas from which to obtain supplies were sought, studied and selected, taking into account the difficulty of their extraction and the proximity of rivers or accessible roads, some of these areas had a variety of species, each serving a specific use.

Some of these areas were the eastern part of Aragon or Catalonia, where its Pyrenean valleys allowed the use of rivers such as the Segre and its tributaries, with fir trees suitable for rigging, just like the Tortosa area, with species such as oak, pine tortosino red or pi roig tortosi which is none other than pinus sylsvestris or coral melis, which was very appropriate for rigging (Ruiz García, 2018, pág. 119), although sometimes, due to the lack of these species, the Salta pine is used for rigging (De Aranda y Antón, 1999, pág. 23).

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Image 1. Pinus sylvestris, conifer with a long and straight trunk, ideal characteristics for the rigging factory. (Wikipedia, 2021).

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2.1. Treatment and storage of the masts

The use of wood from a cut tree without being treated can cause problems in the construction of ships, generating deformations or alterations that require changing parts or worse, the sinking of a ship due to opening its seams, among other problems.
The treatment is not a process that begins once the tree has been felled, since while it is still in the forest, care is taken so that its development and growth is the most beneficial for the marina in the ship factory, in article 71 of the Royal Forestry Ordinance of 1748 describes a technique to improve the qualities of pines destined for rigging "... such as cleaning and opportunely bleeding the best quality pine trees for rigging, with respect to which this benefit may enable them to have all the necessary kindness" (Orden, 1748).

Once the wood reaches its destination, it is introduced or cooled in canals or pipes filled with water for a certain time. In times prior to the 18th century, the custom of covering the logs with mud, manure or ox dung was followed, although in the 18th century and even in the 19th century, rigging perches were buried for years to be cured and preserved, as the following text indicates:[1]

The inventory of bills that he has in Cadiz will probably not include all the rigging parts of the order made by the General Commander of the Navy of the Havana station, for which reason he thinks it would be opportune to unearth those that are necessary from those existing in Santi Petri.

Possibly the buried perches for rigging were over 30 years old, since it is indicated in that same manuscript that the last count was made in 1803 and the document referred to was signed in 1832.

[1] AGMAB *El asentista de efectos navales Felipe Riera pide autorización para desenterrar y remitir a La Habana las perchas de arboladura que hay en Sancti Petri y que pueden hacerle falta para completar el pedido de aquel Comandante General*. Caja 79, Documento 020

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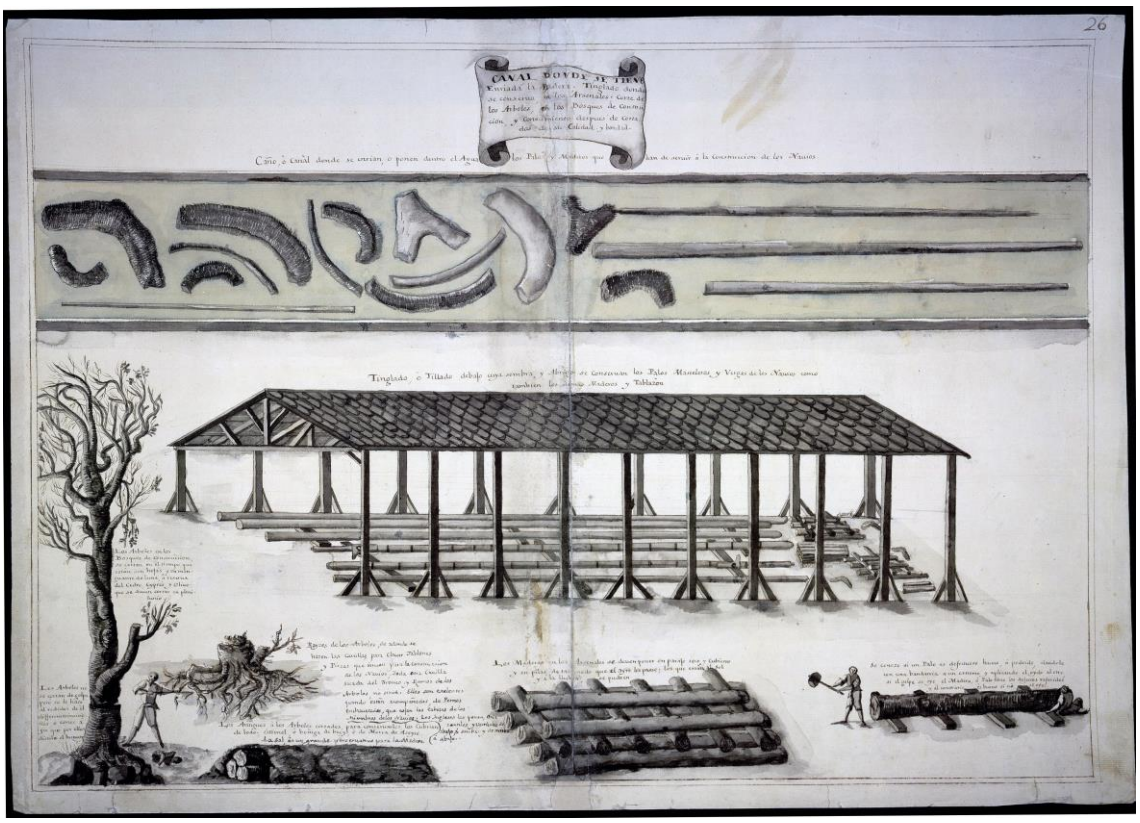

Image 2. In the upper part of the image we can see a channel or pipe where the timber intended for shipbuilding is introduced or cooled, in the center of the image is the representation of a shed or tillage where the elements already carved or ready for use are stored. place in the ship and in the lower central part the way to stack the logs is represented so that they rot, representing in the lower right part the way to verify if the trunk is damaged or in poor condition. (Navarro, 1995, pág. 26)

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The type of trees used for rigging, in many cases, was original from the forests of Ukraine and Livonia, which when submerged absorbed less water than pines, thus they were of greater duration and qualities than the pines of the Spanish Pyrenees. (Boudriott, 1987).

The logs are placed under cover, protected from the rain and the sun and stacked in such a way that the air enters freely between them, allowing them to aerate, preventing them from rotting and when they are worked into their final shape, they are stored in a shed where they are kept until they are placement on the ship.

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3. The masts

The masts are placed perpendicular to the keel, embedded through the fuse in the cockpit, which, in turn, is fixed to the sleeper or on the keel. Due to the diameter and length needed for their fabrication, they are not always available in a single piece or in one piece, if so they are called simple masts, when different pieces are used in their construction, tongue-and-groove with each other and joining the set with steel bands. iron along the mast are called piece mast (Vallarino, 1868, pág. 74).

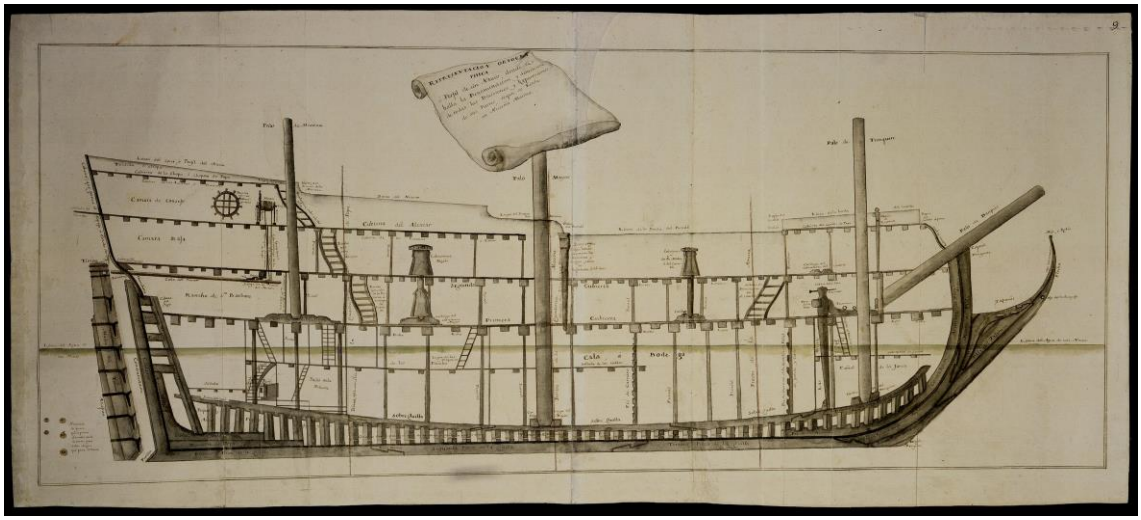

Image 3. Image that represents the settlement of the masts on its cockpit through the wick at the end of the mast. We can see that not all the masts rest on the keel or are asleep. (Marqués de la Victoria) Navarro, 1995. Lámina nº 9)

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The ratchet. It is the most forward mast of the boat and as a general rule it sits on the keel above its cockpit.

The main. It is the largest mast and occupies the central position on the ship, it is one of those that sit directly on the keel.

The mizzen. It is the mast that is located further aft of the boat.

The bowsprit. It is the mast that comes out of the ship from the bow, on the stem with a greater or lesser angle with the horizon, whose direction is called average. To understand the question of the average we will put the following example that Vallarino exposes in his work (1868, p. 85), "such a ship has a very average bowsprit, when it is very high or high, and little average, when it is low or little high over the bow", while indicating that this mast has an angle with respect to the horizon that ranges between 32 and 35º.

Within the length of a mast and its different elements that compose it, we can distinguish the following parts represented in Image 12:

Wick or Coz. Truncated quadrangular pyramid that in turn forms the lower end of the male mast and sits embedded in the cockpit.

Inner body of the mast. From the letter "A" to "C" including the wick "A" "B". The letter B indicates the maximum diameter of the mast coinciding with the upper part of the ship's main deck board, decreasing in diameter to the base of the "F" spike.

Outside body or mast drop. It is the part of the mast from the main deck "C" to the upper part of the cantilevers "E", which is where the shrouds are anchored and capped and the beams that form the base of the top rest.

Body. It is the part of the mast that joins the inner and outer body.

Neck. From the lower part of the "D" studs to the upper part of the "E" canines.

socks. The part that includes from the letter "E" to the letter "G".

Spike. It is the end of the wedges.

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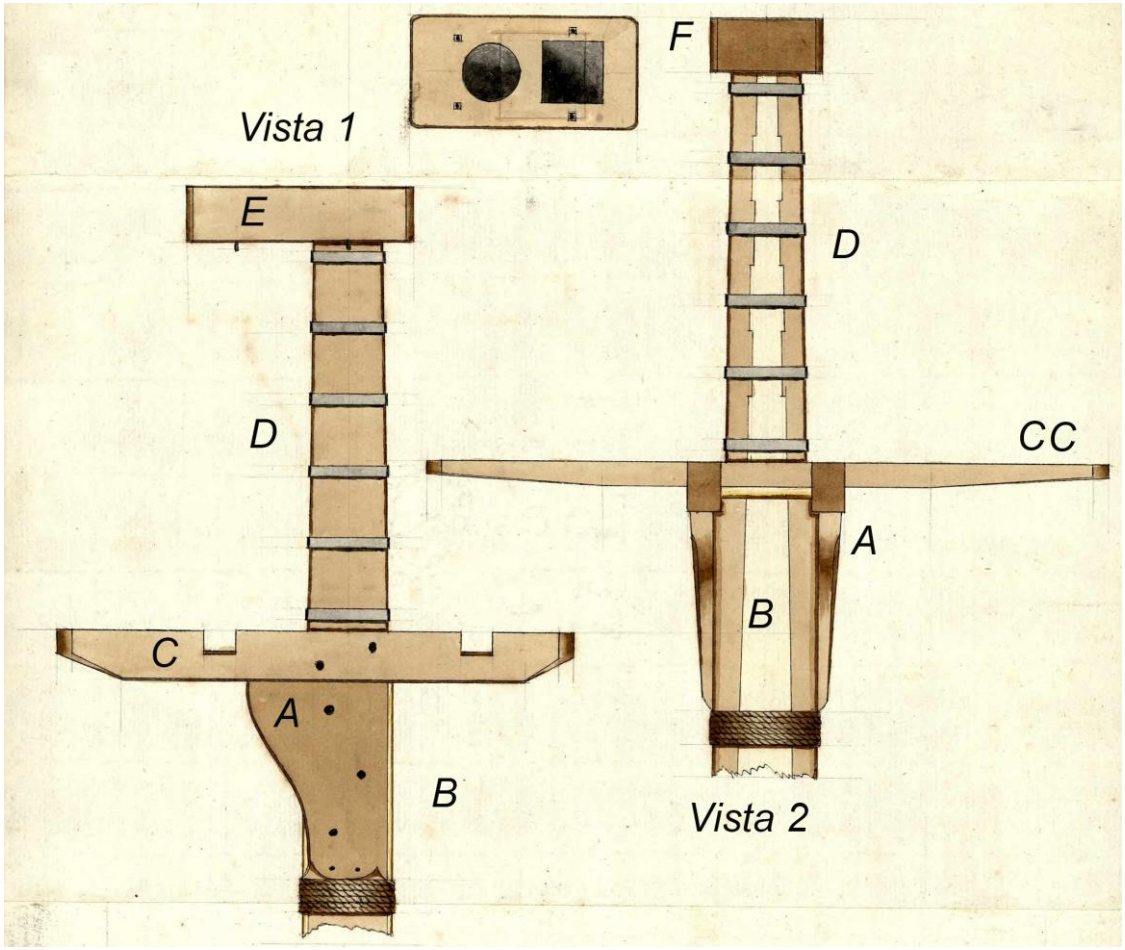

Image 4. Drawing where the following elements are represented: Cacholas (A); The neck (B); Dogs (C); Possibly they are the gags that are bolted to the canines in addition to being dovetailed, although they are not represented in view 1 (CC); Shims (D); Drum (F).

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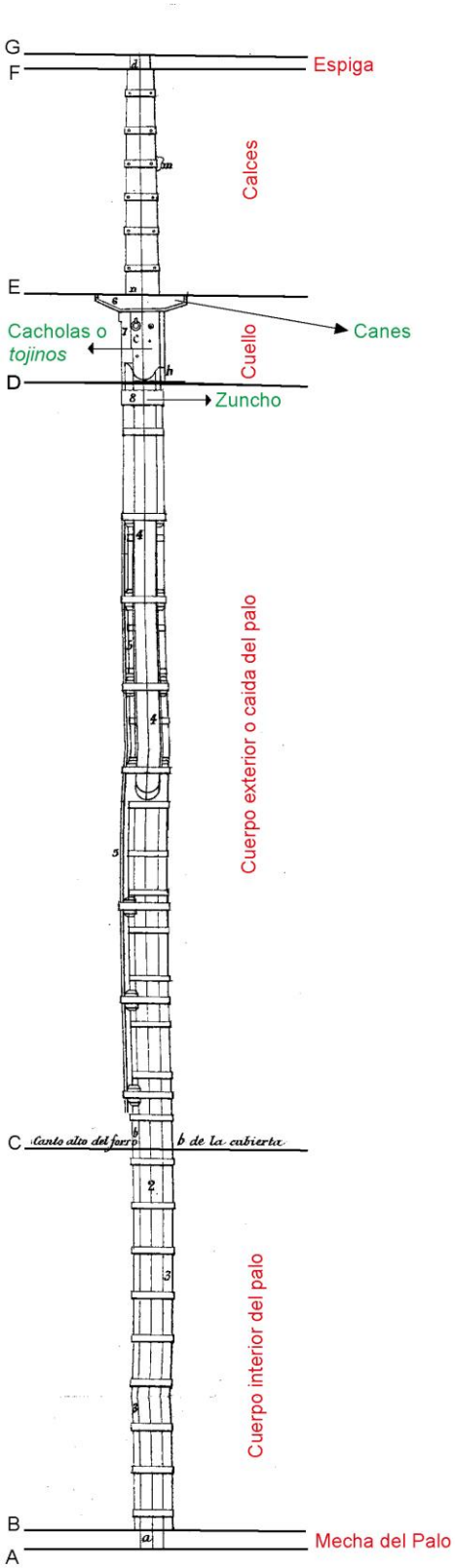

Image 5. Representation of the parts of a mast, drawing extracted from the work of Baltasar Vallarino (1868) and modified by the authors for a better compression of the image.

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3.1. Composed masts

Piece masts are those made up of several pieces or tongue-and-groove hangers fitted against each other to prevent slipping between the pieces and give the whole a greater solidity.

In the manufacture of these masts, the simplest can be made of four or five pieces (Fernández and Rodríguez, 1877, p. 172). These hangers are placed as shown in image 6. Each hanger has a specific name according to the position it occupies in the set. jimelgas (B). If it is made up of five hangers or long pieces, we can see the core or wick (A), the countermechas (B) and the tops or jimelgas (C).

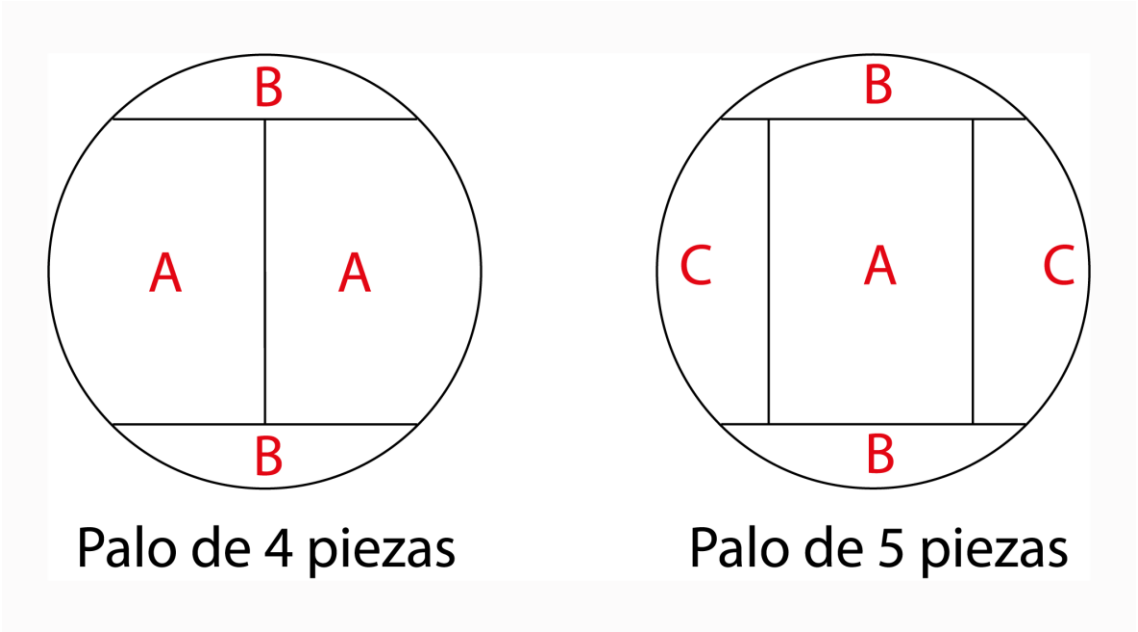

Image 6. Drawings that simulate the parts that make up a piece mast when it is made with different hangers to put together a one-piece piece, as Fernández and Rodríguez explain in their work. Drawing made by the authors.

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When the mast is made with different pieces, each of them must reach a length in relation to the total mast, the wicks must measure 0.67 of the length of the mast and 0.83 the counterlocks and caps (1877, p. 172).

During the centuries of greatest rise of the sailing navy in the Cádiz arsenal, the "piece masts" were made in a somewhat different way than the Ferrol and Cartagena arsenal, although it is not something remarkable, but if some voices that are used when naming certain pieces (Vallarino, 1868, p. 76). Let's see how it developed in Cadiz.

The first element or main hanger is the wick (1), always trying to ensure that this piece has the necessary length of the pole, which would be normal, if so, it has to reach at least the lower end or the median between the main cover to the one immediately below and its upper end up to about 12 or 14 centimeters below the spike of the mast. The next important element are the counterlocks (figure 2), which are attached to the lock on its port and starboard sides (left and right of the lock looking from the stern), these pieces form the bottom of the lock that sits in the cockpit and extends up the top of the mast to a little over ¾ of the length of the mast.

The counterlock in its extension towards the top of the mast and as we have already mentioned, must have a minimum length of three quarters of the lock, although it will be more beneficial if it is longer, ideally at least one of the the two parts that form the counterlock are the same length as the lock, as indicated by Vallarino (1868, p. 75). If one of the counterlocks is shorter than the lock, it is joined to the latter with a header where it abuts part of the lock through a half tongue-and-groove joint, reinforcing this union with at least three bands. This same head joint system is performed when neither of the two pieces that form the counterlock are as long as the lock and trying to ensure that the upper and lower bands are at a consistent distance from this joint.

In the pole factory we have already seen two types of hangers that come together to give their shape and length, the wick and countermecha, now complemented by other

hangers such as the head jimelgas (4) that allow the termination of the mast by its top end. Its thickness or thickness must be sufficient so as not to have to use a knife to fill in the lack of wood in the shape of the mast where this hanger runs, in this way the entire male or mast is solid.

The covers (3) are the pieces that are placed on the stern and bow faces of the tree or mast, from the foot to after the last band placed on the upper part of the mast and tongue and groove with the wick just like the counterlocks. Due to their length, on many occasions they have to be headed or joined with several tops, since they do not always have the full length of the mast.

3.2. The bands

These elements are made of iron with a width that can be between 100 to 116 mm with a thickness of 12 to 15 mm placed between them at a distance of approximately 1 meter, from 100 to 116 mm wide and with a thickness of 12 to 15 mm. mm (Vallarino, 1868, p. 77). But not all of them are closed rings, there are other types of bands that are tightened through some screws on the aft face of the mast, these bands are called hinge bands.

In order to reinforce and maintain the entire assembly that we have seen so far, it is necessary to place iron bands along the entire length of the pole at a certain distance from one another, embracing the pole and adjusting the hangers and knives between them.

To place the bands, remember that the masts have their maximum thickness at the height of the main cover and from that point it thins towards its lower and upper part, therefore, these bands will have a larger diameter those that are closest to the widest. of the mast and from there to the ends they decrease in diameter according to their location.

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To place them once they have been worked by the riverside blacksmith, they are heated or heated, then the surface of the mast is covered with tallow, from the end to the final location of the band to be placed on the mast, in this way avoiding burning the mast and squeezing the breasts as it cools. Once the mast is smeared, the band is inserted with a mallet, hitting on one side and on the other so that the rest is inserted without turning and being blocked.

The placement of the bands on the mast is not random, they are placed along the entire length from its widest part to its upper and lower ends, always bearing in mind that the mast at the height of the main deck must be free to be able to place the wedges for fixing the mast in the mouth of the vat or main deck joints and a band as close to the fuse so that it is practically above the cockpit to give strength to the base of the mast.

3.3. The jimelga

The jimelga (5) is placed to avoid the friction of the yard with the straps in the action of raising or lowering this element, it is nailed or fixed with cord ropes on the bow part of the mast throughout the route it makes the yard in its ordinary movement, being an element of easy replacement if necessary due to wear. Before placing it, the corresponding boxes must be made coinciding with the bands so that its lower face rests on the front of the mast and there are no gaps between the jimelga and the face of the mast.

4. The yards

The yards are wooden hangers placed on the bow part of the masts and topmasts to be able to fix the sails on them.

The sails, as a general rule, are usually one piece or in two pieces if it is not possible in one piece.

The names of the yards depend on the mast where they are sustained, with the exception of the mizzen mast yards.

The names of the vergas according to the suits are the following:

Ratchet mast. Ratchet yard, low topsail, high topsail, bow topgallant and bow topgallant.

Main mast. Main yard, low topsail yard, high topsail, main gavia and main topgavia.

Mizzenmast. Dry cock, overmesana cock, parakeet and sobreperico.

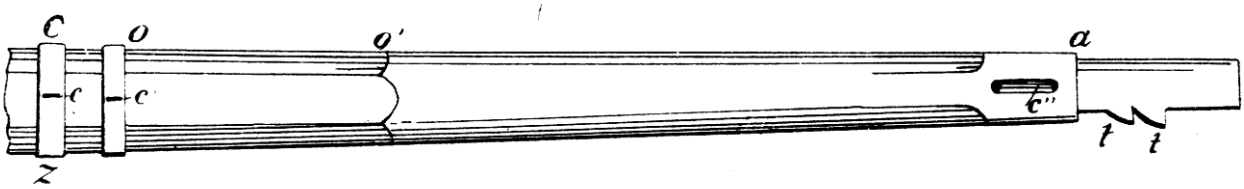

Image 7. Drawing representing the section of the mid-verga (García de Paredes y Castro, 1925, pág. 282).

Description of the drawing according to the text by García de Paredes (1925, p. 282):

c) Octave central part.

o o`) The part of the yard that goes from the "o" to the "o`" is called the cross.

o` a) The part from the "o`" to the "a" is circular in section and is called a third, and from the letter "a" to the end it is called penol.

C) Central strap with an eyebolt "c and c`" to hook the halyard blocks.

c``) pocket made in the square section before the yardarm with its respective sheave that is used to make way for the topsail notches.

tt) tojines.

Toppings. They are affirmed in the yardarms in order to keep the yards horizontal.
The fathoms. They are used to be able to brace the yards or what is the same, to orient them so that they can collect wind.
Halyards. Block used to hoist the yard or a sail.
Sheet. It is used to hunt the sails.
Bowling. Ropes that facilitate the reefing operation.
To pick up or load the round sails it is done with: "the palanquins, which carry the fists of the sail to the cross. The briols, who suspend the cloth from the footrope, The turnbuckles, who carry the luff drop ropes" (Baistrocchi, 1952, p.

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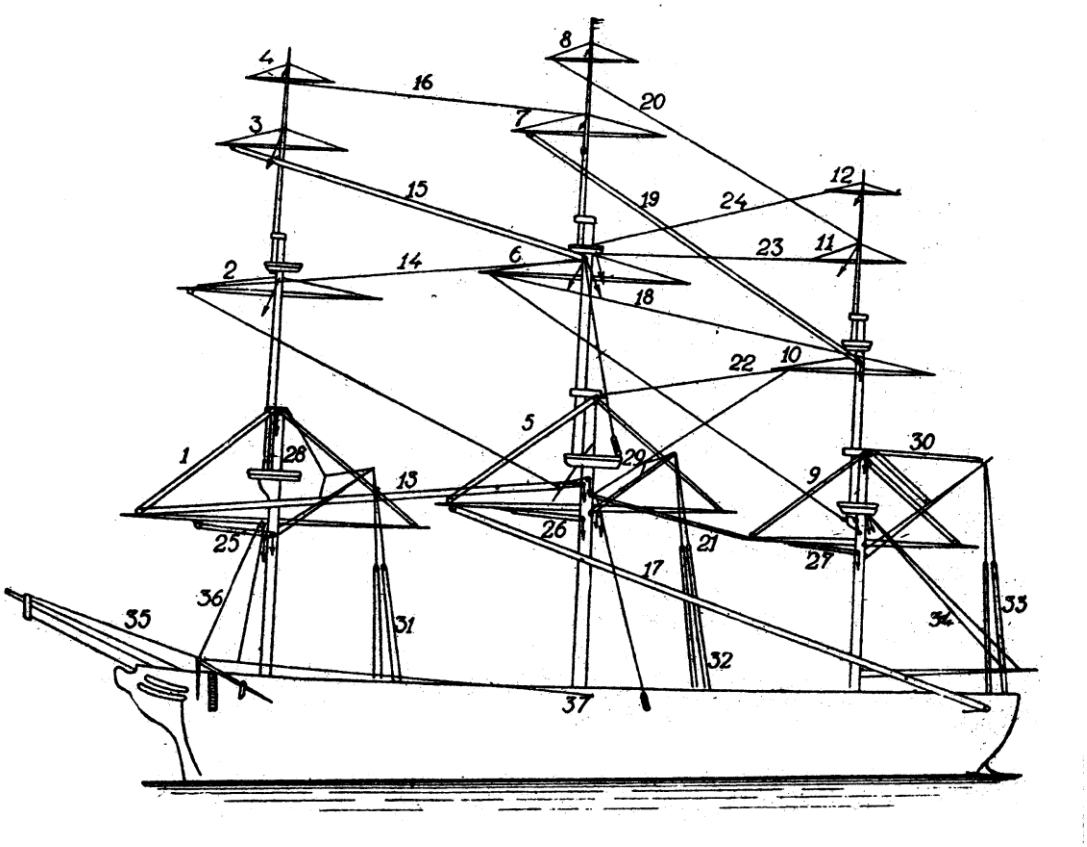

Image 8. Rigging for tilling the yards (Baistrocchi, 1952, pág. 182).

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5. The rigging

The rigging consists of different ropes with different measurements, both in length and in diameter, being used to support and hold the yards and main masts of the ship. They will allow the maneuverability of the yards and sails when carrying out hunting and loading maneuvers, among others. There are two types of rigging:

The firm or dead rigging. It is the one that is always maintained in the same position and tension, among this rigging are the shrouds and stays.

The work rigging. It is the complete opposite of the previous one, including the work ropes and all the gear.

Its general composition is hemp, a plant that has its origin in Asia and is currently more widely cultivated in Europe, including in Spain. Its processing in the elaboration of ends begins with the planting and harvesting, producing its treatment in several processes.

Image 9. Image representing two workers introducing the hemp in a raft with water, retting the hemp (Company Ballesteros, 2020, pág. 17).

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The first of the processes is retting, formerly it was submerged in pits with fresh or salt water, achieving fermentation by means of microorganisms that are in the plant itself. With this technique the separation of the fibrous matter was facilitated.

To keep the bunches at the bottom, boards are placed on top of these stones so that they go to the bottom, controlling the process at different times until they are ready to be extracted from the water, at which point they are dried in the sun, ending the retting.

Once the retting is done, we proceed to the agramado, made with a tool called a grinder or agrama, with which he broke the stems, but they were not completely cut.
The next process is spading, which separated the woody elements from the textiles and softening, which favors combing or raking (Baistrocchi, 1952, p. 78).

Baistrocchi explains in his work that raking removes possible woody substances that may remain attached to the fiber, to subsequently separate the fibers, leaving them parallel, selecting them based on their quality, 1st and 2nd. The inferior to the 2nd category is the tow, which will be given another use that is not the ropes (1952, p. 80).

The raking was done with a tool called a rake or comb, which was a table or bench with steel spikes on the surface, looking like a brush, passing the hemp through its surface to finish cleaning it.

5.1. Components in the manufacture of ropes

Linen. Its cultivation is abundant in Europe and in relation to hemp it has a tenacity one third lower than hemp, weighing almost half that of hemp in its same proportion, obtaining the least fiber that has light tones, to be the dark ones of inferior quality.

Abaca or Manila. It is generally cultivated in India and the Philippines, extracted from wild banana leaves. Its resistance with respect to hemp is one tenth more resistant. It is heavier than Linen but 22% lighter than hemp and is very sensitive to moisture, according to Baistrocchi (1952, p. 78).

Jute. It is productive in America and India, although it is a very light material, almost half the size of hemp, but very vulnerable to humidity, accelerating its decomposition, so its deterioration is very fast and its resistance is similar to that of hemp.

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Palm. They are obtained from the leaves of palm trees with a resistance 1/5 lower than hemp, it is light and due to its resistance to salty sea water, it is widely used in jobs that require a long time submerged in the sea.

Coconut. The filaments that cover the coconut shell are used.

Pita. It is extracted from the leaves of aloes or pitas, its resistance is much lower than that of hemp, it rots easily in the face of humidity and is damaged by the application of tar.

Esparto. It is four times less resistant than hemp, being its most widespread use in mining and fishing.

5.2. The ropes

The material or fiber most used in warships to make ropes is hemp due to the strength it has shown in its long use and flexibility, qualities that give an extraordinary quality to the ship's rigging.

These thick ropes or ropes, which is the correct term in nautics, are made up of smaller elements that, joining together, become a rope which, in turn, depending on the number of cords, will have one or another denomination, for which we will start by knowing that it is actually a rope and what elements it is composed of and how it is manufactured.

Its elaboration is carried out by joining twisted fibers together, this operation being called “quilting”, and it can be carried out from right to left or also from left to right, but which in turn produces a loss of resistance of approximately one third.

The fiber. As we have already mentioned, it is generally extracted with the treatment of hemp as the most used plant and its length is proportional to its quality, the longer the better quality, the fiber that is used to obtain the filastic a length between 1 to 2 meters.

Filament. It is made with the union of fibers placed in parallel, and with their ends interspersed to give it length (Baistrocchi, 1952, p. 74).

The phylastic. It is the thinnest component in the composition of the ropes, it is made with the union of strands or fibers, twisted to the right, that is, the turn that is exerted

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on them is from right to left formed in a spiral due to the torsion submitted by the turns. The union of several filastics creates a cord.

Laces. It is a set of several twisted or quilted filastics, depending on its ore or thickness if its composition is two, three or four filastics. This union of filastics generates the creation of a rope with different thicknesses depending on the number of filastics.

The rope. They are ropes that are used to manage the elements that make up the whole of a ship, influencing their thickness according to the number of cords used for their composition, being able to have from two to four.

The manufacture of the ropes through the union and their padding gives rise to different types of ropes that, depending on the number of cords and how they are twisted, will give rise to a rope with different properties and names, which are described below.

5.3. Types of ropes

The quilting or twisting of a number of filastica forms a cord, which in a number of three or more cords creates a rope. The ore of the cape varies according to the number of strands and according to this thickness or ore, we will say that this cape is a hawser, hawser with four cords or hawser, also called a calabrous cape (Vallarino, 1868, p. 1).

The manufacture of the set of ropes can be carried out manually or with specific machinery for this task, but regardless of how the hemp is manufactured, it must pass verification controls. Its quality is verified by verifying that its retting and drying were carried out correctly, giving the hemp the properties it needs.

Hawser. It is formed by three cords and each one of them quilted from right to left, that is, “to the right”. Formerly, according to what Vallarino explains, it was quilted to the left, which generated little flexible ends (1868, p. 2).

Four strand hawser. It is as its name describes the rope composed of four cords, twisted to the right on an inner rope which is called "core" avoiding with this element that the rope remains hollow inside when it is quilting while compacting plus the union of the cape.

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Calabrote or acalabrotada hawser. It is the nine cords of the same ore are used, for this in the formation of each cord the same number of filastics has been used.
To form the hawser, first three cords are hung to form a hawser, thus until three are made, and once they are finished they are joined by hanging them backwards, that is to say to the left (they twist from left to right).

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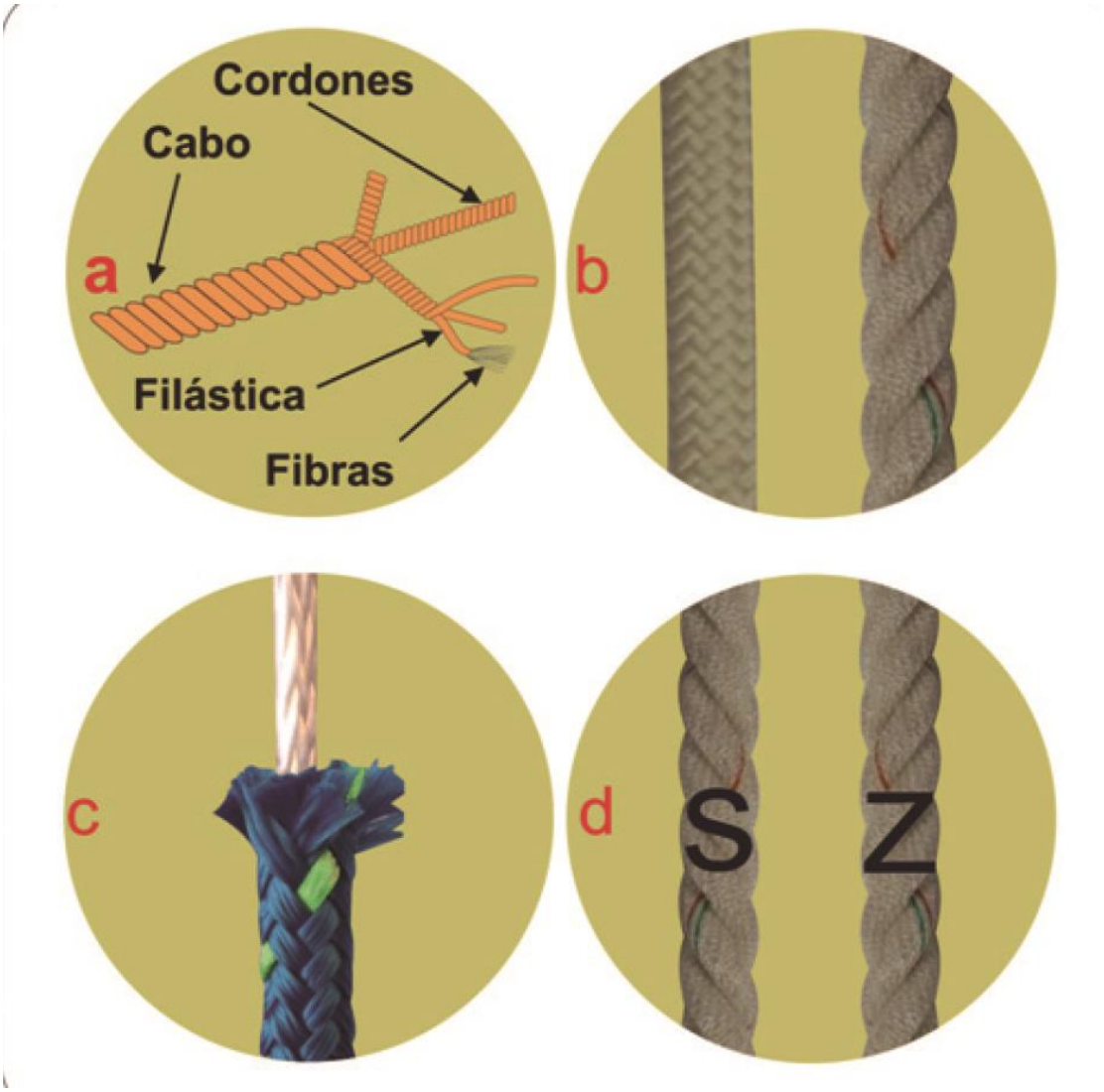

Image 10. Drawing A, a rope is represented with the elements that form it: the fiber as the smallest element, then the filastic and finally the cord. Drawing B, we observe two types of ends, the one on the left is called braided and the one on the right is twisted. Drawing C, we see the detail of the soul that is inside the cape, white. Drawing D, different ways of quilting or twisting, the S is on the left and the Z is on the right (De Lucio, Solano, Rebaza, Alfaro, Tresierra, & Campos, 2013, pág. 33)

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Other hawsers are made with up to twelve cords, dividing into four hawsers, joining them with one of them as a core and the other three wrapping the core, leaving it inside as was done when forming the hawser with four cords. These hawsers were used for the shrouds due to their thickness and strength, which is why they were also used for the larger stays, although by the mid-19th century hawsers, which were made up of four cords, were already being used for rigging.

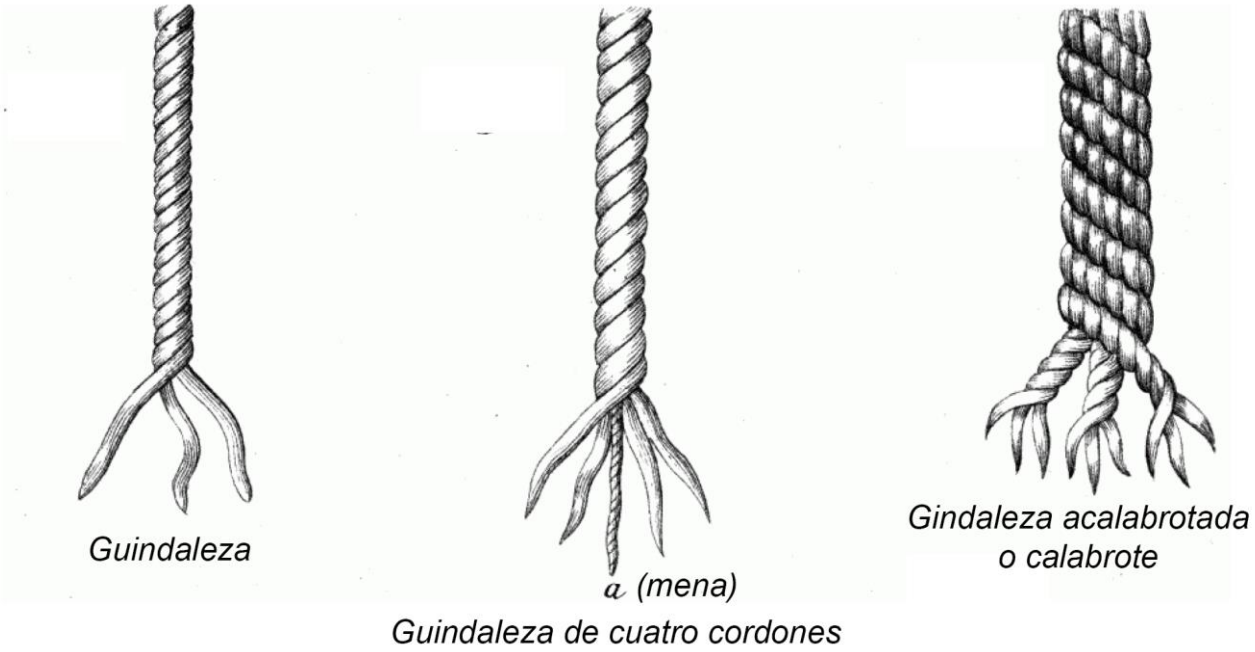

Image 11. Types of rigging according to the number of ropes and arrangement (Vallarino, 1868, pág. Lámina 1).

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Due to the use and location of the ropes, they need to be waterproofed in order to protect them from humidity and rain to prevent them from rotting and breaking or reducing their duration. For better conservation, they are immersed in liquids that penetrate the fiber and increase the resistance of the rope, some of these liquid insulators being linseed oil.

Tarring is also used to prevent water from penetrating inside the cape and rotting it, it is applied to the cape once finished on the cords that will be used for the cape's fabric.

6. Pulleys

The set of pulleys, joists, blocks, etc., is called motonería and the use of these elements together with the ropes that allow their tillage is called rigging.

It is used as a pulley, they are usually made of wood or metal, the latter being more used since the mid-19th century. It is made with a wooden block that is the "body" of the block, being used more commonly for its manufacture oak wood among others, being made in several pieces if the body of the block is large. Its ellipsoidal and flattened shape with a recess or pocket made in the center and towards the ends with the necessary width so that its interior can be placed with its axis a roller. At the upper ends of the sides or jaws, a notch is made for the passage and fastening of the loop when the ligature is made, preventing it from slipping when it is tightened.

The pulley is usually made of wood, normally using the guayacán or of bronze if it is made of metal, being placed inside the pocket crossed by a metallic axis that crosses the block. So that the washer in the entry hole of the bolt has a square or bronze die embedded, as seen in the figure in the middle of image No. 6 with the intention that it can be replaced in case of wear without changing the sheave.

When the pulley is fixed in the pocket, the distance from the top of the pocket to the edge of the pulley is called that throat space.

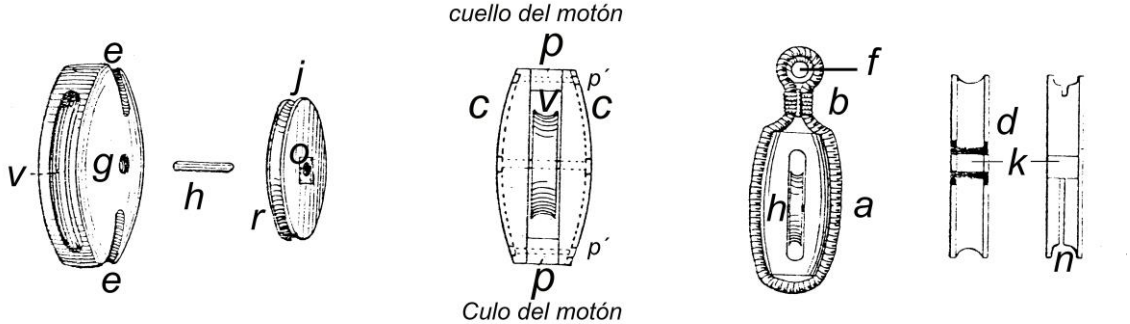

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Image 12. Shape and parts of a pile of wood (García de Paredes y Castro, 1925, págs. 200 - 211 - 221).

Parts of a pile of wood represented in image. Description image first from the left; (g) is the body of the heap and is made of one whole piece of wood. Its external faces are not straight, they make a slight curvature towards the ends; (e) they are some notches that are made in their ends or in the ass or neck of the block for the passage of the strip, preventing it from moving; (g) groove or hole for the passage of the bolt; (h) bolt, passes through the sheave acting as an axis so that it rolls on this bolt; (v) pocket or mortising made in the block; (r) sheave, has a groove on its entire outer edge for the rope to roll, thus preventing it from coming off the edge of the sheave; (j) sheave grooving; (o) hole through which the shaft passes to fix the sheave.

Description image second from the left; (c) jaw in parts when the block is large; (p) pieces that join the jaws with bolts, they are called dice; (p´) bolt that fixes the pieces with the jaws.

Description third image from the left; (f) capping; (b) ligation to tighten the gauze; (a) block gauze; (h) block.

Description fourth image from the left; (d) guayacán wood pulley; (K) bronze socket with bolt hole; (n) Channel made on the edge of the sheave to seat the rope.

When the block has more than one drawer or groove, it is called a block, and it can be two, three or more sheaves or grooves.

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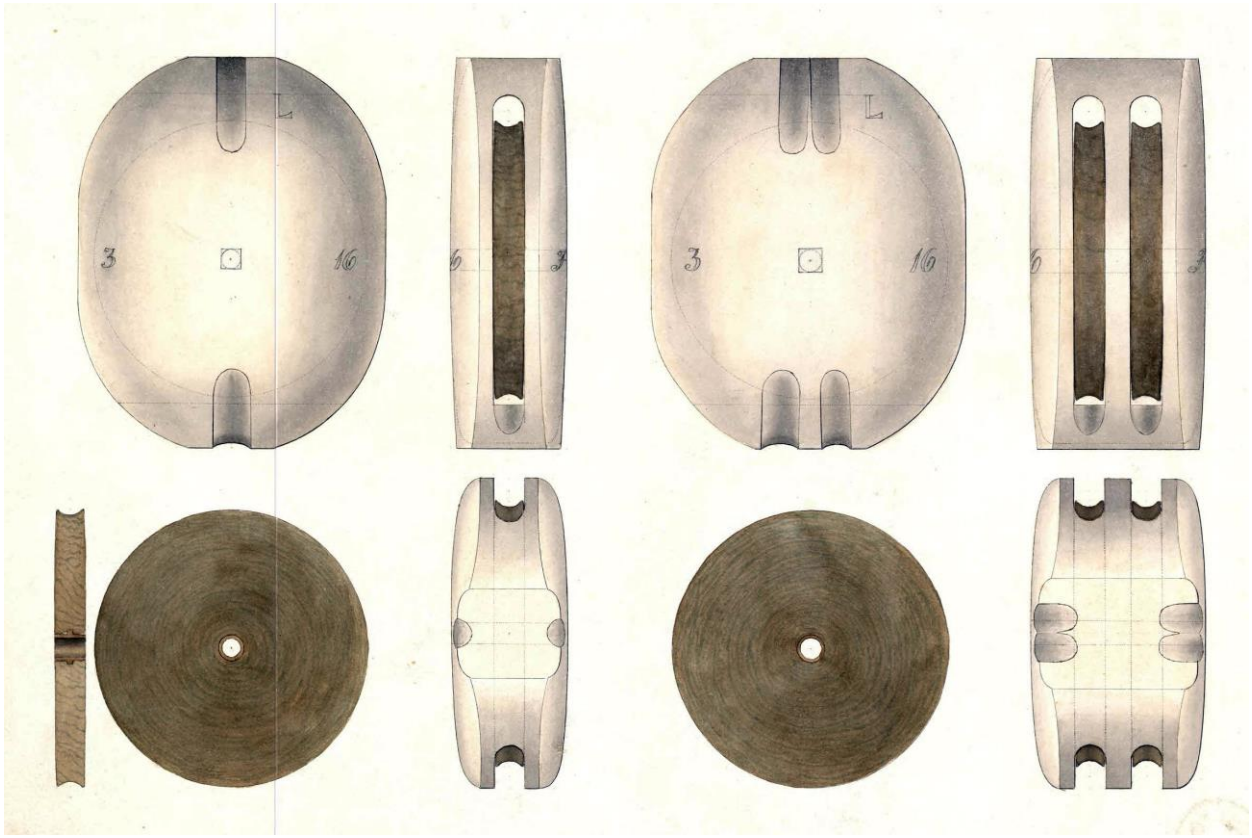

Image 13. Bodies and sheaves of a block (to the left of the image) and a Block (to the right of the image). In the case of the block we see that in the lower and upper part of the body it has two parallel notches for a double loop.

6.1. Wood and measures of the pulleys

It would be difficult to put all the measures that are given for the motonería since it would be very wide. To avoid, we are going to indicate some generic rules based on the ore or diameter of the cape as we will see.

To know the measurements of piles and blocks it is necessary to know the ore of the cape, which in turn will indicate that of the box, being in ordinary rigs the length of the box three times the ore of the cape, being three and a half times when Friction must be avoided as far as possible. For the sheave, its measurement will generally be about two-thirds the length of the block.

With regard to the wood that should be used for the motors, it must be hard and with its dark fiber, resistant to humidity and sun, the quality and polishing of the surface being of equal importance, it must be very smooth to the touch. and without being easily traded.

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Mahogany. Its use was greater in the past, and it was no longer used due to its cost since its characteristics were good for motorcycles.

Oak. Variety of oak and resistant to moisture and wear from inclement weather.
Walnut. Wood tight and resistant to moisture and dryness.

Holm oak. Oak, like oak, is hard and resistant, as well as having an affordable price.
Elm. It is widely used in France, although it tends to become deformed and it is necessary to protect it to prevent moth attack with some type of varnish or other substance that prevents attack.

Olive. It is a wood widely used in Italy, among its properties is hardness, very dense and with a fine surface when polished.

For the conservation of the blocks and blocks, when they are manufactured, they are introduced into linseed oil, the waterproofing being more effective when it is immersed in this element while it is hot. In this way, the wood is nourished and resists humidity and the sun.

6.2. Different types of pulleys

Blocks are essential elements for any maneuver, basically, without them it would not be possible to handle heavy weights on a boat, their shape or size is related to their usefulness and ropes that pass through the sheave located in its drawer. Blocks have a specific name in relation to use and task, below we name the most common:

Hook block. He is the one who wears his cape loop with an iron hook with a thimble on the loop to protect the cape.

Sewing block. They are the ordinary blocks with a loop that is made firm with a ligature.

Lot of rabies. The gauze of these blocks becomes a cajeta or flexible fabric to make it firm with a turn where you want to hook it.

Pigeon mound. This block is anchored at the cross of the topsail yard so that the halyard stem can pass through.

Ironed block. It is the block that has an iron band.

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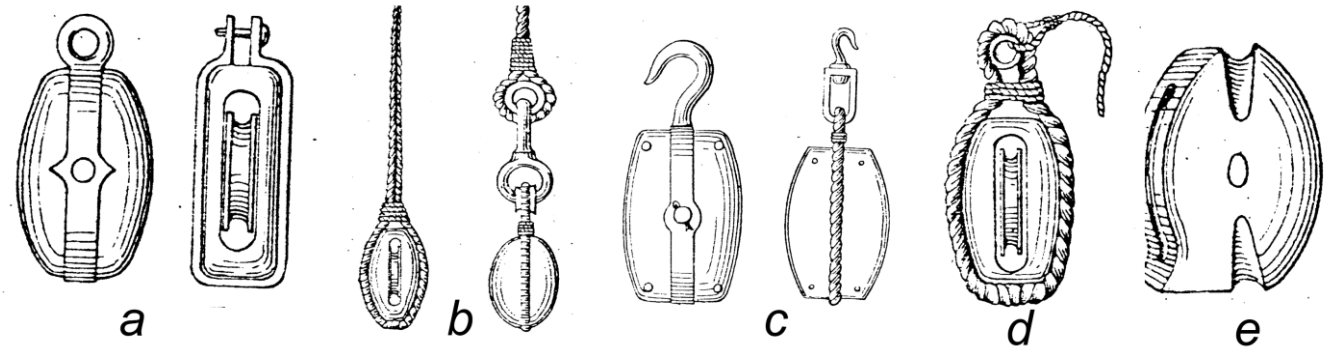

Image 14. Some types of blocks: a) branded block; b) bell block; c) hook block; d) sewing block; e) flock of pigeons (García de Paredes y Castro, 1925, págs. 213-215).

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6.3. Vigotas and blocks

The vigot. They have a wooden body very similar to a flattened and round block, and may have three or four holes in the center of the body that cross from one side to the other, being used for the passage of the lanyards that will serve to tighten or tighten the rigging.

Blocks. It is like a shod block with both sides or jaws with one of them open at the top for the passage of the rope to the sheave and thus allow tillage with the block.

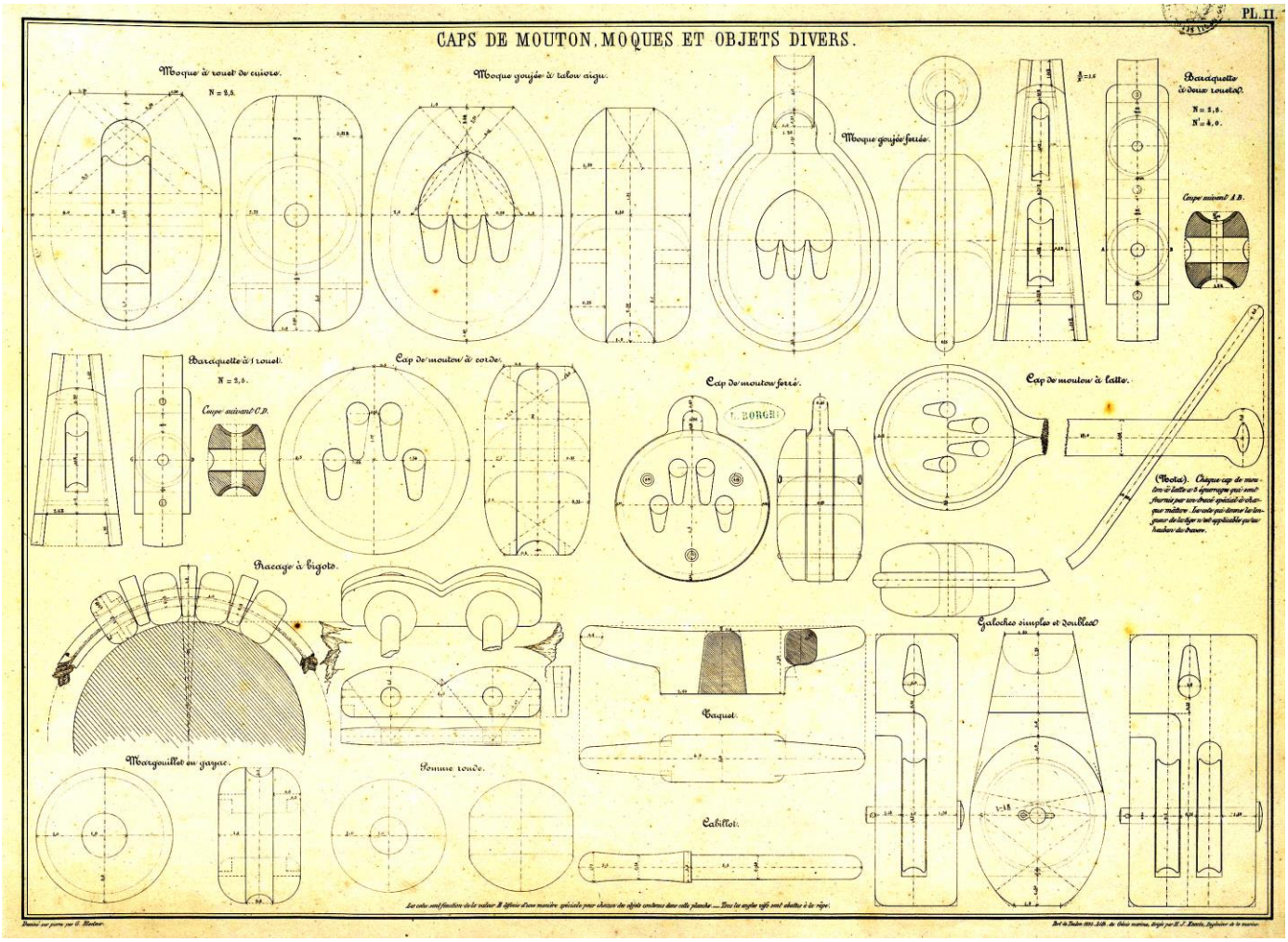

Image 15. Sheet where vigotas (central part) and blocks are represented (parte inferior derecha). (Atlas de poulierie, 1855).

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7. The rigging

When we talk about rigging we refer to the set created between ropes, blocks or blocks. The union of these elements creates a system of pulleys of which a block or block is fixed and joined to another or others that are not fixed by means of a rope, thus achieving a system that will allow lifting or lowering very heavy elements with the least possible effort, thanks to the multiplication of power that occurs when pulling the line of the rigging.

In a boat there are many types of gear, depending on the number of blocks or blocks that make it up and their arrangement, depending on the composition and location they receive one name or another.

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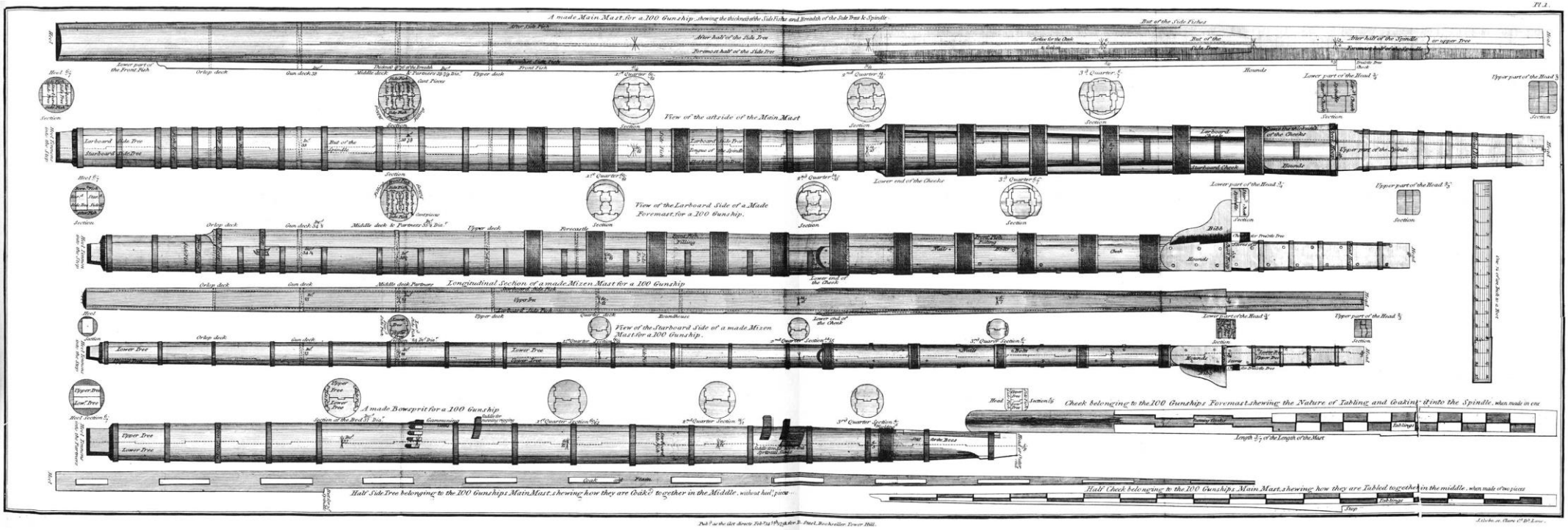

Image 16. Image that represents the different tongue-and-groove joints that are made on the hangers that make up the pole with their respective escarpments and bands (steel, 1794).

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Once the mast is assembled with all its hangers and fixed with the bands, the carving and fixing of the elements that are located below the shims and will serve for the placement of the top and support of the topmast begins, these pieces are the following:

The cacholas: Logs that are placed on the bands (right and left) of the neck of the male poles for sustenance or support of the dogs when they are used, since smaller or small vessels do not usually use this element in their male poles. , carrying out in these cases the support of the beams in the cacholas themselves.
Another variant that its construction has is the incorporation of the heel that is added when they do not have canes in order to give a greater base to the settlement of the baos, which makes it look like a curve together with the cacholas, hence the name that is given to it. given in the manuscript of the Marquis of Victoria calling it "curba cachola" (sic), (1995).
In the cachola a bolt with an eye is inserted that has different functions, such as securing the masts before capping the rigging with the royal rigging (Vallarino, 1868, p. 78).

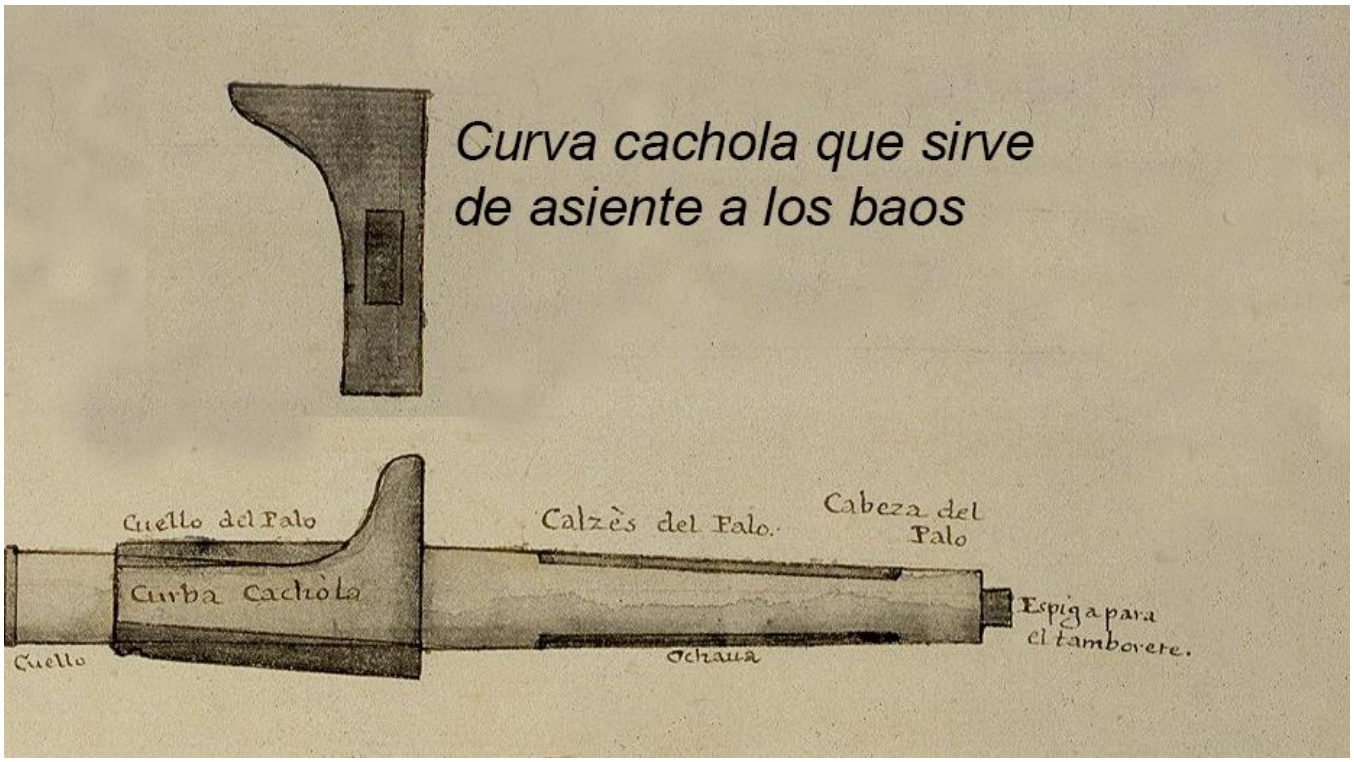

Image 17. Drawing that represents the location of the cachola curve in the mast, at the height of the neck (Navarro, 1995, pág. 42).

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The canes: Pieces of wood bolted one against the other through the chocks and fixed on the cacholas. To prevent twisting of these pieces, two wooden crossbars called malletes are placed on the stern and bow face, on which the other malletes that reinforce the beams that support the top rest.

Baos: They are the necessary mederos to be able to settle the top of the mast, being placed on the starboard and port side of the mast at the height of the shims and reinforced with malletes that act as mouths for the shims, at the same time at their ends they are crossed from the port side. to starboard by other mederos thinner than the beams and embedded in these so-called crosspieces in order to have a greater surface for the crow's nest.

Malletes: They are pieces of wood or wooden bars as they were called in the past and that are indented in other wood in order to form a square hole, sometimes circular or arched, that allows the passage of a piece that will suffer great efforts (O- Scanlan, Spanish Maritime Dictionary, 1831, page 351).

Crosspieces: These are pieces of wood or masts that cross the beams of the crow's nest from port to starboard and are interlocked in the beams halfway through the wood as well as bolted, providing a larger surface area for the crow's nest, hence the importance of their fixation and thicknesses.

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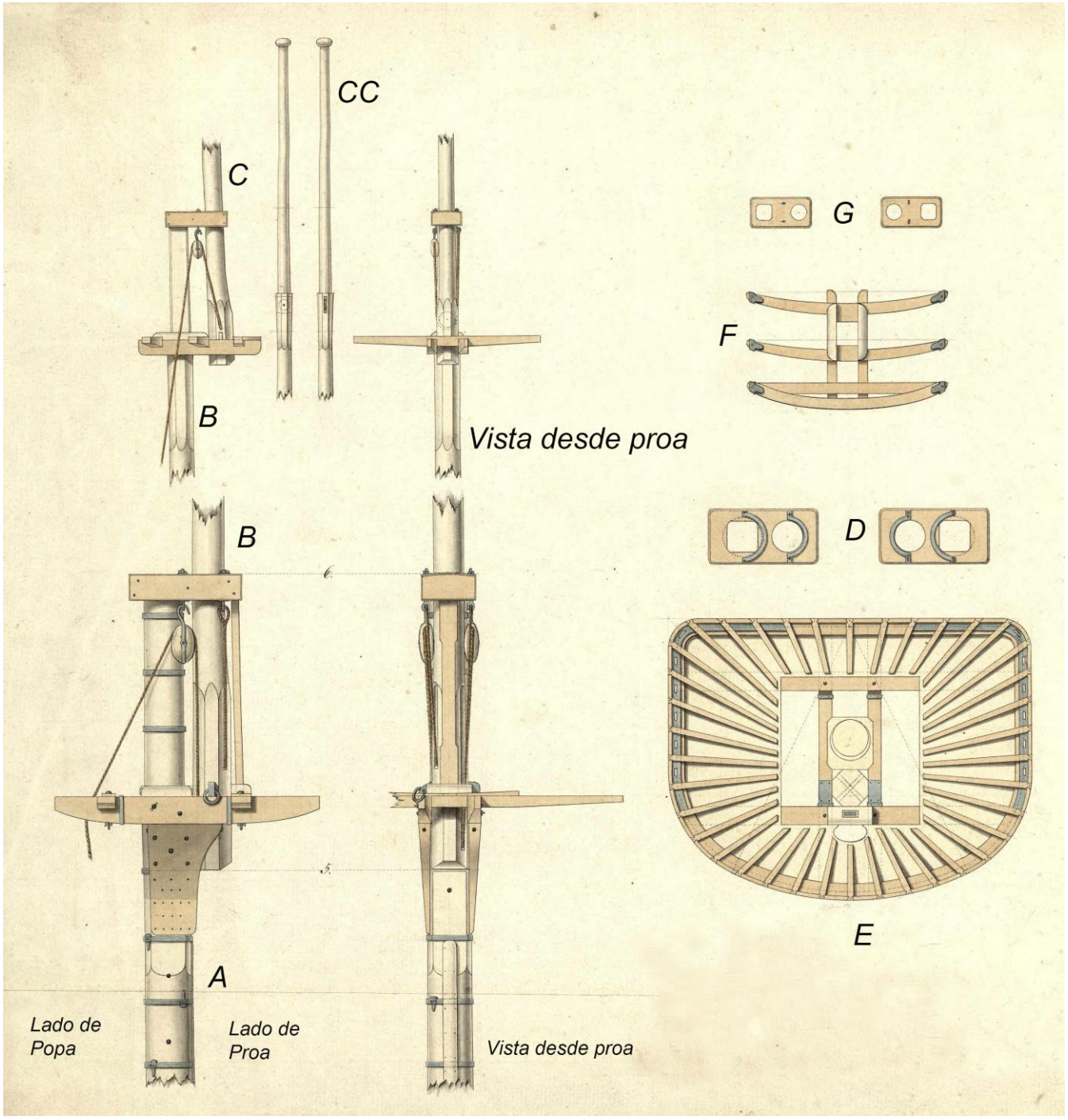

Image 18. Image where the following parts of a mast are represented: (A) Male mast; (B) Mast; (C and CC) Mastelrillo; (F) Baos and spreaders; (D) Tamborete major; (G) Topsail drum; (E) crow's nest.

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7.1. Los topmasts

The masts of the large sailing vessels are not one piece throughout their length, hence their division into three or four parts, each of these parts has a different name depending on the level of height it occupies with respect to the main mast. The first part of the mast is called the main, which as we have already mentioned would be the foremast, mainsail, mizzen and the bowsprit that comes out of the bow. On the male poles and once the elements of the neck have been placed, that is to say, the spigots and all the elements that allow the top to sit, it is attached to the spike at the upper end of the pole, the drum has two holes, one square and the other circular. The first is used to fit the drum into the wick or spike at the end of the mast and the circular or wolf's mouth towards the bow is the passage of the topmast, this circular hole coinciding with the hole made with the beams and spreaders. is.

When fixing the topmasts, it is done in phases, the first is the main topmast and then the installation of the topgallant mast, in the case of the mainmast.

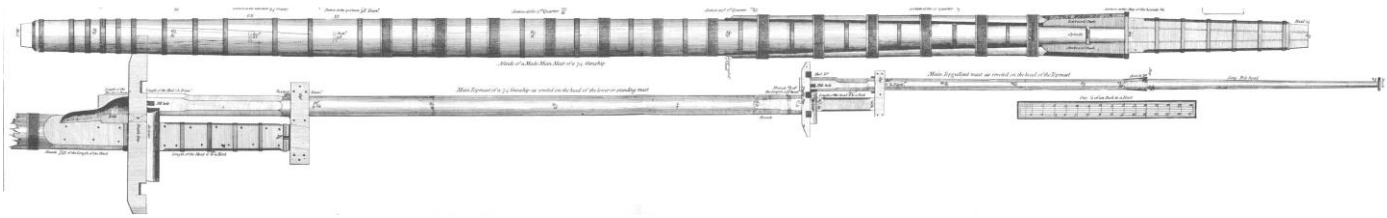

Image 19. Armed and strapped male mast in the upper part of the drawing, chocks of the male mast, greater topmast and Greater Juanete Mastelerillo (steel, 1794).

7.2. The tamboretes

A fundamental piece in the installation of mast and mast mast with drums, mainsail and topsail. The material used was elm and later mahogany, the topsail being made in one piece and the largest in two.

Of its two holes, one is the partners, the circular one, which was generally lined with leather, according to Vallarino (1868, p. 167), allowing the topmast to pass through the partners. The other hole that is located towards the stern once placed, is quadrangular and through it the spike of the mast or topmast is inserted, thus remaining fixed.

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To make the tamborete mayor, the pieces were made meshed to link between the two, being subsequently nailed with riveted bolts and reinforced with two iron bands (Vallarino, 1868, p. 166).

There is another use of the tambourine voice that we explain to avoid your confusion. In smaller vessels such as luggers, this piece is at the foot of the foremast so that the bowsprit of these vessels rests, as specified by Timoteo O-Scanlan (1831, p. 228).

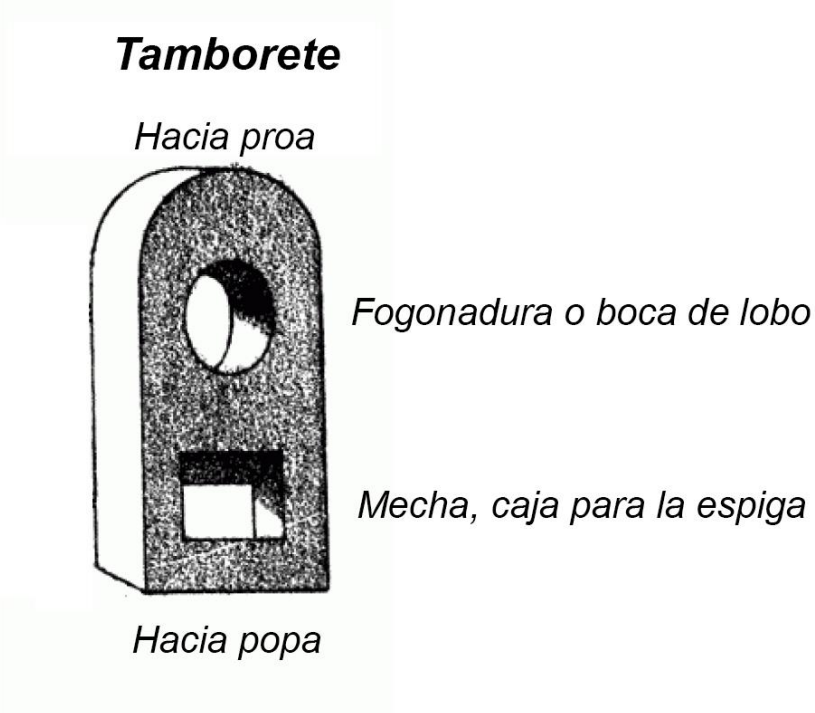

Image 20. Representation of a tambourine (Vallarino, 1868, 27)

7.3. Dress the masts

To dress the male masts in their location, maintaining their perpendicularity, rivets, garrison tables and stays are used. This set dresses and allows the masts to withstand the push of the wind on the sails and the treatments that the sea submits to the boat and that extends the masts with nods and other movements. Its installation requires an order and protocol that varies according to the time and construction nation, but in the end the result of the set is practically the same in all nations.

7.4. Garnish tables

Made of thick planks arranged horizontally along the sides of the ship, in numbers of two per mast, one on each side and with its forward edge coinciding with the rear part

of the mast or the aft face, in this way the shrouds are from the mast towards the stern of the ship.

Its placement has varied according to the construction period, but not its position with respect to the masts, the variation in height with respect to its position on the hull has not been excessive since the objective was always the same, to prevent the shrouds from rubbing against the gunwale of the ship and that they had a wide enough angle to give greater stability to the mast they hold.

The fixing of the tables is done through some curvatones above and below the tables that make up the table, sometimes being about four on its upper face and two on the lower and finished with bolts that go through its entire thickness.

Image 21. Image that represents the garrison table, the table's bolts and the rivets. In this image we can see that the curves that are usually placed under the garnish table have not been represented. Description: (A) Garrison table joist; (B) Deadbolt of the shrouds; (C) Garnish table; (D) Shrouds (Navarro, 1995).

The joists of the garrison table are attached to them, one for each end of the shroud, placed along the outer edge of the table and fixed with chains to the side straps.

The lower end of the chain is attached to the ribbon and at its upper part it is attached to an iron hoop or ring that embraces the beam of the table at its upper end. To finish off the garnish table, a reinforcement or "chain guard" is placed on the outer edge of the table, covering the chains and protecting the edge of the table.

Above the beams of the table are the beams or blocks of the shrouds that are embraced or surrounded by the end of the shroud that corresponds to each one. These two monotes are joined through ropes that are called lanyards and that serve to tighten the shroud, so that later, once tightened, the excess is wound on itself, securing the rope.

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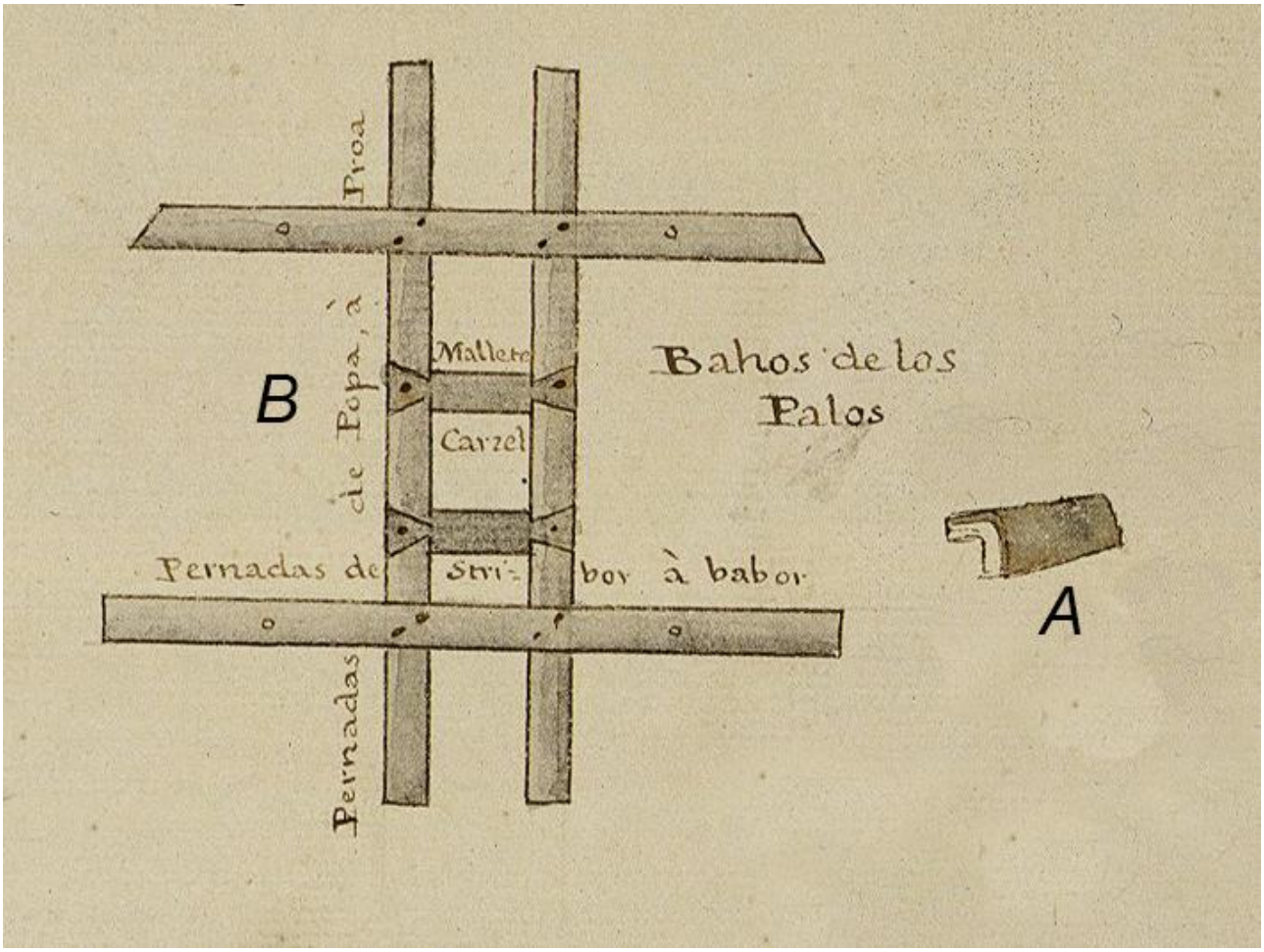

Image 22. Representation of the following elements of the rigging: (A) Pillow, which is placed on the outer edge of the beams to avoid damage to the shrouds due to chafing; (B) Representation of the beams, ridges and cross braces for the settlement of the top (Navarro, 1995), sheet 42.

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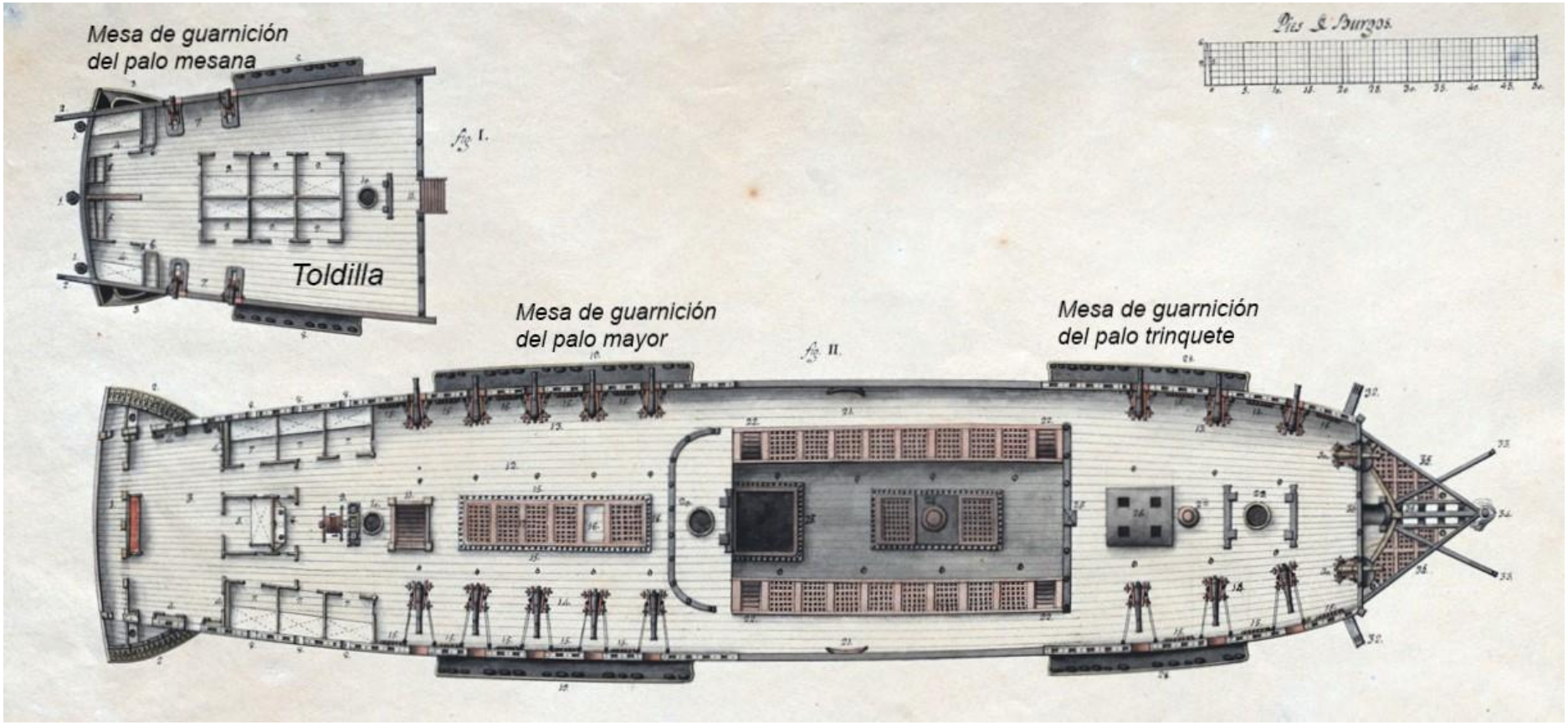

Image 23. Representation of the position of the garrison tables with respect to the masts. Plano del Museo Naval de Madrid. Signatura MNM PB 0.

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7.5. The mesetas

They are smaller garrison tables than those of the main masts and the boats that carry them are usually fixed to the stern of the mizzen garrison table and serve "to fix and tighten on them the topsail topsails' flagpoles, the rough of the bunions, the scantlings fixed in the interior part of the ship and ropes of the maneuver" (O-Scanlan, 1847, pág. 75).

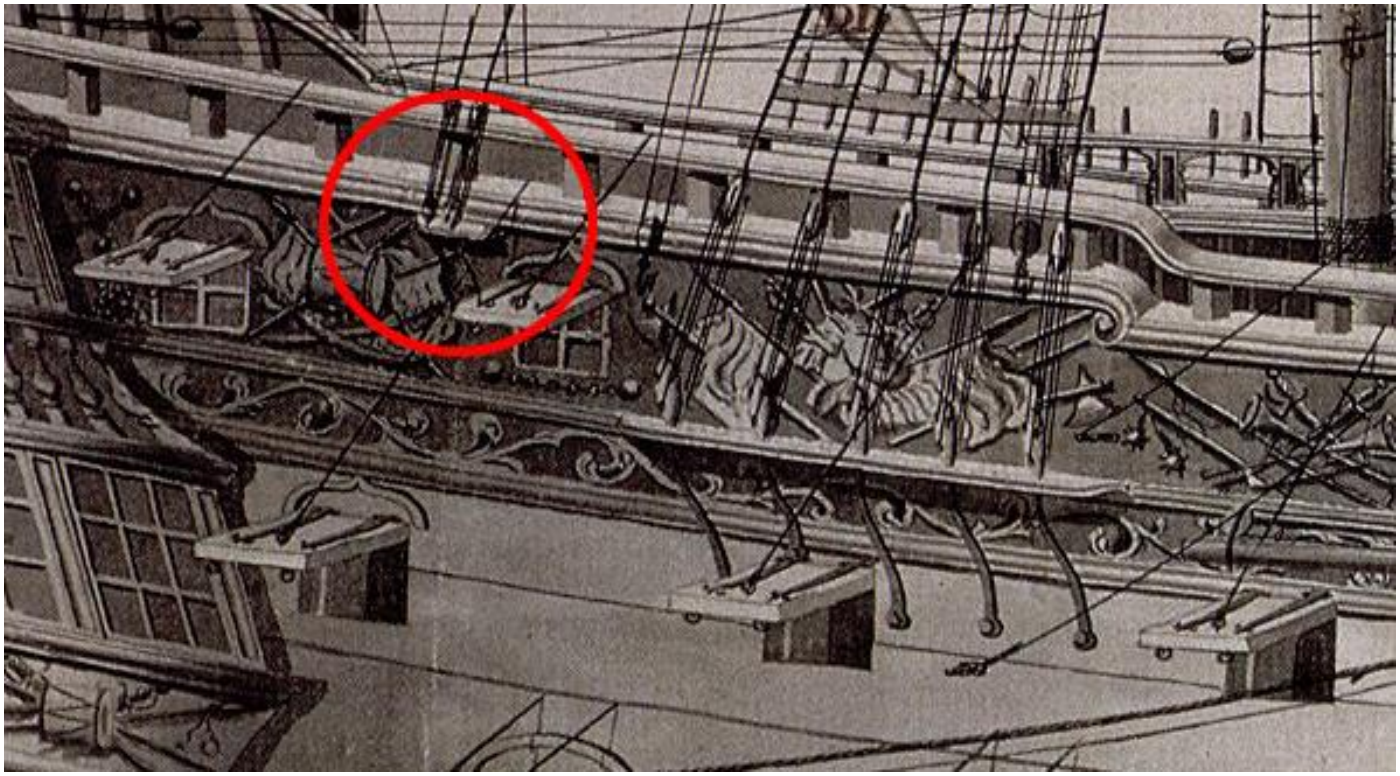

Image 24. El circle in red indicates the location of the meseta (Navarro, 1995)

7.6. The shrouds

They are a group of thick ropes or shrouds made of vegetable fiber, generally hemp, they are used to hold the masts and topmasts firm, from their heads to the trim tables in the case of the masts or to the top in the case of masts. of the topmasts. The placement of the shrouds is carried out on both sides of the mast, hence the importance of the order in the placement of the shrouds when introducing them through the wedges of the male mast.

To make the capping of the shrouds, they are first cut to the size that corresponds to them, making even and simple shrouds if needed.

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Once the shrouds have been cut to size, they are prepared for entrainment, sealing and finally they are lined up, always keeping the end fixed and as tense as possible.
Entrain: A meollar is introduced in the holes of the cords so that the surface of the rope is equalized, see figure 7 of the image 24.

Sealing: In this action, the rope is wrapped with a strip of canvas used to prevent water from penetrating and preventing moisture from deteriorating and rotting the rope, serving at the same time as the base of the lining.

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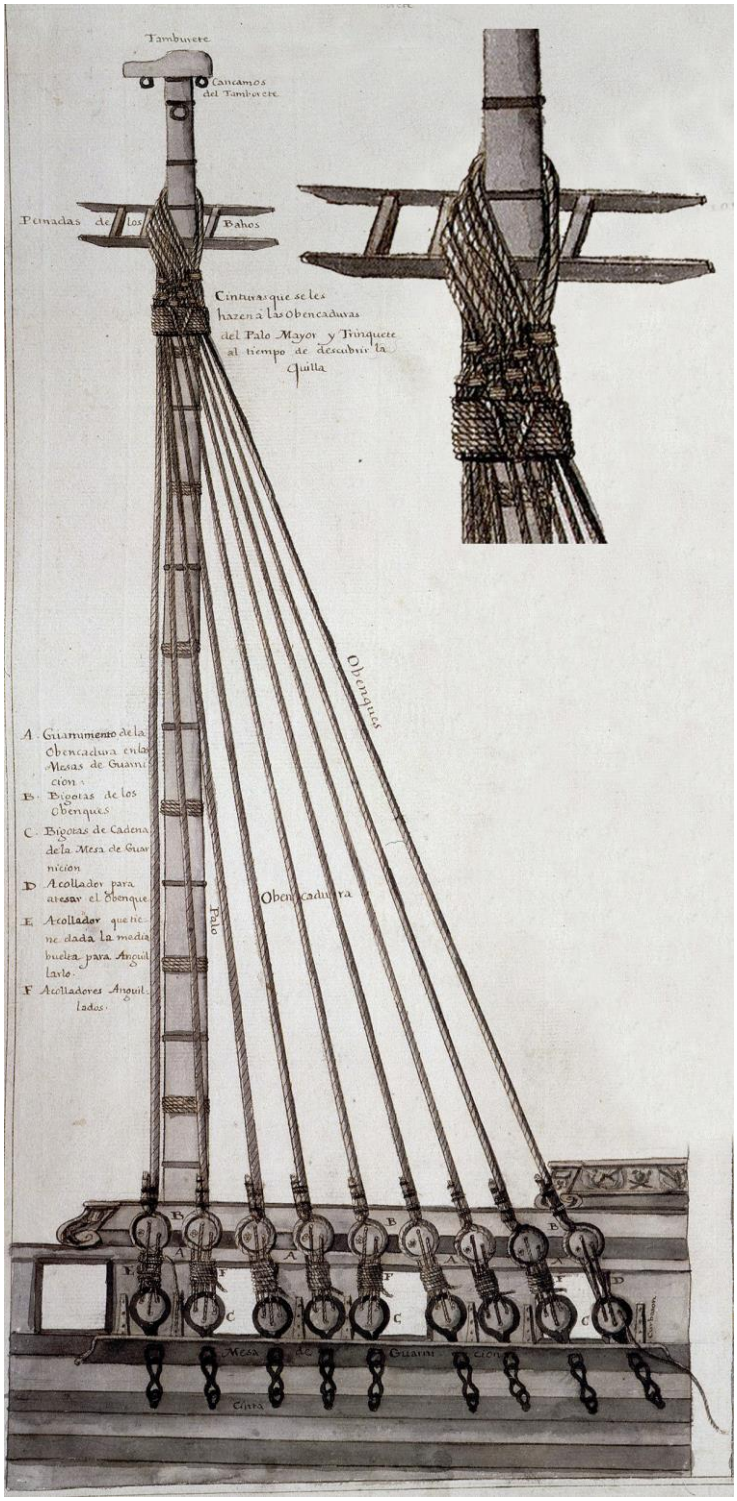

Image 25. Representation of the grommet of the male mast fixed from the shims to the grommet of the grommet joined with the grommet of the garrison table. In the upper right part it is observed how the shrouds are placed in the chocks (Navarro, 1995).

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Lining: To line the rope, a meollar is used, which is used by turning the rope with the pot to line the rope tightly and together. Sometimes it is wrapped after wrapping and sealing the end, but this is not always the case, there are times that it is wrapped first and then it wraps without having to seal.

The number of shrouds will depend on the dimensions of the ship, they can have nine or up to eleven, if so, one of them is simple, although the term simple is more used in the merchant navy than in the war navy (Vallarino, 1868, page 142).

Once the rope is cut to size and prepared, a ligature is made by making a turn and joining one part of the rope with another to leave a hole called "cap" and then pass it through the shims, holding the shroud hanging in this way. at the top end of the mast.
This union is normally done with a grooving machine, although it can also be done by hand with various techniques that, in a certain way, solve the lack of the machine.

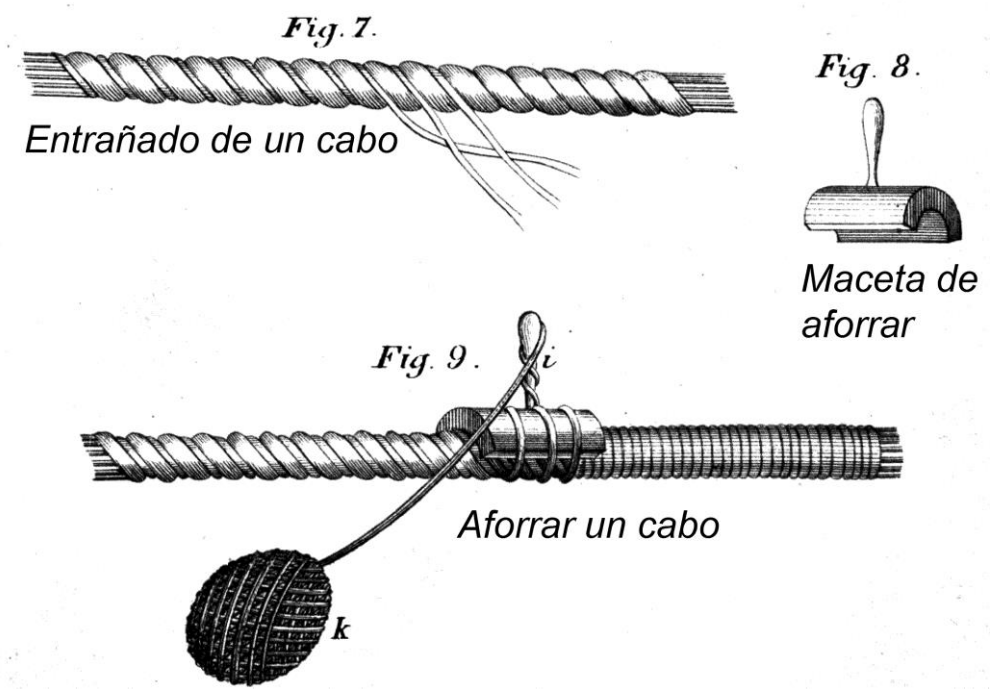

Image 26. Drawing that represents the techniques of entrapping and lining (Vallarino, 1868).

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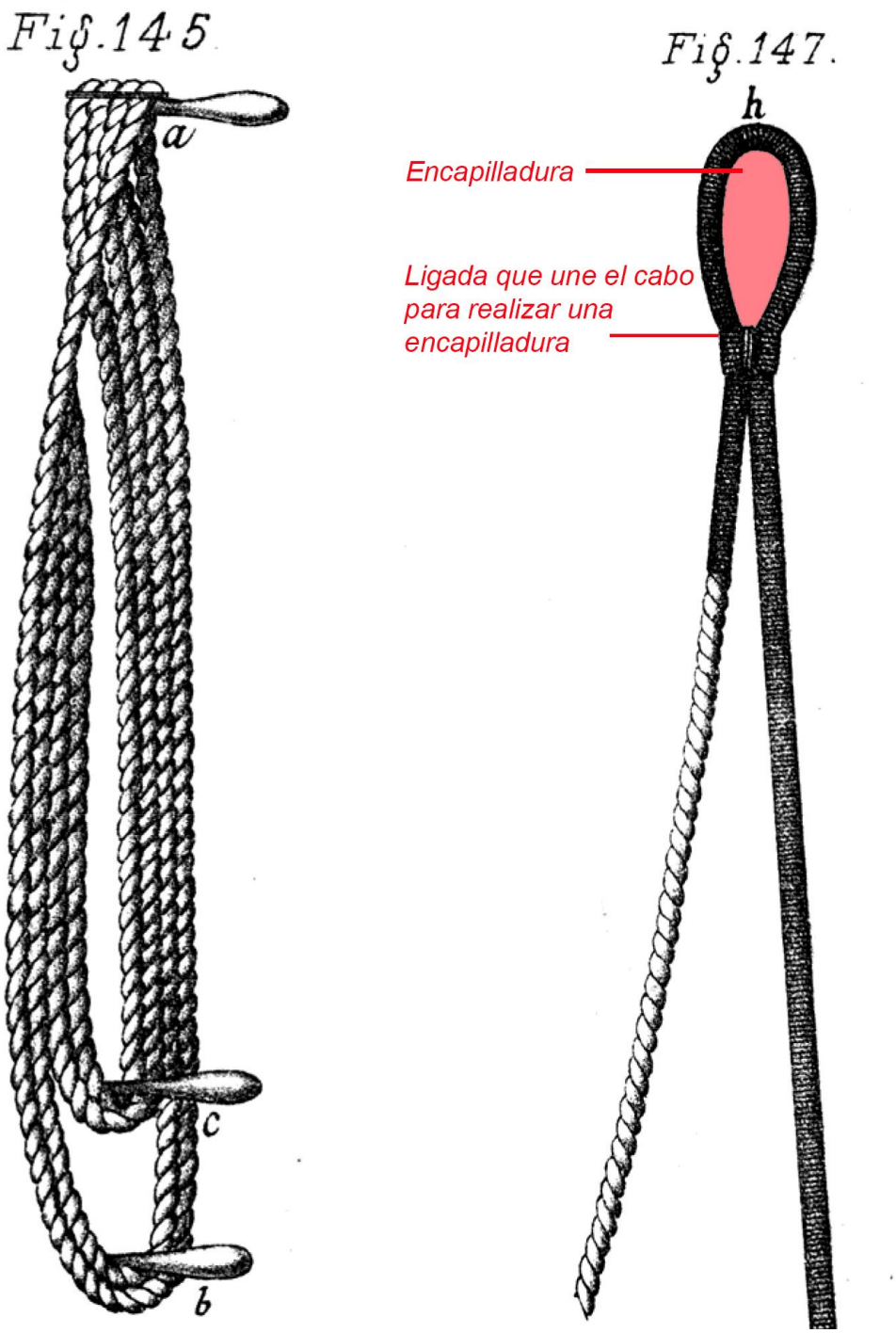

Image 27. Fig. 145 shows the technique for cutting shrouds to size. In fig. 147 shows how a double shroud is made, generating two ends when making a ligature and generating the hood when joining the end once one turn has been made. (Vallarino, 1868).

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As we have mentioned, the shrouds are inserted through the wolf's mouth of the crest already installed to reach the chocks with the hood and, introducing the shroud, it is seated on the beams, supporting its descent towards the garrison table on a wooden block called a pillow, thus avoiding friction with the edges of the wood and its deterioration.

The shrouds that dress the masts can be even or single, it all depends on how the tie is made to the end to form the hood, as can be seen in image 28.

As a general rule, when pouring the masts with the shrouds, start with the single on the port side, and then continue with the single on the starboard side.

In the case of the even shrouds, they are placed in the same order, first the port side and then the starboard side, placing one on top of the other.

In the case of the main pole, the procedure is similar to the ratchet pole with some variations. In this mast, like the ratchet, it begins with the simple shrouds and continues with those that are even, only this time they begin to be placed on the starboard side. In the case of the mizzen mast, it is dressed in a similar way to the ratchet mast.

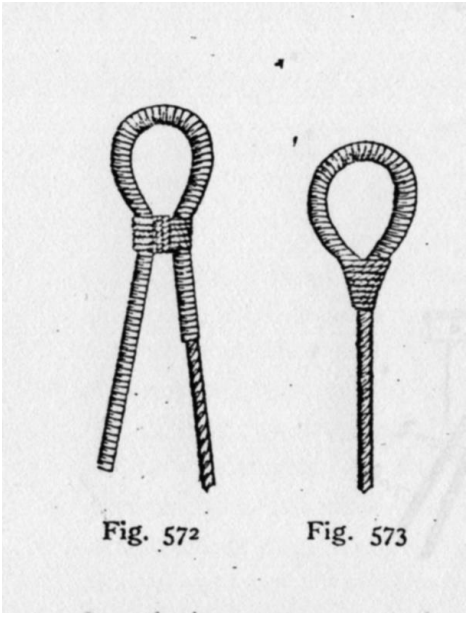

Image 28. The drawing on the left represents a "pair" shroud and the one on the right a simple one. Both with their ligatures and capping to go through the wedges of the mast (García de Paredes y Castro, 1925, pág. 391).

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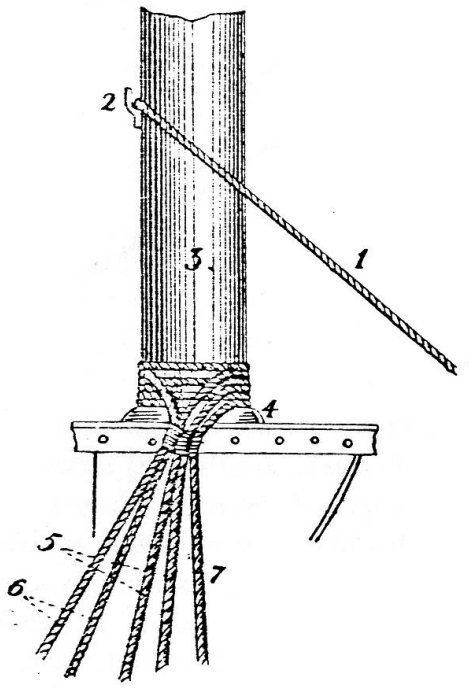

Image 29. Upper drawing: the placement of the shrouds in the ratchet wedges is represented, leaning on the pad that is fixed to the beams in their descent towards the garrison tables (García de Paredes y Castro, 1925, págs. 392-393).

The image, upper part, shows the placement and order with which the shrouds are normally placed as they are introduced through their ridge by the chock. We observe that they are placed one on top of the other, towards one side and the other of the ship.

Description of the image above:

1. Chocks of the ratchet mast.
2. Tojino to fix the stay.
3. Ratchet stay.
4. Pillow.
5. Single port shroud.
6. First pair of port shrouds.
7. Second pair of port shrouds.

Description of the following image, of the main mast (García de Paredes y Castro, 1925, p. 393):

1. Stay.

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2. Tojino stay.
3. Chocks of the mainmast.
4. Pillow.
5. First pair of starboard shrouds.
6. Second pair of shrouds to starboard.
7. Starboard single shroud.

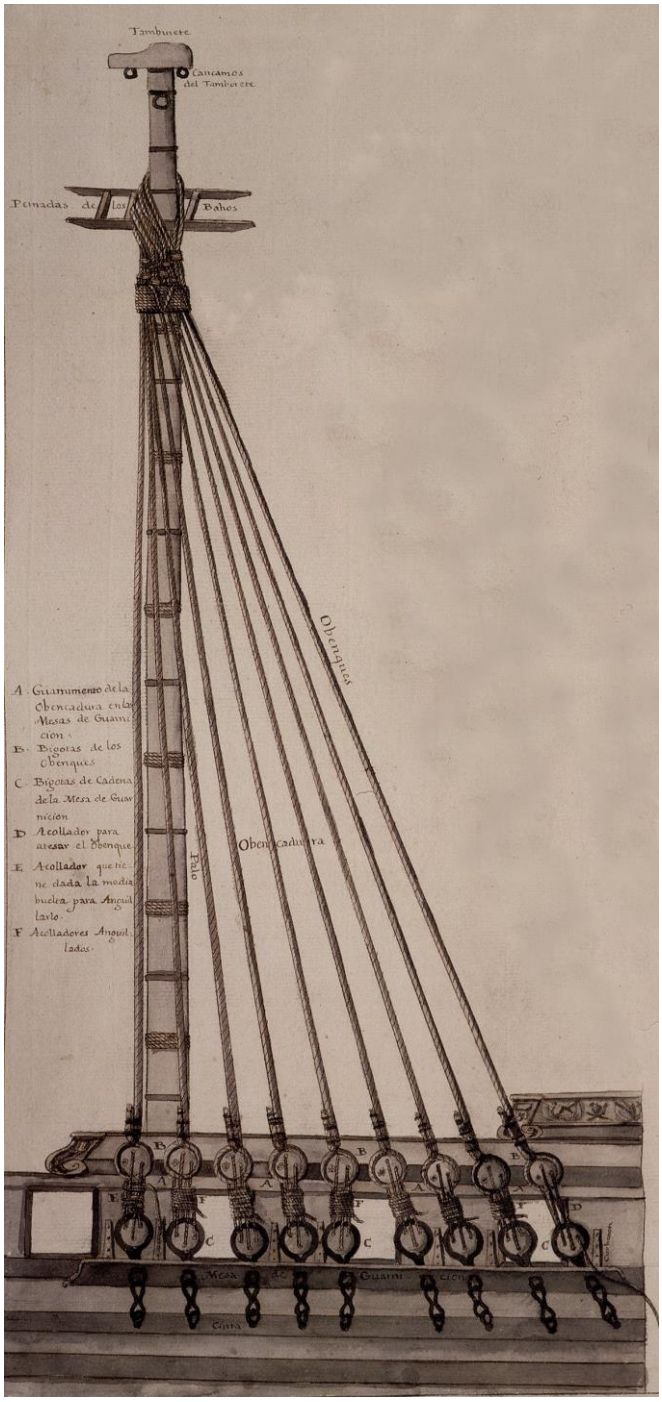

Image 30. Image that represents the shroud already hooded on the port side, being ready to make the arrow (Navarro, 1995, pág. Lámina 69).

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When it comes to dressing the macho masts, a series of rules are generated that, depending on the country and the moment, were carried out in one way or another, although possibly without great variations, one of them being the one described in 1925 (García de Paredes y Castro , pp. 392-393).

1st. In the foremast and mizzen, the shrouds are first capped or introduced through the upper part of the chock through its capping, on the port side. And on the starboard side in the case of capping the mainmast.
2nd. When there are even and single shrouds, the single is always capped first.
3rd. The stay is capped once the simple shroud is in place,
4th. A shroud is always placed on top of the previous one, alternating the bands (one to port and the next that is above it to starboard) and starting with the bow.

7.7. The flechadura

Once we have tightened or tensioned the rigging that we have affirmed, we have to sew or place the ratlines from shroud to shroud. They are ropes that allow you to climb the shrouds as if they were steps.

In the lower part and near the shroud beams, a rigging guard is placed, in the direction from bow to stern, making the rigging or rigging table more firm and, most importantly, to keep the shrouds always at the same distance.

The swing that is used for the rattails has an ore of 30 or 40 mm thick, it has to be working or giving of itself as much as possible, to prevent it from yielding and loosening once placed.

The stitching of the ratlines begins in the forward shroud, that is, the first one that is furthest forward, and the aft or last forward shroud ends. The cape, core[2] or oscillation, which is used as an arrowhead, is lashed in the proel shroud and passes to the next one making a clove hitch, turn or cross mooring on the outside until reaching the popel or popés shroud, where a loop is made with its whip[3] and fixed with a string[4]

[2] The meollar, is a fine rope that is made up of two and sometimes three filastics that are usually extracted from the rigging that is waste and tar. The most widespread use of this cape is ligatures, although it is also used for lining.
[3] When a loop is made, it is the circle or space that is generated with a rope by folding it on itself and joined with a ligature or tie.
[4] Thin rope used for lashing.

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or merlin[5] to the shroud This operation is carried out until reaching the top of the vent with a distance of about 35 cm from one to the other, leaving the vent as a ladder to climb to the top, as shown at next image.

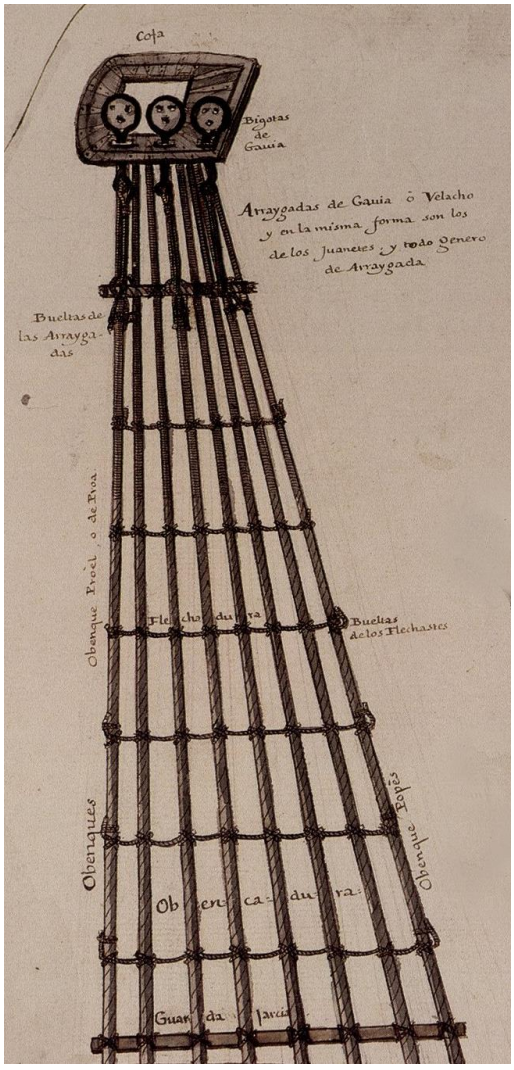

Image 31. Image that represents a shroud with the arrow already sewn. We can see in the lower part of the drawing the rigging guard, which is a wooden strip sewn to the rigging (Navarro, 1995, pág. Lámina 69).

[5] The merlin, less thick rope than the swing made with three cords of two filastics each. Its diameter ranges between 6 and 15 mm, and it can be white, which is called sardineta or tarred, being used the same as the string. (Asesores técnicos: George P.B. Naish, 1982)

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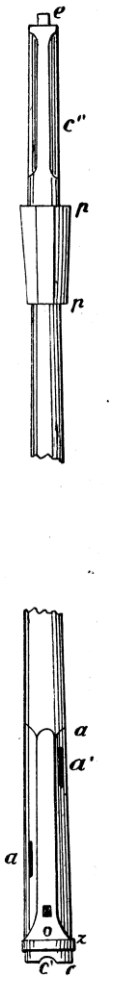
8. Dress the topmasts

The top masts are one-piece smaller masts with a circular section in most of their extension and installed on the male masts to be able to hold the yards with their respective sails, and their fixing on the male masts is done through the drums and tops.

8.1. Topsail topmast

It is the first mast that is fixed after the male masts and, like the main masts, it has different parts that we describe below. (García de Paredes y Castro, 1925, pág. 284).



Description:

c) Lower part of the mast with a square section and reinforced with an iron band.

z) Iron band.

c`) Channel for the passage of the baticle above the band.

o) Rectangular hole for the passage of the wedge.

a, a`) Pockets with their pulleys where the turners will pass.

a) Cylindrical part of the topmast.

pp) Cacholas that serve as a seat for the crosshead.

c``) Part of rectangular section which is called calcés.

e) Square section spike where the topsail drum is inserted.

Image 32. Drawing with the parts of a mast (García de Paredes y Castro, 1925, pág. 284).

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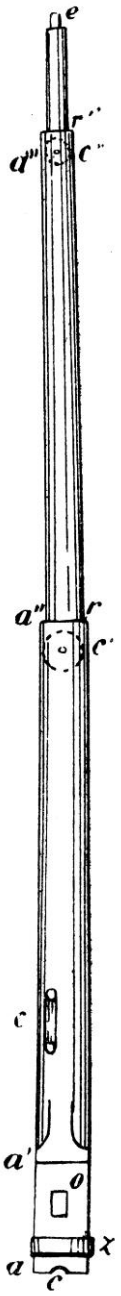
8.2. Bungalow or top mast

It is placed after the topsail mast and joined through a spreader, wedges and topsail drums. They serve as support and orientation of the bunion yards and on, in the following paragraph their description is made (García de Paredes and Castro, 1925, p. 285).



Descrption:

aa`) Square section of the mast.

z) Iron band to give strength to the mast base.

o) Square mortise for the passage of the wedge.

C) Channel for the passage of the baticle.

a` a``) Cylindrical section that has a pocket in its lower part.

c) Pocket with roller to give way to the turner.

c`) Pocket with sheave oriented from stern to bow so that the lifeline or stem of the envelope halyard passes.

r) Cylindrical part with a smaller diameter than the lower part.

r``) Cylindrical part with a smaller diameter than the previous part or (r).

c``) Pocket with roller.

e) Spike, although the portion of the topmast from the projection r` to its end is also called a spike.

Image 33. Bunion top mast details (García de Paredes y Castro, 1925, pág. 285).

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8.3. Fixation of topsail and topgallant masts

On the topsail mast a crosspiece is fixed over the beams bolted to the mast. Like the top of the main masts, the crosspieces have grooves on both sides for the passage of the shrouds.

Once the pillows are placed in the topmast chock, the rigging of the rigging begins, the topsail shrouds are placed and they are "ridged alternately". First a starboard pair, then a port pair, etc." (Vallarino, 1868, p. 177).

With the topsail topmast shrouds, we proceed to place the drum that will serve for the topgallant topmast and then place its spreader and shrouds to finish fixing the masts by means of the stays.

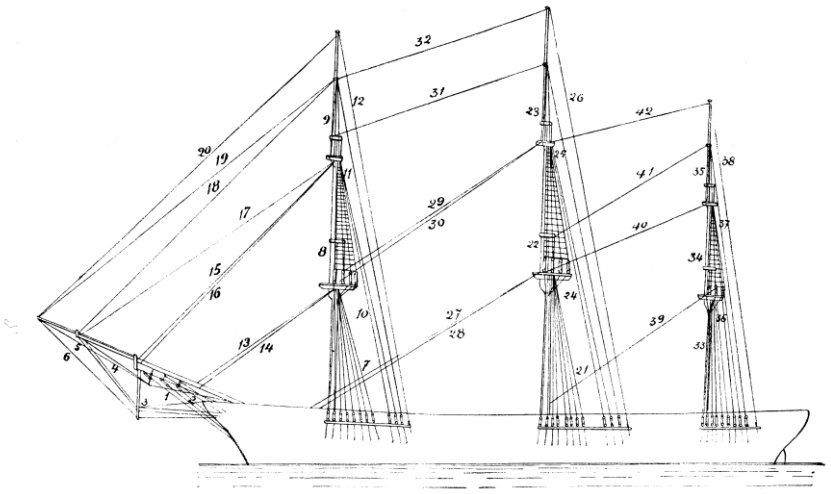

Fig. 443

1. — Barbiquejo del bauprés.
2. — Mostachos.
3. — Vientos del moco.
4. — Jarcia del botalón de foque.
5. — Vientos del botalón de petifoque.
6. — Frenillo.
7. — Tabla de jarcia del trinquete.
8. — Tabla de jarcia de velacho.
9. — Obenquillos de juanete de proa.
10. — Burdas de velacho.
11. — Burdas de juanete de proa.
12. — Burdas de sobre de proa.
13. — Estay de trinquete.
14. — Contraestay.
15. — Estay de velacho.
16. — Contraestay.
17. — Nervio del foque.
18. — Estay de juanete de proa.
19. — Nervio del petifoque.
20. — Estay de sobre de proa o de galop.
21. — Tabla de jarcia de la mayor.
22. — Tabla de jarcia de la gavia.
23. — Obenquillos de juanete mayor.
24. — Burdas de gavia.
25. — Burdas de juanete mayor.
26. — Burdas de sobre mayor.
27. — Estay mayor.
28. — Contraestay.
29. — Estay de gavia.
30 — Contraestay.
31. — Estay de juanete mayor.
32. — Estay de sobre mayor.
33 — Tabla de jarcia de mesana.
34 — Tabla de jarcia de sobremesana.
35. — Obenquillos de perico.
36. — Burdas de sobremesana.
37. — Burdas de perico.
38. - Burdas de sobreperico.
39. — Estay de mesana.
40. — Estay de sobremesana.
41. — Estay de perico.
42. — Estay de sobreperico.

Image 34. System through stays, against stays and shrouds for fixing the rigging (García de Paredes y Castro, 1925, pág. 276).

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9. Sails

The canvas is the main element for the realization of the sails of a ship and the strength and endurance of this material is determined to be used according to the work of the sail. This means that not all sails are the same, using the strongest ones where their work and resistance to the wind is greater and the weakest ones in the case of less effort. In the art of rigging, a scale is used to determine the strength of the canvas, with No. 1 being the strongest, decreasing from this number to No. 8, which would be weakest (Lever, 1842, p. 100).

The sails are made with canvas, but they are not one piece in the shape that the sail should have. To make a sail, strips of canvas are used that are called cloths with measurements that range between 0.58 m wide by 50 or 42 m long (Baistrocchi, 1952, p. 124). According to the 1904 regulation, the panels had to be 40 m long and 580 mm wide, weighing between 15 and 22 kg approximately, depending on the material (García de Paredes y Castro, 1925, pp. 344-346).

This weight is related to the type of material used to make the canvas cloths, which could be linen, hemp, and cotton.

The use of one material or another is mostly marked by the size of the ship, with hemp being used in the larger ones and cotton in the lateen ones and hemp in the auric sails (gaff sails) due to the rigidity that They must have.

In the case of the use of linen, it produces softer, more attractive canvases, but they deteriorate sooner with the effect caused by humidity, and are also less resistant than cotton ones.

9.1. Making of sails

As we have already mentioned before, the sails are made with canvas cloths, these cloths are sewn together with seams. The way to sew them is by mounting one cloth over another between 2 and 5 cm, depending on the sail, calling the part where the two cloths are assembled seam, sewing the edge giving the so-called sheath point.

Next, the sail is inverted and the same operation is carried out on the other side, making the so-called overstitching. The sewing is done with a separation that between 150 or 160 stitches enter one meter of seam (Baistrocchi, 1952, p. 127).

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The rope that is used is tarred and has to be of good quality, being much less flexible than ordinary rigging, although it must be taken into account that it has to allow the undulation of the sail, thus avoiding that they have to be rigid.

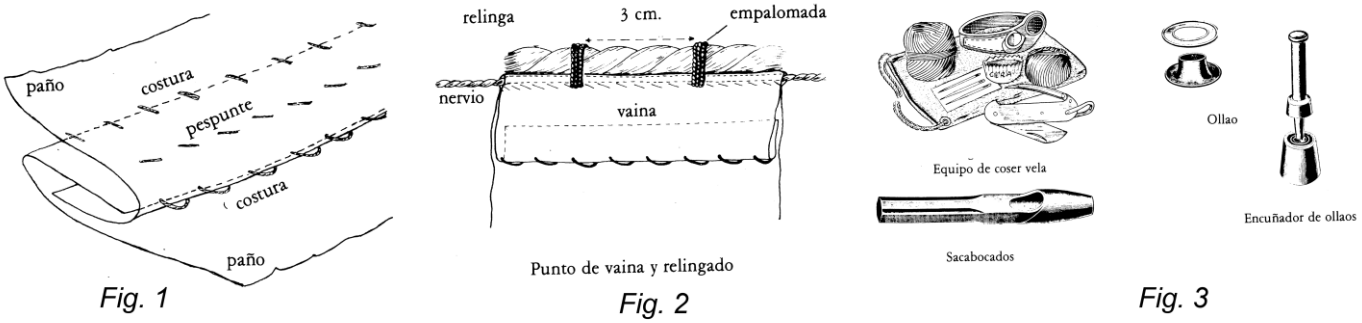

Fig. 1 Fig. 2 Fig. 3

Image 35. (Fig. 1) Drawing that represents how the panels are placed to make the seam between them; (Fig. 2) Drawing where we appreciate the anchor rope with its elements; (Fig. 3) Different tools used for sail making (Bautista Costa, 1983, págs. 278-279).

Nomenclature for about the sails factory

Lunation. It is the curved cut that receives the foot in square or round sails, having its concave part towards the bottom in order to avoid this sail rubbing against the stays.

Beater. Reinforcements sewn into the round sails on the side facing the stern in order to avoid rubbing against the masts.

Stitching Union of one canvas with another using a thin rope passing through the eyelets, called step (Bautista Costa, 1983, p. 277).

Knockdown In round sails, an oblique cut or knockdown is made so that the lower side or pujamen is longer than the upper or luff.

Envergues. They are pieces of small ore ropes called meollar or merlin that are used to secure the luff cuffs to the sail ribs: an example that Baistrocchi exposes is the two envergues that are used to firm the luff cuffs are the grips (1952, p. 125).

Garruchos. When the thimble is not made with a metal ring, it is called pulley, and it is also a ring that is made with the ropes so that two eyelets are made in the sheath of the sail to make way for the cord with which the pulley will be made (Baistrocchi , 1952, p 125).

Keys. They are some crossed stitches that are made on the head ropes when they are not stilted.

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Bowline poas It is a rope that is joined by its whips and creating with its bosom some pulleys for the fall ropes.

Reling. It is the line that is stitched against all sides of the sail in order to provide more strength to the sail.

In the stable sails the headrope is made in two parts: the first one that is made on the drops and luff, the second being on the foot. The headrope is finished off with a thimble for each cuff with a metal ring to be finished as shown in the drawing on the right of Image 37.

Takers. They are the common ends of cajeta that are used to hold the sails.

9.2. Clasification of the sails

Sails can be of two types: the first is quadrilaterals, which in turn are subdivided into three other types of sails such as quadrilongas, symmetrical trapezoids, also called square or round, and trapezoids such as gaffs, also called auric.

Finally we have the triangular ones that are the sails that we commonly call latin and knife. Within the triangular knife sails we have the staysails and the jibs.

In the golden age of sailing in the "ratchet mast, trailing topsails and topsail and topgallant wings were worn, and on the mainmast, topsail and topgallant wings" (García de Paredes y Castro, 1925, p. 349). This practice was in disuse since the second half of the 19th century.

In the 19th century, the option of dividing the topsail and topsail sail in two was devised, in order to avoid taking the reef strip. Taking the reef strip, allows to reduce the surface of the sail from the strip and by dividing the mainsails in two, a risky maneuver is avoided, especially with rough seas or strong storms.

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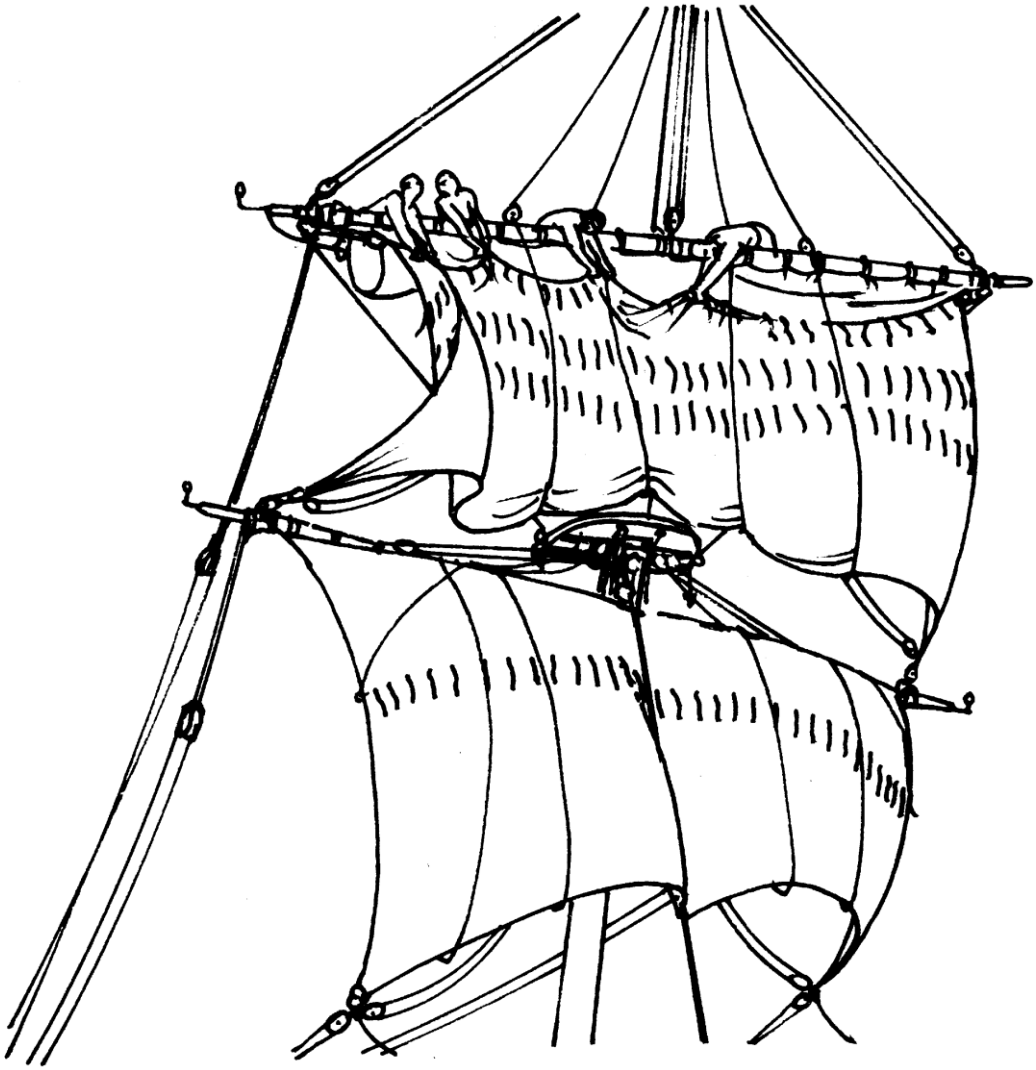

Image 36. Reefing or reefing maneuver to reduce the surface of the unfurled sail to the wind (George P.B. Naish, 1982, pág. 222).

Palo trinquete

1. Vela Trinquete.
2. Velacho bajo.
3. Velacho alto
4. Juanete de proa.
5. Sobre de proa.

Palo mayor

6. Vela mayor.
7. Gavia baja.
8. Gavia alta.
9. Juanete mayor.
10. Sobre mayor.

Palo de mesana

11. Sobremesana.
12. Perico.
13. Sobreperico.
14. Sosobreperico.
24. Cangreja.

Bauprés

15. Contrafoque.
16. Foque.
17. Foque de fuera.
18. Perifoque.
19. Foque volante.

Velas de cuchillo

20. Vela estay sobrejuanete mayor.
21. Vela estay juanete mayor.
22. Vela estay sosobreperico.
23. Vela estay sobreperico.

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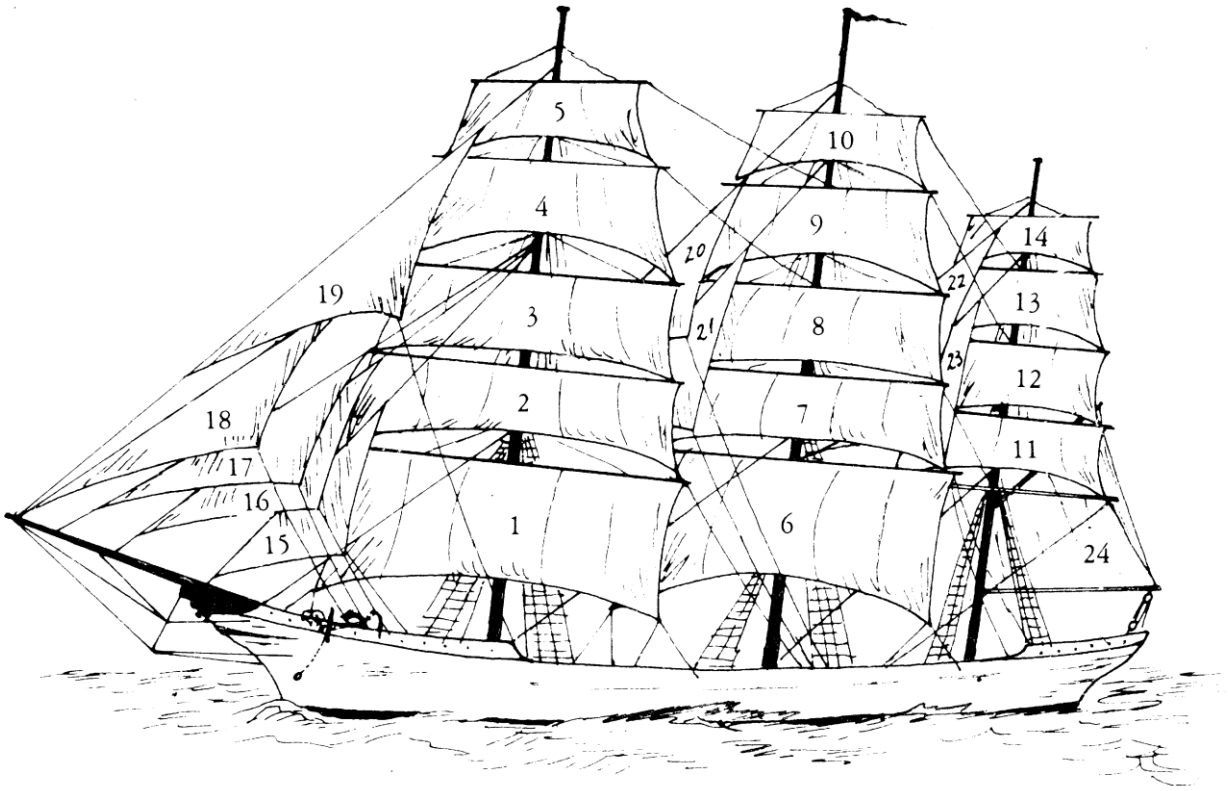

Image 37. Drawing that lists the sails of the last great sailboats, this type of rigging being "double topsails". In this way the topsail is divided into two being the low topsail and the high topsail in the case of the mainmast. (Baistrocchi, 1952, pág. 122).

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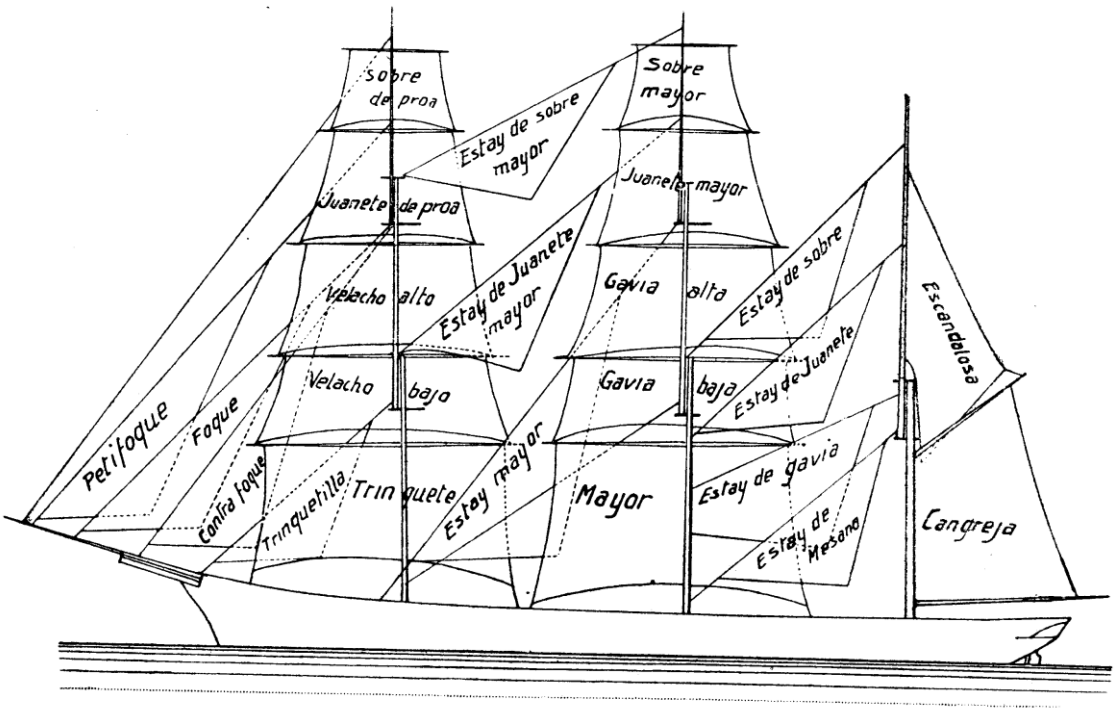

Image 38. Sail names of a frigate-rigged ship. Note that it is not like the previous drawing a double topsail rig. In this case the rig is not a double topsail, the topsail and topsail being integral (García de Paredes y Castro, 1925, pág. 349).

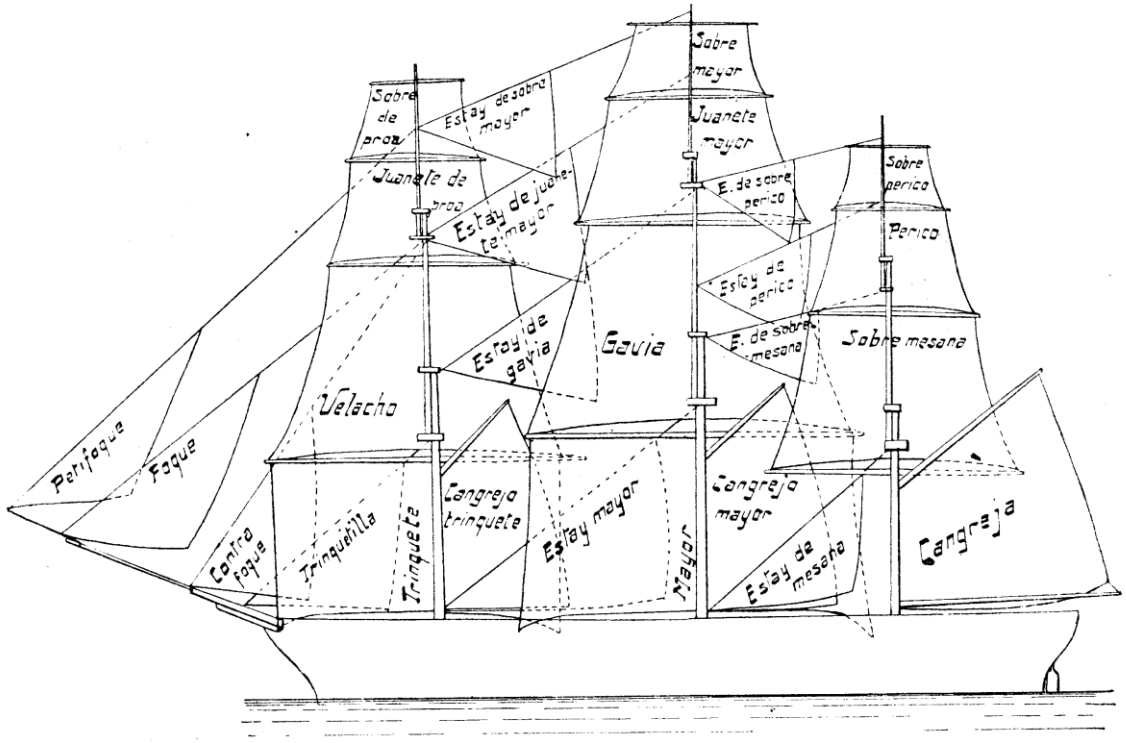

Image 39. Vessel with bric barque or corvette rig, with double topsails, gaff and scandalous on the mizzen mast (García de Paredes y Castro, 1925, pág. 350).

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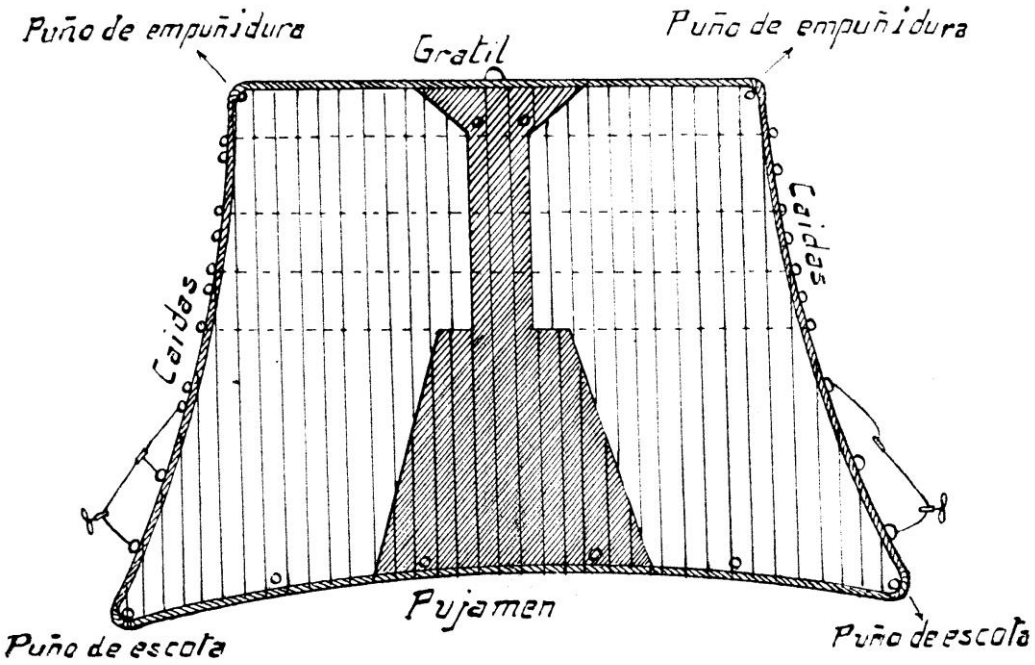
9.3. Sides and angles of the sails

The round sails. They are the ones that are fixed on the yards, they are also called stables, since due to their square shape they have four sides, each one of them having a different name.

The upper part that is fixed to the yard is called the luff, the lower part of the sail is called the foot and the sides or lateral falls.

The fists of round sails are the four angles that the sail has, which are called according to their position. To the top two or top of the sail, clew and the bottom two or bottom, clew.



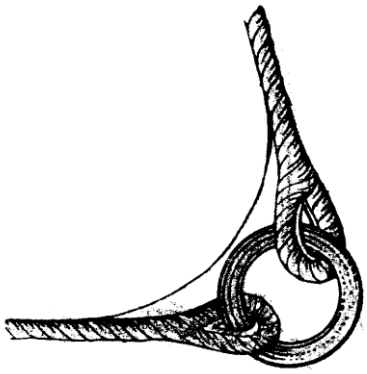


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Image 40. The upper drawing shows the name given to the different names of the sides of a square or round sail and the lower one shows the detail of how the sail ends at its ends through the clew according to the moment in which García de Paredes publishes his job (1925, pág. 351).

Knife sails. They have three and even four sides, they are arranged longitudinally, unlike the round ones they are not fixed on the yards, they are spread on the stays, peaks, masts or ribs.

Three-sided knife sails. When it has three sides, these are called as follows: luff or bow drop to the side that is towards the bow, pujamen or beater the lower side of the sail and the last one that is towards the stern, leech or stern drop, as shown in next image, figure 1.

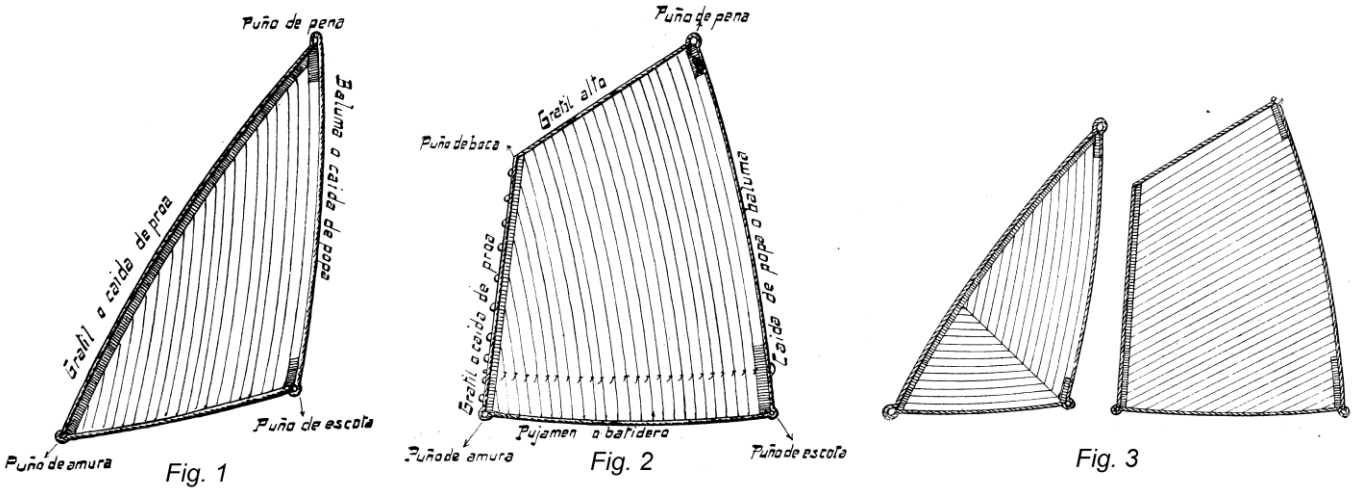

Image 41. Drawings depicting types of triangular or knife sails. In figure 3 we see the direction in which the sail cloths are sewn and its variants according to the type of sail (García de Paredes y Castro, 1925, págs. 351 - 352)

The fists on the lower or lower sides of the knife sail are called: the one towards the bow, the tack, the aft one the clew, and the one at the top is the penalty fist (see previous image , Figure 1).

Four-sided knife sails. When these knife sails have four sides, the names of the sides are called: the luff bow side or bow drop, the upper luff high, the lower one is pujamen or batidero and the aft side the stern drop or leech (see Image 42, figure 2).
In these sails, the cuffs have the following denomination: those at the bow of the mouth and the penny at the stern, with respect to those that are in the lower part of the tack, the bow and the clew, the stern (see Image 38, figure two).

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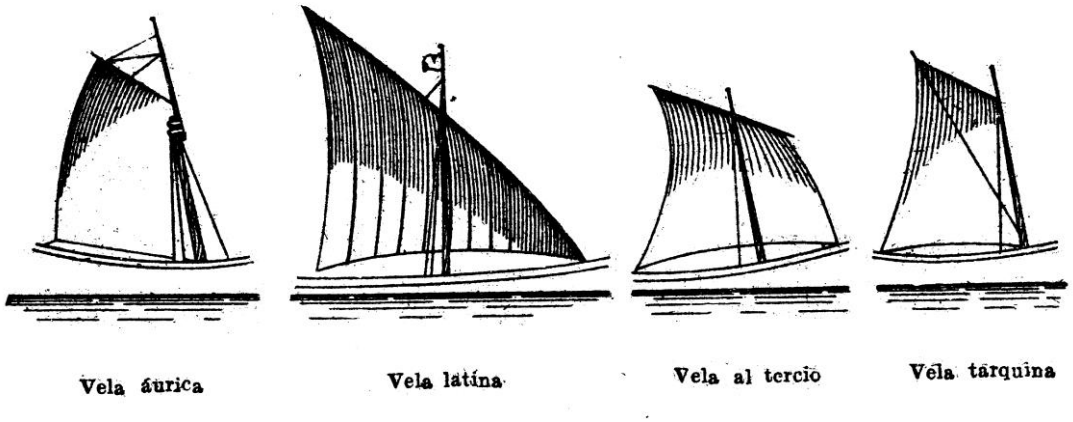

Image 42. Type of sails called knife sails: auric, Latin, third and tarquina sails.

Sail reinforcement. They are reinforcements with pieces of canvas that are made on the sails where it is possible that they have friction or great effort. Some of these reinforcements are the reef strips, the diagonals or reinforcements of the reef lovers, the contour of the sails such as the strips that give the luff its name, drops, etc.

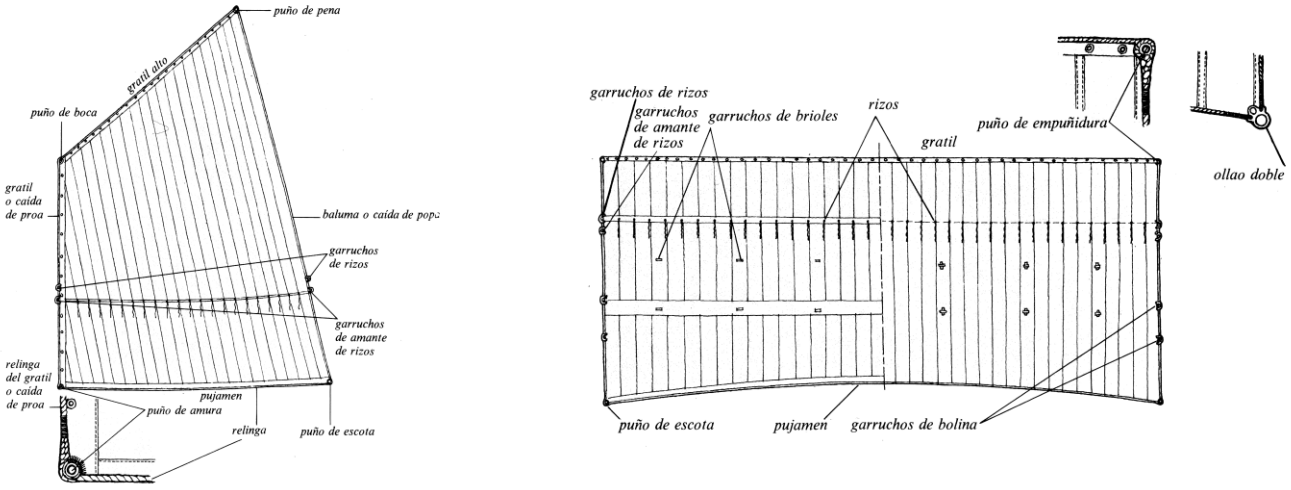

Image 43. Drawings where you can see the reinforcements of the edges of the sails with their garruchos, curls, bolinas garruchos and the girdles of curls (George P.B. Naish, 1982, págs. 82 - 84).

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10. Practicum

10.1. Practice 1

In this practice, a piece of oak trunk will be cleaned and carved to prepare it with its straight sides in a quadrangular shape.

General objective

1. Know the process for handling and cleaning a log of wood preparing it for processing.
2. Carry out the cleaning of a piece of raw wood, barking it and carving its sides with industrial machinery.

Specific objectives

1. Debark a piece of trunk manually with a mast.
2. Saw one side of the piece with the band saw.
3. Cut the debarked piece to leave all four sides square.

Material

tilling machine
Thicknessing machine.
Band saw machine.
Workbench.
Industrial vacuum cleaner with connection to the machines.
1 walking mast
1 pen.
1 ruler.
1 squad.
1 an oak trunk 30 cm long by 18 or 20 cm in diameter.
1 meter.
Gloves.
Protective glasses.

Process

1. Debark the piece over its entire surface.
2. Cut on one side with the band saw to get a flat face.
3. Pass that face through the tillage.
4. Cut another side with the band saw, supporting the carved face on the base of the saw, in this way we try to have two carved faces at 90º.
5. Cut the cut face maintaining the 90º angle with the other.
6. Continue with the rest of the faces doing the same.
7. Pass the machine without stopping the piece by the thickness to correct the angle of the faces and the surface.
8. Check the faces with the square to see if the angles are correct.

Timing

The time to carry out the process is 7 hours.

Evaluation

The way to evaluate this work is verifying that the four faces are straight and sit on a flat surface and that all its sides are at 90º.

10.2. Practice 2

Make a block and block according to the drawings first and second from the left in the top row.

Realization of the Notebook. Taking the drawings as a reference, make the necessary templates to make the block in wood at a height of 15 cm and extracting the measurements in proportion to it.

1. First trace the drawing of the block and scale it to the required measurement.
2. Cut the wood for the body of the block.
3. Cut the dice that will join the jaws and the part that separates one sheave from another.
4. Find the center and drill the hole for the bolt.
5. Make the shape of the body by first cutting with the vertical saw and then running it through the sander.
6. Make the caster template by cutting it out afterwards.
7. Make a milling for the passage of the end through the rolling on the edge of the sheave.
8. Assemble the body of the block by gluing and nailing the required parts.
9. Sand the block and sheave.
10. Glue and nail all the elements and insert the axis to fix the caster.
11. Do the same process with the block.

Timing

20 h.

10.3. Práctica 3

Following the same method as in the previous practice, make a 10 cm bolt and a 15 cm block.

Duration 15 hours.

Bibliography

Arce y Jurado, J. d., & Rodriguez Ayuso, M. (1878). *Lecciones elementales de agricultura.* Madrid: Imprenta y Estereotipia de Aribau y Cª.

Asesores técnicos: George P.B. Naish, A. V. (1982). *Enciclopedia ilustrada de la navegación a vela.* (L. Carbonell Relat, Trad.) Barcelona: Editorial Planeta, S. A.

Atlas de poulierie. (1855). Toulon.

Baistrocchi, A. (1952). *Arte naval* (4ª ed.). (J. Navarro Dagnino, Trad.) Barcelona: Gustavo Gili, S.A.

Bautista Costa, J. (1983). *Tratado de maniobra y tecnología naval.* Formentera: J.B. Costa, 1983.

Boudriot, J. (1987). *The seventy-Four gun ship* (2º ed., Vol. III). (D. H. Roberts, Trad.) Great Britain: Staple Printers Rochester Limited.

Canal Vega TV. (28 de marzo de 2011). *Museo del cáñamo de Callosa de Segura*. Obtenido de Yourube.com: https://www.youtube.com/watch?v=oJYTOQVCpiA

Company Ballesteros, G. (2020). El legado del cáñamo en callosa de segura (Alicante): clave en su industrialización y configuración de su territorio. ((. Universidad de Alicante, Ed.) *GeoGraphos , 11*, 1-25.

De Aranda y Antón, G. (1999). *La carpintería y la industria naval el el siglo XVIII. Cuadernos Monográficos del Instituto de Historia Naval* (Vol. Nº 33). Madrid: Instituto de Historia y Cultura Naval.

De Lucio, L., Solano, A., Rebaza, V., Alfaro, S., Tresierra, Á., & Campos, S. (2013). La pesca artesanal marina en la región la libertad, Perú. *Informe. Instituto del mar del Perú , Vol. 40* (Nº 1-2), 31-134.

Fernández y Rodríguez, G. (1877). *Lecciones de Construcción Naval escritas para uso de los aspirantes a guardias marinas.* Madrid.

García de Paredes y Castro, J. (1925). *Estructura del Buque y Maniobra.* Barcelona: Tipografía Catalana.

Lever, D. (1842). *Arte de aparejar y maniobras de los buques.* (D. J. Palacios, Ed., & B. Villarino, Trad.) Madrid.

Manuel de Reales Ordenes de Generalidad para el Gobierno de la Armada, que dá principio en el año 1824 (Vol. Tomo VI). (1832). Madrid.

Ministerio de Marina. (1849). *Estado General de la Armada.* Madrid.

Ministerio de Marina, comercio y gobernación de ultramar. (1846). *Estado General de la Armada .* Madrid.

Navarro, J. J. (1995). *Diccionario demostrativo con la configuración o anatomía de toda la arquitectura naval moderna. Álbum del Marqués de la Victoria (Facsimil).* Madrid: Lunwerg.

Orden, R. (1748). *Ordenanza, que su magestad, (dios le guarde) manda observar para la cria, conservacion, plantìos, y cortas de los montes.* Madrid.

O-Scanlan, T. (1847). *Cartilla práctica de construcción naval, dispuesta en forma de vocabulario* (Segunda ed.). Madrid: Imprenta Nacional.

O-Scanlan, T. (1831). *Diccionario marítimo español.* Madrid: Imprenta real.

Real Academia Española. (1978). *Boletin de la Real Academia Española* (Vol. 58). Madrid.

Ruiz García, V. (2018). Maderas de Cataluña para la Marina de la Image. Fuentes para el estudio de los bosques catalanes y su relación con la construcción naval en el siglo XVIII. (U. d. Rioja, Ed.) *Brocar. Cuadernos de investigación histórica.* (Nº 42), 97-123.

Secretaría de Estado y del Despacho Universal de Marina. (1802). *Estado General de la Real Armada .* Madrid.

Sociedad Rural Argentina. (1871). *Anales de la sociedas rutal Argentina: revista pastoril y agrícola.* (Vol. 5). Buenos Aires.

steel, D. (1794). *The elements and practice of rigging, seamanship, and naval tactics* (Vol. I). London.

Vallarino, B. (1868). *Ancla de Leva. El arte de aparejar y maniobras de los buques* (Vol. 1). Cadíz: Imprenta y litografía de la revista médica.

Vidaur, L. (1895). *Un curso de agricultura elemental.* Barcelona.

Wikipedia. (21 de julio de 2021). Obtenido de wikipedia.org: https://es.wikipedia.org/wiki/Pinus_sylvestris