3 Masts, Sails and Rigging

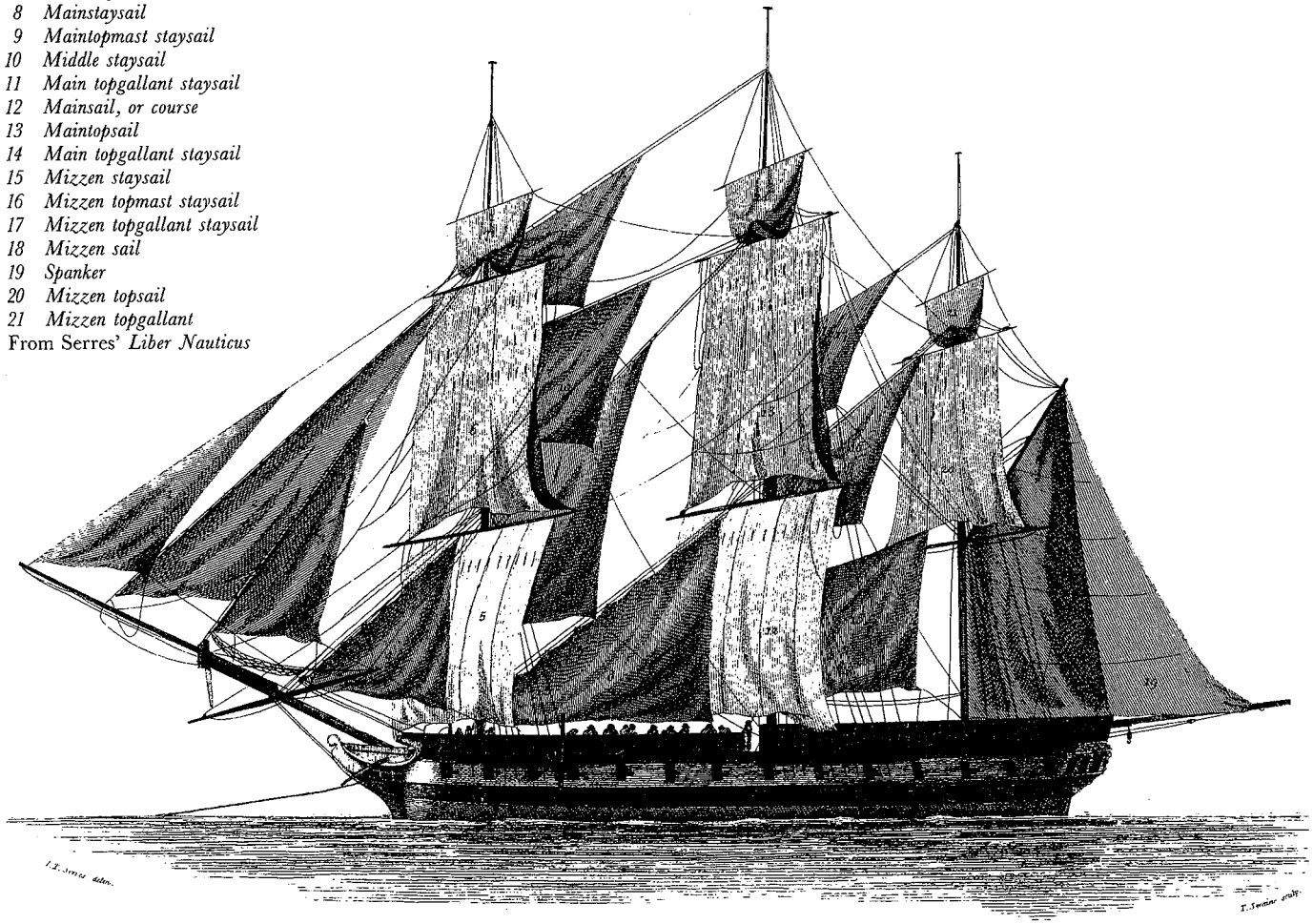
The Use of Square Rig

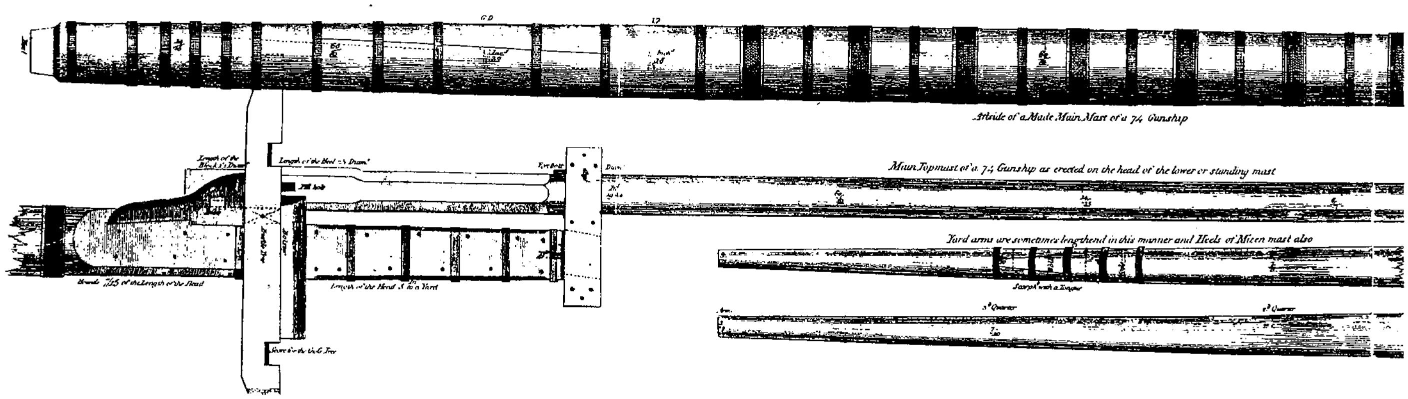
Square rig, in which the sails in their neutral position were at right angles to the line of the ship, were by far the most common on ships of the navy. Even the small brigs, of less than 200 tons, were square rigged with two masts. Ship rig, with three square-rigged masts, was used for all major naval vessels, from about 400 tons upwards. The dividing line was set by the *Cruiser* class of 382 tons, which was brig rigged, and the *Snake* class of similar hull design was ship rigged. At the upper end of the scale, no ships carried more than three masts, and masts and sails were merely increased in size for larger ships.

Square rig had several disadvantages. It required large numbers of men to set and take in sail, and to trim and reef it to suit the winds; though this was not necessarily a problem, as ships needed large crews in any case, to man their guns. A square rigged ship could only sail to about six points, or 67½ degrees, of the wind. A fore and aft rigged ship of the period could usually get within five points, or 56¼ degrees. Square rig had some advantages when the wind was behind the ship, or over the quarter. But the main disadvantage of fore and aft rig was that it was not easy to divide the sails up into manageable portions, and that the types of canvas and cordage available did not make the development of fore and aft rig very easy. As a result, all real fighting ships, big enough to carry a serious armament, were square rigged; fore and aft rig was confined to small vessels which were intended to sail rather than fight, and which would engage only merchant vessels or small privateers.

A full-rigged ship could carry four sails — course, topsail, topgallant and royal — on each of the main and fore masts, and three on the mizzen. It had about eight staysails, and four jibs, as well as studding sails; including spares, up to 40 sails would be carried. A ship would need about 1000 rigging blocks to lead the ropes and give mechanical advantage. The sails of the *Royal George* of 1788 weighed nearly 10 tons, and were said to cover an area of more than two acres.[1]

The sails of a square-rigged ship, hung out to dry in a calm.
1 Flying jib
2 Jib
3 Fore topmast staysail
4 Fore staysail
5 Foresail, or course
6 Fore topsail
7 Fore topgallant
8 Mainstaysail
9 Maintopmast staysail
10 Middle staysail
11 Main topgallant staysail
12 Mainsail, or course
13 Maintopsail
14 Main topgallant staysail
15 Mizzen staysail
16 Mizzen topmast staysail
17 Mizzen topgallant staysail
18 Mizzen sail
19 Spanker
20 Mizzen topsail
21 Mizzen topgallant
From Serres' *Liber Nauticus*





The spars of a 74-gun ship, showing the mainmast, the topmast and topgallant with the crosstrees and trestletrees joining them together, and the mainyard showing how the parts are scarphed together. From Steel's *Mastmaking, Sailmaking and Rigging,* 1794

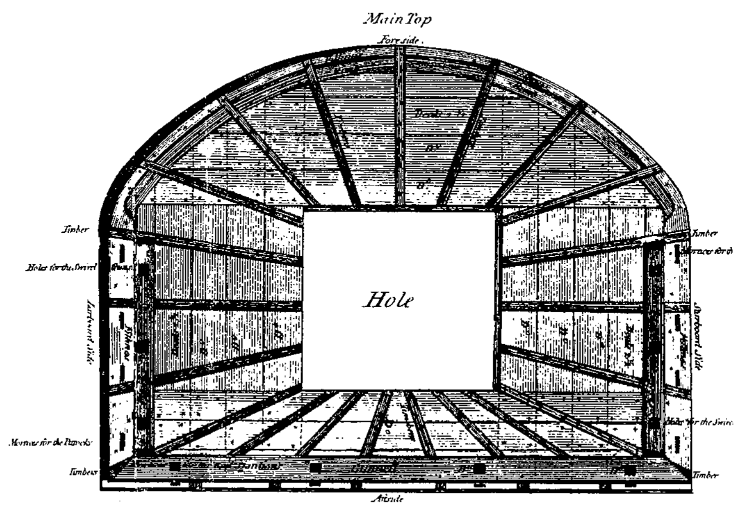
Masts

A full-rigged ship had three masts, the fore, main and mizzen. The main was placed near the centre of the vessel, and was the largest. The foremast was placed at the forecastle, and the gap between it and the main was quite large. This was to prevent the main from masking the foresails in a following wind, and to help in tacking, when the yards of the fore and main would be braced in opposite directions for a time. The mizzen was considerably smaller than the other two, and was placed on the quarterdeck, quite close to the mainmast.

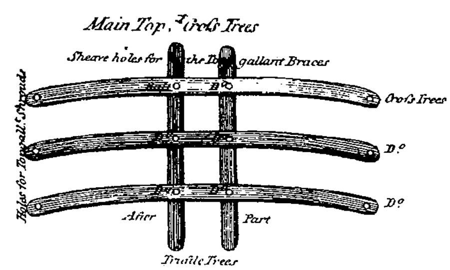
The term 'mast' was slightly ambiguous; it could refer to the whole structure right up to the highest point on the ship, or it could mean one of the two or three sections which were placed one above another. Thus the 'mainmast' consisted of the mainmast proper, or lower mast; the topmast, and the topgallant mast. Of course, the lower mast was the largest; it was often made up of several pieces of timber carefully joined together, and held in place with ropes until about 1800, and iron bands after that. The lower mast rested on the kelson of the ship, on a block of wood known as the step. It passed through holes in each deck, known as the partners, and was held rigid by means of wedges. It reached its maximum thickness where it passed through the upper deck, and began to taper after that. It was round in section for most of its length, and until it reached the hounds, where the top rested. After that, it was square. However, below the top, were projections from the mast — the cheeks running down the sides, and the front fish which went some considerable way down the front of the mast.

A top was a broad, flat, D-shaped structure, placed at the hounds of the mast. It served as a platform for the men working in the rigging, to spread the shrouds which supported the topmast, and to strengthen the join with the topmast. The latter was made in a single piece. It began just below the level of the top, and continued up to the level of the head of the lower mast, to which it was joined by means of a piece of timber known as the cap. It tapered after that, and became hexagonal in section under the hounds. Like the lower mast, it had a square head above the hounds. The topmast had no top as such, but only a structure known as the crosstrees, which had no large flat surface but otherwise served the same functions as the top. The topgallant mast came above that. It was similar to the topmast in shape, except that it ended in a button.

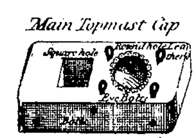
The bowsprit protruded from the bow at an angle of about 25 degrees to the horizontal. It was lengthened by means of the jib-boom. It served to support the rigging of the foremast, to lead the bowlines forward, and to take several sails, including the jibs and the spritsails.



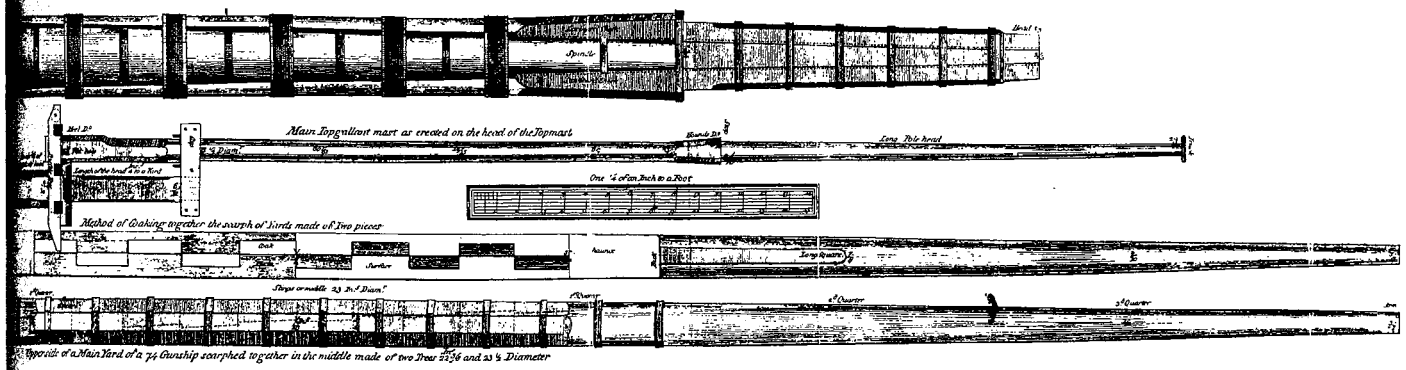
Plan view of the maintop of a 36-gun ship. From Steel's *Mastmaking, Sailmaking and Rigging,* 1794



Plan view of the topmast crosstrees. From Steel's *Mastmaking, Sailmaking and Rigging,* 1794



The maintopmast cap. From Steel's *Mastmaking, Sailmaking and Rigging,* 1794



Standing Rigging

The masts were supported by the standing rigging. Unlike the running rigging this was relatively permanent, and so was prepared for long life. Much of it was 'wormed, parcelled and served', and all of it was tarred to give a black appearance. There were three main types of standing rigging: shrouds, backstays and stays.

The lower shrouds ran from the hounds of each lower mast to the channels which projected from the sides of the hull. They could be tightened to compensate for stretch, by means of a system of 'deadeyes' and 'lanyards'. The shrouds of the upper masts were similar, but ran to the top or crosstrees of the mast below. Under the top, the futtock shrouds led downwards to join on the shrouds of the lower mast. Catharpins were fitted between the shrouds on opposite sides, at the level where the futtock shrouds met the main shrouds; they were used to tighten the shrouds and allow more space to turn the yards into the wind. Both shrouds and futtock shrouds were fitted with ratlines — lighter ropes which were tied horizontally between the shrouds at regular intervals, giving a kind of ladder up which the men could climb to the tops.

Backstays were similar to shrouds in function, except that they ran from the hounds of a topmast or topgallant all the way to the deck. Some, the running backstays, were less permanent than the others.

A forestay ran forward from each mast, at an angle of about 45 degrees, to meet another mast, the deck, or the bowsprit. The backstays served to support the masts against any forces from forward, for example when the ship was tacking. They, too, were tightened by means of lanyards, though 'hearts' were used instead of deadeyes.

The bowsprit was held against upwards pressure by its 'gammoning', which lashed it to the knee of the head. The bobstays ran forward from the cutwater of the bow to near the end of the bowsprit, while the jib-boom was braced by means of the martingale stay, which passed through the dolphin striker, a piece of wood projecting downwards from the head of the bowsprit. This was relatively new, having been introduced in the 1790s.

Yards

Each square sail was hung from a yard. A yard was octagonal in cross-section near its centre part, the slings. It became circular after that, and it tapered towards the ends (the yardarms). It was fitted with several cleats to retain the rigging attached to it. On the very largest ships, the mizzensail, though a fore and aft sail, was also fitted to a yard, with one end projecting forward of the mast; though the foremost part was no longer used. After about 1800, every ship had its mizzensail attached to a gaff, which ended where it met the mast. The spritsail yards, attached to the bowsprit, were similar to those of the other yards. More specialised items included the studding sail booms and yards, which were used only in very light winds, to extend the normal sails.

Rigging to the Yards

A lower yard was hauled up by means of thick ropes known as jeers, passing through large blocks under the top. The upper yards were raised by halyards, which passed through a block set in the mast itself. The lower yards were held against the mast by a complicated arrangement of ropes and bead-like pieces of wood known as parrels. Trusses served a similar function for the upper yards. In both cases, the system had to allow the yard to rotate round the mast, and to be raised and lowered when necessary.

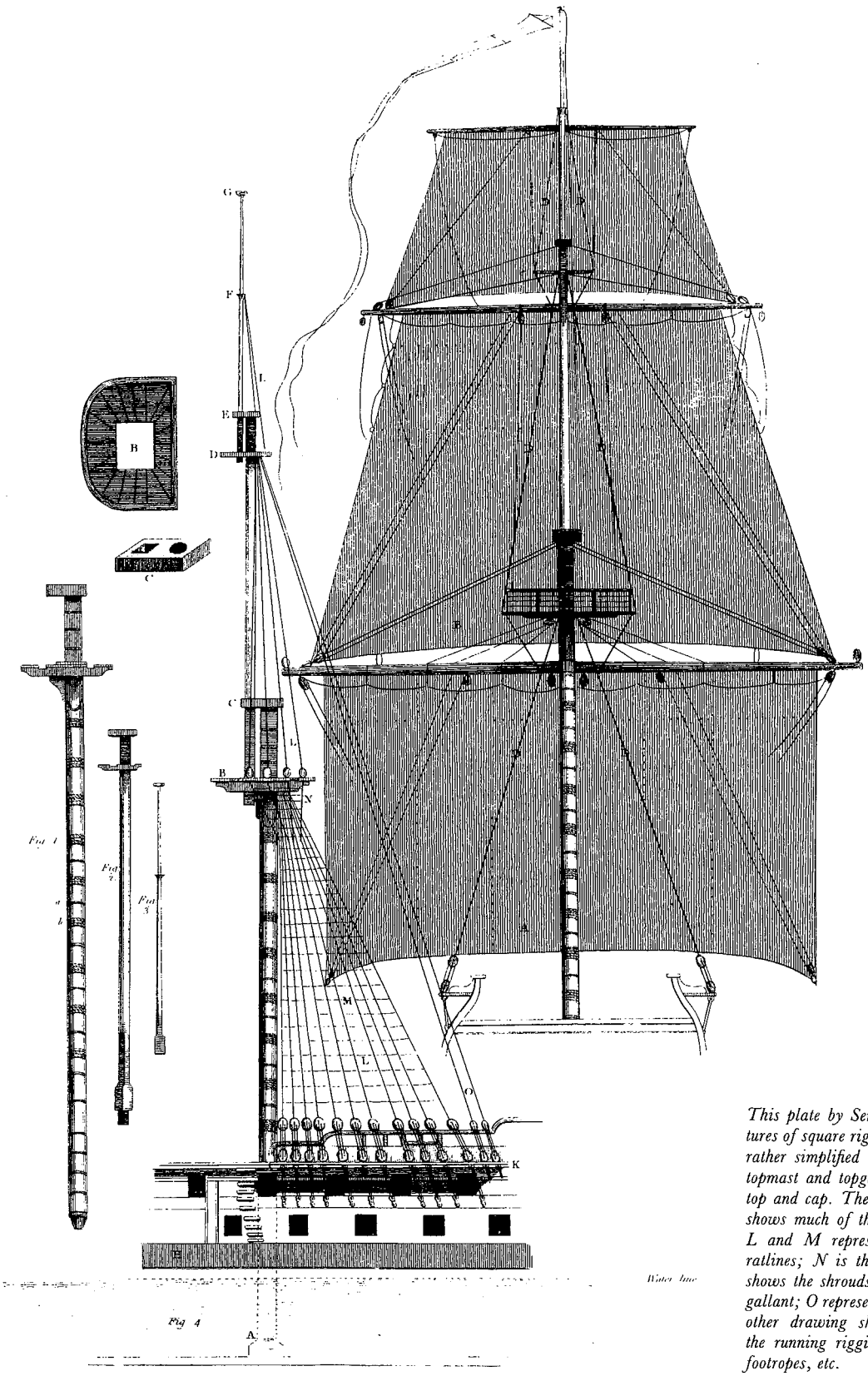
The yards were kept horizontal by means of lifts. Each lift led from the head of a mast, through a block at the yardarm, back through another block at the head of the mast, and then down to the deck. Footropes were slung under the yards, for the men to rest their feet while working on them. These were supported by stirrups hung from the yards themselves.

Braces were used to alter the angle between the yard and the fore and aft line of the ship, to suit the wind. The pendant of each brace led from the yardarm to a block. The pendant of the brace was taken through this block, with one end fixed near the deck, and the other at a cleat or kevel, so that it could be taken in or let out when necessary. The braces of fore and mainmast led forward; those of the topsails, topgallants and royals led through a block in the mast behind, and then down to the deck. The braces of the mizzen led forward, to the mainmast.

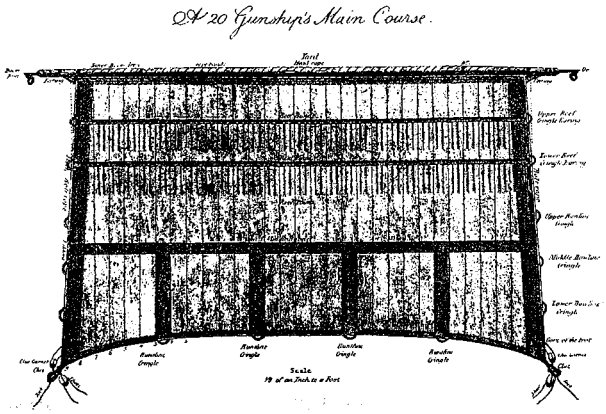
Sails

Sails were made from strips of canvas of different thicknesses, according to the intended use; thicker canvas, for heavy weather, was number 1, and weighed 44lb per 38yds; while light weather canvas was number 6, weighing 29lb. The strips of canvas were 2ft broad, and were sewn together with about 1½ in overlap. A kind of hem, known as tabling, was sewn round the whole sail, and round that was rope, known as bolt rope or head rope according to its position on the sail. Loops were formed in the corners of the sails, for attaching rigging lines. These were known as earrings at the upper corners and clews at the lower. Other loops, attached to the sides and bottom of the sails were known as cringles. Large sails, especially topsails, had lines of reefing points, light ropes which could be tied together to reduce sail in heavy weather. Some sails also had double thickness of canvas, known as lining, at crucial points.

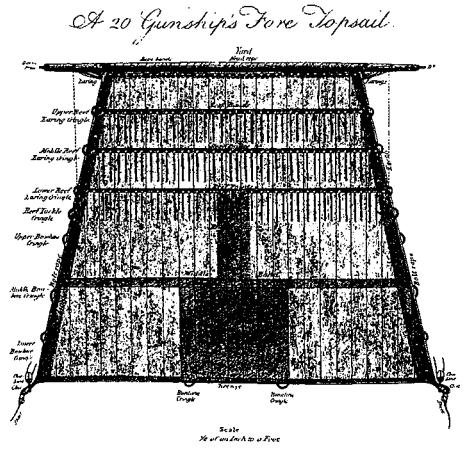
There were four main types of sail. Square sails were hung under a yard. Only the lower sails, known as the courses, were approximately rectangular — the topsails invariably narrowed towards the head. The



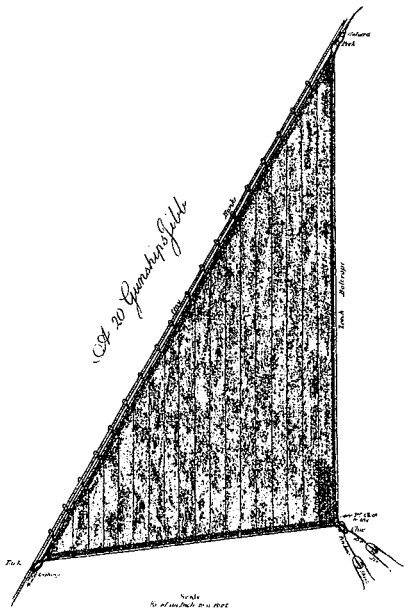
This plate by Serres shows many features of square rig. Figs 1, 2 and 3 give rather simplified views of lower mast, topmast and topgallant. Above are the top and cap. The main lower drawing shows much of the standing rigging – L and M represent the shrouds and ratlines; N is the futtock shrouds; L shows the shrouds of topmast and topgallant; O represents the backstays. The other drawing shows many parts of the running rigging - lifts, clewlines, footropes, etc.



Course

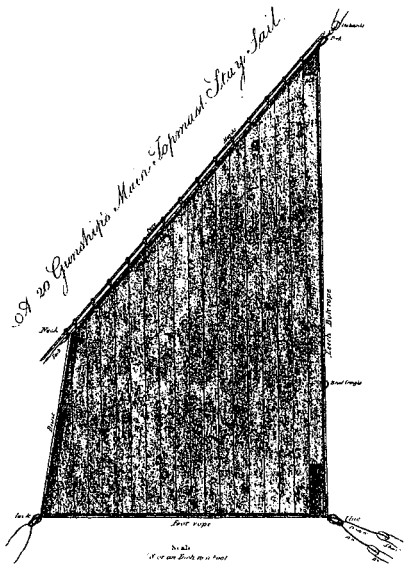


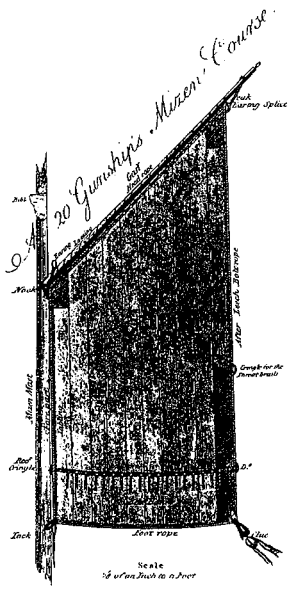
Topsail



Jib

Staysail





Mizzen course

Different types of sail, from Steel's Mastmaking, Sailmaking and Rigging., *showing the arrangements of lining, reef points, etc, and also the ropes attached to the corners.*

The fore and aft sails of a 74, from Rees's Naval Architecture.

Fig 1.

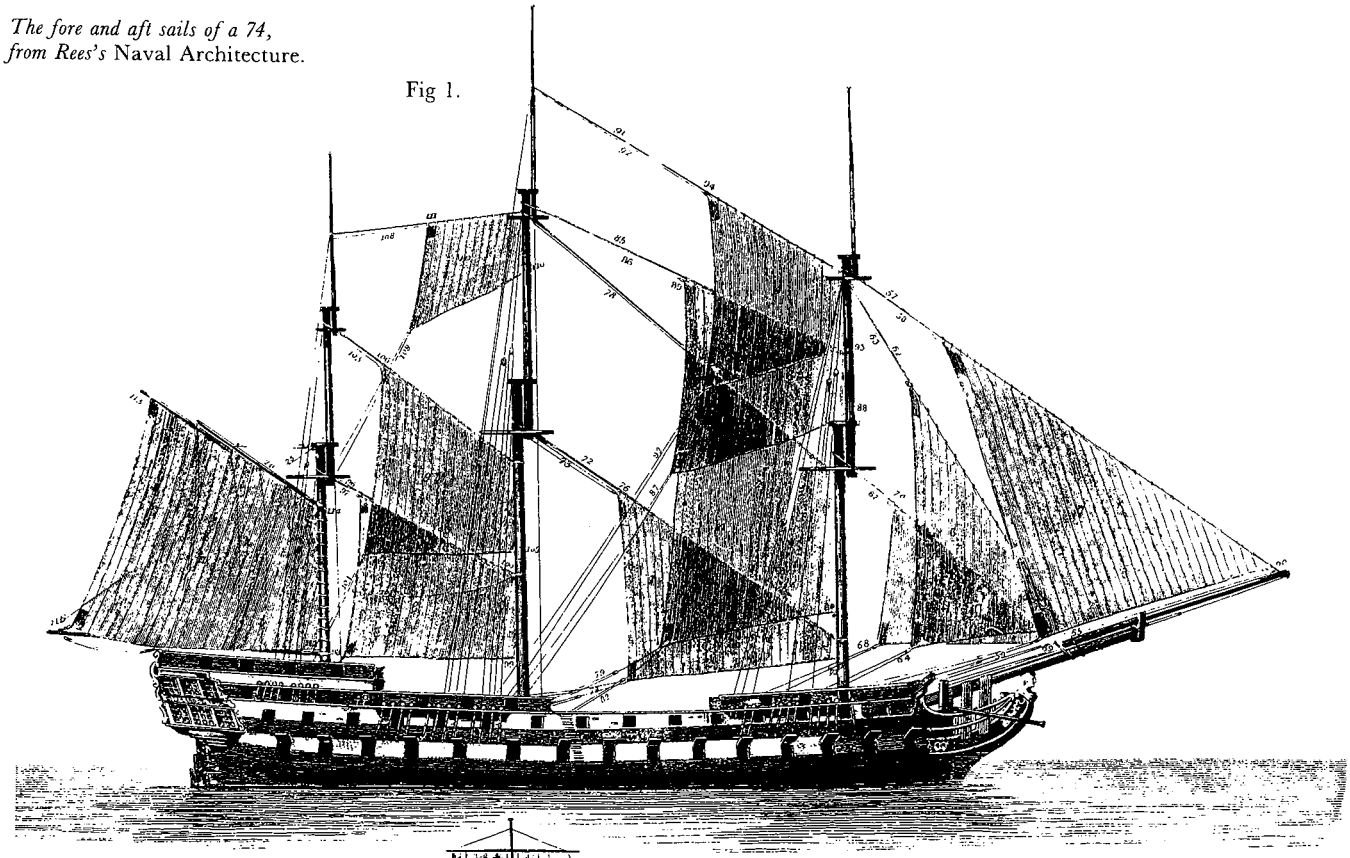
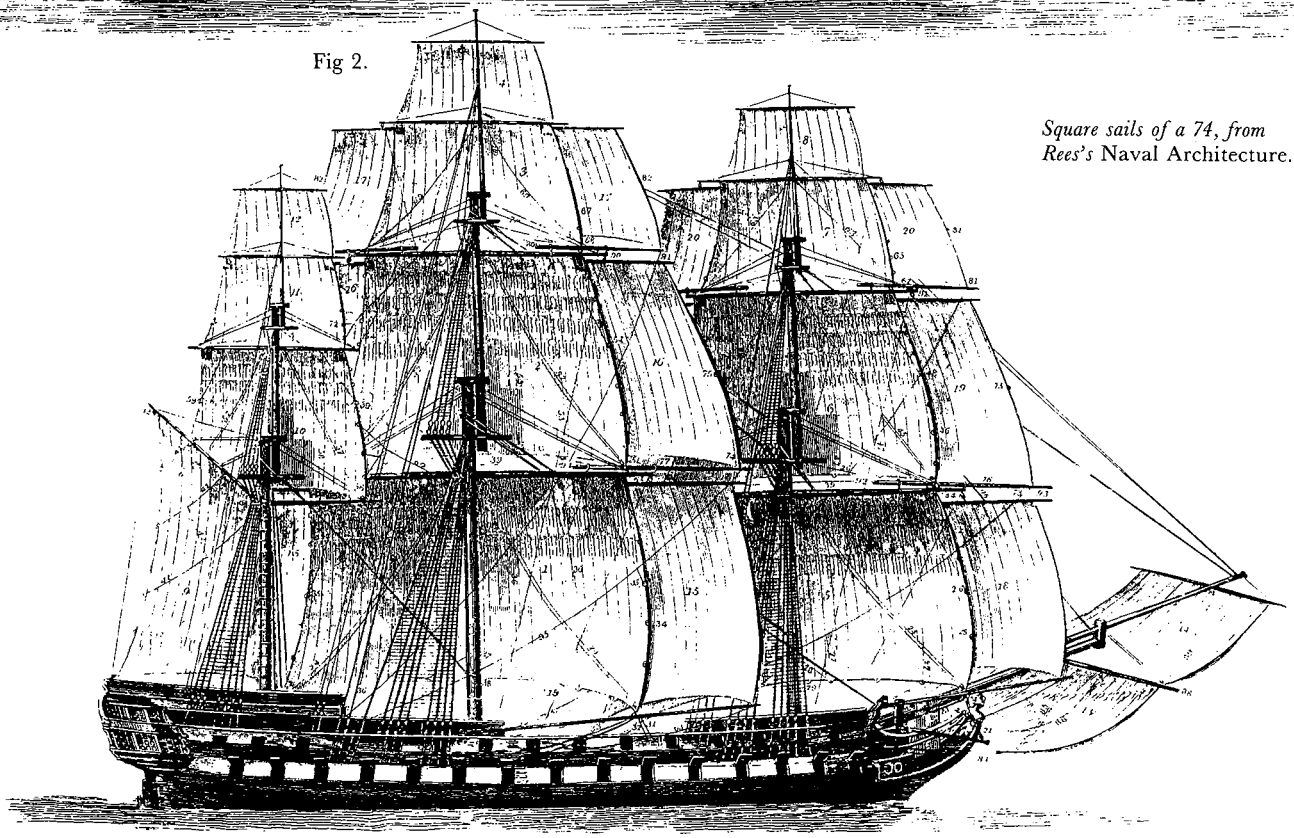


Fig 2.

Square sails of a 74, from Rees's Naval Architecture.



mizzensail was essentiall a gaffsail, quadrilateral but not rectangular. Staysails were usually hung from under a stay, and were mostly quadrilateral, with parallel sides; while jibs, hung from the forestays, were triangular. In addition, studding sails had parallel head and foot, but angled sides.

Rigging Attached to the Sails

The sail was hung from the yard by means of robbands, passed through holes in the sail and tied over the rop of the yard. The outer ends were stretched along the yard by the earring, which was taken round the yardarm cleats.

The lower corners of square sails were controlled by means of sheets. In the case of the upper sails, these served mainly to stretch the sail out to the end of the yard below. The sheet was attached to the clew of the sail, and then led along the yard and down to the deck by means of blocks. On the fore and main courses, the sheets were crucial to the trim of the sails. They could be taken in on one side and let out on the other at the same time as the braces were moved, in order to alter the angle of the sails to the wind. Each of these braces had a pendant, with one end attached to the clew of the sail and the other to a block. The fall of the brace was attached to an eyebolt on the outside of the hull, and then went through the block on the pendant. It was led back through a sheave in the side of the hull, and it was this end which was used to trim the sail.

When necessary, the clews of the fore and main courses could be held forward by means of the tacks. This was especially necessary when the ship was sailing close to the wind. The fore tack led forward to the bowsprit, the main tack to a sheave in the hull. Bowlines served a similar purpose, in keeping the edges, rather than the corners, of the sails forward when sailing close to the wind. They were fitted to all square sails, by means of a system of bridles; they led forward to the mast ahead, or to the bowsprit, or, in the case of the fore course, to the boomkins — small spars projecting diagonally downwards and forward from the bows of the ship.

Sails were taken in and furled with the aid of clewlines and buntlines. Each clewline ran to the corner of a square sail, and was used to haul it up towards the centre of the yard. Buntlines ran aft of the sail, to cringles at the foot; they hauled the other parts of the sail vertically up to the yard. Slablines were similar, but ran forward of the sail. Reefing tackle led from the end of the yard to the reefing cringles, set in the edges of the sail on a level with the reefing lines. It was used to haul up the upper part of the sail when reefing.

Spritsails and spritsail topsails were square sails, hung from yards under the bowsprit. Their rigging was generally similar to that of other square sails, but they were nearly obsolete by this time, as their function had largely been taken over by the jibs. However, the rigging of their yards helped to brace the bowsprit against sideways pressure.

The Rigging of Fore and Aft Sails

The mizzen was the only gaff sail carried. It was hung from a yard or gaff, projecting from the mizzenmast at an angle of about 45 degrees. The outermost end of the gaff was held up by a peak halyard (sometimes known as a topping lift at this time), and the inner end by a throat halyard. The side to side movement of the peak of the gaff was controlled by vangs, leading to the rails on each side of the deck. The sail itself was laced to both the mast and the gaff. Its foot was loose, but it was controlled by means of a single sheet, leading from the clew of the sail to the taffrail at the stern of the ship. Its forward corner, the tack, was attached to an eyebolt in the deck. When not in use, the mizzen was hauled up to the mast and gaff by means of brails. In light winds, the mizzen course could be replaced by a larger sail known as a driver. Its foot was extended by means of a boom, as the normal sheeting arrangement would not work with such a large sail.

Stay sails were hung from the stays running between the mizzenmast and the foremast, and between the main and the foremast. The head of each was hung from the stay, and could be pulled back along it by means of a rope known as a downhaul, for furling. Conversely, it was hoisted by means of a halyard, which led up the stay to a block where it met the mast behind, and then down to the deck. A staysail needed two sheets, one for each side of the ship, to be used according to which tack the ship was on. Both were attached to the same clew, and led down to the appropriate side of the ship. Staysails were mostly quadrilateral, and therefore each needed a rope known as a tack, to control the other lower corner. This usually led to the mast just ahead of the sail.

Jibs were similar to staysails, except that they hung from the stays between the foremast and the bowsprit, and were triangular instead of quadrilateral. Their rigging was similar to that of a staysail, except of course that they needed no tacks. Their exposed position in the extremity of the ship caused some special difficulties; the foremost jib was attached to a special stay, which could be brought back some way aft by means of a traveller running along the bowsprit.

Various types of fore and aft rig, from Steel's Mastmaking, Sailmaking and Rigging