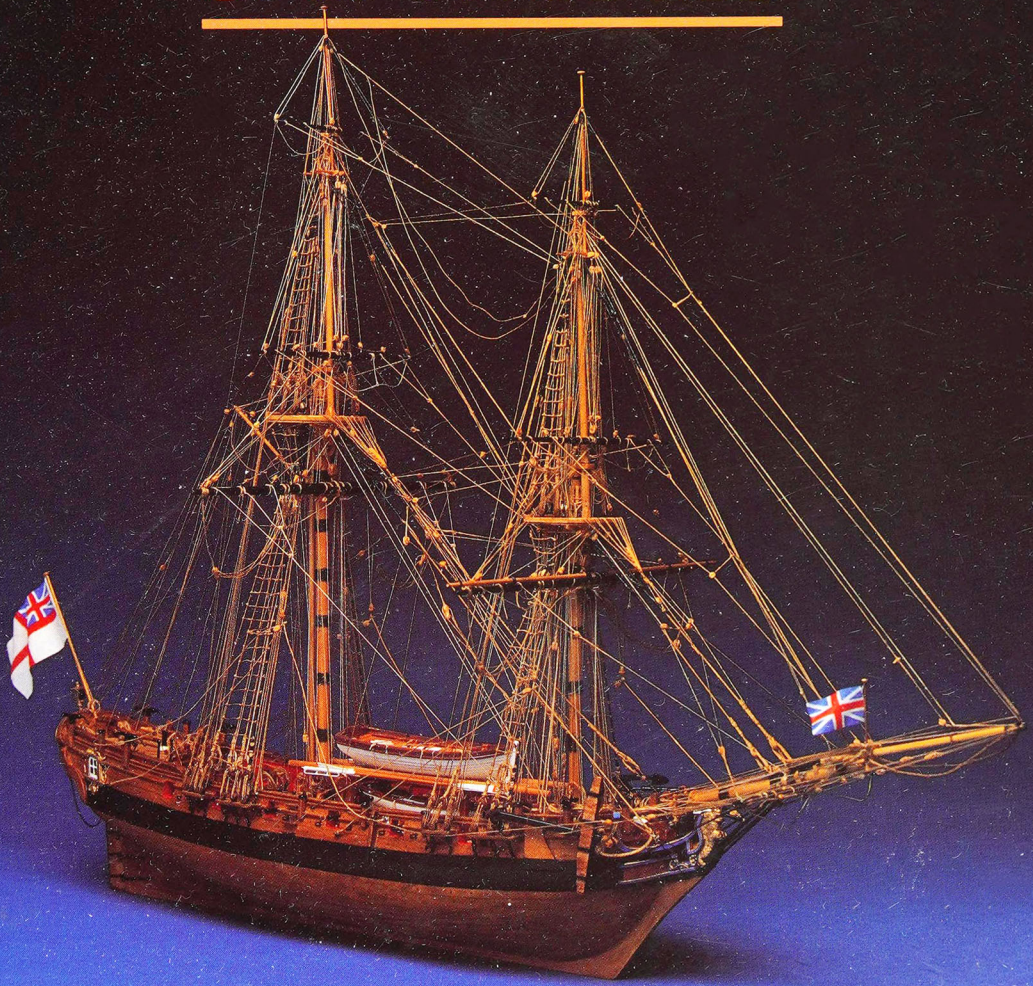
BUILDING PLANK-ON-FRAME SHIP MODELS



Ron McCarthy

The Author

The late **Ron McCarthy** had been a professional modelmaker since leaving school at the age of 14.
His first job during the Second World War was building 100ft to the inch Admiralty recognition vessels. He was also a member of the team which built the model of the Mulberry Harbour.
After the war he worked for a number of years building shipbuilders' models. He built many sailing ship models and was a regular contributor to the journal *Model Shipwright*.

Front cover and back photograph
The author's model of HMS Cruiser, specially commissioned for this book.
(Photographs: Michael Bassett)

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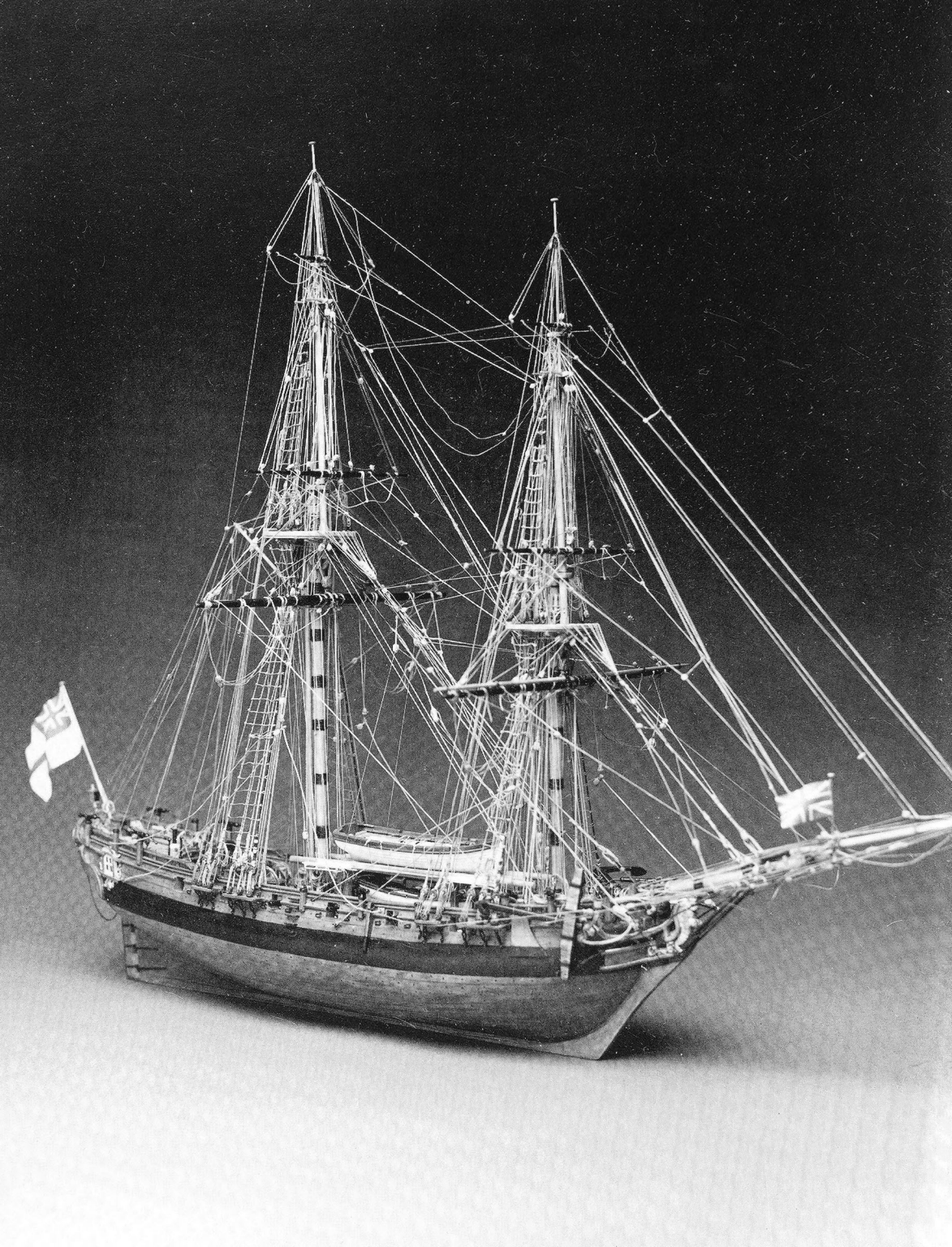
Frontispiece: The Royal Navy snow rigged sloop *Cruiser* of 1752, built to 1/72 scale by the author.



BUILDING PLANK-ON-FRAME SHIP MODELS

Ron McCarthy

CONWAY
MARITIME PRESS

This book is dedicated to the memory of my wife, Eileen Margaret, whose ardent support in this work remained constant to the last.

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Contents

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RON MCCARTHY

Foreword

HOBBIES, I SUPPOSE, START as an ambition to make real an interest, to transform a conception into a tangible form which can be seen, held and felt, and be appraised by others. They are an intimate declaration of self, and come as varied as all our diverse personalities. For my part, I found my expression in the art of model building, and from an early age. And the best of it has been building model ships. With the hobby, and later professional involvement, has come a host of extras to enrich my time: the study of the social and political needs which laid the keels of the ships and sent them on their voyages to the far reaches of the earth; the lore of the sea and all the tales and fables, myths and mysteries the sea has inspired; and not least the friendships made in the world of model making. This book is part of that experience; it is the story of a model ship. To take an idea, conceive it as a three-dimensional image, and recreate in a tangible form its history and historical context, is the core of this book. From a plank of rough hewn lime, we can watch it take shape as a unique structure until it stands complete, an embodiment of the search for perfection.

The model featured in this book is that of the Royal Navy snow rigged sloop *Cruiser* of 1752, and was chosen because it is a simple example of a single decked ship but incorporates all the structural and rigging practices of a wooden vessel which can be applied to any ship of this era.

While every endeavour has been made to include all the essential elements of building an eighteenth-century model ship, this book itself is only the key to a door, a door that leads to the far greater expanse of the modelling world. It is a world in which many notable people have contributed their knowledge and experience to the growth of model shipwrightry, and in which the products of their art grace both homes and museums. I hope you will find there a share of all the pleasures I have enjoyed over the many years since I laid my first keel.

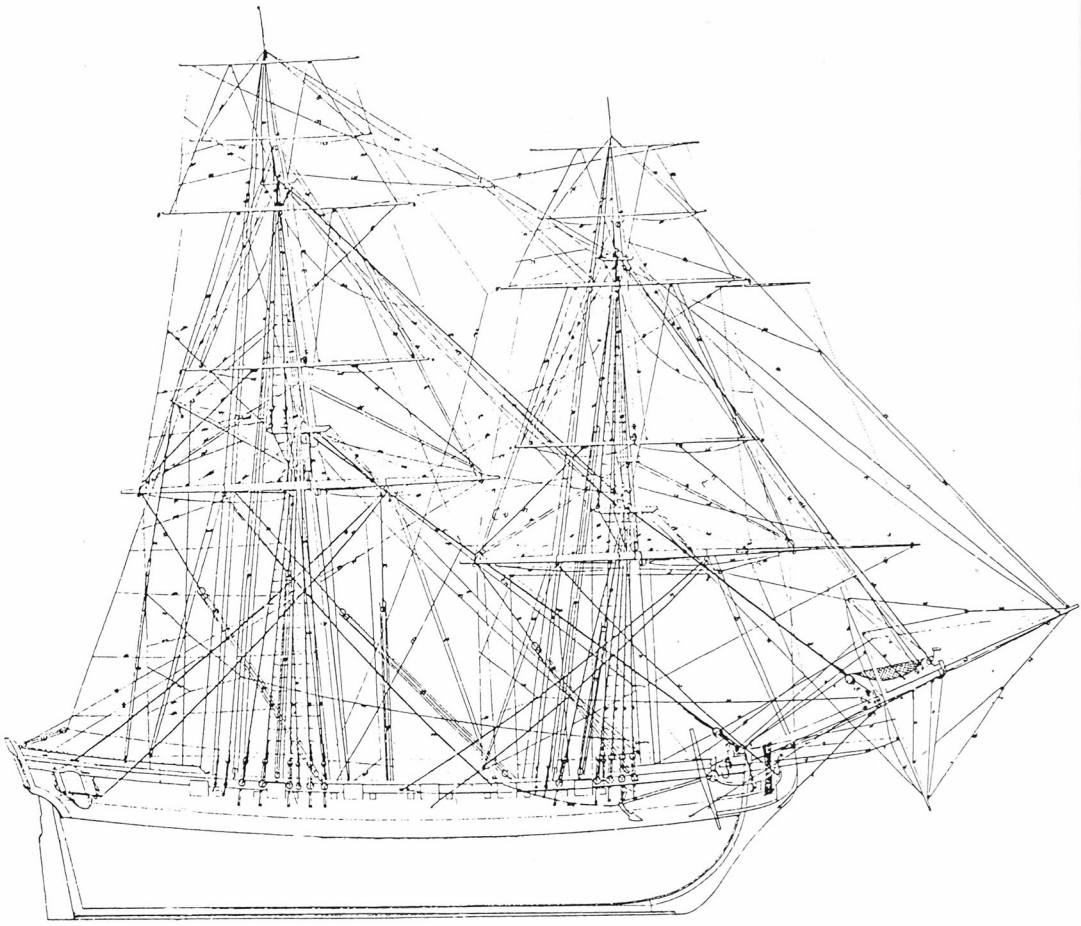


FIGURE 8. Sail and rigging draught of *Cruiser*, 1752, by F H Chapman. By permission of the Sjöhistoriska Museet, Stockholm.

1

First Considerations

THE ROYAL NAVAL snow rigged sloop *Cruiser* of 1752 was built in a year that looked both back to previous building practice, and forward to the new. She was not a famous ship, and did not distinguish herself in any particular way except by hard work and a constant call to duty. She was like so many sloops and frigates throughout the ages: the work horse of a protecting navy. For most of her career she was stationed in home waters. First commissioned in 1753, she patrolled off the North Foreland and the North Sea, and in 1756–57, the Downs. In June 1760 she was recommissioned for cruising and convoy duties and remained on these duties until the conclusion of the Seven Years War in 1763, when she was paid off in April of that year. However, she was again recommissioned in May and took up Channel duties, on which station she remained until 1770 when she went again to a station off the North Foreland/North Sea. On 10 September 1772 she sailed for North America. This brief history of her career, together with the names of her captains, is shown in Table 1, reproduced here by kind permission of the National Maritime Museum, Greenwich.

Her log shows that throughout her time in home waters on patrol work and convoy work, there was, to quote from the many daily entries, 'No remarkable event to report'. It is a story of patient duty in all weathers, chasing off insurgent French fishing craft and keeping a watch for smugglers, and at one time acting as escort and baggage carrier to the Royal Yachts. She was an integral and vital part of the renowned wooden walls behind which the folk of Britain could sleep in peace and ease of mind. In this respect she is a worthy example for a typical Royal Navy sloop model.

On 2 October 1776, just after the fermenting North American colonies had erupted in their War of Independence, and some four years after taking up station off the coast of South Carolina, where she had confounded the contraband runners of that coast, *Cruiser* met her end. No longer fit for service after her prolonged years at sea, she was ordered 'to be destroyed by fire' by the Naval Commander in Chief, Lord Howe. She was burnt off Cape Fear, just south of Wilmington, South Carolina. It was perhaps an ignoble end to a noble little ship, which had served King and Country so well for nearly a quarter of a century.

Cruiser's specifications are shown in Table 2. Five other sloops of the class,

TABLE 1: Station Record – HMS *Cruiser*

Commissioned	*Captain*	*Station*	*Action or Event*
1753–55	Hyde Parker	Off Foreland and North Sea	1753 Commissioned
1756	W Norton	Downs	
1757	B Hartwell	Downs	
1760–61	P Forbes		Commissioned June '60 Cruising and Convoy
1762	C Leslie		Cruising and Convoy
1763			April Paid Off
1763–65	J Macbride	Channel	May '63 Commissioned
1766	C Roche	"	
1767–69	R Keeler	"	
1770	J Brisbane	North Foreland and Dungeness	
1771–72	J Cumming		10 Sept '72 Sailed for North America
1773–74	Tyringham Howe	N Carolina	
1775–77	F Parry	"	
Disposal			Burnt off South Carolina 1777

By courtesy of the National Maritime Museum, Greenwich.

TABLE 2: Specifications – HMS *Cruiser*

Class:	*Snow Rigged Sloop*
Gun deck:	75ft 6in
Length of keel:	62ft 3in
Beam, overall:	20ft 7in
Beam, moulded:	20ft 0in
Depth:	9ft 4in
Tonnage:	141 tons
Armament:	8 × 3pdr carriage guns 10 swivels
Complement:	80 men

TABLE 3: Sloops Laid Down 1752–54

Ketch Rigged	*Built*	*Launched*
Speedwell	Chatham	21 October 1752
Fly	Portsmouth	9 April 1752
Happy	Woolwich	22 July 1754
Ranger	Woolwich	7 October 1752
Snow Rigged	*Built*	*Launched*
Wolf	Chatham	24 May 1754

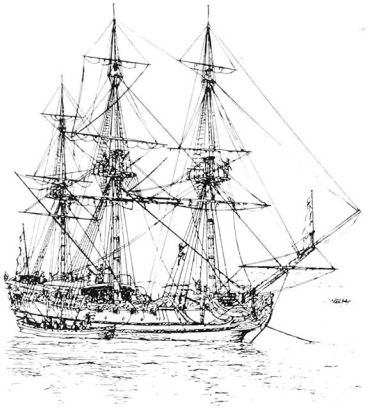


FIGURE 2. Royal Yacht *Caroline*. The run of the rigging on *Cruiser*, especially when rigged as a ship, would be similar to that shown here. Drawing reproduced from *The Royal Yacht Caroline 1749* by Sergio Bellabarba and Giorgio Osculati, by courtesy of the publishers, Conway Maritime Press.

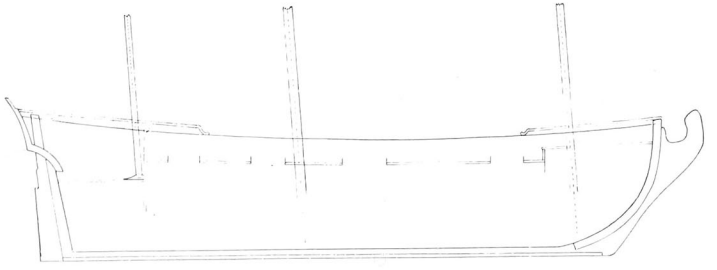


FIGURE 1. HMS *Cruiser*, as converted to a ship rigged sloop, 8 December 1753.

laid down for the 1752–54 Establishment, are shown in Table 3.

These ships have an interesting historical background. They were born of the prevailing political situation, namely the French and Austrian Wars. The prevention of smuggling and the discouragement of French privateers were paramount in protecting the realm's legitimate trade and commerce. For this reason the Admiralty felt the need for fast, shallow draught ships that could carry out a policing role around the most vulnerable stretches of the coast, notably the Channel and Foreland Stations, and this was the priority given to the shipyards in these middle years of the eighteenth century. There was also a desire on the Admiralty's part to seek the best design of hull and rig for that duty, resulting in much experimentation. In this search for improved hull and rig forms, *Fly* was based on the proven design of the captured French 74 gun vessel *Monarch* and ketch rigged, while *Cruiser* was based on the proven qualities of the Royal Yacht *Caroline*, built at Deptford in 1749, and was snow rigged. But not for long. With the Admiralty experiments continuing, *Cruiser* was later, in December 1753, given a mizzen on her short quarter deck and was ship rigged. This proved so successful that ketch rigged sloops fell completely out of favour, and the snow rig to a lesser extent, in a marked preference for the ship rigged sloop. However, with the advent of the brig-of-war later in the century, the snow once again came into its own. A profile of *Cruiser* stepped with a mizzen is shown in Fig 1. *Caroline* was, of course, ship rigged, as shown in Fig 2.

While *Cruiser* as a named and specifically classed vessel may be an ideal subject for the shipyard plank-on-frame construction outlined in this book, it may not be everyone's idea of the type or period of ship with which to begin. Before proceeding with the construction of the model, it is as well to consider why *Cruiser* has been chosen.

Motivation and Objectives

Many beginning modellers will already have a preference for a particular class of ship and period. It is worthwhile to consider the pros and cons of various types of vessel. One might initially be drawn to a famous named ship, such as *Santa Maria* of 1492, or *Golden Hind* of 1578, or *Endeavour* of 1768.

Or perhaps the choice will be inspired by a particular rig, such as a schooner, brig, ketch or ship; or by a particular type, galleon, galley, herring bus or carrack. Whatever the option, the pages that follow will help you to reach your final goal.

The term 'prototype' in modern usage is used for the full sized ship on which a model is based. To my mind there is much misuse of this word today. The *Thorndike Dictionary* defines it as the absolute original, and gives as an example 'The prototype of a present day ship is a hollowed out log'. This I can go along with as it fits my conception of the word. However, to save confusing both myself and my readers, I will use it in its modern idiom. That said, I prefer to use the terms which I consider more definitive, and have talked here of either a

'representative model' of a given class, or a model of a 'named ship'. It is clear that there are two roads down which the modeller can go, and it is a choice that must be taken early in the proceedings to avoid disappointment later. There are advantages and disadvantages to both, and we will examine their respective merits, starting with the named ship.

The Named Ship

To give some consideration to a named ship, I once decided to make six or so plank-on former models of *Santa Maria* as a commercial project. I maintained that as little or nothing was known of this ship so named the models need only be based on the popular conception. In this respect I thought I was on safe ground. At the time there were many kit forms of various quality available to the public, all claiming the name *Santa Maria* on their boxes, boldly and without hesitation. Mostly, they followed the 1892 reconstruction of the ship as a nao as conceived by Fernandez Duro, with some adaptations peculiar to the kit designers. One, I observed, had a wheel on the poop, which was also out of scale, if it had a scale that could be trusted. But then this was a fun aspect of the business. After much delving into researched material on *Santa Maria* and especially following the excellent work by Xavier Pastor in his book *The Ships of Christopher Columbus* (Conway Maritime Press), which was published at this time, I decided I could not continue with the model, and relegated it to a 'typical late 15th century Nao of Western origin'. This was about as far as I could go and retain any claim to be honestly authentic.

A model of the 1892 Duro replica of *Santa Maria*, presented to the Science Museum by the Spanish government, was put on display to the public. However, in the light of twentieth-century research the model was rerigged and apologies made by the museum in their catalogue for the erroneous hull construction. A later replica, built after research by Guillen in 1927, took the form of a caravel, not a nao; a further replica was made in 1963 after research by Martinez Hidalgo, and reverted to the original conception of the ship as a nao. This nao differed considerably from the 1892 version, not only in its rig and sail arrangement but also noticeably in its hull construction. Other ideas of *Santa Maria*'s form of rig and build can be seen in paintings, such as the one by the Dutch marine artist Cornelis de Vries. These differences of construction can be seen in Fig 3.

As well as *Santa Maria* as a named ship, with little or no authentic data to support the claim of a name, many other ships fall into this category, though some have far more claim than others, such as the famed and celebrated *Mayflower* replica sailed to Plymouth, Massachussetts, by Commander Alan Villiers in 1957. The difficulties of research raised in building this replica are fully outlined in the book *The Voyage of Mayflower II* by Warwick Charlton (Cassell), and demonstrate yet again how difficult a claim to a name can be.

On the bright side, many named ships are well documented and have been extensively researched and, naturally, the closer we come to our own period the easier the task becomes, as far more documentation survives together with authentic draughts drawn up by naval architects and kept in the archives of the world's great maritime museums. Here, too, can be found surviving contemporary models together with their researched history, an authority that can confidently be relied on. Trouble may arise, however, when these draughts are taken up by

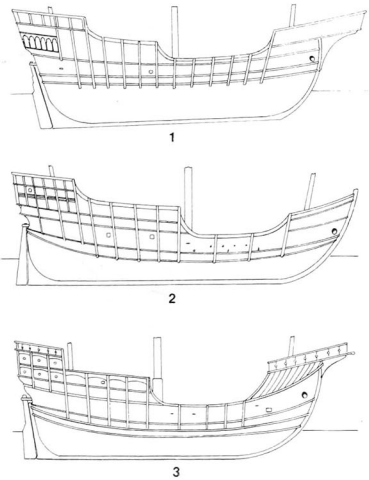


FIGURE 3. *Santa Maria*. These three versions of the *Santa Maria* illustrate one of the problems encountered when dealing with famous but poorly-documented ships, and could arise with other ships for which no plans exist, such as *Golden Hind* and *Mayflower*. 1. As conceived by Fernandez Duro as a nao, 1892. 2. As a caravel, by Guillen, 1927. 3. The replica as researched by Martinez-Hidalgo, 1964. Drawings reproduced from *The Ships of Christopher Columbus* by Xavier Pastor, by courtesy of the publishers, Conway Maritime Press.

private firms in the business of supplying model plans, who use copies of them as a basis for their own marketing sales. Here the model builder's own evaluation of their authenticity must prevail, either by carefully studying the published catalogues, or by gaining confidence in the draughtsmen they sponsor. There are publications which offer these recommendations and comments, but in the final analysis it is wiser to arrive at your own assessment.

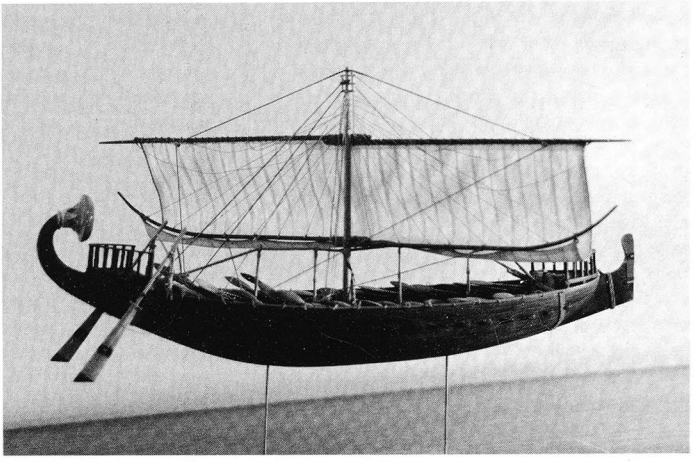
There is yet another pitfall for the named ship, which is that while the plans for the ships may be fully authenticated, drawn up by the most reliable of marine draughtsmen, they may only depict the ship as she was at a given period. It is as well to establish this period. Normally, the plans are taken from builder's draughts and show the ship as launched. However, it must be remembered that in the life of a ship many alterations can, and often do, take place. Also, in seventeenth and eighteenth-century sailing ships, including Royal Navy ships, the rig of the vessel was at the discretion of the captain. This was especially so with such sails as drivers, trysails and flying kites rigged once the vessel was at sea. Many arrangements of the gear and tackles were unique to the captain. This was still very much in vogue up to the last days of the sailing era. To take Columbus as an example, he changed the rig of *Pinta* from a lateen rig to a square rig just before he set sail to cross the Atlantic. On the whole, the named ship model needs to be researched far more thoroughly than the representative model, and all data obtained authenticated to ensure that the plans used are absolutely true and genuinely accurate, and that where alterations have occurred they are annotated. Even then, the plans should only be used in conjunction with the findings carried out in recent research, for many plans on the market today were drawn up decades ago, and modern maritime archaeological finds are altering our ideas on rigs and constructional practices considerably, especially since the raising of *Wasa* and *Mary Rose*.

The Representative Model

With the representative model there is not so much concern with the detail of the particular ship under construction as with that detail's historical accuracy. This is just as important for the hull construction as for the sails and rigging, and for such incidentals as the binnacle. In this respect a far deeper knowledge is required of maritime history and shipyard practices than for making a named ship model. In the latter, much of the constructional work and detail of deck fittings would have been carried out by the naval draughtsmen whose drawings are being used. But a representative set of draughts may have a tendency towards 'poetic licence', which can result in additions or rigs being incorporated which are completely out of period. Models built from such sources lack the discipline of the named ship, where only that which is known to have existed is built in.

It is true that minor embellishments of detail can be set on the model of a named ship, but these are strictly limited. Even so, care must be taken that they are in period. For example, fire buckets, fore channel heads, lifebelt boxes and oil lamps, amongst many other items, can be added to named ships, none of which may appear on the draught, but all would have been expected there, and all strictly to period. The point is that without the strict discipline of the named ship there is a danger of 'gilding the lily' or, worse, a runaway pandering to particular whims and fancies.

To cite an example of this, I once built a representative model of a *Queen*



1. Model of the Egyptian Queen Hatshepsut's ship, *c.*1500 BC.

Hatshepsut ship, an ancient Egyptian vessel of 1500 BC (see Photograph 1). The only authority for this vessel was from the ships depicted on a relief in the temple of Queen Hatshepsut at Deir-el-Bahri, at best a flat profile view. An exhaustive study of these ancient ships by Björn Landström published in his book *Ships of the Pharoahs*, unfortunately now out of print. But as there was such a paucity of information for the final appearance of the ships, it left a wide scope for speculation and interpretation. In view of this, great care had to be taken not to run amok. I have seen some three or four models of this ship, no two of which are in any way the same. Different interpretations have been made not only on the final colour schemes and decoration, but also on the shape of steering oars, the fore stage and stern stage rails, and the angle, sweep and height of the stern, and in particular the variation in the Lotus Flower trumpet shape over the stern. In actual fact it is not particularly important that any of the models is entirely correct or incorrect, as these Egyptian vessels would have varied just as much in real practice. If we take as a modern parallel Manfred von Richtofen's all-scarlet Albatros DIII, which he flew for a time in the Great War of 1914–18, the pilots of his squadron all chose their own brazen colour schemes; so one can easily imagine ancient Egyptian captains with their flamboyant love of colour being much of the same mind, while the shipwrights themselves would have added their own touches. The important point is not to overdo it but to keep it in context, be consistent and in tune with the period. None of the models of these ancient Egyptian craft I have seen looked incorrect, or out of place with their final finish. All seemed to portray exactly what they were meant to be, though, as I say, no two were the same, and all had arrived from the same single basic profile relief.

So there is a need, with the representative model subject, for a sensitive understanding of the period, and a good acquaintance with the historical background in both social and political spheres, all of which can influence the final finish of the model. There is a strong feeling amongst some model builders that there is nothing as uninspiring as a faultlessly crafted but

characterless model ship; one that says nothing at all about the person who made it. For example, who can ever fail to recognise the stamp of a Norman Ough warship? With the representative model there is a wonderful opportunity to impart to it much of yourself, but at the same time ensuring that it is tempered with some modesty and much moderation.

Structure

Here there are fundamentals that cannot be baulked. Before attempting to build a model ship in any way, the basic elements of the ship's construction should be studied. In our case, as we are talking about wooden vessels of the mid-eighteenth century, it would be a distinct asset for the model builder to have a working knowledge of the building practices of that period. Only then can corners be cut and a move made towards an individual concept of design structure, whether moving from the confines of a precut and prescribed kit assembly to scratch building, or, as my path took me, from the carved hull to the framed one. For me it was a rude awakening into the many rules and regulations that govern the structuring of a ship, be it a barge or a deep-water carrier. In the case of a navy ship, many of these rules have long been laid down by Admiralty Board Specifications. In the case of merchant ships, by Lloyds from at least the middle of the eighteenth century, and more lately, of course, by the Board of Trade, and it is as well to become acquainted with them as they may apply to the ship being considered.

Scale

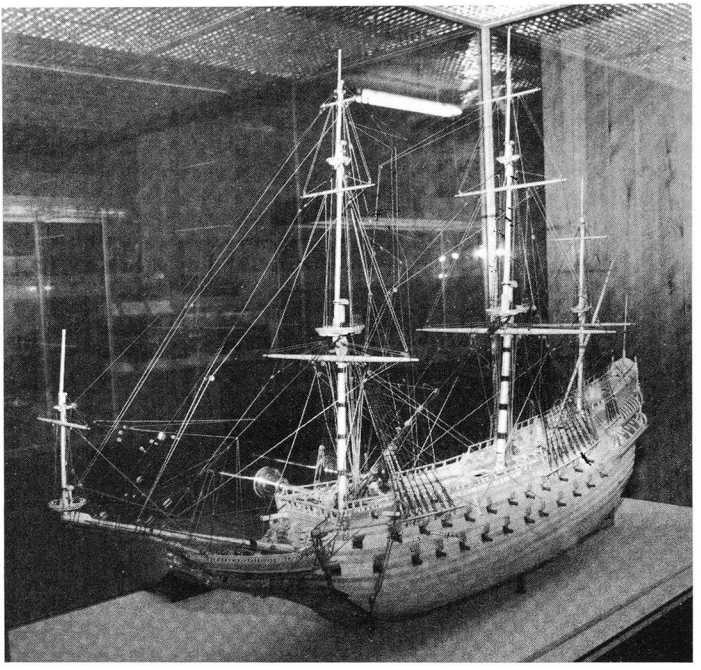
Having decided on the vessel to be made, be it a named ship or a representative model of a class or period, the matter of scale must be considered. Miniature models are a fascination, and are a study in constructional techniques in themselves. No such complete fine work is intended for these pages; there are books devoted to this art written by the experts in it, and currently available. However, that said, there is much work about a large scale model which entails fine work practice. For instance, a model anchor winch can consist of several dozen parts of finely executed work. Where occasion merits, such miniature modelling is often desirable for good effect.

The scales to be considered are what are termed the workable ones: anything from 1/16in to the foot to 3/8in to the foot will produce something that can be accommodated in the home and be easy to handle.

Taking this loose formula as a guideline means that a scale is largely determined by the overall size of the vessel on which the model is based. A model of a small cutter could comfortably be made to a much larger scale than, say, a model of a 72 gun ship. As far as *Cruiser* is concerned, with a gun deck of 75ft 6in, a working scale of 6ft to 1in, or 1/72 scale, is ideal as this produces a model of about 14in for overall length of hull; not a large model to contend with, and one that should sit neatly in any home. At the same time, the detail is large enough to work without trouble; for such items as the ribs and trucks of parrels, the truck would be something like a millimetre across with a No 75 hole drilled through the centre. Also sheet blocks and buntline blocks can hold their distinction in this scale quite easily. Anything larger, and these items would need to be very carefully executed, while anything less than 1/96 scale would prove troublesome to represent with conviction. All these points should be borne in mind when deciding on a scale.

Presentation

When constructing a plank-on-frame

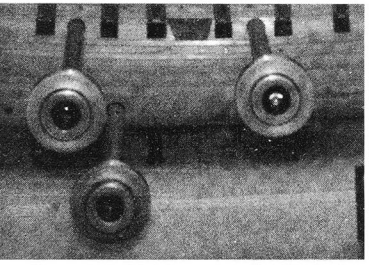


2. Model of the Swedish warship *Wasa* (1628) in the Science Museum, South Kensington, London.

model as built by shipyard practice, much of the fine work involved will not be seen in the finished model. This is a continuing dilemma for model shipwrights. One answer is the Navy Board model, which leaves the frames below the wale without the strakes, and much of the deck planking not placed, to expose the structure of beams, carlings and lodging knees. Although Navy Board models, with their unique framing and their purpose, are a set apart from our concern here, a lesson can be taken from them inasmuch as the model constructed in accordance with shipyard practice can be left bare of strakes and planking in the same way for presentation, and if desired left unmasted and, of course, unrigged. Models made to hull only stage, and cased, can be a great attraction.

Another method is to use the partly exposed commercial exhibition approach. Today, this is much exalted by travel agencies, and formerly by tourist shipping lines, to display to the public the commodious and comfortable accommodation on board their vessels, be they Rhine river craft or Baltic ferries. There was also an *Endeavour* model of this nature in the National Maritime Museum. With it the model maker can enjoy the best of both worlds, but is regrettably left with an incomplete ship's model, one half of the model not only being bereft of strakes and wales but the frames as well, leaving an uninterrupted view of all decks and their details. A fine example of this is Harold M Hahn's model of the schooner *Halifax*, which can be seen in his book *The Colonial Schooners*.

Another idea used to display hidden work is the use of removable sections, either horizontally by removing the whole upper part of the hull from



3. The spy hole lens viewing system outside the case of the *Wasa* through which the viewer may see the internal structure of the model.

just below the chain plates, or a vertical slab of the hull taken from between the fore and main channels. In either case this can expose the model to much damage and eventual wear and tear at best, and leaves little satisfaction for the cost of time and effort in that the first device only exposes one more deck, while the second exposes only parts of others, at the same time running the risk of a seriously injured eye from a yardarm while venturing to peer into a dim interior. A more ingenious solution can be seen in the Science Museum's excellent model of *Wasa*. Here they have provided the public with a spyhole telescope arrangement on the outside of the case, so that a lower gun deck can be viewed in its entirety, complete with cannon and crew (see Photographs 2 and 3).

The most successful and convincing method of exposing some internal work which would otherwise be concealed has been accomplished by showing a model in a dockyard scene, where it is either near completion or in dock for some repair to the lower hull requiring the removal of several strakes. One of the best of these is Harold M Hahn's *Schooner on the Stocks*, from his diorama now in the Mariners' Museum, in which he shows several schooners in various stages of construction. Perhaps there is room for compromise here just to show one ship very near completion. There are many convincing examples of the ship in for repair, with the ship on the stocks, and the removed strakes laid out in the yard.

Another way of showing detail is by a photographic record of work carried out, compiling an album of photographs showing the progress of work from keel to completed model, with some caption comment to each picture, and logging a date. There is a danger that if a roll of film does not develop successfully, by the time the end of the roll has been reached much of the work photographed will have been concealed by the progress of construction, or lost in the maze of rigging. Where rigging is concerned a photographic record of work can be greatly enjoyed, as a carefully made euphroe or gammon rack block can be shown as a set piece before it becomes merged with the whole, as can the internal arrangement and detail of ship's boats if covers are eventually fitted, or one boat nested inside another.

When I built my *Endeavour* (Photograph 4), I fitted all decks and bulkheads to the cabin accommodation. All are concealed, but I have the smug satisfaction of knowing they are there. Like possessing a secret. But with this perversion comes a guilt complex. Knowingly to ignore a mistake deep within the hull, though never seen, would haunt me for ever. It would have to be corrected before being sealed away. Also, it must be remembered that with modern medical technology, flexible searching rods complete with lights and miniature television cameras can not only photograph kidney stones *in situ* but search into the innermost parts of a model ship and discover the wood shavings, sawdust and lost belaying pins which may be lodged there, thought by the modeller never again to be seen.

With the *Endeavour* model, I have left all the hatches open so that something of the lower decks can be seen. It imparts a sense of depth, and a feeling that something is going on there; that the hatches are leading somewhere below. The forecastle reflects light from behind the open gun ports, and from behind the glazed ports and windows, while the model itself retains a completeness.

In the end it is a highly individualistic choice, with a strong case for personal preference, and what may be a desired effect with one model may not be so with the next. The *Cruiser*

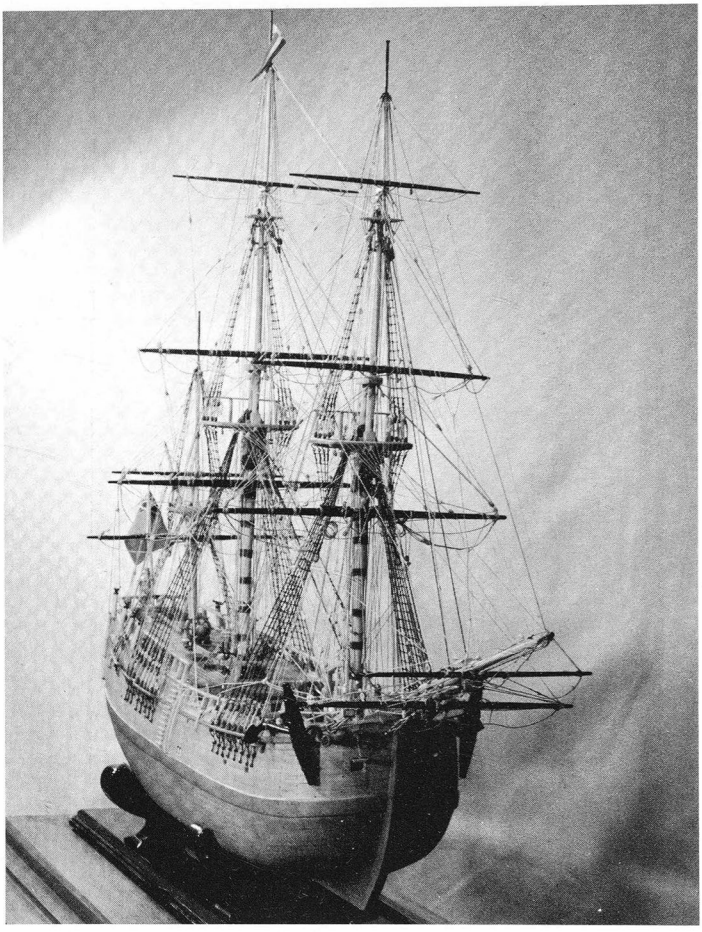
model will be completely planked, though some hatches may be left open to show there is a below deck.

Work Place

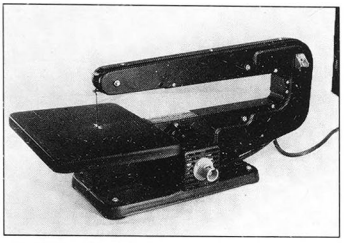
One of the main attractions of building a plank-on-frame model is that only a small space in which to work is needed, such as a desk or side table in a convenient position, preferably near a window for natural light and where work can be left without fear of it being disturbed. If we consider the fairly large scale chosen for *Cruiser*, and that the hull at this scale will not be much over a foot long, the frames are going to fit into the palm of a hand. As each frame is made up of several parts, each component is going to be very small, easily worked on a work surface top of some 4ft x 2ft. An ideal item for this is a pedestal desk, which has several drawers on each side of the leg space to house all the tools likely to be needed for such a model.

The tools required for the built-up model are few, and for the most part inexpensive, though some items may be costly, such as power driven tools. An electric fretsaw, a Dremmel, is shown in Photograph 5, but there are others on the market. More convenient and less noisy are the small piercing saw or the deep throated fretsaw (Photograph 6). The 3in Petite circular saw seen in Photograph 7 is a definite asset. However, ⅛in sheet lime can be stripped down just as successfully with a craft knife and an 18in or 24in straight edge. Neither of these electric power tools is strictly essential; indeed their hand operated equivalents may be preferred if you do not care for noise. Or a low powered (12–14 volt) DC lathe arrangement can be used (Fig 4). This tool may not be called into service much in the early stages but will come in useful later for such fittings as tillers and helms, balustrades and capstans. Most have an extension for finishing off masts and spars.

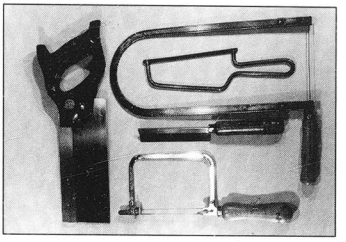
Needle files (see Photograph 8) are essential for shaping, especially when blockmaking. Apart from their various shapes, they come in several cuts, from rough to fine, and in a range of lengths from 3in to 6in. Their quality depends on their price, and in their quality their accuracy. Obviously, good quality files, costing up to six times the price of a cheap one, should not be used for cleaning up a soft solder



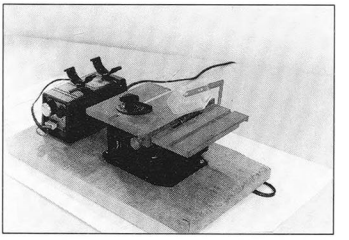
4. 1/72 scale model of the bark *Endeavour* (1768) built from Admiralty plans. The rigging was based on information contained in the book *Masting & Rigging of English Ships of War 1625-1860* by James Lees (Conway Maritime Press, London 1984). The hull was built of pine, on the bread-and-butter system of waterline sections, and carved to frame thickness inside and outside. It was planked in spruce. All decks were fitted, and the accommodation bulkheads are complete with their doors. Little of this can be seen except through the hatches. The blocks and parrals were of boxwood. The model, which was completed in 1989, was spray finished in eggshell varnish.



5. Electric fretsaw with an adjustable table, the desirable feature of a long throat, and a power take-off socket to which a flexible drive to take sanding, drilling and grinding assessories can be attached.



6. Useful saws. *Left*: short, brass-backed, fine toothed tenon saw. *Top*: deep throat fretsaw and *inside* a junior hacksaw. *Centre*: brass-backed jewel saw. *Bottom*: piercing saw.



7. Miniature electric (12-volt) circular saw with, *left*, a transformer fitted with an overload cut-out device. It can take various blades suitable for cutting wood, metal and plastic and can cut wood up to about 3/16in (4.5mm) thick.

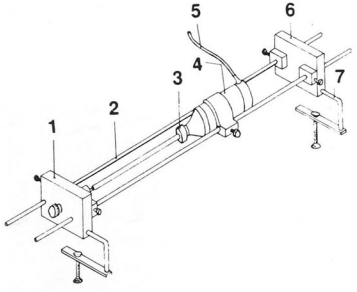
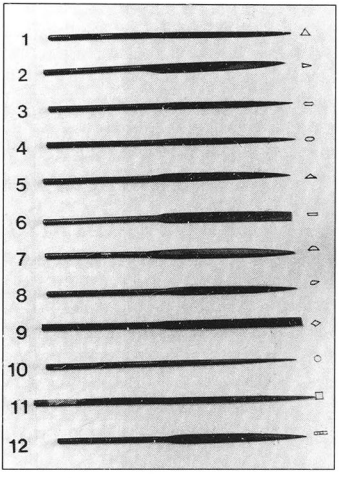


FIGURE 4. 18 volt, 3 amp DC Mini Lathe.

1. Cast metal tail stock
2. Stainless rods 16 inch extensions
3. Chuck with various-sized collets
4. 18 volt, 3 amp DC motor
5. Cable to transformer
6. Cast metal head stock
7. Clamps

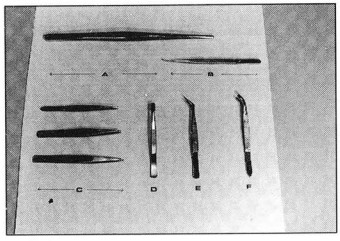


8. Swiss needle files. *From the top*: triangular, knife, round-edge joint, crossing, barrette, hand, half-round, pippin, slitting, round, square, and warding.

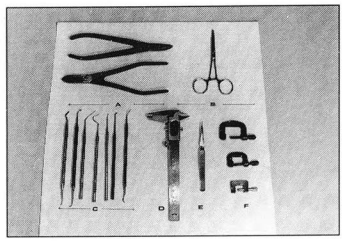
joint as the file becomes clogged rapidly, while for shaping a 1/72 scale buntline block only the very best will suffice.

Sources of Tools

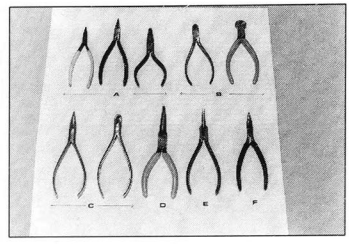
Tools and accessories can be gathered from many sources, most of them remote from model building. In the display of tweezers (Photograph 9), for example, the 10in forceps are from a supplier of entomological equipment. A catalogue from a specialist supplier will prove very useful for finding other items that can be used in model work. The flat spade ended forceps are designed for plucking eyebrows, and can be bought from a chemist. Photograph 10 includes a Spencer Wells artery clamp, a scissor-like instrument with locking handles, which can be obtained from a supplier of surgical instruments. Amongst the pliers are those used by professions such as dental mechanics and instrument makers. The very useful probes can be obtained from those discarded by a dentist. A selection of essential pliers and cutters can be seen in Photograph 11. Amongst the pin chucks (Photograph 12) are three slender examples, as used by dentists, which are useful for drilling a hole in an awkward recess in a ship's model. For removing dust from a model – and they do get dusty whilst under construction – a ladies' face powder brush is ideal. The point is to develop a keen eye for such items either when window shopping, or browsing through the advertisements in the large range of magazines now published, including those for the model builder. Other useful sources are newspaper small advertisements, car boot and garage sales, jumble sales and flea markets.



9. Tweezers. A. 10in (250mm) crocodile. B. Nipping, with curved point. C. Pointed, available with various end grips from wide to narrow. D. Flat spade. E. Curved pointed. F. Curved spade.



10. Miscellaneous tools. A. Curved and straight tinsnips. B. Surgical artery clamp. C. Dental probes. D. Vernier scale sliding calipers. E. Entomological head sprung tweezers. F. Miniature G clamps.



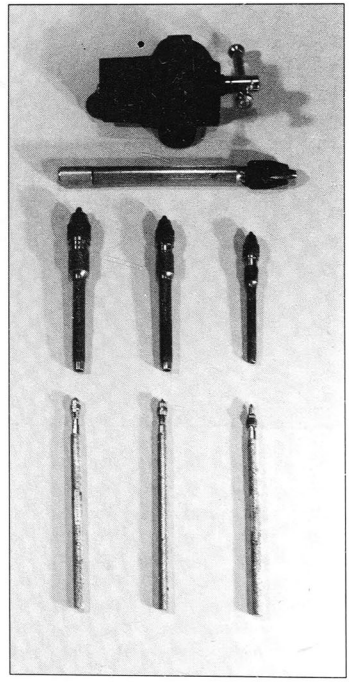
11. Pliers (all about 4in or 100mm long). A. Round nose. B. side and end cutters. C. Nipping head and pincer head. D. Long nose, angled. E. Flat spade nose. F. Pointed nose.

Finally, there is the home produced product. The first of these is the sandpaper stick. It is simply a trued up strip of durable wood of any length from 6in to 10in, of about 1in x ¼in. Both flat surfaces of the strip are faced with sandpaper, either middle 2 or a grade of your choice. It is essential that the sandpaper is glued under pressure to ensure a perfectly flat and even surface. The edges must be kept absolutely square and the sandpaper trimmed sharp and clean. With this tool the smallest work can be shaped up with great precision. Another home produced item can be a dowel or draw plate. These items are extremely expensive to buy and, for the purpose of making trennals, quite disproportionate to the need. A suitable plate can be made from a piece of sheet steel or an old steel rule, which is drilled through with a series of holes from 1/32in to ⅛in, countersinking all holes on one side to give a sharp edge. By clamping this plate in a vice and drawing a split cane through the holes in a diminishing progress, a few feet of trennals stuff can be produced in a few minutes. When the holes become blunted it is a simple case of drilling a new set. Other home produced items are clamps and jigs, which can be made from clothes pegs. Salvaged plastic containers can be used for storage, and a two-litre ice cream container is ideal for holding rigging material. Similarly, a filter case, discarded from a computer processing unit, is ideal for housing needle files as it is made of many corrugated and padded layers into which the file handles can be inserted (Photograph 13).

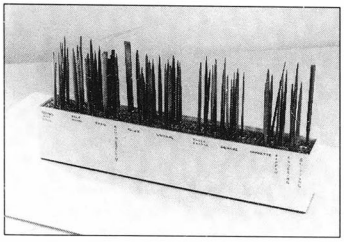
Timbers

For the best model work, wood without any apparent grain or figuration should be used. The best woods for this are the traditional ones of the fruit variety, and of course, lime and box. This is to keep the appearance of the timber work in scale. Many models, perfect in every respect, are spoilt by the use of timber such as black bean, which is dark brown with black figuring streaks and curly mottles. Such figuring may look fine on a piece of furniture but rather begs credibility on a model. Naturally, timbers with an open or rough grain should be avoided.

The timber used in the shipyards at the time *Cruiser* was building was also traditional, being mainly oak for all the framing and outer skin of strakes and wales. The keel would have been elm, which although highly susceptible to the Lyctus beetle is very durable under water, and was also used, hollowed out, for the bilge pumps. As



12. Pin chucks, etc. *Top*: Miniature 1in (25mm) vice with, immediately below, a brass pin chuck with reversible head. *Middle*: Three standard type pin chucks. *Bottom*: Three dental pattern pin chucks.

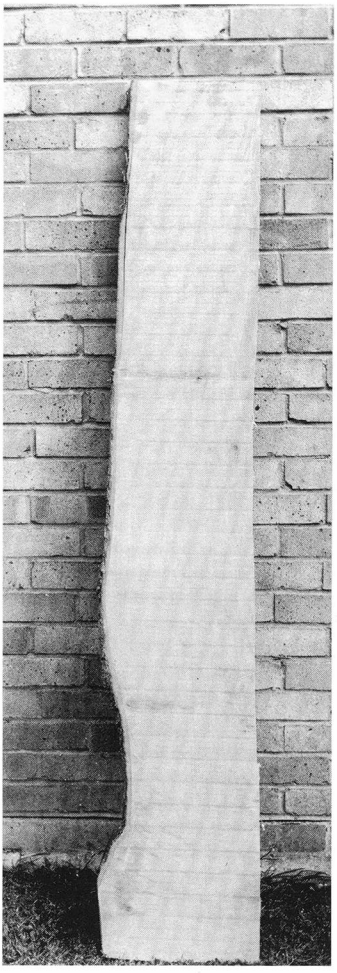


13. Method of storing needle files. The holder in which the files are placed is a filter from a computer main unit, comprising a plastic box fitted with corrugated aluminium interspaced with felt.

it does not splinter finely, it was also used at times for the gun decks. For lining the gun decks, pitch pine would have been used, and also, sometimes with fir, for the bulkheads. Like the other woods, pitch pine is heavy, being around 41lb per cubic foot, and being heavy, dense and tough with a high resin content, making it resistant to moisture. None of these woods is suitable for model work.

Returning to the built-up model, boxwood is the most frequently chosen material. This is a hard, light yellow wood, with a uniform grain without any distinction of rings, swirls or figuration, and is ideal for the built up ship model, equal for framing, planking detail, and masting. The best quality being up to 70lb per cubic foot, it is difficult to work and needs the hands of the experienced for its best effect. Cherry is another favourite, with the same qualities as box and the advantage that after immersing in water it takes on a brownish red colour which can be very pleasing in a model. Apple is more plentiful than pear, but both have the same advantages of a fine grain without mottling or figuration. The model of *Wasa* in the Science Museum is made from pear, and shows this wood to good effect when handled by an expert.

An ideal wood for the *Cruiser* model would be English lime. This is a tinted, pale brownish to white wood, and lighter in weight than those mentioned above, being on average about 35lb to the cubic foot when seasoned. It is straight grained, without figuration and easy to work, and is especially suitable for carving as it cuts clean, deep and sharp without splintering, in any direction. Care must be taken as it sands rapidly, but it leaves a smooth, silk-like finish. The one snag with lime is that it is highly susceptible to woodworm, but if this penalty is recognised at the outset and preventative measures taken by applying a good soaking of a preservative during construction, the problem should not arise. A ½cu ft lime plank was purchased from which to cut the material for *Cruiser* (Photograph 14).



14. The half cubic foot of English lime wood.

Not everyone will have access to a circular saw bench with which to cut such a plank into suitable sizes, not just for one ship, but also for a good reserve of stock. The material for

Cruiser will not amount to much more than ⅛cu ft. These planks are not sold in much less than ½cu ft pieces but it is by far the cheapest way to buy timber. For those without these facilities, cut sizes of most of these woods can be obtained from model supply shops, which also often advertise their products in model maker magazines. A typical extract from a recently obtained list of cut sizes of lime sheets suitable for the built up model is 4in x 36in, ranging in thickness from 1/32in to ¼in. Prices, of course, will vary from vendor to vendor, and it is worth checking which 'lime' it is: it can often be American Bass, which has neither the quality nor the workability of English lime.

Other materials

A useful little information sheet on rope making is given to visitors at the ropery at Chatham Historic Naval Dockyard. A ropery has stood on the site since 1618, and one is still in use today. Flax, jute, hemp, sisal and cotton have been the mainstay of this trade. Their natural fibres are very strong when wet, have little stretch, and can tolerate extremes of temperatures. Today, nylon, polyethylene and polyester are counted amongst rigging materials used. All these fibres, natural and man-made, can be used by the model shipwright, though sisal and cotton should be strictly avoided. Most rigging bought from a supplier is hemp, and comes in a good range of sizes from 0.10mm to 4mm or 5mm. It is best to buy it wound onto a reel, as winding from the hanks can become a frustration of tangles; many modellers, however, like to hang the hanks with weights for a few months to stretch them. Man-made fibre threads can be obtained from departmental stores and fishing tackle shops, and white nylon can be dyed grey or brown for rigging. Rope making can be done at home on a suitable self-made rope walk, but a description of this practice would require a chapter in itself; a drawing of a typical rope making machine is shown in Fig 5.

Another item for which to keep an eye open is sail making materials. Sails can be made from both paper and cloth, but once again scale should be the main consideration. So many models, otherwise perfect, have been made ridiculous by sails made up not only with out of scale stitching but out of scale material. If scaled up, these sails would have a thickness of several inches and stitches of over a foot in length.

Finally, we come to consider glues and varnishes. Today there are glues on the market for every conceivable purpose, from wood through to glass and die cast metal. All are useful somewhere around the model during construction, and there is no better advice than to become acquainted with them all. However, White Woodwork adhesive is ideal for most gluing as it acts as a filler for loose packed joints and does not need to be set under pressure. Properly applied, it is stronger than the wood it joins. Similarly, there are now a number of polyurethane varnishes on the market, which come both in clear and in various wood effects, matt, satin or gloss finish. They are intermixable, so the scope for variety is enormous. Apart from finish, they act as a sealer and preservative, and for this reason should be applied inside the hull and on the underside of decks. Applied in several thin coats these varnishes spread well, leaving no drag, and provided each application is rubbed down lightly with fine sandpaper and each coat is allowed to dry hard. For a spray finish they are ideal.

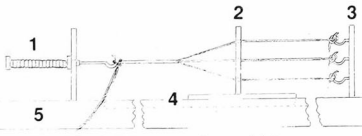


FIGURE 5. An example of a model Rope Walk.

1. Sprung tensioned rotating hook
2. Traveller
3. Fixed hook thread anchor
4. Traveller riding channel
5. 4- to 6-foot base for Rope Walk

2

Making the Draughts

DRAUGHTSMANSHIP IS AN integral part of the model shipwright's make-up but he or she does not need to be an accomplished draughtsman. Absolute accuracy of the measurement is the order of the day, coupled with hair thin lines. Add to that a competent understanding of scales, and the conversion of scales, and the battle has been won. Presentation is not important: even drawn on wallpaper or a page torn from a scrapbook, a drawing is an asset to assist in the construction of a ship. When that use has passed, so will any reason for keeping it (although, of course, it is wise to keep if there is a chance it will be needed on another occasion). To help with this, a scale card can be very useful. This is a table of scales worked up for a particular model, and can have infinite use on, for example, ships built to a consistent 1/72 scale. The table acts as a ready reckoner of full size to scale size, from 6ft down to a fraction of an inch, and consulting it saves much reworking of the scale when dealing with any part of the construction; Table 4.

When working to the fine lines required for a draught, a sharp pencil, honed to a needle point, is a prime tool. For this, cosmetic emery boards (cardboard nail files obtained from a chemist) are very useful. A few touches of the pencil point to one of these soon restores that essential point. Alternatively, any small pad of fine sandpapers will do the job.

In the course of building *Cruiser*'s carcase, everything will depend on the accuracy of the draughting of frames for cutting, as well as on the fretting of the frames themselves and their precise placement from a construction draught. It is not wise to accept without question a set of drawings from which to build a particular model. These draughts should be used purely as a starting base, and even the very best should be checked thoroughly for

TABLE 4: 1/72 Scale

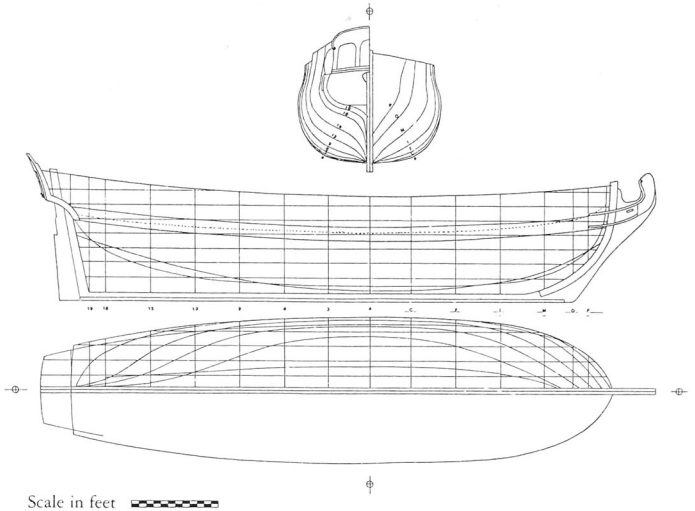
Full Size	*Scale Size*
6ft	1in
3ft	1/6in
2ft	1/12in
1ft 6in	1/12in
1ft	3/12in
9in	3/24in
6in	1/12in
4½	3/48in
3in	1/24in
1½in	1/48in
3/4in	1/96in
3/8in	1/192in

contradictions or for errors of rig which have emerged in the course of modern research carried out since the draughts were made. An example of this is the sail and rigging plan of *Endeavour*, obtained from one of the most reliable sources in the model maritime world. The drawing was made many decades before, and its author long passed on, but in the light of modern knowledge the draught is at great odds with what is now considered correct. In the past two decades so much has been achieved by marine archaeologists and historical maritime researchers that much opinion and concept has been changed, even in the last decade, and the consequent publications are wide-ranging and numerous. Remember, however, that the model builders of the past were not so fortunate, either from the volume of work or its easy access by price. Many early modellers trod a lonely path, and although many still work alone, they now have the privilege of a tremendous back-up from an international band of model shipwrights, all freely exchanging their ideas and expertise through such journals as *Model Shipwright*, not to mention the help given by all the maritime museums around the world. Such is the scene today for all who wish to avail themselves of it.

What, then, if a set of draughts can be obtained to cover all likely needs? A search through two or three of the many catalogues and lists of plans to hand, whose sources are listed in the current maritime modelling periodicals, will reveal a number of full set attractions. A few amongst the many draughts offered are sets that consist of a lines drawing, a profile or arrangement, a sail and rigging plan, a sheet of detail and spars, and a construction draught with perhaps some station sections. One such set is Harold A Underhill's brigantine *Leon*. These draughts are still obtainable, though very expensive if all five or six sheets are purchased. However, in seeking a full set, one is severely restricted in choice; not only on the era and class of ship but, more importantly, on the choice of scale. Much better by far to acquire a little skill in draughting up one's own requirements from any given lines draught: then the whole panorama of maritime history, with its ships of any age, is there for the choosing, and the task becomes infinitely more interesting and rewarding.

The National Maritime Museum has a million such draughts, which have always been available to the public on request, and in addition they can supply complete sets of draughts of specially selected ships at very reasonable prices. However, the fact remains that the vast majority of those of the wooden ship era are lines and profiles only due to the fact that sail and rigging plans and those of spar details were rarely made and very few survive. The Museum provided a copy of the Admiralty Draught lines and profile of *Cruiser* of 1752, reproduced in Fig 6.

I was fortunate in the choice of ship as the subject for this book as the mid-eighteenth century was a time of change and experiment, not only in England but with all the then great naval powers of the western world. The *avant-garde* naval architect of the day, Fredrik Henrik af Chapman, came from Sweden. That he designed *Wasa*, which sank on launch, is no discredit to him but to the powers of his time insisting on an extra lower gun deck against his advice. Chapman (he had an English surname because his father was an émigré Yorkshireman) came to England in the 1750s to study English shipbuilding methods, which was very fortunate from the naval historian's point of view and for many a latter day model shipwright, for he drew up numerous draughts of



Scale in feet

FIGURE 6. Lines plan of *Cruiser* as in 1752. Taken from an original Admiralty draught.

Length overall	87ft 9in
Length on gun deck	75ft 6in
Breadth overall	20ft 7in
Breadth moulded	20ft 0in
Depth of hold	9ft 4in
Burden	141 tons

All measurements to inside planking (except breadth overall).

the ships he visited in an era which is lamentably devoid of such historically vital maritime material. His work is enshrined in his famous *Architectura Navalis Mercatoria*, the original of which, together with his other material, is held in the Sjöhistoriska Museet, Stockholm.

During his tour of the English shipyards he paid a visit to Deptford and there made draughts of *Cruiser*, both lines and profile and, more importantly, a sail and rigging plan. These are reproduced in Figs 7 and 8. My thanks are due to Mr A Arnö of the Sjöhistoriska Museet for lending me the negative and dao of the sail plan. I obtained the Chapman lines draught from sources at home, although this had been available from Stockholm had I needed it. These draughts provided a good base from which to proceed, but further research led to even further encouragement. This was the book by Sergio Bellabarba and Giorgio Osculati on the Royal Yacht *Caroline* of 1749 (Conway Maritime Press).

Caroline was also built at Deptford and launched some two years before *Cruiser*'s keel was laid. *Cruiser*'s specifications were very loose by Admiralty standards, much of the construction being left to the shipyard. However, they were specific in that the vessel was of shallow draught, speedy, and able to come about easily, and for this purpose should follow the construction and lines of *The Royal Caroline*. The lines of this yacht can be see in Fig 9, and are an interesting comparison with those of *Cruiser*.

Caroline had proved a very successful ship with all the requisite qualities and a speed in a fair wind of 10 knots, with which the Admiralty Board seemed well satisfied. As was King George II, who was a much travelled monarch, indulging in frequent trips to the Continent. His influence on the affair must have been considerable. It is interesting that in future years *Cruiser* paid escort to *Caroline* on at least one occasion of these many trips. The development of the design of *Caroline* is from the design by Lord Danby for the yacht *Royal Transport*, a present from William III to Czar Peter the Great in 1698. That story is interesting and well worth reading up, but suffice it to say that the *Caroline* design formed the basis of all British Naval Frigates, and even larger ship construction, for more than half a century after her launch. Even more importantly, as her construction is well documented, it can be safely followed for that of *Cruiser* inasmuch as that to be a fast ship she had to be lightly timbered. This follows with both the Admiralty draught and the Chapman draught of her lines, and agrees that she was double framed throughout with a double siding of some 16in to 17in with room of about 8in, giving a room and space dimension of 25in. With this information a construction draught can be made.

The first step towards this is to make from the ¼in to 1ft Admiralty lines draught a reduced 1/72 scale

profile, body plan and half breadth outline drawing. This will fit comfortably on a sheet of A2 cartridge paper. The scale of inches should be drawn on this sheet, so that when some half dozen photocopies are run off they can be instantly checked for any distortion. This will complete an outline arrangement as shown in Fig 10. With these copies, there is now the basis to draw up, without undue repetition, all the draughts that may be required. The outline draught is made in the following way. A copy of an original Admiralty draught would have been made from an original that may be all of 240 years old. Apart from being very unfamiliar by modern standards, much of it may have faded. Therefore it is advisable to pencil in new waterlines and buttock lines at 2ft intervals for ease of working. Taking the draught as being at 1/48 scale, this gives a division of 1/2in spacings. Starting at the base line of the body plan, mark a series of horizontal lines at these 1/2in intervals across the body plan. From the centre line of the body plan mark off a series of vertical lines right and left of the centre at 2ft or 1/2in intervals. The horizontal lines of the grid so formed are the newly formed waterlines. The vertical lines are the newly formed buttock lines. All these lines are then numbered accordingly. The next step is to mark in the 2ft spaced waterlines only, on the sheet plan, retaining the original station lines. These lines run from bow to stern crossing the station lines, and are started again at base.

On the half breadth plan, mark out the buttock lines at 2ft intervals from stem to stern. These lines also cross the existing station lines. All these lines should be numbered to conform with those of the body plan, and of course beginning from the centre line. The draught is now ready to lift off all dimensions for the new 1/72 reduced outline draught.

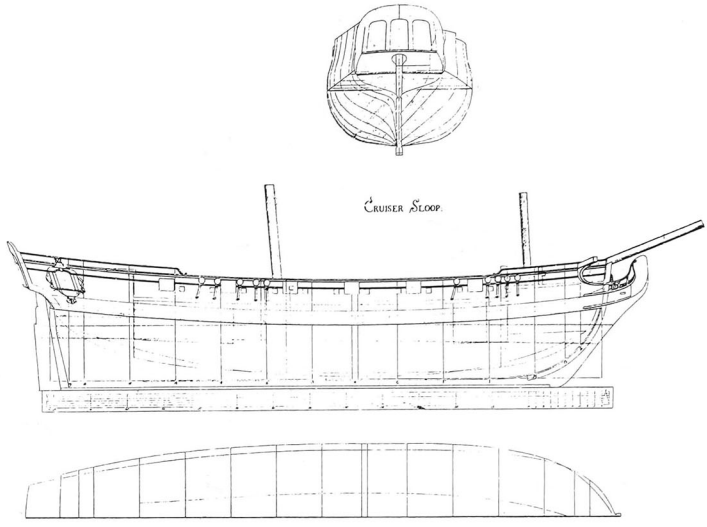


FIGURE 7. The original F H Chapman draught of *Cruiser*, 1752.
By permission of the Sjöhistoriska Museet, Stockholm.

Outline Draught

The first step towards this is to transfer all the new grid lines made on the 1/4in original draught to a fresh sheet of A2 paper, reducing the 1/48 scale lines to those of 1/72. This will give each line a grid width on the proposed body plan of 1/3in or, by use of a conventional steel engineering rule with 1/24in divisions, 4/12in. The waterlines are drawn to this scale on the proposed sheer draught, and the buttocks lines on the half breadth plan. The original station lines are then set into these lines to form the grid, starting, of course, from dead flat frame. On the new sheet there should now be three separate grids, one below the other and in order of body plan, sheer plan and half breadth plan. The task now is to infill these with the outlines of the vessel.

This can be done in either of two ways: with a precisely set pair of proportional dividers (Fig 11); or by reading each measurement off as full size on the 1/48 scale drawing and converting that measurement to 1/72

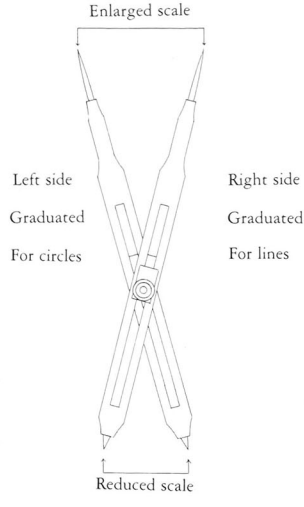


FIGURE 11. Proportional Dividers (length 20cm).

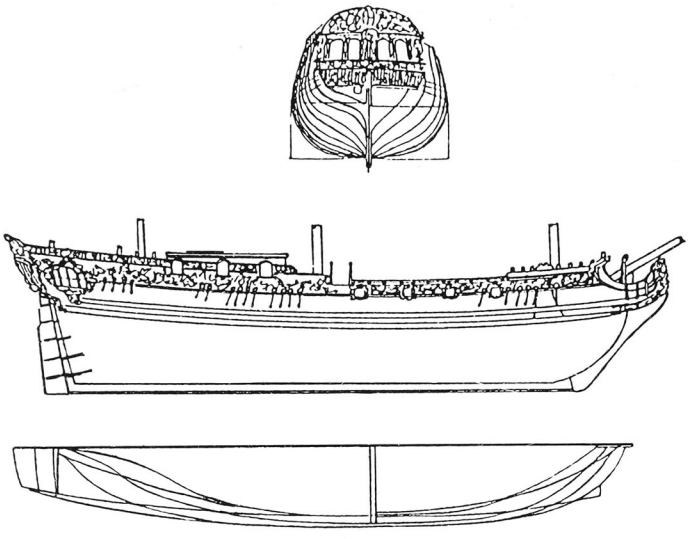
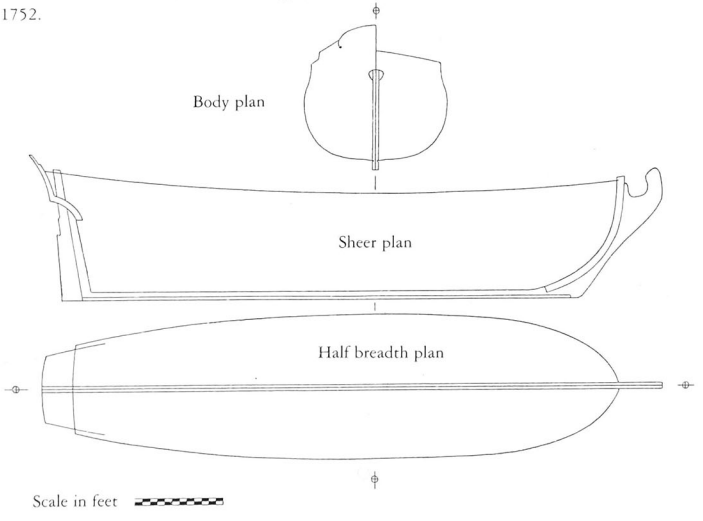


FIGURE 9. Lines of the Royal Yacht *Royal Caroline*, built at Deptford in 1749. The similarity between the lines of *Caroline* and those of *Cruiser* are easily identifiable. The lines of *Caroline* formed the basis for British naval ship design as far forward as the next century.

FIGURE 10. *Cruiser*. Basic outline draught, 1752.



scale for the other. If the proportional dividers are even a fraction out, this could result in a creeping distortion which would confound the whole exercise. Reading off each measurement may take a little longer, but is a sure method to arrive at a true reduction or enlargement draught. Another good reason for using a scale read measurement is that it familiarises the model builder with all the various sizes of scantlings and dimensions, whereas with the proportional dividers they are read off blindly. Also as a safeguard, it is best to draw in on the new draught an overall measurement first, so that the new lines can be contained within these boundaries.

Cruiser's moulded breadth is 20ft 0in at the dead flat (widest) frame, ie to outside of frame or inside of planking. This means that the moulded or greatest width of the dead flat frame of the 1/72 scale body plan should be marked in at 3 5/12in, that is, at 1 8/12in on each side of the vertical centre line.

Continuing with the body plan, it is now just a matter of starting with the first waterline above the base, and measuring out along it from the vertical centre line to the point at which the outermost frame crosses it. This should read off at 7ft 9in, or 1 7/12in at 1/72 scale. A dot should be placed at this point on this waterline on the new body plan each side of the centre line. This process is continued on each side of the waterlines and buttock lines where they intersect with this frame, the measurements on the buttock lines being taken from the base line upwards.

It is important in this exercise to take all the measurements from one side only of the original body plan, repeating the same measurement on each side of the new body plan, since one side can differ from the other on an original drawing. When all the dots have been completed, they are

joined up, using a French curve to form the outline of the widest frame of the body plan.

For the sheer plan outline the station lines on the original draught can be used, measuring up from the base line to that of the sheer line. A start can be made at dead flat, working outwards from this, measuring each station line on the original, converting the measurement to 1/72 scale, and marking each measurement off on each appropriate station line on the new draught. Extra grid lines may be required around the stem and stern areas to gain a greater accuracy for these outlines. When all lines have been so marked, the dots should be joined with a weighted, flexible curve and French curves to form the sheer outline. The half breadth plan can be done in he same way, using the station lines on the original and converting to the new draught, all measurements being taken from the centre line of the keel to the outermost line of the original half breadth plan at dead flat, following this through where it may tuck under the prow or stern. A further description of this conversion appears later in the book. The work can be seen in Fig 12. With the outline of the vessel drawn on this grid draught, all the grid waterlines and buttock lines should be removed to leave the basic profile, body and plan outline draught.

The next step is to prepare a working lines plan, as in Fig 13. The most important feature is the body plan, which is drawn by putting in all the frames, using the method adopted above for taking off and drawing the widest (dead flat) frame on the outline draught. The accuracy of the buttock lines and waterlines to be put on this will depend on the accuracy with which this body plan is drawn. To save much time and effort here, a pair of dividers can be used. Engineer's screw adjusted spring dividers, as in Fig 14, may be preferred to the usual drawing instrument, since these will not alter when transferring a measurement from one draught to another.

Lines Preparation Draught

Compare Fig 12 with the completed lines plan, Fig 13. The object is to transfer the waterlines and buttock lines appearing as curved lines on the Admiralty sheer and half breadth plan to the new drawing.

If we imagine that the sheer plan shape was a completely carved wooden hull, and this was sliced through horizontally along the length of each waterline, it would result in a number of slices of wood with the curved outline of their respective waterlines. Similarly, if the hull were cut vertically lengthwise along the buttock lines, these pieces would show the outline shape of each of the buttock lines. Once these basic concepts are understood, the whole purpose of a lines draught will be clear.

The buttock lines of the sheer plan

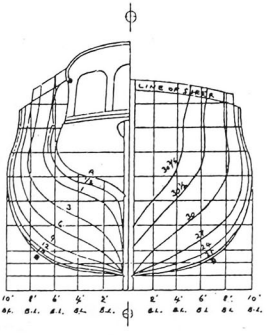
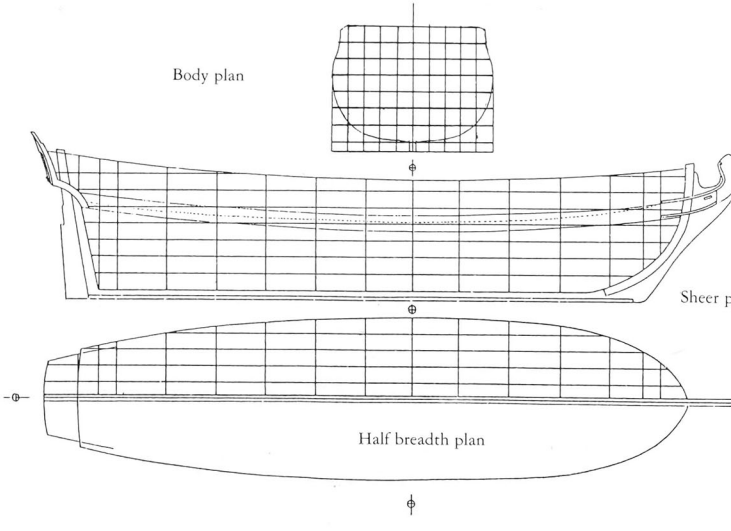
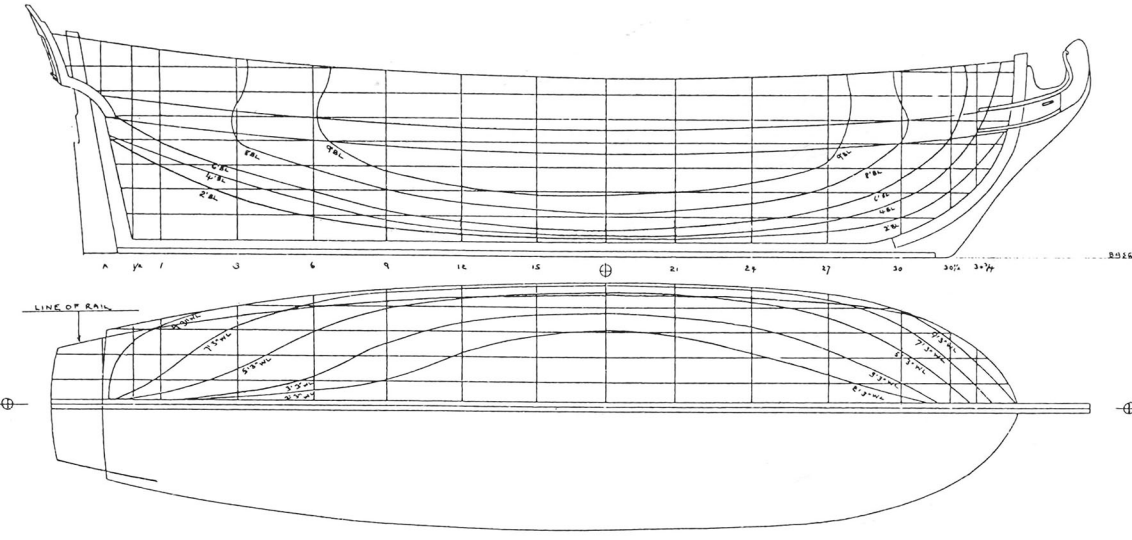


FIGURE 13. The completed lines plan.

FIGURE 12. Lines plan. A grid pattern has been marked on the three basic views.





and the waterlines of the half breadth plan are formed by taking their measurements from the newly drawn in body plan. Dealing with the sheer plan first, the vertical station lines marked A to 30¾ refer to the frame numbers on the new body plan. On a body plan it is customary for the frames or station lines aft of the dead flat (or in some cases the midship frame or station) to be placed to the left of the vertical centre line, and for the frames forward of the dead flat to be placed to the right of the vertical centre line. Dead flat is usually marked thus ⊗ and is in reality a starting point of the greatest breadth.

Starting with the 2ft buttock line, the nearest to the keel, with the spring dividers measure the distance from the base line up to the point at which it is crossed by frame 30¾, and transfer this to the new sheer plan, putting a dot at the point indicated on the vertical station line 30¾. This exercise is repeated for frame 30½ on the body plan 2ft buttock line, and so on until all frames have been taken up on that buttock line. When each station line on the sheer plan has been so marked, the dots are joined together with a long curved sweep to form the first, or 2ft buttock line, on the sheer plan. On large scale draughts this sweeping curve is inserted with the aid of a flexible spline or batten, held in place by a number of weights. These splines are made of lancewood, spruce, or nowadays of clear acrylic. They can be obtained in a variety of lengths and cross-sections to suit the application. For a small draught, such as this one, a 24in weighted, flexible curve serves just as well.

To return to the lines draught, having dealt with all the frames of the body plan crossing the 2ft buttock line, we can move out to the 4ft buttock line and repeat the process for this one and for each of the other buttock lines in turn. The result will be four buttock lines on the sheer plan. The terminal points of these buttock lines are taken from the sheer line of the body plan. Sometimes only these lines aft of dead flat are termed buttock lines, while those forward of the dead flat are termed bow lines.

The curved waterlines for the half breadth plan are set on the new draught in much the same way as the buttock lines for the sheer plan except, of course, all measurements are

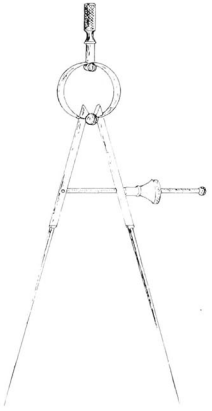


FIGURE 14. Engineer's dividers.

taken from the vertical centre line of the body plan to where a frame line cuts a waterline, starting with the 2ft waterline. Beginning at the prow, you will see that this first waterline commences at frame 30, and that frames 30¾ and 30½ are too high up the body plan centre line to be affected. When all the station lines on the half-breadth plan have been so marked out and all the dots joined for form the respective waterlines, the lines draught, as such, is complete. Free of the draughting aspect of the work for a while, we can consider the type of framing to be used, and the room and space required.

Room and Space

The original Admiralty builder's draught shows stations at 6ft 3in intervals marking every third frame, indicating two frames set between each station. This arrangement conforms with that of *Caroline*, on which *Cruiser* is based, and in common with the lighter framing of that ship, allows for a far larger room than has hitherto been the practice. At this point let me explain what we mean by Room and Space (Fig 15).

A frame has two principal dimensions (a sided size and moulded size – Fig 16) and three principal components (the floor, the futtocks and the top timbers). These are joined by scarphs, anchor pieces and chocks (see the inset in Fig 18, below). Their dimensions are determined by building formulae based on other given dimensions, all as specified by Admiralty requirements. These tables of formulae are set out in many surviving Admiralty documents. Those concerning the typical construction of the 141 ton burden sloop *Cruiser* are as follows. To arrive at the depth of keel, on which dimension the frame sizes are to be based:

The moulded breadth x $^{17}/_{32}$in

As the specified moulded breadth of *Cruiser* is given as 20ft 0in, this would read:

20ft 0in x $^{17}/_{32}$in = 10.625in

or, rounded up, a depth of keel of 11in. This would not include the false keel. This measurement reads as 11in on the Admiralty builder's draught, and so conforms to the formula. Armed with this confirmed measurement, the next set of formulae for the frames can be considered (Table 5).

In considering the disposition of the frames for the construction draught, the only concern at the moment is with the sided sizes of the frames to determine the room and space required. The figures with which to work have been established, together with a knowledge of the practice of the period based on the Royal Yacht *Caroline*. *Caroline* had been built with double framing throughout, including the cant frames, of which more later.

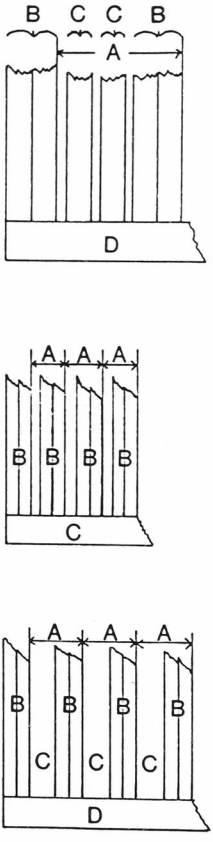
Double frames consist of a single frame made up of a floor, second futtock and top timber, which was fayed and bolted to another frame made up of a first futtock, third futtock and top timber (Fig 17). This gave a sided size for a double frame of 8¾in for floor and 7¾in for first futtock to a total of 16½in. Taking the dimension from the builder's draught of 6ft 3in from the aft side of one station frame to the aft side of the next, leaving an infill of two frames, the total space required for the three double frames would be 49½in. This, subtracted from 6ft 3in or 75in, would leave a total room of 25½in. If you divide this by three it gives a room of 8½in. A rough guide for a sloop at this time is that the room is equal to a single frame sided space. So once again, by rule of thumb or by formula, we are on course.

Gun Port Dispositions

The next consideration before proceeding with the disposition of the frames is the gun ports. It must be

FIGURE 15. Examples of room and space framing. The three diagrams illustrate how the disposition of frames in their room and space altered both with the period and purpose of the vessel.

1. Typical room and space of a naval frigate of 1790. The small space and great room was to permit enough ventilation while giving maximum timber to resist shot. A. Room and space. B. Double frame. C. Filling frame. D. Keel.
2. Room and space on Royal Yacht *Caroline*, 1749. This was the arrangement used for the *Cruiser*, 1752. A. Room and space. B. Double frames. C. Keel.
3. Room and space for a merchant brig, 1870. With single frame disposition the space would remain equal to the room. A. Room and space. B. Double or square frame. C. Space equal to frame. D. Keel.



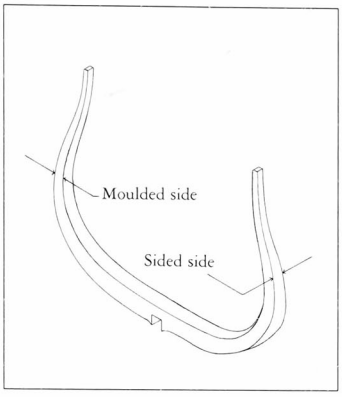


FIGURE 16. Frame dimensions.

TABLE 5: Frame Scantling Sizes

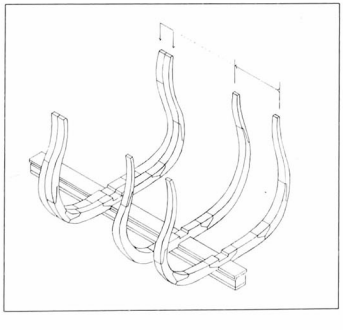
Moulded at Head	*Depth of Keel*	*Rounded up*
Floor	11in × 0.59in	6½in
First futtock	11in × 0.536in	6in
Second futtock	11in × 0.29in	3¼in
Top timber	11in × 0.29in	3¼in
Sided Sizes		
Floor	11in × 0.786in	8¾in
First futtock	11in × 0.714in	7¾in
Second futtock	11in × 0.679in	7½in
Top timber	11in × 0.643in	7in

TABLE 6: Gun Port Dimensions

Minimum distance between centres of gun ports:	(3.053in × 24)	= *6ft 4½in*
Length of gun port fore and aft:	(3.053in × 6½)	= *19¾in*
Height of gun port:	(3.053in × 6)	= *18¼in*
Top of sill from deck:	(3.053in × 3½)	= *10½in*

Straddle chain plates used on builder's draught.
All port sills to follow deck sheer.
The gun port to sit between two main frames.

FIGURE 17. Method of assembly of a double frame.



remembered that *Cruiser*, as any other warship of this period, was designed as such, and built to carry guns. Unlike on a merchant vessel, the guns were not placed on board as an afterthought.

Here again is an involvement with formula. *Cruiser* carried eight 3 pounder carriage guns, as well as ten swivels, and it is the carriage guns which are of immediate concern. While the ship carried only eight cannon, the Chapman draught shows that she was pierced for twelve carriage guns, six gun ports to each side. Little notice should be taken of the position of these ports as shown, for this is purely indicative. Their size and true position is governed by the formula, and the design of the ship by their placement. But more importantly, she was pierced for twelve cannon, and because she carried twelve cannon, they would not have been 3 pounders but 4 pounders. In view of this the ports' position and size would have been based on 4 pounder shot. It is as well to bear these points in mind when viewing the construction.

he diameter of a 4 pounder shot was 3.053in. The formula states that gun ports are spaced apart, centre to centre, twenty-four times the diameter of the shot. The gun port length fore and aft should be 6½ times the diameter of the shot. The height of the gun port should be 6 times the diameter of the shot. The sill or lower edge should be 3½ times the diameter of the shot above the deck. The dimension of gun

ports for *Cruiser* would be as shown in Table 6, as built for 4 pounder carriage guns. This formula is based on a table of shot sizes as used by the Royal Navy at this time, which can be seen in Table 7.

Another consideration is the room required to work the guns. By Admiralty directive the distance between the guns for 3 or 4 pounders was to a minimum of 6ft 9in. This fits in favourably with the formula for distance between gun ports, though in the final work out *Cruiser*'s gun ports were considerably greater than this minimum requirement.

There are two further aspects of the framing which must be borne in mind. One is the disposition of the sweep ports, in the case of *Cruiser*, and the other the space and position of the quarter light. The sweep ports were placed between the frames in much the same way as the gun ports. There were eleven ports per side placed one each side of each gun port, except in the case of the aftermost one, which had just one sweep port on its fore part. They were given sills and top pieces in the same way as the gun ports; these sweep ports were about 9in wide and 7in deep. This size would be governed, of course, by the diameter of the sweep. The port covers will be discussed later.

The squared spacing for the quarter light was taken from the quarter badge as shown on the original draught.

Armed with these vital dimensions it is possible to construct a disposition of frames draught. At this time the angle of the cant frames together with their required number can also be determined. More of this aspect will be dealt with under the discussion of cant frames in Chapter 3. A disposition of frames draught is shown in Fig 18.

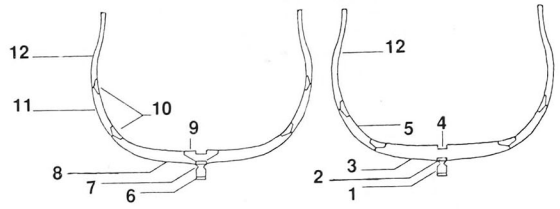


FIGURE 18. *Cruiser* – Disposition of frames.
Timbers of the double frame:

1. Keel
2. Hog
3. Floor timber
4. Rebate for keelson
5. Second futtock
6. False keel
7. Rabbet
8. First futtock
9. Cross chock
10. Anchor piece
11. Third futtock
12. Top timber.

Keel and Keel Assembly

Having completed the main draughts, we can now move on to the more exciting work of construction. The fundamental part of any ship, of course, is the keel and its components, and it is here that a start should be made.

No model should be attempted without an intimate knowledge of its structure and composition – which is often the modeller's reason for disdaining kits. With a kit, one is wise after the event; with scratch building one has to be wise before the event, or disaster will follow. It is one thing to assemble numbered parts, with no idea of their purpose or cause, following the instructions of an exploded diagram, and quite another to be in the place of the original pattern maker, researching, draughting and making up the components oneself. With the latter there is an intimate acquaintance with all the reasons why and how something is being done, giving purpose and meaning to the task and thereby producing great satisfaction with the end product – even if it is not as perfect as the kit.

With this in mind, a sketch of the keel and its assembly should be made (Fig 19) as a working draught. The example shown is a simplified arrangement of what in reality would have been built in the shipyard, but its essential elements are all there. For the purpose of this model of *Cruiser*, to be more ambitious is unnecessary. The usual building practice for this keel assembly is detailed in Fig 20 for

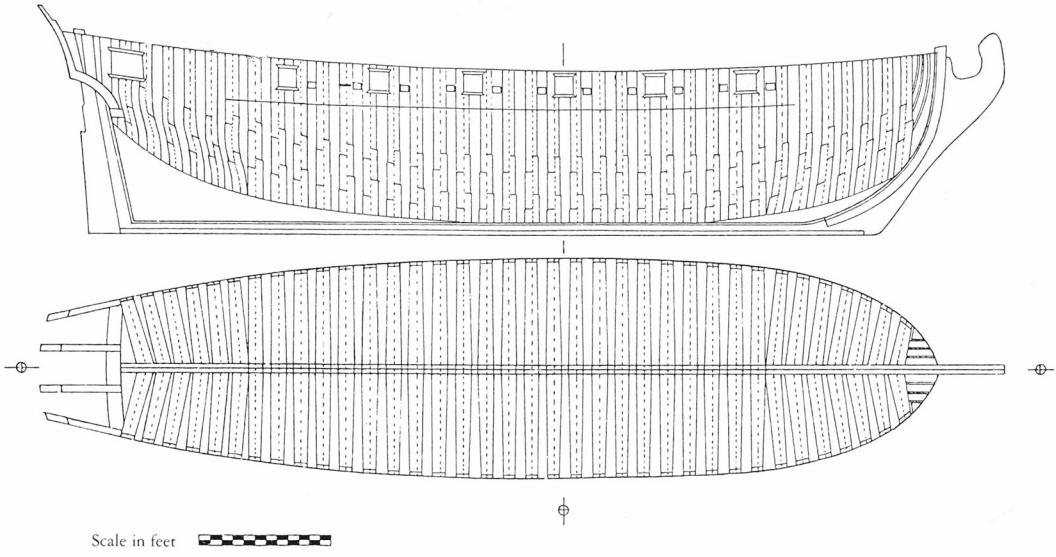


TABLE 7: Royal Navy Shot Sizes, mid Eighteenth Century

1lb shot	1.923in diameter
2lb shot	2.423in diameter
3lb shot	2.793in diameter
4lb shot	3.053in diameter
6lb shot	3.494in diameter
9lb shot	4.000in diameter
12lb shot	4.403in diameter
18lb shot	5.040in diameter
24lb shot	5.546in diameter
32lb shot	6.106in diameter
36lb shot	6.350in diameter
42lb shot	6.684in diameter

the stern timber, and Fig 21 for the stem and prow. This greater detail can be undertaken by a model builder if warranted as in the case of a large scale model, or if the hull under the wale is to be left completely exposed. But the simplified form of the assembly can only be undertaken with confidence if there is a complete understanding of all the components that fashion it.

It can be seen from Fig 19 that the sections of deadwood, or rising wood, have been made from one piece: one fore, and one aft. In normal practice the deadwood would have been made up from much of the spare timber around the yard, being scarphed and jointed to suit the overall requirement, and in this way have taken on any form of structuring. With the fore piece the hog has been included with the boxing.

The purpose of the deadwood is to form a seating for those half frames, mostly cant frames, that due to their high rise with the sweep of the ship fore and aft, cannot be accommodated as one piece athwart the keel, as can be seen when all the frames are placed. A simplification of this is for the deadwood to rise up with the same siding as the keel. In building practice note would have been taken of the bearding line. This line is usually indicated on the old draughts as a sweep from centre to stern and as a sweep from centre to the stem. More noticeably, it is to be found in the stern, as the rise of floors here is fare greater than those on the fore part of the ship at this time. The bearding line affords a narrow shelf on which the heels of the cant frames can rest. This was achieved by making the scantling of the deadwood below the bearding line slightly greater than the deadwood above it, and was later faired off to the frames. In most instances this curved shelving would not have been any greater than 1in or 2in at the most. In view of this, and the small dimension of the model, the bearding line can be ignored. Other simplifications can be to the head timbers and stem, which can be cut as one, as also the keel and false keel.

The reason for keeping the apron as

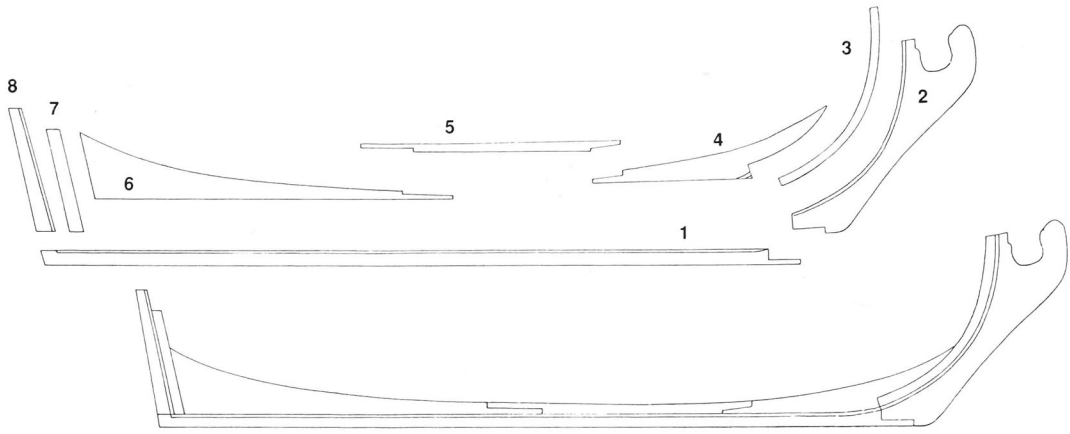


FIGURE 19. Assembly of keel, stem and sternpost.

Top drawing

1. Keel and false keel combined in a single piece
2. Combined stem and head
3. Apron
4. Combined rising wood, hog and boxing piece
5. Hog piece
6. Rising wood
7. Inner post
8. Sternpost

Bottom drawing

The assembled structure.
All pieces glued and fastened with cane dowels. The rabbet line cut in before assembly.

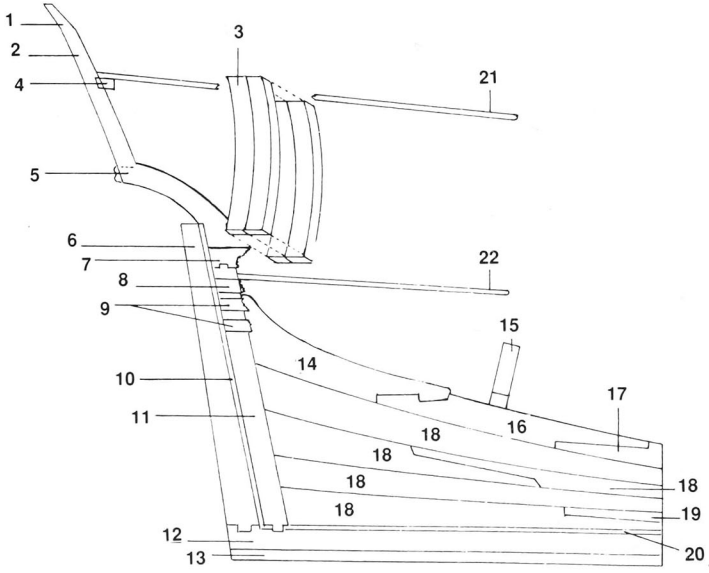


FIGURE 20. Stern timbers

1. Taffarel
2. Stern counter timber
3. Fashion piece projection and cant
4. Quarter deck transom
5. Counter rail
6. Sternpost
7. Wing transom
8. Platform deck transom
9. Transom pieces
10. Line of rabbet
11. Inner post
12. Keel
13. False keel
14. Sternson knee
15. Crutch
16. Keelson
17. Scarph
18. Deadwood
19. Scarph of hog
20. Rabbet of keel
21. Line of quarter deck
22. Line of platform deck

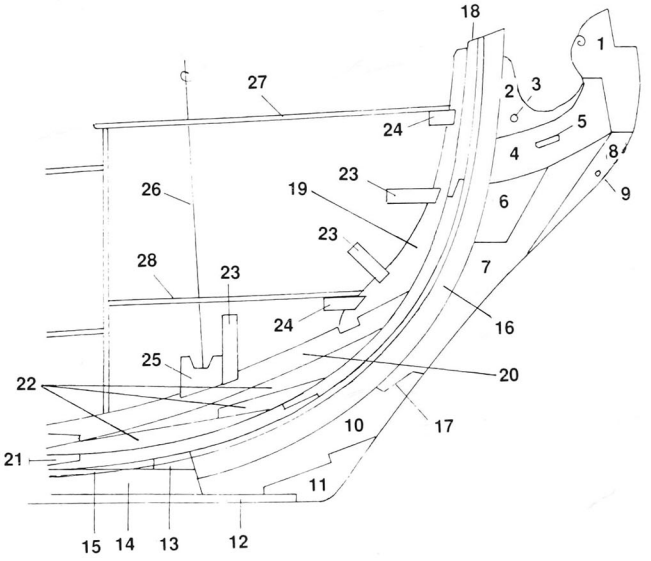


FIGURE 21. Proposed arrangement of stem area.

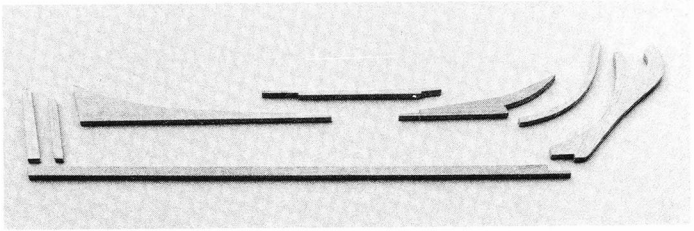
1. Figure piece
2. Gammoning knee
3. Hole for mainstay collar
4. Gammoning piece
5. Slot for gammon lashing
6. Chock
7. Lacing (main piece)
8. Bobstay piece
9. Hole for bobstay lashing
10. Gripe
11. Forefoot
12. False keel
13. Boxing
14. Keel
15. Rabbet
16. Stem
17. Scarph
18. Apron
19. Stemson
20. Keelson
21. Hog
22. Deadwood
23. Breast hook
24. Deck hook
25. Mast step
26. Line of foremast
27. Forecastle deck
28. Fore platform deck

a separate piece from the stem, as the deadwood from the keel, is to facilitate the cutting or chamfering of the rabbet, the recess which is required at these points for fitting the strakes, especially for the garboard or first strake along the keel, when planking up the hull. The rabbet should therefore be as wide as the thickness of planking intended to be used.

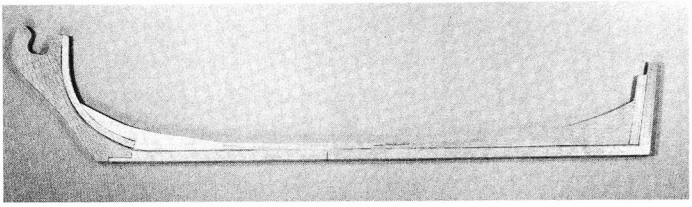
If all these pieces are made to run through with the same moulded width as the keel, including the hog, it is possible to cut them all from one sheet of lime. Finished components of the keel assembly can be seen in Photograph 15 and as joined up in Photograph 16. When joining these pieces, white PVC wood adhesive is ideal, and all joints should be pinned with cane dowel. It is vital that the stem and stern post run true to each other and the keel, at 90 degrees to the jig baseboard to ensure the stem and stern post are square to centre. They should be placed flat down on a glass top while gluing through. Felt covered lead blocks can be set on the keel's flat surface to ensure no part of it will lift out of true. When the glue has set firm the joints can be drilled and fastened with cane dowels.

Building Jig

If the frames have been draughted and cut to their exact dimensions there should be little or no tolerance in their make-up. At the scale to which *Cruiser* is being built, this lack of tolerance is even more acute. There is a moulded size of the floors and first futtocks of only 1/16in, reducing to a top timber size of a mere 1/64in. A saw cut under or over on these dimensions could have serious consequences. Equally, the tracing taken, and the draught made, cannot afford to be even the thickness of an ink line out. Yet however accurately this work is done, it is of no avail if the frames are not faired up absolutely true on the keel, or the keel, stem and stern post are not set up absolutely dead square to a base. This last can only be assured



15. The component parts of the basic keel and deadwood assembly.



16. The keel assembled.

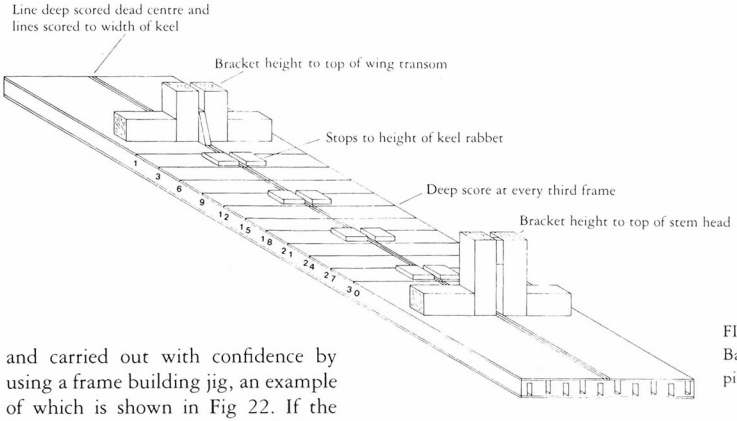


FIGURE 22. Building board jig.
Base of ¼in blockboard. Brackets of ⅞in trued pine.

and carried out with confidence by using a frame building jig, an example of which is shown in Fig 22. If the frames do not run true, it will show up as a hollow or a bump when attempting the planking, however slightly the frames may be out.

There have been many types of jig advocated in various journals over the years, but the example shown here seems to be the most useful as it not only maintains the stem and stern post true at 90 degrees to base at all times, but also allows the frame to be removed for work to be done, and replaced to a trued up position without having to reinstate securing pieces, which would have to be trued up each time they were renewed. Yet the whole jig can be simply made.

You need a piece of perfectly flat machine milled board. This should extend about 4in beyond each end of the keel, and be about 2in wider each side of the widest frame. For *Cruiser* a piece 24in x 7in from a sheet of ⅞in blockboard would be adequate. Blockboard, like plywood and chipboard, is a machine manufactured product. It is preferable because it consists of several pieces of machine planed obechi faced top and bottom, with a 3.32in

mahogany ply, so it is not given to warp or shift in any way, is true in every direction, perfectly flat, and ideal for the purpose.

Finding the exact centre on the flat top of the board, score a line at right angles across the width and another down the exact centre of the length. With the board now quartered, two further lines are scored each side of the centre line lengthwise, to represent the width of the keel. All the station lines are then pencilled in at right angles across the width of the board, with the first scored line made acting as the dead flat, the station lines extending fore and aft of this. These lines should be double checked for their accuracy, then scored in. The reason for scoring, and not leaving them as pencil or ink lines, is that in time a pencil line can wear off, whereas the scored line is permanent.

The next job is to consider the brackets to hold the stem and stern posts. metal brackets can be used, both the flat strip angled type or the pressed steel types used for shelving. But while these may prove suitable, given that they are trued up at a 90 degree angle, some compromise must be made in the jig to allow for their fixed manufactured height up from base. You will find that all such bought in items require a compromise. With a jig, there should be no such compromise. It needs to be exact in every respect, so it is strongly advised that the brackets be tailor made. That said, machine planed timber pieces or sections can be an asset if bought from a reliable source. For example, a 6ft length of 1in x 1in pine may be true to measurement throughout its length. A few inches of this wood can be used for the brackets.

First, cut two lengths to the height of the stem, and two to the height of the stern post to the point at which it is crossed by the wing transom. The next four pieces to cut are to buttress these uprights, the buttress pieces being laid lengthwise to form four right angled brackets. The ends of all these pieces must be accurately squared up, either on a disc sander or with a new sharp broad sandpaper stick carefully applied while the block is held firmly on a flat top. The four uprights are glued to their buttress pieces on a flat glass top and checked with an engineer's square and left to set.

Next, make eight 1in x 1in pieces of ⅛in ply to be spaced along each side of the lines of the keel on the baseboard. These pieces should not extend up beyond the bottom line of the rabbet for obvious reasons. Their purpose is to maintain the keel in a true position on the baseboard so that the keel slots neatly between them. With these glued in position, attention can be given to the keel. Lightly mark in with a pencil all the station lines, on both sides, with an engineer's square; squares come in a range of sizes from 3in up.

PVC glued joints can generally be handled after an hour or so, but with the imperative 90 degree angle required on the brackets, they should really be left overnight in a warm room to set firmly. The next day they can be checked again on the glass top to make sure they have remained true. the marked up keel can now be placed in its slot, and the brackets in their lateral positions to support the stem and stern posts. With everything trued up the brackets can now be glued to the baseboard in such a way that the keel assembly can slot in and out of them without pressure, yet once there remain quite secure, without any movement. When the brackets have set firm they should be checked again, to ensure that the stem and stern posts are a true 90 degrees to the base. Stops should then be placed between the pairs of

brackets to prevent any fore and aft movement of the keel.

You can appreciate that the construction of even a simple jig is not to be hurried. It is worth taking the time as the whole future truing up of the ship will depend on its accuracy. This stage of the jig can be seen in Photograph 17 with and in Photograph 18 without the keel assembly. You will see that the station frame lines on the baseboard have been numbered from 1 to 30 with printed gum stickers, obtained from a stationer, which are a help when placing in the frames.

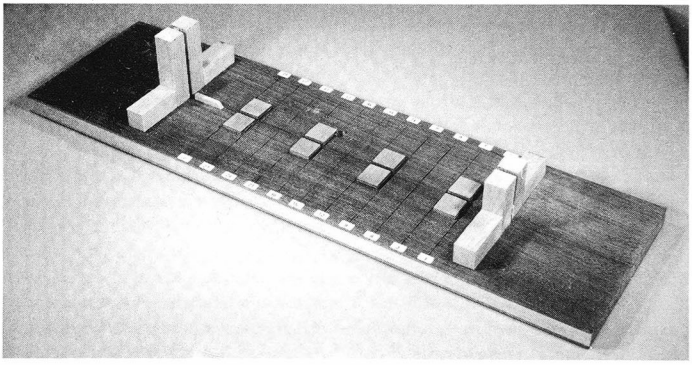
Now we can return to the frames, and again to the drawing board.

Lifting the Frames

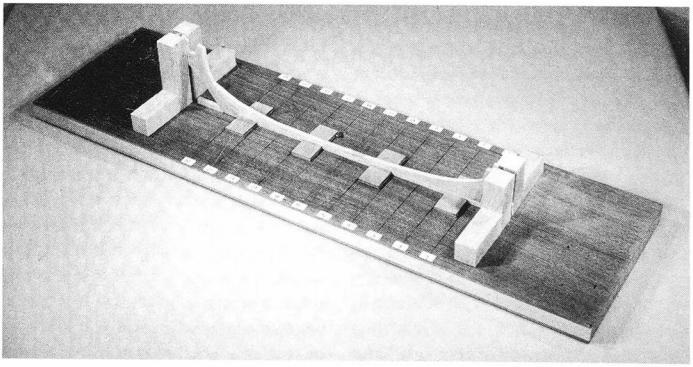
The number of frames to be set on the keel is 36, including the cant frames. Each frame needs to be drawn up separately, and to do this the precise shape of each frame needs to be ascertained. The only way to do this is to lift them from the lines draught (see Fig 29), using both the buttock lines and the waterlines. This can be done by adapting much the same technique as used in draughting the new lines drawing from the original 1752 Admiralty builder's lines.

The first stage is to rule in with single lines one face of all the frames on the lines draught. In doing this, all existing station lines should be ignored, unless they happen to coincide with the lines of the frames you have decided on.

As with the *Cruiser* draught, the lines of the frames should begin at dead flat, working outwards from this



17. Building jig, with stem- and sternframe brackets and keel chocks in position on the baseboard.



18. Jig with the keel, stem and sternpost in place.

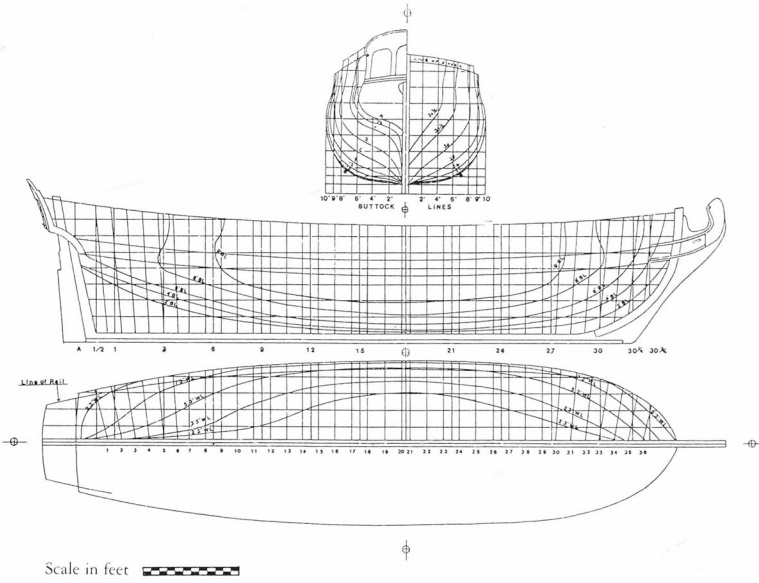


FIGURE 23. Lines plan arranged for the frame outlines to be transferred to the framing grids.

Frames to be lifted numbered 1 to 36 on the half breadth plan. All station numbers and lines shown on the sheer profile to be ignored.

Waterlines taken from the half breadth plan. Buttock and bow lines taken from the sheer profile.

All frames forward of the dead flat (frame 21) are lined abaft the frame. All frames aft of the dead flat (frame 20) lined on the forward face of the frame, thus allowing for the bevel.

point fore and aft, all the lines being carried through from the sheer plan across the half breadth plan. The distance between these frame lines was predetermined by the exercise of room and space carried out earlier, and was governed in turn by the frame disposition draught (see Fig 18). To allow for the future bevel, all frame lines should be drawn in on the lines draught at the point of their greatest moulded breadth. This means that all lines drawn aft of dead flat should be taken from the fore part of the frame, while all lines drawn forward of the dead flat would have their lines drawn from the aft face of frame; this arrangement can be studied in Fig 23.

The next stage is to draw up a series of body plan grids. Thirty-six of these grids are required, and at 1/72 scale twelve frames can be drawn on a single sheet of A3 size draughting paper. Set up on a board with a T-square and set square, this is a simple procedure. The sheet can then be photocopied. Alternatively, only one graph can be drawn on a sheet of A4 and photocopied as necessary.

These grids will of course be consistent with those of the body plan on the lines drawing, conforming with the buttock lines ruled by division across the half breadth plan and the waterlines ruled across by the same division on the sheer plan. Whatever lines exist on these three aspects must agree in every respect with the lines of grids for frame lifting. For the *Cruiser* lines, these are at 2ft spacing (see again Fig 29). It is important to appreciate that the greater the number of these divisions placed across the body plan, and reflected as curved buttock lines on the sheer plan and as curved waterlines on the half breadth plan, the greater will be the accuracy of the lifted frame.

For this reason an extra division can be added between the 1ft 3in waterline and the 3ft 3in waterline on the body plan and sheer plan, giving an extra essential 2ft 3in waterline, which again is reflected on the half breadth plan. In the same way, an extra 9ft buttock line can be added on the body plan and half breadth plan, and shown as a curved line on the

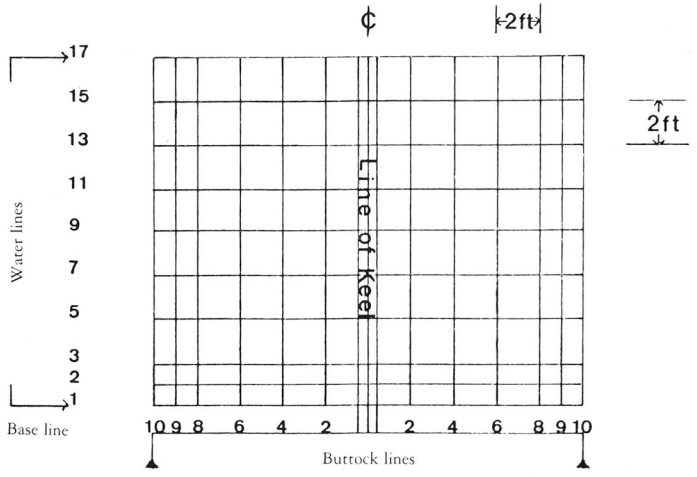


FIGURE 24. Grid for layout of lifted frame.

sheer plan, omitting its straight line on the half breadth plan. The design of the finished grid for lifting the frames can be seen in Fig 24, and that with the outline of number 7 frame marked on in Fig 25.

To lift the frames in this way, you can start on the dead flat point of the half breadth plan, that is frame number 20, or at any other point. With a pair of dividers, measure up from the keel centre to a point where the 2ft 3in waterline crosses it, and transfer this measurement to the grid by placing one point of the dividers on the centre line and marking a pencil dot where the other point of the dividers touches the 2ft 3in waterline of the grid, both sides of the centre line being taken up. This exercise is then repeated for frame 20 with every one of the four waterlines that cross it, including the 9ft 3in waterline of greatest breadth. There should now

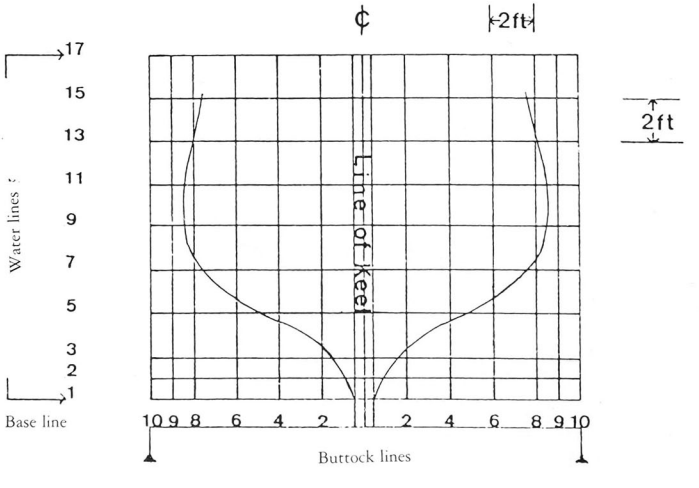


FIGURE 25. Frame grid with typical frame outline marked in.

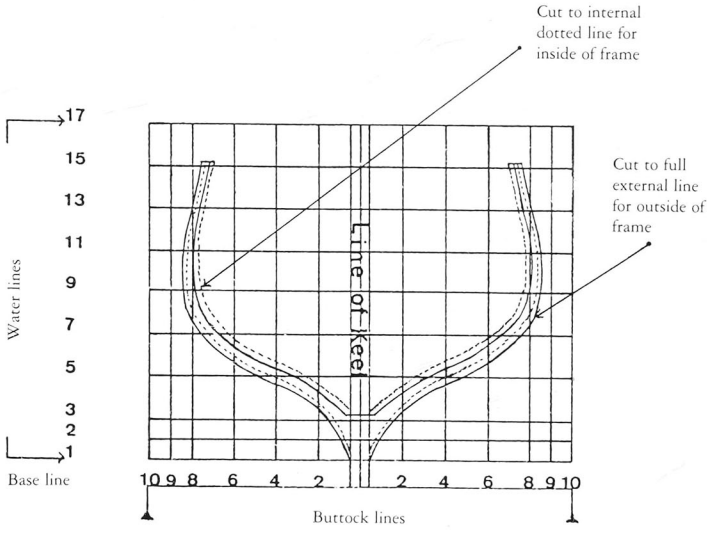


FIGURE 26. Grid showing a frame with both faces marked in to indicate amount of bevel.

be a series of ten pencil dots marking out the shape of the frame on all the waterlines.

Lastly, the top width of the frame is marked in from the line of the rail which is seen to run for the most part inside the 9ft 3in waterline. Now proceed to add those of the buttock lines of the sheer plan. Still on frame 20 on the sheer plan, place a point of the dividers on the base line, the bottom line of the keel, and take a measurement up to the 2ft buttock line. This is transferred to the grid by placing one point of the dividers again on the base, and the other point on the 2ft buttock line of the grid, once again on both sides. This exercise is repeated until all the buttock lines that cross frame 20 have been taken up.

To determine the height of the frame a measurement is taken from the base to where it meets the sheer line. The whole series of dots is then joined up with a French curve. When attempting this it is as well to consult the curves of the station framing on the body plan of the lines draught, especially with a vessel such as *Cruiser*, which has a marked tumble home. To have added these as higher waterlines on the half breadth plan would have created a confusion of lines, as all these lines would have fallen inside the 9ft 3in waterlines of the greatest breadth. As it is, the line of rail needs careful study to trace its true route. This, of course, is required as stated to mark off the top width of the frame. At this stage the line of the wale could be marked on, as well as the deck lines, although this can also be done later on.

Having dealt with frame 20, proceed steadily aft, then forward of the dead flat until all the frames have been graphed up. All the moulded sizes to form the full moulded shape of the frame can now be added.

Consideration should be given to the bevel of the frames. You will see that an incidence of bevel is incurred as the frames sweep fore and aft from dead flat, to follow the mould of the ship, and that the bevel of any one frame is not consistent throughout its

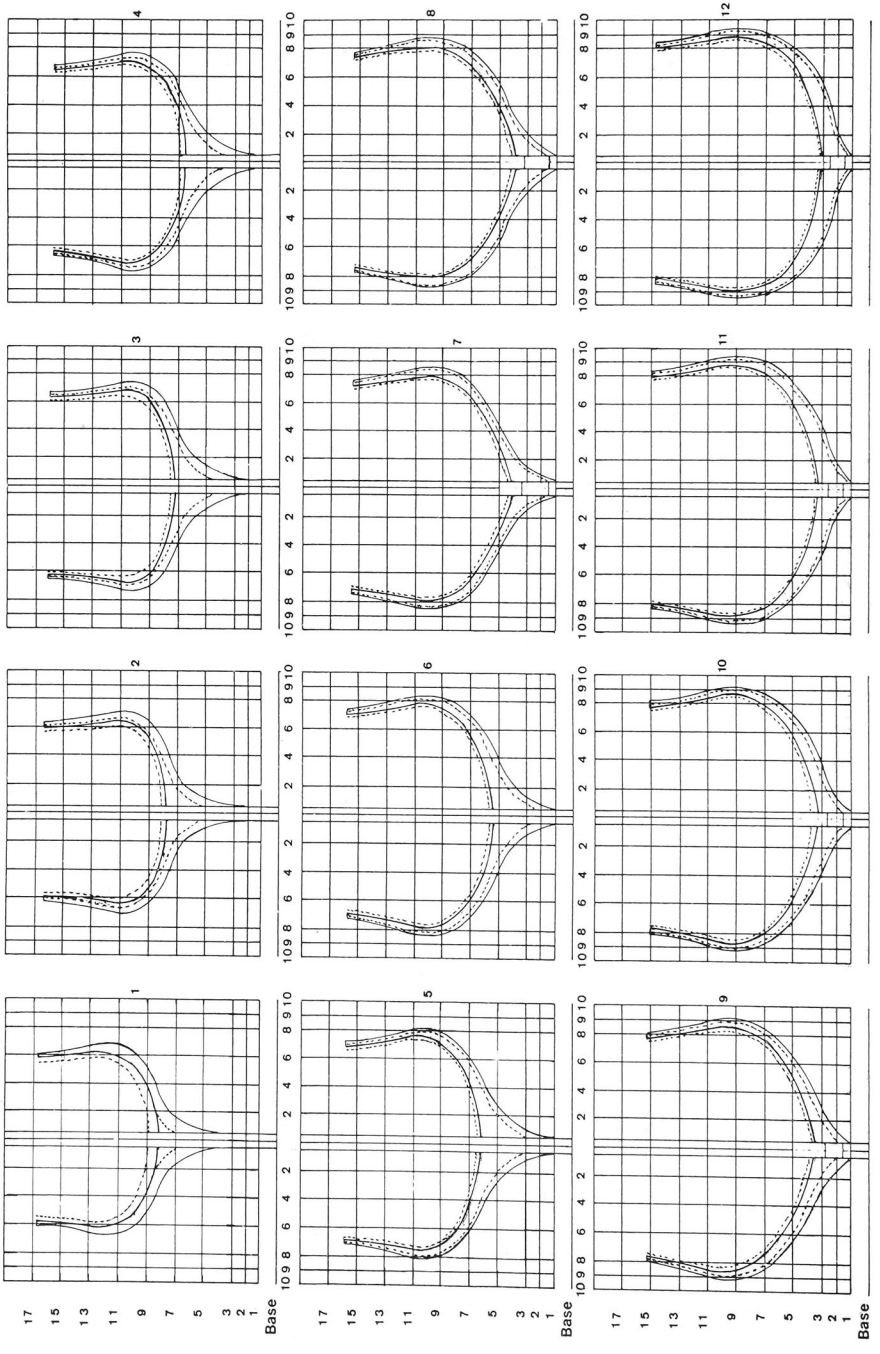


FIGURE 27. Layout of frames 1 to 12

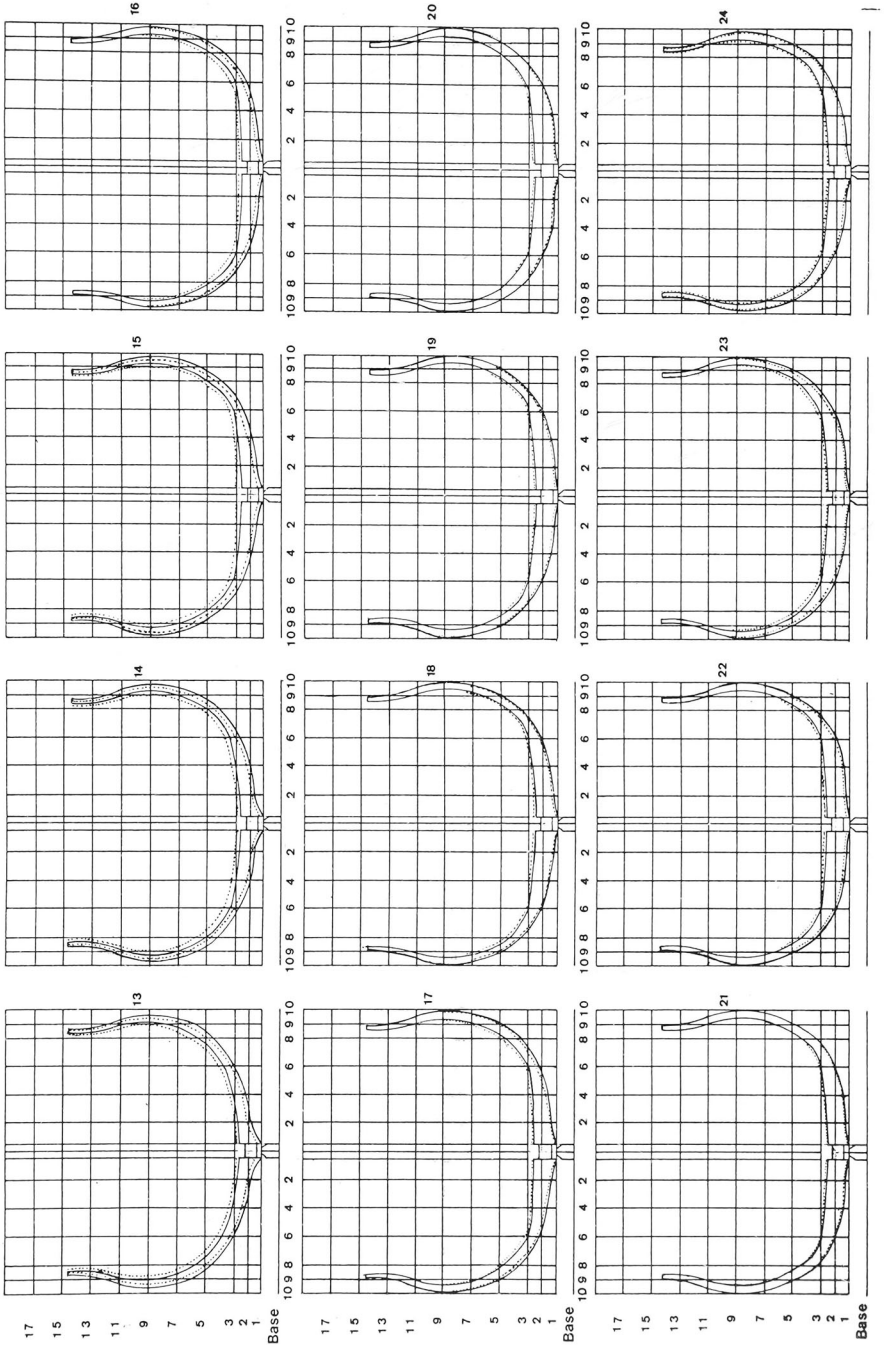


FIGURE 28. Layout of frames 13 to 24

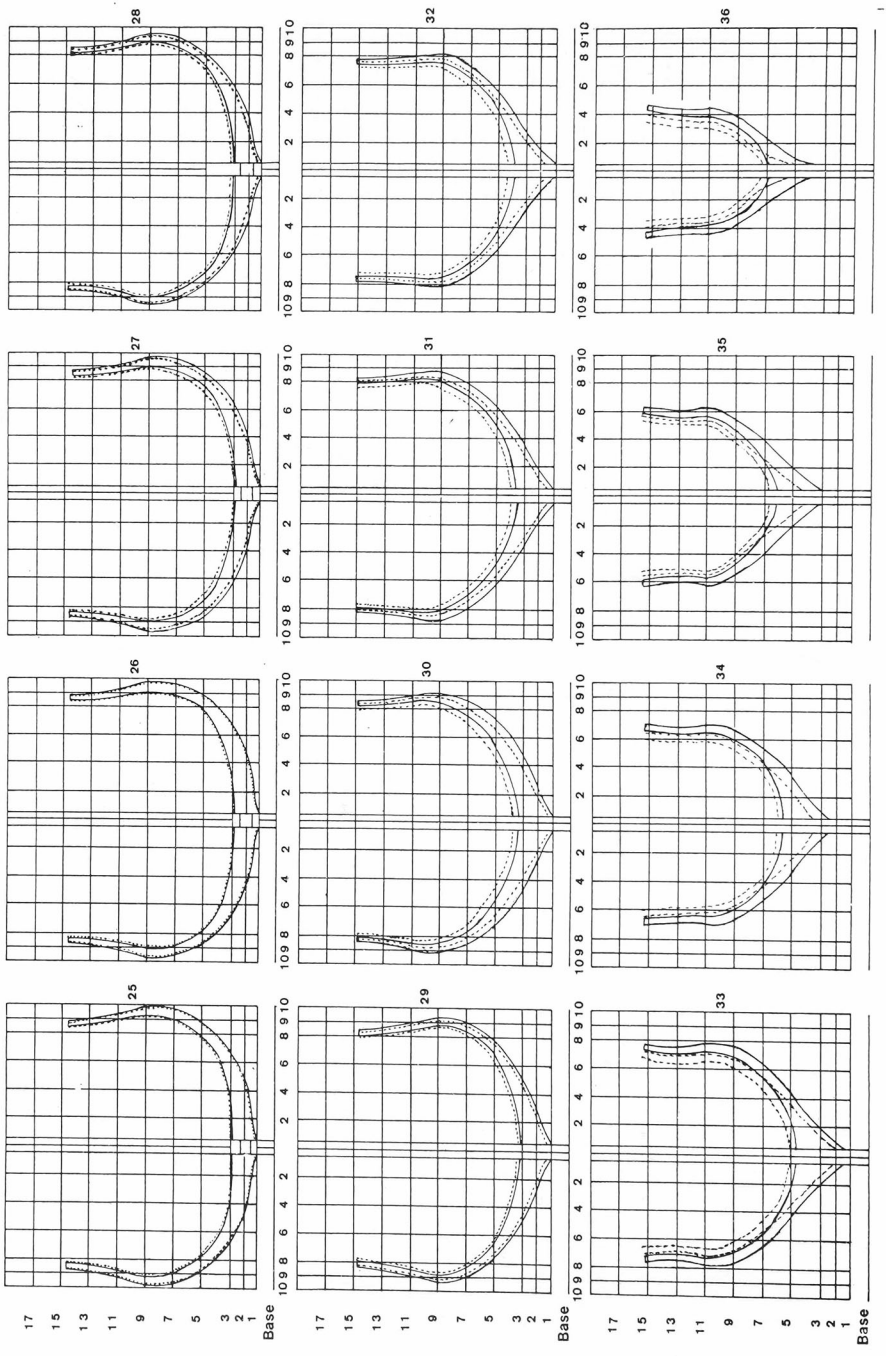


FIGURE 29. Layout of frames 26 to 36

curve. To achieve this there is a calculated method, sometimes termed ghosting, which consists of laying on the frame grid the ghosted outline of the incidence of bevel as a kind of dotted second outline.

With a modern age wooden merchant vessel, where the frames may not be so frequent, this second frame line, which is the aft face of the frame aft of dead flat, and the fore face of the frame forward of dead flat, can be laid in at the same time as the lines for lifting the frame were placed. All you need is the dimension of the sided size of the frame. If the double frame is to be made in one piece, as is usually the case in model work, the sided size of both frames is required. In the case of *Cruiser* at 1/72 scale, this was $1\frac{1}{4}$in. This side of the frame can then be laid on the grid either as a dotted line or a coloured line at the same time as the original operation described. The two frames so laid on the grid (Fig 26) will then allow for the angle of bevel to be shaped to give a true run for laying on the planking externally, and for the bilge stringers and deck shelving internally. The full line should be cut for the outside of the frame, while the dotted is cut for the inside. This incidence of bevel is usually very slight as it creeps along from frame to frame, but the method described here is a sure and accurate way of obtaining the bevel.

The complete range of thirty-six frames so lifted can be seen in Figs 27 to 29, and as laid out are worth careful study for they are indicative of the lines of the ship and give a good impression of what is hoped will eventually be achieved.

This can be carried out as one operation when lifting frames for a latter day wooden cargo vessel or a medieval nao, where the frames are more widely spaced, or when a much larger scale has been used for an eighteenth-century warship.

On *Cruiser*, where the frames are set much closer, confusion will arise at such a small scale if the second frame is logged in the first instance on the draught, since mistakes could be made very easily in taking off the wrong frame measurements. To avoid this the second frame line should be taken off as a separate exercise, marking off each line in a colour as work proceeds, so that the last line marked on the draught will always be the one being lifted.

Once the square frames have been dealt with, thought needs to be given to the cant frames (see Chapter 3), although these do not differ much from those that sit on the keel and should not present any problems.

3

Frame Structure

WHEN FORMING THE frames, the straight grain of the timber should follow the curve of the frame as far as possible. This is accomplished through its varied components of floor, futtocks and top timber, and in the shipyard by the use of compass oak. For *Cruiser*, the double frames could be made as one, to give a single sided size of just under ¼in for the two frames. In this way it would simplify the double frame construction to just one floor timber, with one futtock and one top timber per side. The cant frames could be arranged in a similar way.

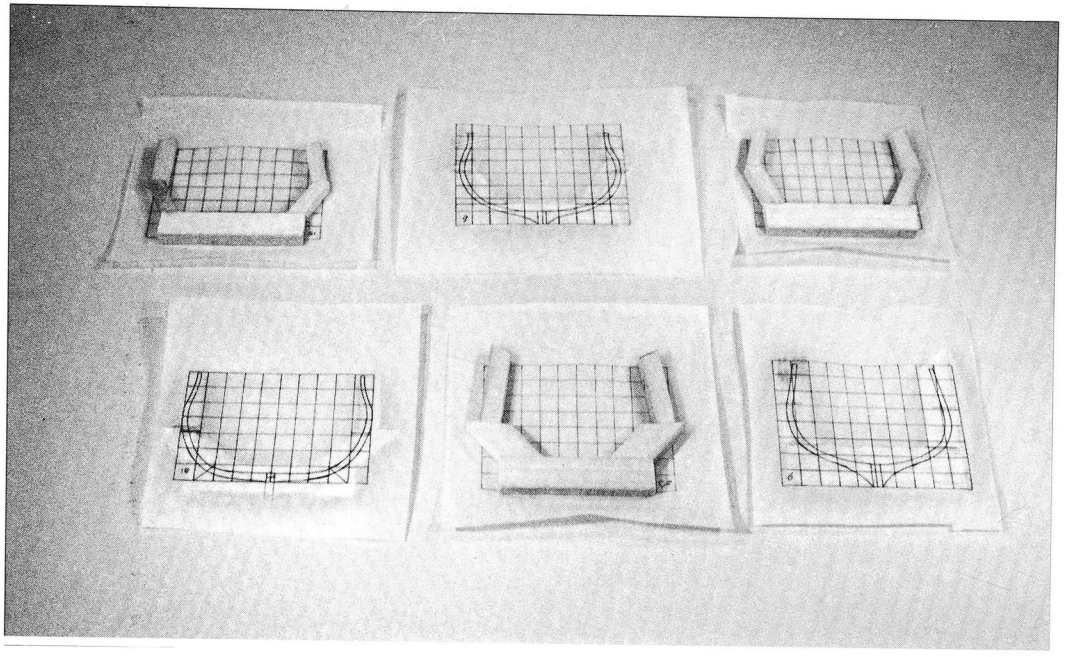
Use can now be made of the frame draughts, which should be marked off with floors, futtocks and top timbers. The joints of these pieces should be made consistent, so that they will come in way of the thick stuff later. The strakes known as the thick stuff are the longitudinal boards of the internal strengthening of the hull covering the frame joints.

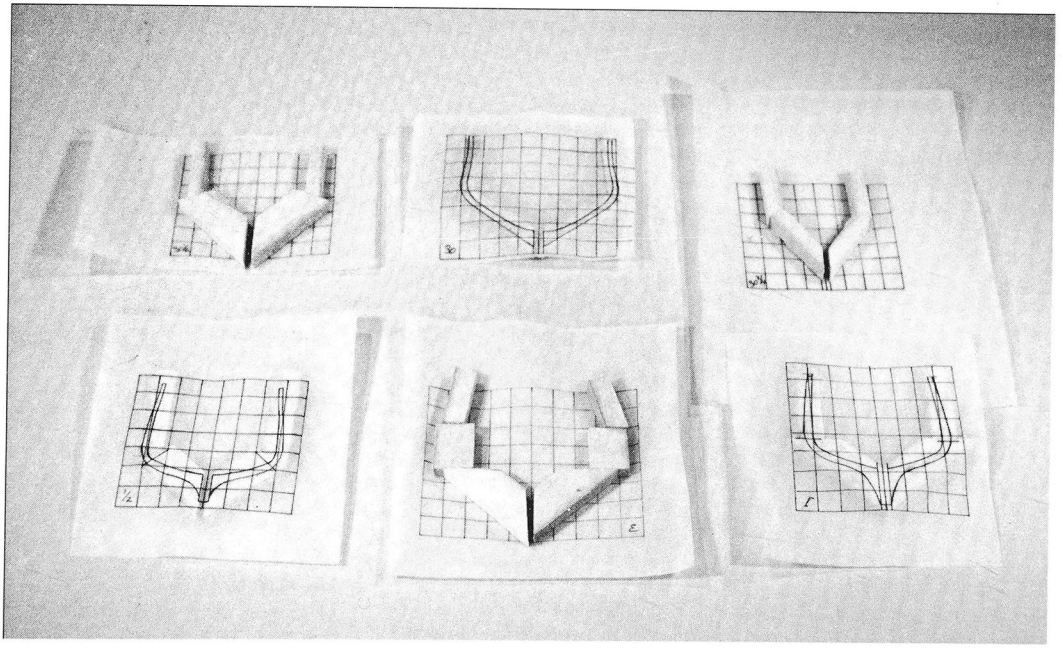
The next stage is to trace off, on tracing paper, the full outlines of each frame, ensuring that the score to fit over the hog is at absolute centre. The material for the various floors, futtocks and top timbers is then cut from a prepared ¼in thick strip of lime, and the pieces glued to the tracings across their indicated joints. These should be placed on a plate glass surface, weighted and left to dry. Each of these frames should be numbered and a bevel line indicated. A few frames so prepared can be seen in Photographs 19 and 20. When the joints of the frames have thoroughly set, they can be drilled through and cane dowelled. After this, they are fretted out around their tracing, the outer line for the full moulding of the frame, and the dotted inner line to allow for the bevel. Each frame can then be sanded to size, at the same time taking off both internal and external bevels. At this stage it is wise to leave the moulding of the top timber at rail level somewhat fuller than its finished size, to allow for any discrepancy in the fairing up of the frames at this rather fine point. A few of these frames may be seen in Photograph 21, stacked to show the flow of the bevelling. Photograph 22 shows some frames scored for hog and keelson.

It is now time to deal with the cant frames. On *Cruiser* these run from No 30 to No 36 on the fore part and from No 1 to No 6 on the aft part. Cant frames are those which come where the line of the ship narrows, both towards the bow and the stern, and where the bevel of a square frame would become too excessive. Generally, the cant frames are set at an

19. Frame construction: Floors, futtocks and top timbers assembled and glued to grid sheets on which frame outlines have been marked.

20. Cant frames similarly arranged for cutting.





angle never greater than 45 degrees. The outer face of the frame should run in a fair line with the planking of the ship, and no bevel should be more than 25 per cent of the moulded size. In construction they are formed up in the same way as the square frames, and retain the same sided and moulded size as those frames. Their room and space is also equal to the square frames, though the first cant frame is usually fitted close in to the last square frame at the point of the hog., gathering its correct room and space as it reaches the full breadth mark of the ship at this point. In this way the cant frames need to be planned very carefully, but by drawing up their plan view, their correct angle can easily be found. The cant frames do not normally stretch across the keel but are seated on the rising wood or deadwood fore and aft. If the rising wood is too shallow to afford them a good housing, a floor needs to be incorporated. On *Cruiser*, all the cant frames should have a sufficient housing on the deadwood so as not to need a floor. If these frames are to be tenoned into the deadwood the tenons should be cut in at the same times as the rabbet. You must remember to increase the size of the frame to allow for its seating in the mortice. Two cant frames can be seen in Photograph 23.

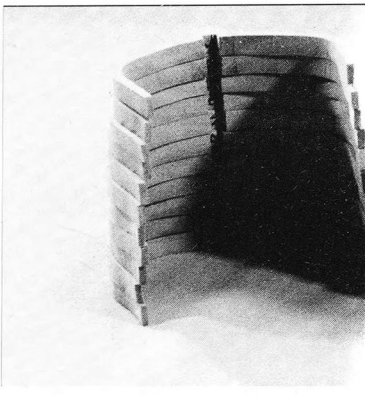
Setting up the frames in the jig is the most vital part of any ship modelling construction. The jig has been formed to retain the true alignment of the stem and stern post to the keel. It is imperative that all the frames be set on the hog not only at their exact centre but also in their predetermined frame numbered position. So it is a good idea to mark onto the hog, while in a flat position, the exact placings of each individual frame and, to avoid confusion, the spacings need to be numbered. This can be done by placing the keel assembly directly onto the frame disposition drawing. At this point the tenons for the cant frames can be added.

Having found the exact centre of each square frame to fit over the hog, it remains to set the frame to the exact height of the sheer line port and starboard. This is simplified if the frame has been cut to this height during construction.

There are two ways in which to find the true positions. The first is by using a centred spline, as shown in Photograph 24. The spline is made from a trued piece of squared mahogany, morticed and tenoned with a right angle piece at one end, to slot firmly between the brackets of the jig at the stern portion, and with an accurately centred slot at the other end to fit over the stem head. A line is then scored along the centre for the length of the spline as a ready fixing for a compass point. This arrangement gives a firm fixed centre along the entire length of the ship at the sheerline level, which can be easily removed and replaced as necessary.

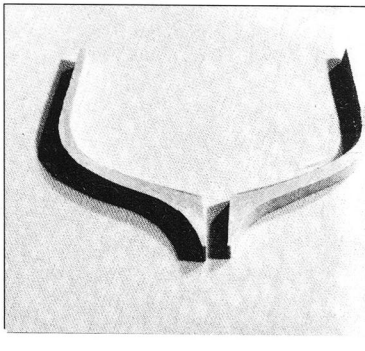
When setting up the first frame at dead flat, it should be set in a vertical position with a set square, and its correct alignment centre to keel established by placing one point of a pair of dividers on the spline groove, and the other to mark an equal distance on the port and starboard sides of the frame. Having done this, the score of the frame is then lightly glued and again trued up while the glue sets. With this arrangement of jig, it can be easily checked for its true alignment from now on. All the square frames are now dealt with in this way and, as progress is made, the preset bevels, both internal and external, can be checked to ensure that their flow runs to a smooth through course. This is best done by removing the ship from the jig and viewing he whole with a keen eye.

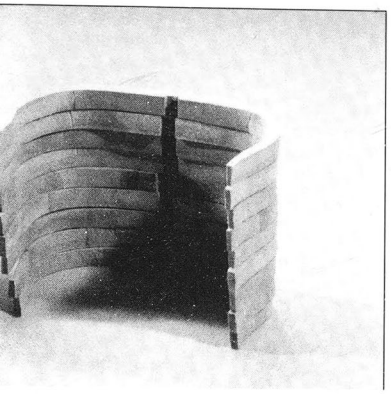
For the cant frames, a card template of their plan position should be

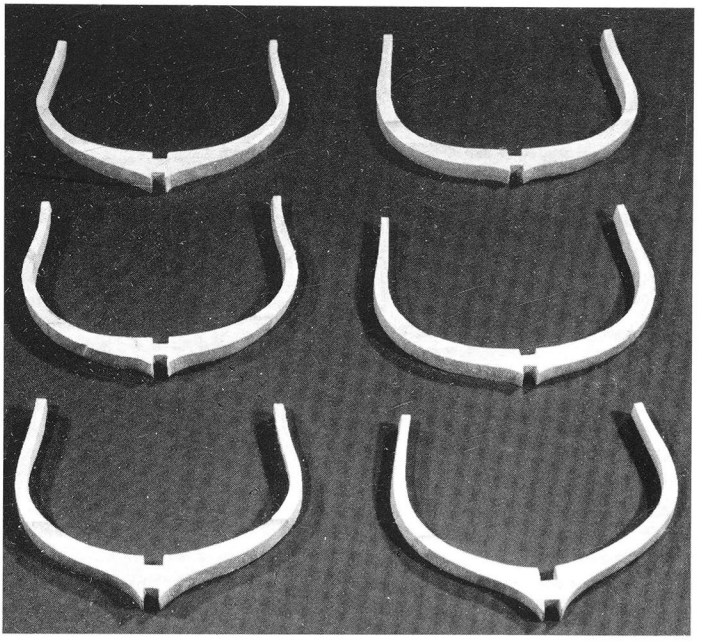


21. Square frames cut and shaped. Note the recess for the hog, to be added for increased stability.

23. A pair of completed cant frames.



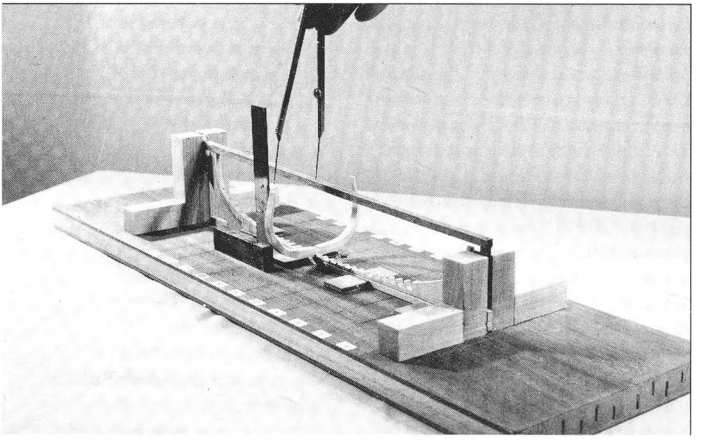




22. Finished square frames, complete with bevels.

made from the disposition drawing and the lines drawing, showing the angle of cant at the line of the sheer rail. The cant frames are then set into their tenons on the deadwood at these angles. When the frames have set firmly, they can be drilled through and cane dowelled to the hog and deadwood.

As an alternative to the spline arrangement, a full plan template can be used for all the frames. This involves taking a plan of the vessel at the point of the sheerline rail, and



24. Setting up the frames in the jig. Note the use of dividers to ensure uniform positioning.

marking in the disposition of all the frames. A similar spline to the one used in the first method would need to be made, but with the sheer spokeshaved on. The card or millimetre ply template could then by fastened at the exact centre of the spline, giving the true position of all the frames both for their placing on the keel and for their sheerline alignment. Whichever method is used it is imperative that the frames finish with a fair flow of the lines. This is best achieved by taking the ship from the jig, as already described, and viewing it with a careful eye along all its aspects, especially along the line of the sheer and of the bilge. Any detraction from the flow of the lines should then be checked and corrected, as it will become virtually impossible to correct any errors afterwards.

At this stage the hull has little structural strength. In the shipyard all the frames, as assembled, would be bolstered and shored up ready to received the further timbering. On the model the frames can be strengthened by fitting the keelson in place over the floors. This may or may not be need to be scored over the floor tops for a seating, but for a stronger construction, it is wise to give it this advantage. Once the keelson has been fastened home, the stemson and sternson knees can be fitted.

The next task is to fair the internal bevel ready to receive the internal timbering. As the bevels were preset, very little work is needed and it should be possible to place in the first internal timbers, which are the limber strakes. The limber strakes are the lowest internal strakes, set each side of the keelson at a distance of 9in, reducing to fay into the keelson at their ends. Usually these consisted of two strakes set side by side, *Cruiser*'s dimensions being 10¼in x 3in for the first strake and 9in x 2¾in for the second strake. In practice the strakes were made up with 25ft lengths, which were joined with flat scarphs. These timbers ran approximately from the fish room to the forecastle break. All this internal work can be seen in Photograph 28.

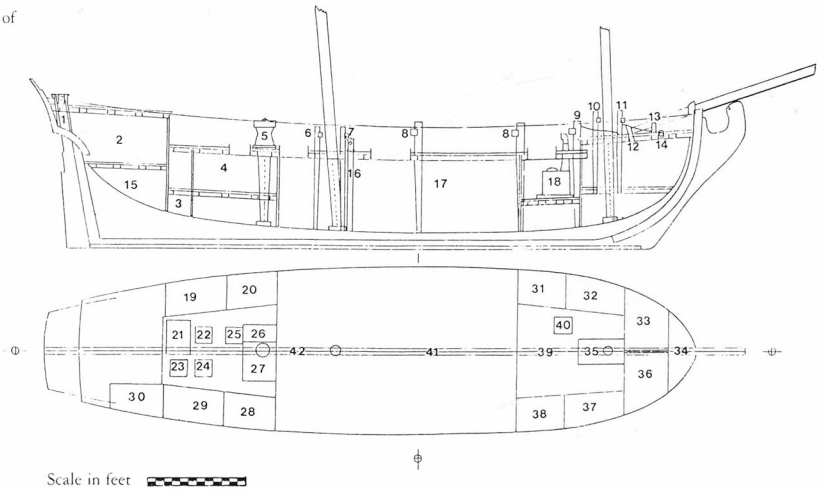
If the inside of the model is going to be fully lined, relying on some of the main structure to give it the necessary strength, the longitudinal timbering can be fitted as one single strake. Although it was the practice at the time to use at least three strakes of thick stuff on frigates and sloops, the structuring of *Caroline* shows only one strake. As this is sufficient, this is all that need be fitted.

It was usual with frigates and sloops built with three strakes to lay the centre one directly over the floor head or futtock joint, with the two lesser ones placed one above and one below this centre strake. The dimensions for the centre strake in respect of a sloop would be for the width, as the depth of keel, and the depth, about 35 per cent of this. This thick stuff is also known as the longitudinals and in later construction the stringers.

The next consideration to strengthen the framing is the deck clamps or beam shelves. The dimensions of these scantlings are once again based on the keel. In the case of a sloop of the period the deck clamps consisted of two thick bands of planking which run fore and aft with the sheer of the ship for an appropriate deck, on which the beams of that deck would rest.

The first strake has a width 15/16 of the depth of keel with a thickness of a third of this. The second strake is 2in less in both dimensions. To determine the position of the beam shelves on the framing of the model, you first need to locate all the required decks on the disposition draught, as transposed from the Admiralty arrangement draught.

Thought needs to be given here to



Scale in feet

FIGURE 30. *Cruiser*. Arrangement of accommodation.

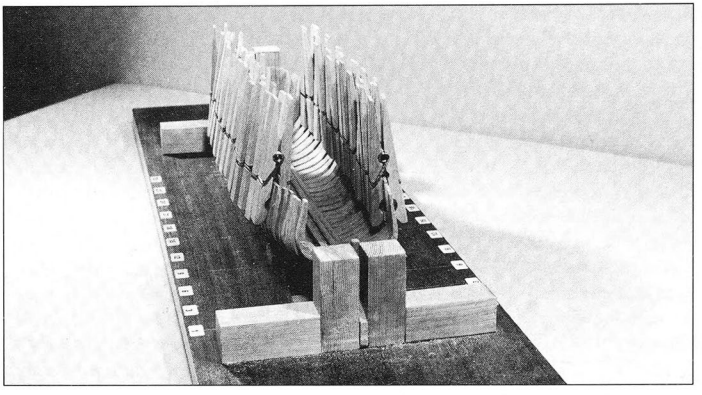
1. Rudder post trunking
2. Captain's cabin
3. Magazine
4. Ward room
5. Capstan
6. Main jeer bitts
7. Main topsail sheet bitts
8. Gallows
9. Anchor bitts
10. Fore jeer bitts
11. Fore topsail jeer bitts
12. Bowsprit heel stop
13. Manger
14. Manger scupper
15. Bread room
16. Brake pump elm tube
17. Main hold
18. Stove
19. Surgeon's cabin
20. Officer marine's cabin
21. Powder room
22. Scuttle to filling room
23. Scuttle to bread room
24. Scuttle to fish room
25. Scuttle to spirit room
26. Slop room
27. Gunner's store room
28. Gunner's cabin
29. Lieutenant's cabin
30. Captain's bed space
31. Boatswain's cabin
32. Sail room
33. Boatswain's store room
34. Forepeak store
35. Steward's room
36. Carpenter's store room
37. (Larder) pantry
38. Carpenter's cabin
39. Galley
40. Scuttle to coal hole
41. Seamen's accommodation
42. Senior seamen's accommodation

the amount of detailing to be included, for while a single deck vessel such as *Cruiser* had a large hold under the gun deck, there would have been several platform decks both at the fore part and the aft quarter of the ship. These can be seen in the accommodation drawing, Fig 30. If it is intended to show a fully modelled oven, at least one platform deck on the fore part of the ship would need to be constructed on which it could rest. This would be viewed through an open companionway to the galley area. At this stage similar arrangements can be under consideration for other decks, such as the officers' quarters aft.

Decks that have to be fitted, of course, are the main deck, the forecastle deck, the quarter deck and that for the main cabin. These have already been drawn in on the disposition drawing.

To find the true position of the beam shelving you must find out the thickness of both the decking and the beams which support it. For a sloop of war the gun deck or main deck would have been oak or elm. If oak was used it would have been 3in thick. The beams for the gun deck would have been $\frac{1}{35}$ of their length thick, which for *Cruiser* would have been 6in. This conforms to the Admiralty draught. The deck thickness for those decks not bearing the weight of armament would have been 2½in with deck beams 1/50 of their length thick. So the top of the beam shelving is on its deckline, minus the thickness of the deck and its beam. This was marked on the disposition draught.

To transfer these lines from the disposition draught to the model a gauge should be made from a strip of millimetre ply some 4in long and 1in wide, taking care to ensure that all edges are square. The bottom narrow edge of the strip is lined up with the base of the sheer draught of the disposition drawing at frame No 6, where the main deck beam shelf commences, and is marked off at that point. With the model once again sitting square in the jig, the ply strip is presented to frame No 6, ensuring that the ply template is square to the base of the jig. The frame is then marked off port and starboard. This exercise is then repeated to all the frames so affected. It is important that there is no lateral movement with the model in the jig at this stage, or that the template employed does not flex



25. Spring-type wooden clothes pegs make useful clamps when glueing up. They can be adapted for many jobs.

in use. For this reason ply is preferred here to card. It is obvious that any such movement would confuse the measurements taken.

The beam shelf can be cold bent to sit flat along all frames at the points that have been marked. This is easily done when using lime as it will bend and retain a position readily. It is never wise to force any such component part into a model, especially where the frames depend on such a scantling, and can easily be thrown out of true. Once the beam shelf has been so construed, it can be glued in position. The frames are then checked again for their true alignment before the beam shelf is clamped to the frames. This can be simply done with a series of household clothes pegs (Photograph 25). These pegs can be used in a variety of ways, some being cut for specialised use. More will be seen of them as progress is made. When the glue has set, the beam shelves can be cane dowelled. All other beam shelving is dealt with in this way.

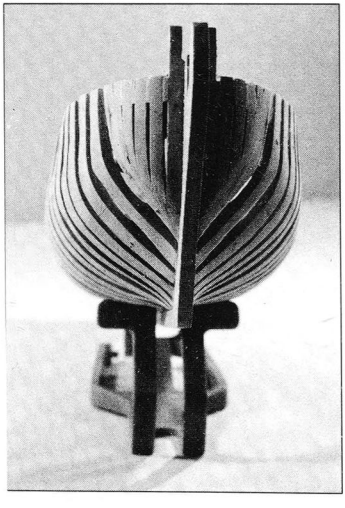
Hawse Pieces

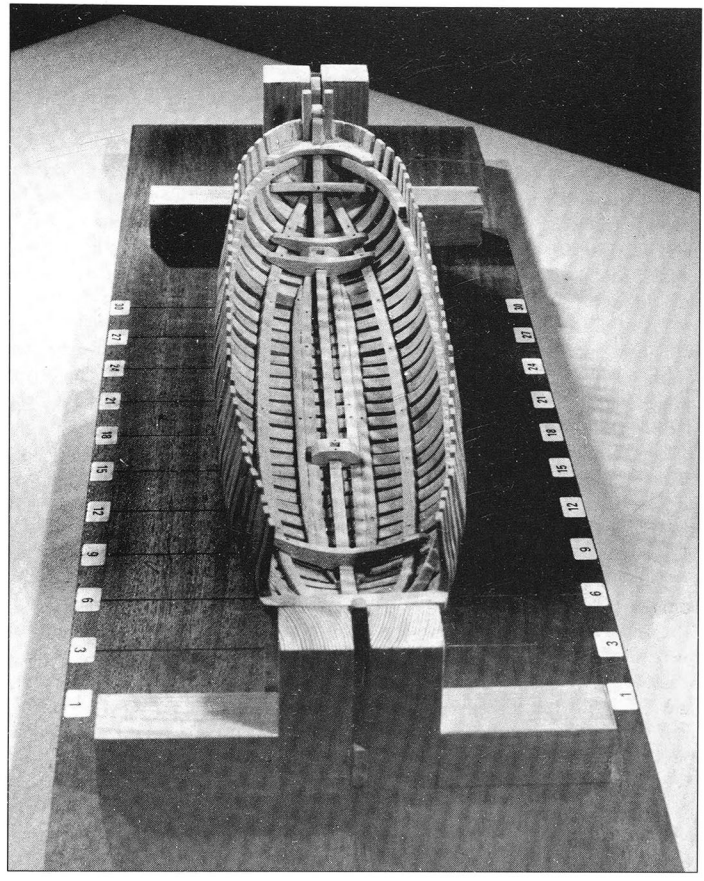
When the glue and dowelling of the beam shelving has set, the now formed up sloop can be removed from the jig. Look along its lines to ensure that all runs true. It is now a rigid structure, which with care can be worked. It is also time to consider the way ahead. The degree and amount of lining will need to be decided. Apart from such items as the deck hooks, there is very little more internal work to be done before the framing will need to be fully lined, if this is the intention. Strengthening pieces such as the riders, breast hooks, steps and crutches are all set on over the lining or ceiling. But first there is the matter of the hawse pieces.

Hawse pieces are the framing timbers at the prow of a ship where cant frames can no longer proceed. Their siding and moulding dimensions are to that of a single frame. They sit on a line with the stem, curving back to fit with a tenon joint into the first cant frame, being set about 2in apart. In the way of the hawse holes, from which items they derive their name, their scantling is increased so that they can be fayed together. To ensure a greater strength only half a hawse hole is cut in each timber. With *Cruiser* just four of these timbers would be required per side, not counting the knighthead (Photograph 26).

The knighthead was originally a hawse piece which sat next to the stem, and became extended up as a housing for the bowsprit, and as such also served as an item for belaying and for setting up tackle. For this reason,

26. Bow view showing knightheads, hawse pieces and cant frames.





27. Interior of the hull, looking forward, showing breasthooks, deck hooks, crutch in the stern, and mast steps astride the footwaling.

they were also known as the bollard timbers. As in the case of *Cruiser*, where the diameter of the bowsprit is slightly greater than the moulded size of the stem at the point where it passes through the knightheads, a stem piece is fitted. This is a slimmed down hawse piece to sit between the knighthead and the stem apron, and extended up only to the height of the stem at that junction. Other arrangements of this have the inside faces of the knightheads cupped to accommodate the bowsprit. All the hawse pieces, including the knightheads and stem piece, are fashioned from single pieces of timber. They are held in place in their upper parts by the breast hooks and deck hooks. This arrangement can be seen in Photograph 27.

Deck Hooks

The next item to be fitted is the deck hook for the forecastle decking. This in practice was normally made from compass oak in one piece. For a mid eighteenth-century sloop it had a length of 16in for each 3ft of beam, with its thickness 7/12 the depth of the keel. the width at centre was approximately 2in for every inch of siding, with the ends, where they squared

with a beam, being one-third of this. However, with the shortage of compass oak, there were alternative constructions to this by using ekeing pieces to supplement the reach or depth of the deck hook. These were simply fayed-in lengthening pieces.

The hook was fayed directly onto the cant frames and the hawse pieces, with its top surface level with the deck beams, so that the decking could be run through to lay flat on it. For this reason it was given the same sheer and camber as the deck. A deck hook would be so fitted for all deck arrangements at the prow. A typical deck hook can be seen in Photograph 27. It follows shipyard practice by being scored around the knightheads and the stem apron. Other aspects of the internal structuring can be seen in this photograph.

Breast Hooks

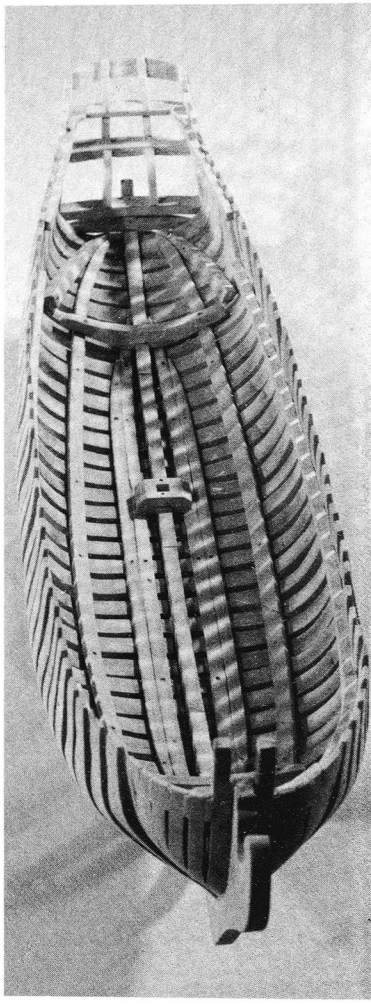
The breast hooks were made from one piece of compass oak to obtain the maximum strength. They were fayed and bolted to the lining of the ship athwart the cant frames and hawse pieces on the fore part of the ship. Where they came in the way of the keelson and limber strakes, they were rebated to fit over these members and sit square again upon the lining. Two, and sometimes three, were fitted to a sloop at this time, the upper one being longer than the others, with a maximum length of 13ft 6in. For all rates the siding was three-quarters that of the keel depth. The depth of the hook at centre was about three times greater than its siding, with the arms narrowing off from this as they followed the flare of the ship. The ends of the arms were rounded down. For the model all hooks could be made from lime sheet, two being incorporated with a mast step, which was a common practice at this time. A third breast hook should be set to reinforce the fore cant frames (see Fig 21 for positions of breast hooks and deck hooks).

Mast Steps

The mast step, as its name implies, is a block set on the keel to house the foot of a mast. In the case of *Cruiser*, as she was snow rigged, two would be required, one for the foremast, which passed through the forecastle, and one for the main mast, which passed through the main deck just abaft of the dead flat. An auxiliary mast is set immediately abaft the main mast of a snow, on which the gaff of the driver is set, and to which the luff of the driver is laced. This auxiliary mast has its heel set on the main deck. When *Cruiser* became ship rigged, the heel of the mizzen was housed in a block set on the deck of the main cabin (see Fig 1). Before the two mast steps can be set on the keel, the exact position and rake of the masts must be determined. Once this has been done the positions must be accurately marked on the top of the keelson with a small pencil cross. The centre of this cross will mark the exact position where the mortice of the mast will rest. As this is a vital measurement it should be double checked to ensure it is absolutely true. The reason for this will become apparent in a moment.

The blocks were normally made from a selection of solid oak timber. A vertical tenon was veered into the top of the block proportional to the mast's diameter. This was half the diameter of the mast in the fore and aft direction, and two-thirds the diameter of the mast in the thwartship direction. The depth of the tenon was about half the diameter of the mast. The mortice piece cut on the heel of the mast would be a snug fit for this.

These pieces can be made from lime, and when cutting in the tenon, pass it through the complete depth of the piece so that the top of the keelson with the pencil cross where the mast



28. Interior of the hull, looking aft. The stern timbering includes the fashion piece connecting to the transom. The crutch and mainmast step can be seen.

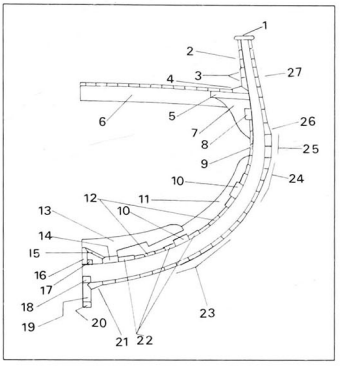


FIGURE 31. Hull cross section showing construction.

1. Gunwale
2. Quickwork
3. Spirketting
4. Waterway
5. Lodging knee
6. Deck beam
7. Hanging knee
8. Deck clamp
9. Lining
10. Thickstuff
11. Futtock rider
12. Ceiling
13. Floor rider
14. Limber strake
15. Limber board
16. Keelson
17. Limber hole
18. Hog
19. Keel
20. False keel
21. Garboard strake
22. Foot waling
23. Bottom planking
24. Diminishing strakes
25. Wales
26. Black strake
27. Top strakes

step will set is visible. When the block is fully fashioned, and the tenon hole fitted over the cross, the masts will have their exact positions.

The fore and aft siding of the block was approximately twice the width of the keelson, with its thwartship dimension approximately four times the width of the keelson. The height was that of the keelson plus that of a good timber hold for the mast mortice. The block was given a broad bevel on its top fore and aft edges, scored over the keelson and the limber strakes and bolted through the lining (Photograph 28, and see Fig 21). That for the fore mast of *Cruiser* should be set between the two breast hooks for a combined strength. Both mast steps should be glued and dowelled through the keelson.

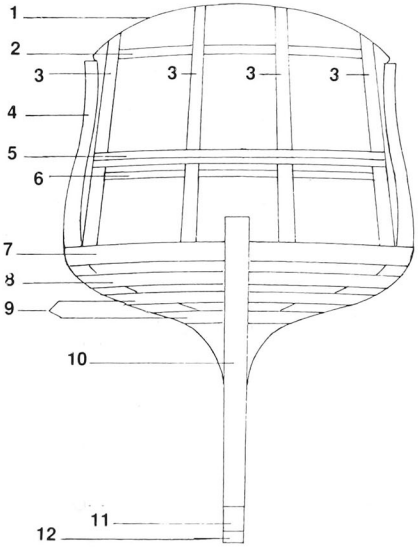


FIGURE 32. Counter timbers.

1. Taffarel
2. Quarter deck transom
3. Counter timbers
4. Fashion piece
5. Counter rail
6. Tie beam
7. Wing transom
8. Platform deck transom
9. Transom pieces
10. Sternpost
11. Keel
12. False keel

Crutches

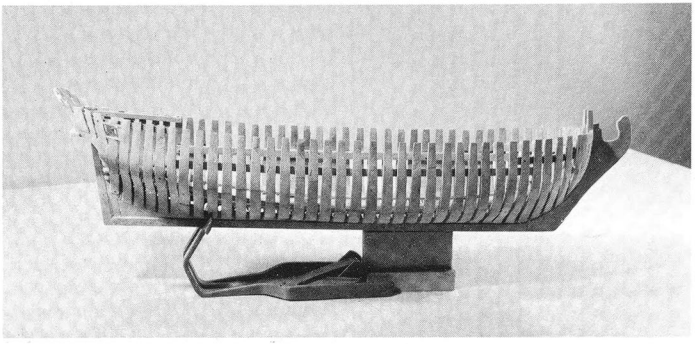
These are of a similar construction to the breast hooks, and differ only in that they are used athwart the aft cant frames to impart additional strength to these members, and in that way the angle of the arms is more acute. Only one needs to be fitted to *Cruiser* (see Photograph 28 and Fig 20). Had she been ketch rigged, as four of her sister ships were rigged, a further crutch could have been fitted in the way of the mizzen mast step.

There are some other internal strengthening pieces which should be mentioned here, though not essential to the model. These are the floor riders, futtock riders and breast riders, which are short internal frames bolted over the lining and fitted relevant to their named parts. They make an extremely interesting feature when viewed through an unplanked model. These can be seen in Fig 31, as can the limber board which is omitted on the model.

Stern Timbers

The final timbers to be fashioned and placed to complete the framing are those of the stern (Fig 32 and Photograph 29). As with the fore cant frames, those of the stern should not be fitted at a greater angle than 45 degrees. This leaves a whole area to be infilled with timbering between the last cant frame, which is generally known as the fashion piece, and the rabbet of the sternpost. This is mostly done with transom pieces below the wing transom, and counter timbers above it.

However, the timbering can

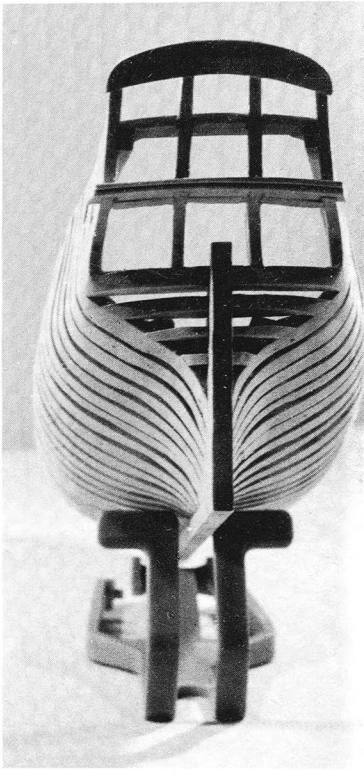


30. The completed carcase of the model.

commence by fitting the platform deck transom, as it rests immediately beneath the importantly placed wing transom. The platform deck transom serves the same purpose in the stern as the deck hook serves in the fore part of the ship. It should be scored around the inner sternpost on its aft part, and fayed by its ends to the fashion piece on its fore part. It should have the same sheer and camber as the deck it will support, with its top surface on a line with those of the deck beams.

The wing transom which, as already stated, is the most important timber to set since the entire structure of the upper works will rest on this member, is the next item to place. This should be set in its exact position fore and aft, with its wings at the exact height from base, and equidistant from the centre line. It is set by a tenon to the top of the inner stern post on its aft side, and fayed by its ends to the fashion piece on the fore side. It follows the line of the sheer and has the same camber as the deck. This can be seen in Figs 32 and 20. The four counter timbers can now be cut to shape and fine finished. Before being tenoned into the wing transom, all further rebating to be required on these pieces should be completed, as they are very fine and can easily damage.

The remaining timbers for the stern structure can now be made up before assembly. These are the tafferal, quarter deck transom, and the rails. Once fitted, they are anchored in position by the quarter deck beam shelving. When the final transom pieces have been fitted, the carcase of the model will be complete and ready for planking (Photograph 30).



29. Stern timbering.

4

External Planking

CARVEL PLANKING, that is planking fitted to the frames of a ship edge to edge and caulked, came into common practice in the western hemisphere from the Mediterranean during the fourteenth century. Prior to this, extensive use of clinker boarding was used for such ships as the Whitby cog and those found on the Rhine. The use of short broad boards for the planking was transferred from the clinker method to that of the carvel built ship. It is therefore safe to say that the earlier the shipbuilding practice, the shorter and wider would be the strake. By the mid eighteenth century the planking had assumed a more rational dimension, both through the design of the ships and the advance of technology. At this time the external planking of a sloop would have had a strake of an average length of some 25ft, with a width of between 10in and 12in, and a thickness of 3in to 4in, these dimensions being continuous from the garboard strake up to the turn of the bilge, and to the first strake of the diminishing timber.

Once again these dimensions were based on those of the moulded depth of keel. Starting with the garboard strake, the first strake placed against the keel and fitted into the rabbet, the general formula for its width was approximately two-thirds of the moulded depth of keel, which would agree the Admiralty draught for *Cruiser* showing a width of the garboard strake as some 9in. The thickness of the strake at the keel edge was three-quarters of its width, which would be an acceptable 7in for this dimension, with a thickness on the outer edge of half this, giving it a dimension of 3½in. This would agree with the original appraisement when dealing with the body plan, showing a maximum beam inside the planking of 20ft. A thickness of planking at 3½ in each side of the beam would agree the specification maximum beam of 20ft 7in.

The keel edge of the garboard strake was bearded on its top and bottom planes to form a snug fit into the rabbet. A section through this strake was not therefore rectangular, but more in the form of a trapezium. The length of the timbers forming the strake would be 25ft and gained from straight grained oak.

The first strake set against the garboard strake would have the same thickness as that strake's outer edge, being 3½in, and would be continued in this way up to the first strake of the diminishing timber. This was known as the bottom planking.

The diminishing strakes were some

four planks set between the top of the bottom planking and the underside of the wale. These were graduated in their thickness to taper from the greater thickness of the wale to the lesser thickness of the bottom planking. Other than this the diminishing strakes would be of the same width and cut in the same lengths as the bottom planking.

Cruiser had just one wale which was set below the deck line, and as was the practice followed the sheer of the ship. This was the main external longitudinal timber to strengthen the frame of the ship, and prevent hogging; a problem which had plagued ship builders from ancient times, since a ship lifted by a heavy sea on its midship section would be left without support at either end, causing the ends to sag. Methods of strengthening the construction of the wale at this time, other than parallel planking as used on *Cruiser*, will be mentioned later.

The thickness of the timber used for the wale was half the moulded depth of the keel, which for *Cruiser* was about 6in. During this period the greater width of the wale to the bottom planking would have registered this difference of 2½in. Earlier in the century it would have been twice this size. The lengths of timber were similar to those of the bottom timber at 25ft, with the shift of butt in line with these. The wale was composed of two parallel strakes each approximately 11in wide. These two heavy timbers of the wale were the first pieces of external planking to be fitted.

Immediately above the wale was a single inverted diminishing strake, of the same dimensions as the bottom planking, but with its bottom thickness the same as the top of the wale, and the width of the strake tapered off to agree the thickness of the top timber. When the wale was the only part of the hull to be painted black, this single diminishing strake immediately above the wale was included, and came to be known as the black strake.

It was during this period that British shipbuilders considered other forms of construction than parallel planking for the wale, and eventually for other parts of the ship, such as the diminishing strakes. This took the form of top and butt planking, anchor stock planking and hook and butt planking, all of which are shown in Fig 33. This form of planking did not come into use in English shipbuilding until the third quarter of the eighteenth century, and was only adopted then by a few of the European yards. To remain in context with the period *Cruiser* was parallel planked throughout. Above the black strake the timbering was much finer. While the width of the plank remained a consistent 10in to 12in, the thickness of the top planking for a sloop was only one-ninth of the moulded depth of the keel, which gave those for *Cruiser* a thickness of some 1½in. This dimension remained constant for the whole of the topside planking at this time.

In considering the topside planking, a word here about the rails. The first rail up from the waterline was the waist rail, which was fitted a specific distance below the top timberline. On *Cruiser* this was 1ft 3in, and being a single decked ship, it was not continuous, being interrupted by the gun ports and channels. It had was 3in wide. The sheer rail ran fore and aft along the top of the timber line, the width of this rail being approximately ½in greater than the waist rail.

The rail that ran above the sheer rail was known as the drift rail. When this rail ran to the sheer of the forecastle and the quarter deck, terminating at the breaks of these decks, they were known as the fore drift rail and main drift rail. The fore drift rail ran parallel to and at a prescribed height above

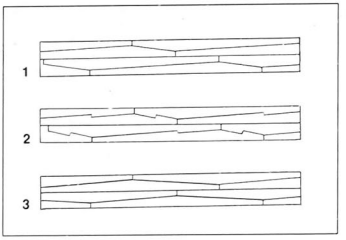


FIGURE 33. Planking of wales and diminishing strakes.
The arrangements shown are designed to give greater strength to these parts.
1. Top and butt planking
2. Hook and butt planking
3. Anchor stock planking

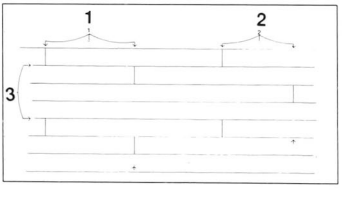


FIGURE 35. Rules for hull planking.
1. There must be a minimum of 5ft between butts on adjoining strakes.
2. There must be a minimum of 4ft between butts with one complete intervening strake.
3. There must be a minimum of three complete strakes between butts landing on the same frame.

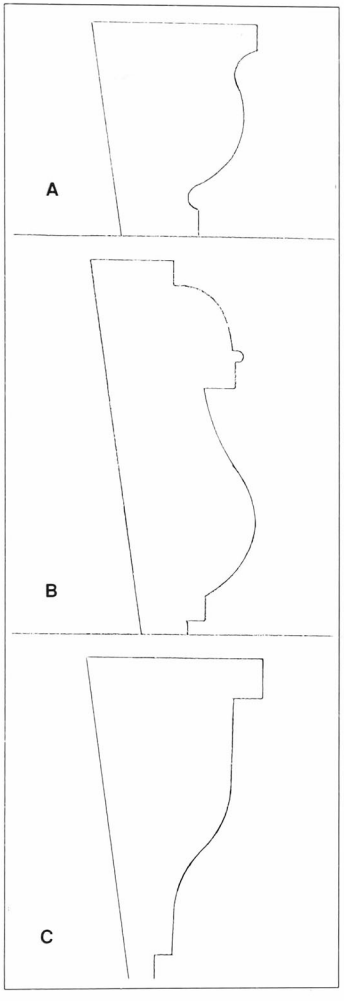


FIGURE 34. Cross sections of mouldings as used on *Cruiser*.
A. Drift rail. B. Sheer rail. C. Waist rail.
At 1/72 scale it was not possible to produce these mouldings satisfactorily, so they were simulated by bevels and chamfers on strips of wood.

the sheer rail, with its after end terminating in a scroll. On *Cruiser* the height of this rail was 6in, was open, and tenoned over the timberheads, though on some sister ships it was planked.

Cruiser's main drift rail, in common with other ships, also ran parallel to the sheer rail but was infilled to accommodate the raised quarter deck. This infill was known as the drift planking. Starting with a scroll just before the quarter deck break, its after end was fayed into the tafferal. A typical moulded section of these rails is shown in Fig 34, though their sections can be seen on arrangement draughts as they turn into the stem.

You will appreciate that in planking the model with various thicknesses of strakes, the external shape of the hull will be changed from that of its frame structure. In this way it is as well to revert to those first considerations given to the draught, and how it was essential to make sure that the draughts being used were drawn to either the internal or external lines of the planking. All the external planking described can be seen in Fig 31.

Shift and Butt

Rules and procedure for laying the planks onto the frames have always existed, having emerged from the long experience of ship construction. Most of these rules were defined in Admiralty specifications, and were incorporated during the latter part of the eighteenth century into the requirements stipulated by Lloyds Underwriters of London. Subsequently, many of these rules were adopted as conditions for insurance purposes by other maritime bodies, such as the American Bureau of Shipping.

The basic rules that concern us for laying the strakes are those governing the fastenings and the shift of butt. With the butts, there should not be less than 5ft between the butts of any adjoining planks, unless there is a strake between, when the distance between butts must not be less than 4ft. No butt should come on the same timber (frame) unless there are at least three strakes in between them. This is shown in Fig 35. The shift of butt allowed on *Cruiser*, where 25ft strakes were used, was for the second plank down a move of butt by 6ft, for the third strake down a move of butt by 12ft from the first butt, and for the fourth strake down a move of butt by 18ft from the first butt. This is termed a three plank shift. All butts should land on the centre of a frame to ensure a good fastening. When arriving at these divisions consideration should be given to the one that would occur in practice; that above all there would be a conservation of timber. It therefore follows that a line of strakes from stem to stern would be so divided as to be the most economical in the use of timber, and be of equal proportion, yet retain the butts within the rules.

The best way to arrive at an arrangement for the butt joint positions is to draw up a rough plan of the frames, showing these with single vertical lines, and cross them with the number of planks (strakes) required, placing a pencil cross where the butts would occur. The pencil crosses can then be erased and shifted around until a suitable layout is found. This is known as a shift and butt plan.

Fastenings

The width of a plank defined the scheme of fastenings, as eventually approved by Lloyds. Generally speaking, planks narrower than 6in were fastened by a single trennal alternating down a frame from right to left corners, while those from 6in to 11in wide were fastened by alternating two trennals and a single trennal per plank, the first double trennal running down diagonally on the frame

from left to right, followed by a single trennal in the second strake, with the double trennals of the third strake running diagonally down the frame from right to left. For all planks 11in wide or over, double trennals were used on all strakes, the trennals sloping down the frame from left to right. Where a butt occurred a trennal would be fastened in each corner, giving a four trennal fastening over the butt. For the wale strakes, these butts can be flat scarphed over the frame and fastened in the same way as a straight butt.

For the most part the fastenings were composed of trennals, though many other forms of fastening were used about the ship such as forelocks, spikes, dumps and clench bolts. None of these except the trennals concern us here, for fastenings such as spikes and dumps used on decking were countersunk and infilled with wooden filling pieces, which were then planed smooth. Trennals were the most common form of fastening at this time, the name being derived from the two words 'tree nail'. These were oak dowels up to 3ft long and ¾in to 2in in diameter. The wood for these was obtained from the newest growth at the top of the tree as this was the most supple of the timber. The strength of a 2in diameter trennal was about 4000lb per square inch, but they were inclined to rot. Greater strength and durability was given to the oak trennal by splitting its end after insertion, and hammering home a pitch pine wedge which, as far as *Cruiser* is concerned, is mentioned purely as a matter of interest.

The trennals most prone to rot were those below the waterline, so clench bolts were sometimes used. These were copper rods fitted with a head, the rod being up to 2½in in diameter. They were used also for such timbers as the heavy wales where the plank and frame were bored through and countersunk. The rod was then rammed home to leave about ½in of the rod proud of the internal timber. A washer or rove was fitted over this, and the end of the rod ball-peened over the rove like a rivet. With the bolt so secured, the countersunk hole was then caulked and planed off. In this way it is obvious from a modeller's point of view that the same effect would appear on the surface of the planking if either a trennal or a clench bolt had been intended.

Another point to consider about the trennals is their use in securing the planking of the model. You must remember that in a model at *Cruiser*'s scale, building practice is being adapted to suit the model's constructional needs. So a little licence can be given. For a 10in or 11in plank, correctly speaking two trennals would be required for each alternate plank, but as a further stipulation at this time required that the combined diameters of two trennals should not exceed one quarter the width of the plank, the diameter of a trennal could not be greater than ⅛in at 1/72 scale. This cane dowelling fastening, if fitted to the model, would prove ineffective, being so flimsy. Something in the region of 1/24in diameter cane dowelling would be required for a satisfactory fastening. In view of this, and for the sake of the appearance of the model, one trennal per strake on each frame would not only be acceptable but desirable, and may be carried out as for single trennal planking. When connecting the butt on the frame a trennal could be placed at the top of one butt and at the bottom of the other.

One further point about trennals concerns those that secure the planking to the deadwood. Here the guideline for neat rows of trennals afforded by the frames no longer exists. To avoid the trennals wandering off in all directions, a strong pencil line

should be drawn from the centre of a cant frame, as a pencilled continuation of the frame, across the deadwood to the keel. If the trennals are drilled and fixed along these lines, their neat appearance should be maintained.

Stealers and Drop Planks

When planking a ship, the strakes should follow the form of the frames in a natural sweep from stem to stern. The strakes will, as a matter of course, broaden and narrow as they follow the sweep around the hull, but as they approach the stem and the stern, problems will arise in maintaining maximum widths for the strakes bent around these acute curves, and also parity of their hoods into their respective rabbets. The hood of a strake is that part of its end which fits into the rabbet.

In the after end of the ship, especially under the counter or beneath the transom, an increase in width greater than that which can be covered by the maximum width of the plank runs will occur. Due to the double curvature of the ship in this region, it would not be practical nor desirable to broaden even a 3½in thick plank to twice its width to deal with the problem.

In the same way, at the fore end, and especially with a bluff bowed ship, there may be a reduction of area to be covered by the full width plank. To maintain the flow and sweep of the planking, it may be necessary to reduce the width of one or two planks towards their ends to such an extent that their hoods would be too narrow to secure a successful fastening. To overcome both these problems, stealers and drop planks are introduced into the planking runs at these points.

A drop strake is an extra short plank of the same width and thickness as the planking being used, which was fitted some two or three frames back from where the continuous strake required a greater width than its maximum designated. At this point the drop strake was set into the continuous strake by half its depth, to rise at an angle which followed the flow of the curve, and land on the rabbet with a hood equal to that of the strake into which it had been set. The top edge of the drop strake was then curved back to align with the top edge of the continuous strake at the joint of the inset. The next continuous strake was set above this to follow through with the line of the curve. In this way, at the start of the drop strake, there will be two strakes on the run, whereas at the end of it there will be three.

The stealer is an alternative method of expanding the planking. It is similar to the drop strake except that it is quarter fitted into the last laid continuous strake, and the one above it, and runs out in the same way to give a landing of three equal hoods on the rabbet.

Should more than one stealer or drop strake be required, than at least one full continuous strake should sit between them. Both stealers and drop strakes should follow the flow of the planking, and in no way appear obtrusive. They should be fitted low down on the bottom planking, their position being determined when marking out the planking runs.

Where the planking area narrows, as it might about the bow, a reducing stealer would be used. Here two continuous runs of planking may be stopped short of the stem where their combined width would be equal to one strake at midships. A single short stealer plank is inserted at this point, and run into the stem rabbet to give a hood equal to those of the strakes below. The same rule applied to the reducing stealers as the expansion stealers in that should more than one reducing stealer be required, a full

continuous strake should sit between them. Their position, too, should be low down on the bottom planking, and be determined on the planking run. A safe guideline is that a stealer will be required if the area to be covered at the stem or stern rabbets is half a plank wider, or half a plank less, than the width of the plank being used. Both stealers and drop strakes are shown in Fig 36.

External Planking

The first of the external planking to be fitted should be the wale. This is made up from two strips of lime each to a scale size of 11in x 6in. While these slender strips may bend around the frames without too much trouble, their curvature is best done by the hot can method (Photograph 31) so that they can sit flat on the frames. This is an efficient and simple method of bending timber. As can be seen, a tin can stripped of its label and washed clean is secured in a vice, and a small means of heating inserted just under the lower rim. This can be either a stub of candle or a methylated spirit burner of some kind. The heat generated is quite considerable, and is effective in bending the work around the curve of the can in a very rapid and precise way. Care should be taken when carrying out this work to avoid blistered fingers. A strip of wood used to apply any pressure prevents this.

The same procedure as used for the main deck clamp should be used to find the position of the wale. With the model in the jig, mark off each frame measurement, both top and bottom of the wale, as they are lifted from the lines drawing. The wale is bent round to these marks, glued and dowelled home.

When fitting the external planking care should be taken to make sure the flow and sweep of the strakes run in natural curves from stem to stern. To do this the hull can be divided into planking sections. With the model out of the jig, two pairs of 1/32in square spruce battens are sprung round the frames of the model, dividing it into three sections to determine the best flow of the strakes. With a small model such as *Cruiser*, only two battens need be run round per side, but with a larger model or hull more battens and divisions would be required. In this way the area from the keel up to the underside of the wale can be divided into three 3/4in planking sections. Having determined a good flow with the battens, especially around the bilge and up under the counter, the battens can be fixed to the frames with lill pins. This can be seen in Photographs 32 and 33.

However, before finally fixing the battens, it is advisable to measure round the centre frame at dead flat, which is the widest frame to be planked, from the keel to the underside of the wale. This can be done using a strip of paper placed round the frame from the keel and marked off under the wale. For *Cruiser* this should give a measurement of 2 1/4in. Accepting that at 1/72 scale a 10in plank would be about 7/84in, dividing this into 2 1/4in gives approximately fifteen planks, which would divide conveniently into five planks between battens. This is inclusive of the space of 3/32in occupied by each batten.

Each frame can now be divided into five equal parts between the battens, allowing for a width of batten to be included in one part. This will give the required width size of each strake round the hull. Where the division increases around the stern region to a greater width than 7/48in, it should be compensated by a stealer in such a way as not to disrupt the even run of the planking. In the same way allowance should be made in the region of the bottom planking of the stem for reducing stealers.

One way to determine the width of

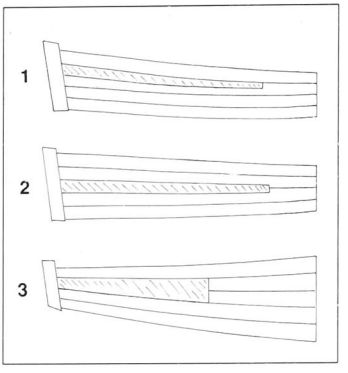
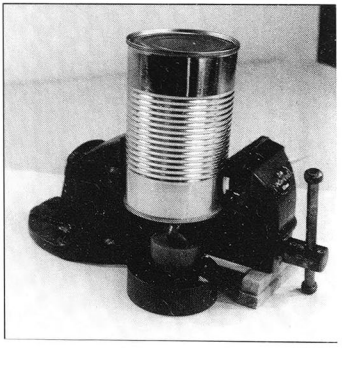
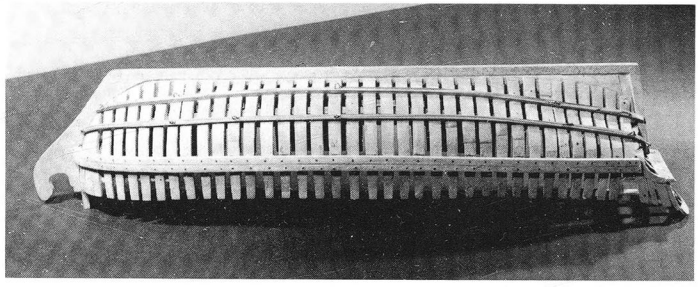


FIGURE 36. Stealers.
The shaded areas show three methods of fitting stealers in planking.
1. Drop plank
2. Expanding stealer
3. Diminishing stealer

31. The 'hot can' equipment for bending strakes and wales.



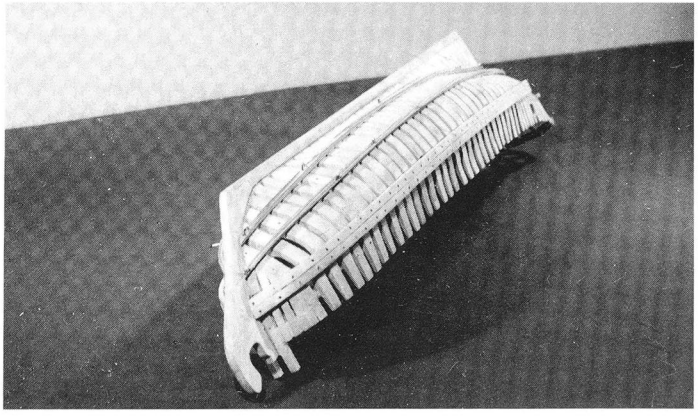


32. The hull with the wale and the planking division battens in place.

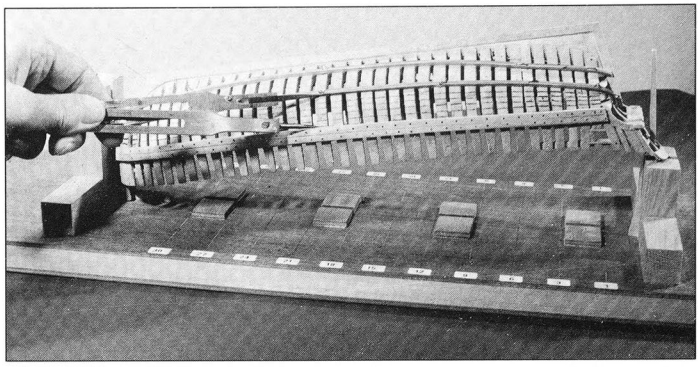
a strake on any given frame is by using a pair of proportional dividers, set to give a proportion of a planking division. For example, they can be set at 5 to 1, if a five plank division is required. Each frame is then read off along its battened division to give an accurate reading of five-fifths of the width of the division on that frame. Each of the five planks is then fitted to its pencil mark accordingly (Photographs 34 and 35).

Another way is to set the dividers on a reducing ratio, commencing with the 5 to 1. Each such frame division is then transferred to the strake to be fitted until all frames have been taken up. The strake can then be shaped to size and fitted, until the run is completed. The proportional dividers are then reduced to a ratio of 4 to 1 for the next run of strakes to be laid and completed. Then 3 to 1 and so on until the space is filled. However, this can be a rather tedious exercise on a small model, especially where needle sharp pencilled divisions along the frames serves the purpose equally well.

With *Cruiser*, the space above the wale was found to equal those division below the wale inasmuch as five planks would be required to cover the area. However, here the gun ports and sweep ports would need to be considered and the whole treated in a special way. Also, there was the further matter of the rails. For this reason it may be as well to leave most of this planking until the deck planking has been completed. This would ensure that the gun port sills are set at the correct height of 10½in above the deck.



33. Another view of the hull showing the sheer, or run, of the wale and the planking battens.

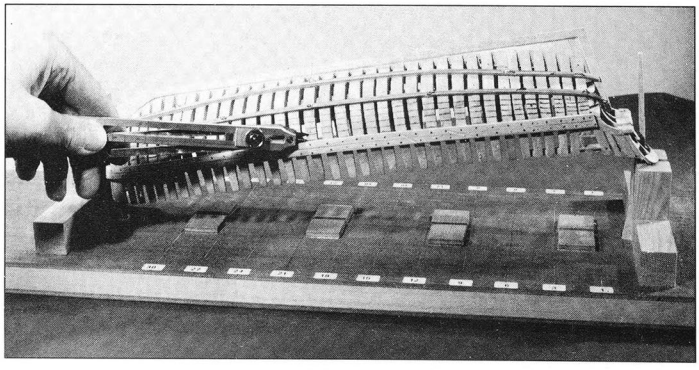


34. With a pair of proportional dividers set at a ratio of 1:5, five equal divisions can be marked at any position in the span.

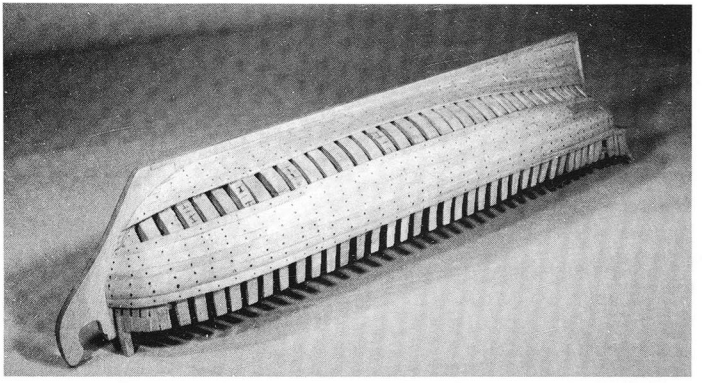
Planking should begin with the garboard strake, as this has a distinctive shape and needs to be fitted carefully into the keel rabbet. Using a shift and butt planking sketch as guideline, the four corner method of planking should be used as the best way to proceed. This is done by fitting the first plank of the strake into the rabbet of the stem foot and its run along the keel, first on the port side and then on the starboard. Taking the first planks of the garboard strake as being 4in long (equal to 24ft in scale), they should be fitted into the stem foot rabbet, port and starboard. Similar pieces are then fitted aft into the rabbet of the stern post and the run of the keel, port and starboard. Lengths of planking can then be run between them on both sides, to complete the garboard strakes. Both strakes should be cane dowelled into the rabbets.

The idea of the four corner method is to avoid any undue stress on or distortion of the frame structure by exerting an equal pressure all round. Secondly, and just as important, it allows for a neat, accurate and firm fixing of the hoods into the rabbets, which otherwise might prove difficult.

The next plank up from the garboard strakes should be set 6ft back from the first butt of the garboard strake, and its hood fitted into the stem rabbet. The procedure for the four corner planking is continued in this way until the whole of this section of bottom planking is complete. Where drop strakes and stealers are required, they should be fitted in this section. Single dowel fasteners can be



35. Using the opposite end of the proportional dividers (still set at the 1:5 ratio), the width of a strake at a particular frame can be obtained. By setting the dividers to the distance between the planking guide battens at each frame, the widths of the individual strakes at each frame can be determined.



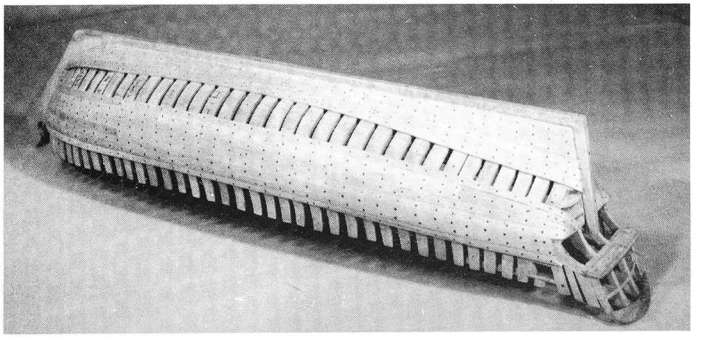
36. Bottom strakes and diminishing strakes in position.

used throughout. In the course of this planking the first batten up should, of course, have been removed, to accommodate the fitting of the last strake in the section.

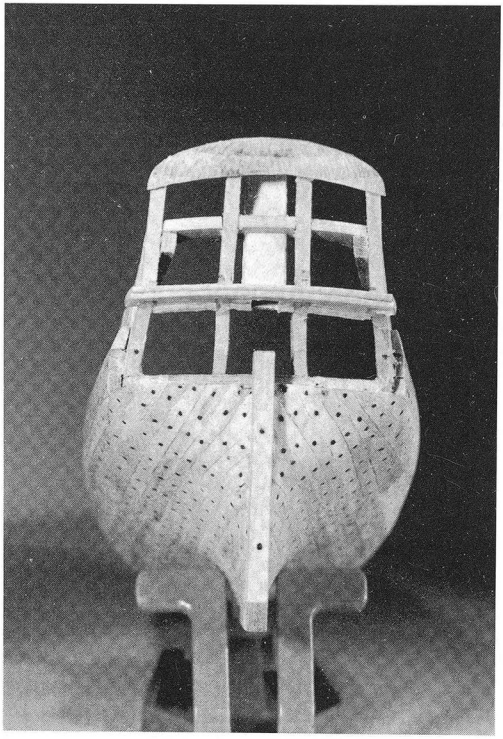
The next section to be completed is from the wale down to the second batten. This band of strakes includes all the diminishing strakes. These can be set in square, the rake being taken off with a flat gouge on completion. Pre-empting their angle can be done with a small drawing marking off the depth of each strake as it declines, but this may be rather an unnecessary exercise in a small vessel with such a short reach of strakes. The rake of these diminishing strakes is, of course, determined by the depth of the wale at their top and the last of the bottom strake's depth at their bottom. With *Cruiser* there is an incline from 3in to 6in over five 10in strakes.

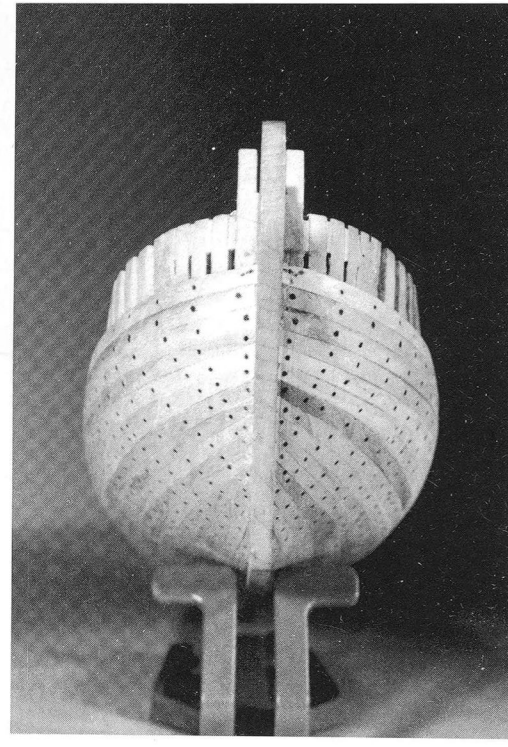
Care should be taken to ensure that the pattern of shift and butt of these top strakes matches those of the first section of planking fitted. This is a simple matter as only five strakes of the centre section are involved, and the shift of butts can be easily calculated; it shows, too, the need for the guideline sketch. After the final strakes in this section have been fitted, the second batten is removed. The planked model at this stage is shown in Photographs 36 and 37.

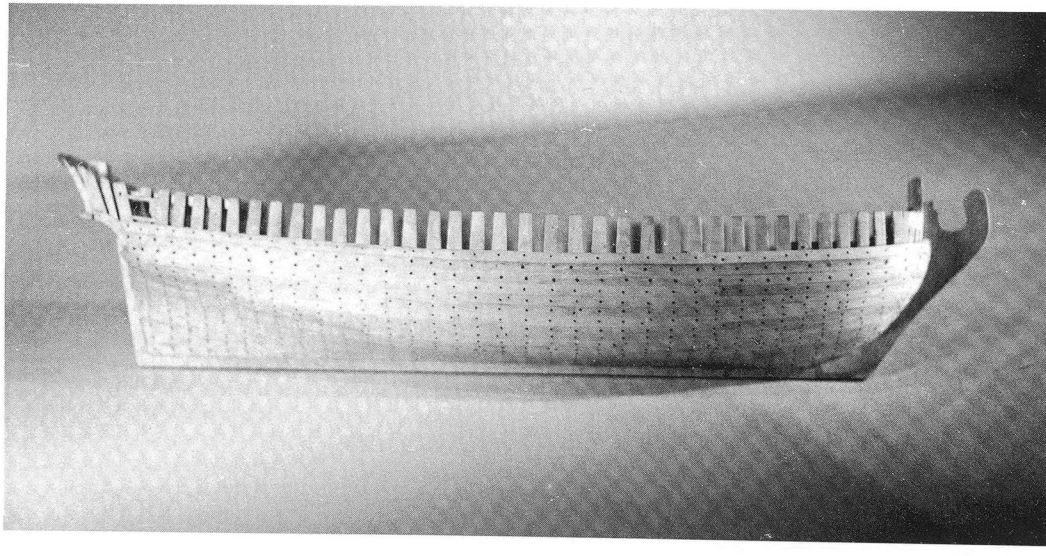
The centre section should be completed from the bottom to the top, the last plank to be fitted being at midships. This is the simplest plank to fit, as it has little shape, is easily accessible, and can be bedded down to a flat surface.



37. Once the planking battens have served their purpose they have to be removed, as here. The planking of the remaining centre section is not as difficult.







◀◀ 38. The stern, showing the rise of the planking. The 'hot can' method was used to shape the planks before fitting, Some stealers had to be fitted.

The black strake can be fitted at this stage. This is the strake above the wale, which aligns with the top of the deck clamp. The section of this strake is trapezoid, and it diminishes in depth from that of the wale on which it sits to that of the first bulwark strake, which rests above it. The reason for fitting this strake is to allow the protruding trennals to be cut off with the rest, before fitting the deck beams. This is done when the glue of the planking and the trennals are dry, after which both the inside and outside of the planking can be sanded, and the hull given a liberal coating of Rentokil as a long lasting preservative. This is especially important when using lime.

Where no interior lining or footwaling has been carried out, some model shipwrights advocate lining the inside hull at this point with a shellac coated gauze, such as a 1in wide finger bandage. This can be laid in strips along the stringers. The inside planking is first coated with a shellac or varnish, the gauze strips pressed into this while wet, and when dry given a second top coat of varnish. The idea of this is to preclude any movement of the timbers through dampness or hostile atmosphere.

Views showing the completed planking up to the deck level can be seen in Photographs 38 to 40.

◀ 39. The fore end, showing the symmetry of the bow strakes and how they fit into the stem rabbet. Stealers have had to be fitted.

40. Hull planking completed up to deck level.

5

Internal Structure

IT IS AN ADVANTAGE to use the jig throughout the making of your model. It will need to be modified in way of the fore uprights to accommodate the head timbers. The first alteration will be to move the fore uprights from their vertical position to that of a horizontal one so that they will just grip the foot of the stem. The jig is no longer needed to maintain the hull in a square state, as the hull is now rigid by virtue of the structure so far completed. But there remains the need for a safe berth for the ship as the rest of the work is carried out, including, and especially for, all the masting and rigging. A simple modification to the fore brackets will answer this requirement for the moment.

The work so far may have taken several months, which raises the point of sustaining progress on a model. The amount of work involved is not always appreciated by new modellers, or for that matter by the over-enthusiastic old hand. It is easy to over-simplify and underestimate the time a task will take, so that interest may flag or the work becomes irksome. If this happens it is best to put the model away for a few weeks, or even months, and return to it with a fresh mind. To work on a model consistently for a year or more does not suit everyone.

Interior Structures

In considering the next stage of construction, thought should be given to how much of the interior should be exposed. There may be an urge to make the oven and have a glimpse of this as a point of future interest. It would need to rest on the half deck just aft of the forecastle break. It should be fitted by putting in the beam shelving, followed by the beams, and lastly by planking over them.

Deck Beams

The dimensions of the beam shelving for this half deck will be about three-quarters the depth of keel for their width, and the thickness one-third that width, which makes their section 9in x 3in. The beams to rest on these would be rather heavy at 9in x 6in, as they have to support the weight of the oven. Those beams used for the forecastle and quarter deck, and the other non weight bearing half decks, would be something less than this. It is difficult to formulate deck beam dimensions, but the thickness of the non weight bearing beams would have to be about $\frac{1}{30}$ of their length. For

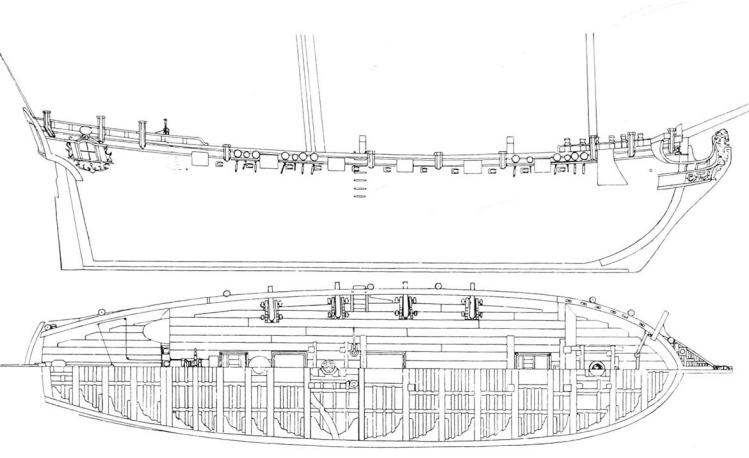


FIGURE 37. General arrangement of *Cruiser* when rigged as a snow.

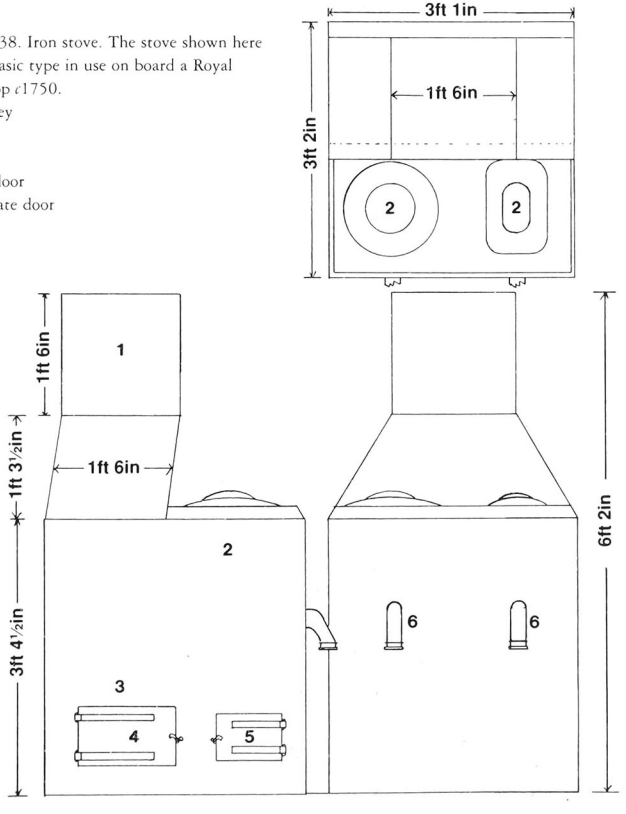


FIGURE 38. Iron stove. The stove shown here was the basic type in use on board a Royal Navy sloop *c*1750.
1. Chimney
2. Boiler
3. Oven
4. Oven door
5. Fire grate door
6. Cocks

weight bearing beams, such as those used on the main gun deck, the thickness should be about 1/35 of their length. A beam was always about one half again wider in its width than its depth.

Taking the average length of a beam at midships at the gun deck level on *Cruiser* as 18ft, or 216in, this divided by 35 would give a depth of beam of 6in. Adding half this dimension again to the depth would give a width of beam of 9in. This conformed to the size of beam indicated on the Admiralty draught. As stated, those beams for the non weight bearing decks would be slightly less than this based on the formula of 1/50 part of their length. Their disposition is shown in the arrangement drawing, Fig 37.

Four beams should be fitted to the galley area for the decking. This is a very tight area, as you can see. As the hatch giving access to the galley is a largish one, affording a view into much of the interior, it should not only be decked, but also fully lined, and given a bulkhead across the aft part leading into the main hold (see Bulkheads in Chapter Six for details). Matters dealing with the decking will be dealt with in detail below, when the main deck planking is discussed.

Iron Stoves

The iron stove can be a little model in itself. That for *Cruiser* can be seen in Fig 38. Iron stoves were an innovation of the mid eighteenth century. Before this time the ovens as such were just copper cauldrons in a brick surround with a brick hearth and fire box. The dishes which came from this arrangement were consequently of the boiled kind, and records show that there was not much variety. The iron stove was a great improvement and was quickly adopted, many designs and improvements being conceived by the rapidly developing industry.

The stove chosen for *Cruiser* has

two boilers, a large one and a small one. At the side of the stove is a door for the coal fire together with another door for baking or roasting requirements. Two brass taps are situated on the fore part for the needs of hot water. By today's standards it is a basic arrangement for feeding eighty officers and men but one which must have made their meals that much more acceptable. There are other arrangements of these iron stoves for the larger ships, which come equipped with a spit and grill, a still, two fire boxes and two roasting ovens, the exhaust from which led into a common chimney. Because of the great weight of the stoves, they were usually placed on the centre line of the ship, and as low down as possible. *Cruiser*'s oven should be placed immediately abaft the forecastle break, at the centre of ship and just abaft the anchor bitt pins which pass through there. The chimney for the exhaust fumes of the stove should pass up through the main deck at this point. A selection of chimney designs can be seen in Fig 39. They were made in two parts, one integral with the stove, and one fitted above the deck line. The latter was made from either metal or wood, and if wood was usually lead lined. Most were made with cowls which could be turned to face the lee. The one on *Cruiser*'s stove was square, with a square cowl. The stove has to be fitted before the main deck beams are fitted.

Master Cabin

The next item to consider is the hung deck for the master cabin. This is set immediately aft of the main deck and some 1ft 6in below it, starting directly beneath the quarter deck break, and terminating against the counter timbers. This deck should be laid in the same way as that for the galley. Depending on the amount of detail you require, the individual planking of this deck can be omitted. Instead, it could be made from one piece of ply, as it was the practice at this time to cover the decking of the captain's cabin with canvas, this often having a chequered pattern of black and white squares. However, so as not to deviate too far from shipyard practice, this may not be desirable and it should be individually planked.

The master cabin should be fully lined as much of it will be visible through the stern windows, light being admitted by these and those across the quarter deck bulkhead. For this reason the small ladder leading down from the door on the main deck should be fitted at this time, and also the rudder post trunking, which runs up through the deck to rise above the quarter deck to a height sufficient to house the rudder head and tiller. Allowance should be made to this height for the thickness of the quarter deck planking. This is also the time to varnish the hung deck, should you want to, and to fit any furnishings such as a table and chairs or cot into this very open cabin space.

Other Below Deck Areas

The final area which could warrant a sense of 'something going on below' is that immediately forward of the master cabin, the half deck occupied by the ship's officers. Here the companionway to this accommodation is rather small. Once a ladder has been placed there little more will be seen, so this area can be completed with the deck only, without any attempt at lining.

Disposition of the Deck Beams

The dimensions of the main deck beams have already been established. Their disposition is shown on the half breadth plan of the arrangement drawing (see Fig 37). There are fourteen main deck beams shown on the

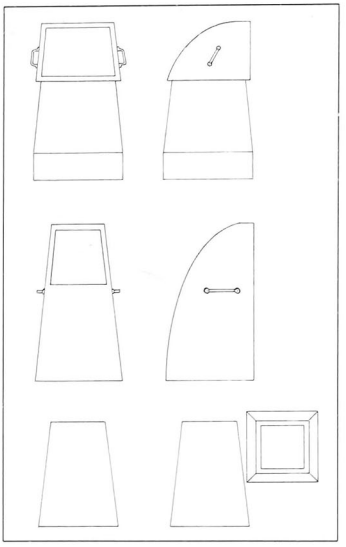


FIGURE 39. Wooden chimneys of *Cruiser*'s period. They would have been lead lined. At the top is the type fitted to *Cruiser*. The base was 1ft 10in square and the height 3ft 0in.

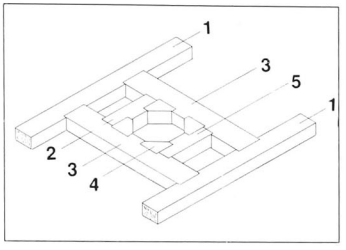


FIGURE 40. Arrangement of mast partners.
1. Deck beam
2. After partner chock
3. Master partners
4. Filling chocks
5. Fore partner chock
The flat surfaces of the angled filling chocks were curved to suit the circumference of the mast when bedded home, after which wood wedges were fitted and covered with canvas.

Admiralty draught, placed either beneath a gun port or immediately to one side of it. These beams also form the fore and aft boundaries of the four hatches. Each of the beams should be given a 6½in camber overall by cold bending the piece of lime to conform to the shape of the camber template made from 1mm ply. As with all templates, and of course try squares, the work should be lined up against them, and shaped until all light ceases to pass through any point of contact. This is an essential point in forming the camber, and just as important as ensuring the strict conformity of the thickness of the beams. Without this precaution, trouble could ensue when laying the decking. Of equal importance is the care that must be taken when sanding down the decking. Sandpaper, even the finest grade, can cause dips and furrows which might prove difficult to eradicate once they have been set in, and may require relaying that section of the deck. No attempt should be made to sand around hatch coamings or other fixed deck fittings with unsupported sandpaper. For this purpose small specially designed sandpaper sticks are advised. Those which are very useful for this work are about 2in x ½in x ¼in with ends angled to 30 or 45 degrees. These prove most effective in keeping the work square when sanding into awkward corners and against vertical right angled structures.

Beam Arms

There arose the need to place in the beam disposition draught one set of beam arms. Where a beam cannot reach across from the port beam shelf to the starboard beam shelf because of some obstruction, curved beams are used called beam arms. These begin on their respective beam shelves each side of the obstruction, and curve back aft to be fayed in with the side of their adjacent beams. With *Cruiser* the main mast partners, jeer bitts, fore topsail bitts and pumps all come in the way of a straight run for a beam, so the beam arms have to be used. This is also a convenient place to change the run of the lodging knees, as the beam arms rest about the dead flat. Aft of the dead flat the arm of a lodging knee is fayed to the fore side of the beam, while forward of the dead flat it is fayed to the aft side of the beam. At the point of dead flat where the two opposing toes of the lodging knees meet, they are usually crossed and fayed together. However, in this instance, the heads of the beam arms come between them, so the two opposing toes can be fayed into it, one on each side, as shown on the beam disposition draught (see Fig 37). Fig 40 shows constructional details of the mast partners. Once fitted, all the beams should be cane dowelled through their ends into the beam shelving.

Bulkheads

Before proceeding with the quarter deck and forecastle deck beams, it is necessary to fit their bulkheads. That for the quarter deck can be seen in Fig 41. This is made up with a framework of panels, four windows and a door. Further reference to bulkheads will be made in the following chapter.

The cowl hood over the door entry port should now be made. This can be fashioned from a block of lime, shaped on the outer surfaces and then carved on the inner surface to ½4in thickness with a ¼in flat gouge. Once these two bulkheads have been fitted, the beams for these areas can be fitted.

Jeer and Topsail Bitts

Before proceeding with setting in the carlings and lodging knees, all those items which, while they sit on the top decks, begin their life either on the keelson, or that pat of a frame adjacent to it must be fitted. The first of

these are the main jeer bitts and main fore topsail bitts, together with the fore jeer bitts and the fore topsail bitts. The bitts consist of a pair of short posts called pins with a cross bar between them. They are used for belaying their named lines. The jeer bitts are always placed just aft of the centre line of the mast, while the topsail bitts are always on the fore side of the mast. The dimensions of the main jeer bitts for a sloop can be seen in Fig 42; these are the same for the main topsail bitts.

The fore jeer bitts and the fore topsail bitts are ½in less than those of the main in the square section of the pin, and for the cross piece. The pins for the fore bitts being 7½in square in section as opposed to 8in for the main. However, the height of the cross piece above the deck taken from its underside, remains the same for both for the fore and the main bitts at 1ft 10in. This height remains fairly constant for most classes of ship at this time, irrespective of the sizes of the pin. The pins of these bitts continue down from the deck level to rest beside the keelson. The pin remains square where it is scored into its immediate deck beam and bolted through. Beneath this it tapers on its aft side to about two-thirds of its width at its foot, where it is bolted through to be fayed onto the floor of a suitable frame.

When fitting these items, allowance must be made in their height for the subsequent decking which will surround them. Their finished height should not, of course, be taken from the beam to which they are fayed. It is an easy mistake to make when placing them for height. Just as importantly, extreme care should be taken when fixing their position to ensure that they are exactly where they should be. There is not a great deal of comfort in having to cut them away after the deck has been laid because they are found to be out of true. Short of pulling up the deck and starting again, there is little that can be done to save the marring of an otherwise perfect job. To obviate this catastrophe an exact centre pencil line should be maintained on the beams at all times. The use of this will prove invaluable as work proceeds up to and including the planking.

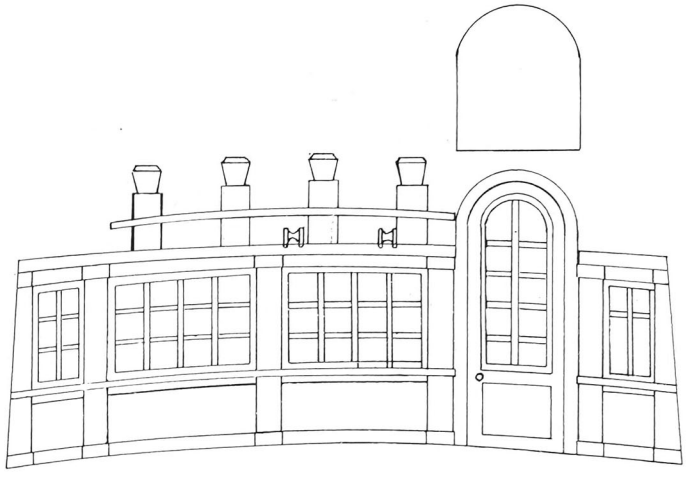


FIGURE 41. Quarter deck bulkhead. The timberheads are of square section. At the base of the two inboard ones can be seen the fairleads carrying the lines running between the helm and the tiller. Above the door is the plan view of the canopy.

One final point about the bitts. It seems there is no set pattern for fitting the cross pieces facing fore or aft. Some contemporary models have them facing aft, and others to the fore, while there are some models on which the jeer bitts are facing to the fore and the topsail bitts facing aft. Many drawings show this great variation, and it could be just a matter of convenience from a belaying point of view that they are set with these differences. It depends how close the bitts are to the mast. With regard to the fore topsail bitts on the forecastle deck of *Cruiser*, the bowsprit step should be set between the bitt pins of this (Fig 43). The step should be fitted before planking, as its lower part is fayed to the deck beam there. Care should also be taken to line up the tenon for the bowsprit mortice to fit

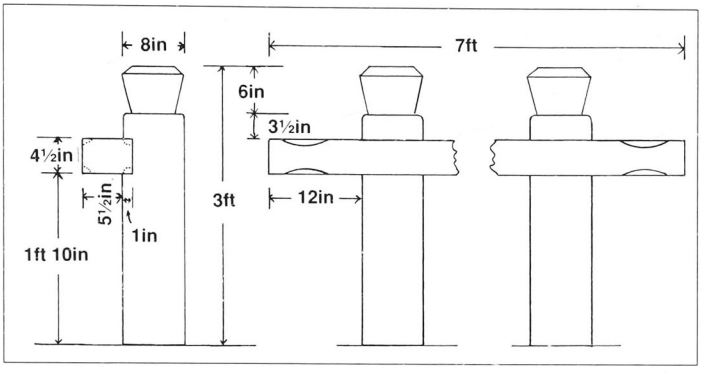


FIGURE 42. Main jeer and topsail bitts. The fore jeer and topsail bitts were ½in smaller than those for the main, shown here. The height of the cross piece above the deck was the same for each set.

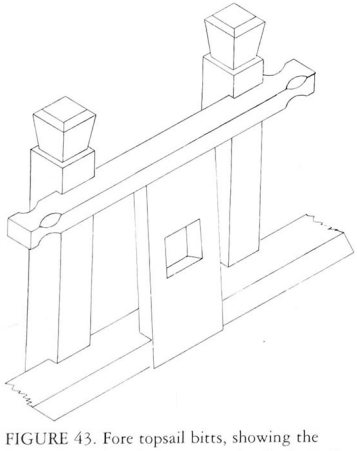


FIGURE 43. Fore topsail bitts, showing the method of fitting the block to take the heel of the bowsprit.

home at the correct angle for the spar. A spare spar or dowel of the same dimensions could be used for this exercise.

Riding Bitts

The next items to be fitted on the forecastle are the riding bitts, or as they are also termed, the anchor bitts. These consist of two staunch posts with a heavy cross piece set between them. Their use, as their name implies, is to secure the mooring hawse whilst the ship is riding at anchor. For this they need not only to be of a sturdy construction but also well fitted to the most robust parts of the ship. Usually just one set was fitted to a small craft such as *Cruiser*.

The more common arrangement for a frigate or larger ship was to use at least two sets of riding bitts, one positioned some 12ft behind the other along the centre line of the gun deck, but so constructed as to form an integral whole. Those on *Cruiser* should be set midships at the break of the forecastle, the pins being seated on the gun deck whilst the standards run forward on the forecastle top. The standards are the curved down cheeks of the bitts bolted to the front of the pins, giving them support against the pull of the hawse. On *Cruiser* they sit on each side of the fore jeer and topsail bitts. As with the jeer bitts, the riding bitt pins pass through the deck to run down to the keelson area where they are bolted through an appropriate frame floor member. They are also tapered off on their aft side by one-third of their width at the heel. The dimensions are given for these bitts in Fig 44, but the bites of the cross piece must be aligned with the hawse holes, so that the hawse can have a clear run.

Gallows

The gallows fitted to a sloop for housing the boat and the spare spars come next. They consist of a pair of upright timbers with a sided dimension of 8in and a depth of 10in, with a top beam of the same scantlings, standing at a height of 6ft above the deck. Two pairs of these should be fitted, spaced 16ft apart on the centre line of the ship. The first pair fay into the beam by the fore hatch, and the second pair fay into the hatch beam before the main mast. The upright timbers of the gallows reach down through the deck with their feet fayed to the floors of a frame. Photograph 41, showing the upper strakes of hull planking removed on the port side, demonstrates the height of the gallows.

Ship's Boats

The Admiralty order of the time required that sloops on Channel duties should carry a six-oared 24ft to 26ft cutter and a 16ft to 18ft longboat; constructional details of these are given in the next chapter. As *Cruiser* spent most of her time on Channel duties, these are the boats which will be fitted. Both boats have provision for masts and consequently fixed centre thwarts, which prevent their being nested. In view of this the cutter is housed on the top of the gallows, while the longboat is stowed on crutches beneath the gallows.

Capstan and Pumps

The final items to consider, where part of them rests on the keelson region below, will be fully described in the next chapter. That said, it will be as well to become acquainted with their construction before commencing any part of them. The first of these are the elm tree pumps, the main parts of which naturally run down from the gun deck to a place beside the keelson, with the working part of the pump visible above the deck situated just forward of the main mast. Two pumps should be fitted in the positions shown in the general arrangement drawing (see Fig 37).

The second of these items is the capstan, the tapered spindle of which rests on a block set across the keelson. The capstan is placed just abaft the main mast, and its construction is detailed in Chapter Six.

Carlings, Ledges and Knees

Having made provision for all of these below deck items, the decks can be completed. The first item to go in are the carlings. These are timbers similar to, and with the same function as, the deck beams, the difference being in their size and that they run fore and aft of the ship, being scored into the deck beams. Their runs fore and aft are known as tiers, being the side tiers, the middle tiers and the midship tiers. Each tier has to be a given distance away from the next, the distance depending on the deck and the ship. The number of tiers used depends on the deck and the ship. Two principal tiers of carlings should be set on *Cruiser*, the side tier and the middle tier. As with the deck beams, the depth of a carling is always less than the breadth. Those for *Cruiser* should have a dimension of 8in x 5in. Where they come in the way of a hatch, they form its fore and aft sides.

Once the carlings have been set attention can by given to the knees, the flat curved brackets which support the deck beams. These fall into two categories: the lodging knees and the hanging knees. These were usually made from compass oak in the yard. On the model a satisfactory arrangement can be found by cutting them at a 45 degree angle across the grain of the lime, so there should be little or no complication from splitting. Their arrangement is to act as a pair of brackets to support and hold in a deck beam on the beam shelf. In practice the hanging knee was bolted in a vertical position to the side of the beam, with its top flush with the top of the

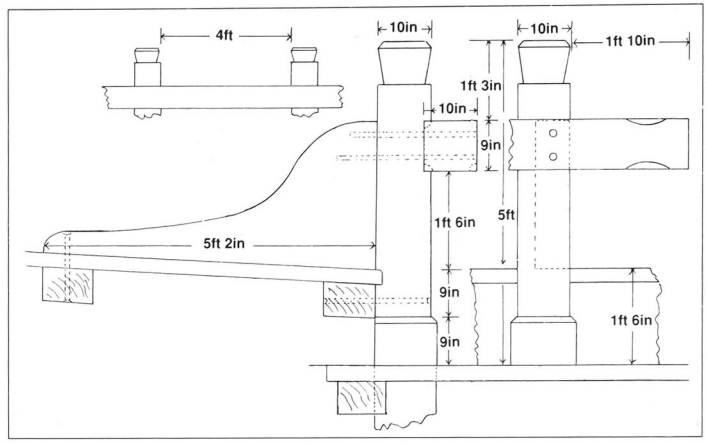
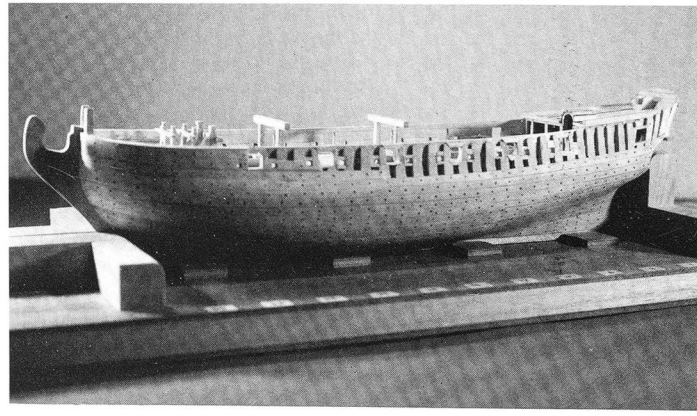


FIGURE 44. Dimensions of the anchor or riding bitt.

41. Top strakes removed to show the height of the gallows.



beam. Those forward of dead flat are fitted to the fore side of the beam, those aft of dead flat to the aft side of the beam. They sat over the lining, and were bolted through this and the beam shelving (see Figs 31 and 37 for details).

As already explained, the lodging knees take up an opposing stance, being set on a horizontal plane, with their flat top flush with the top of the beam they are supporting, and through which their arm is bolted. For those lodging knees aft of the dead flat, the arm is bolted to the aft side of beam. In this way each toe of a lodging knee is fayed into the side of a hanging knee. The scantlings of the knees varied according to their position. Generally they are the same thickness as the carlings. On the lodging knees, the arm usually reaches to within a short distance of the side carling. As the toe of this knee is fayed in with the opposing hanging knee, the hanging knee is proportional to this, the top of the knee running along the beam being on a parity with the opposite arm of the lodging knee. The throats of the knees are in the form of an arc to afford maximum strength with the minimum of weight. This arc should be the same on all the knees fitted.

The ledges are the lightest timbers of the underdeck structure, and run athwartships in line with the beams to rest between the carlings, to which they are fayed with a 1in score. Where they meet a lodging knee or filling piece, they are fayed in with a 1in score in the same way as the carling. The number set between each pair of beams was usually three, but this depended on the space available. With close set beams two, or even one, ledge would be fitted. The scantling of a ledge varied according to its position or requirement, but on a model it would be best to make them consistent with the formula for a sloop, ie 7/12 the width of the carling, with a thickness of some ½in less than this.

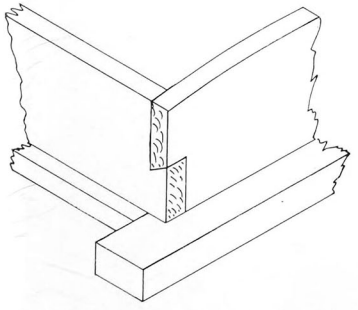


FIGURE 45. Hatch coaming corner, showing the method of forming the angled joint.

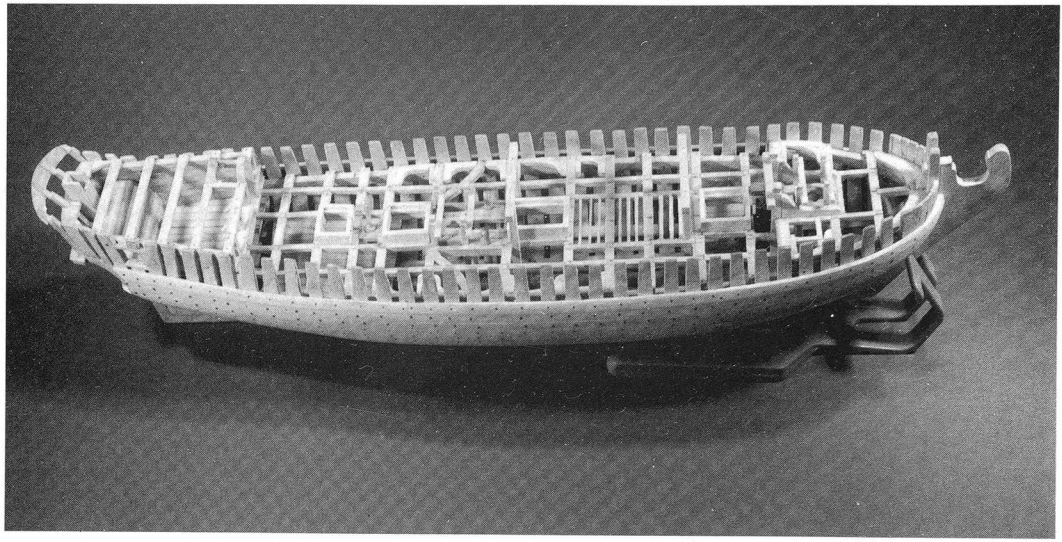
Hatches

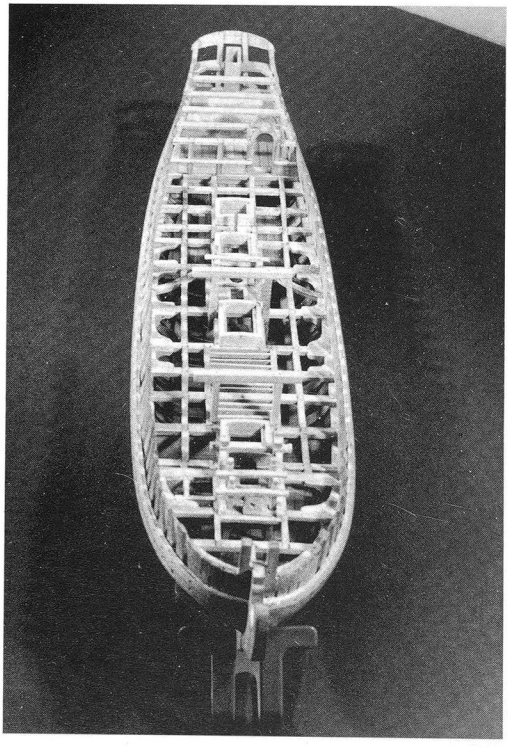
Embodied in the structuring of the beam and carling work is the provision for the hatches. There are four on *Cruiser*, as shown in the general arrangement drawing (see Figure 37). For the most part the beams form the thwartship boundary of the hatches whilst the carlings form their fore and aft boundaries. Where these scantlings fall short, filling pieces of the same scantling should be fitted. When laying the decking, allowance must be made for the hatch coamings to sit directly on the beams and the carlings, as would be the normal practice. The thwartship coaming of the hatch should be given a slightly greater camber than the deck, and the fore and aft part of the coaming made some 9in high, being somewhat more than the coamings of the earlier part of the century. This was part of an Admiralty directive. The coamings should be joined at their corners with a half depth overlap, seen in Fig 45. In practice the overlap section of the coaming was bolted through the beam, making the whole structure a watertight fit. The edges of the planking where it met the coaming should be caulked. A 3in batten should be affixed to the inside face of the fore and aft coaming to support the gratings. Hatches of the period were generally longer than they were wide, with the exception of those which served as companionways, or where deck space did not allow the practice, such as might be found on a cutter.

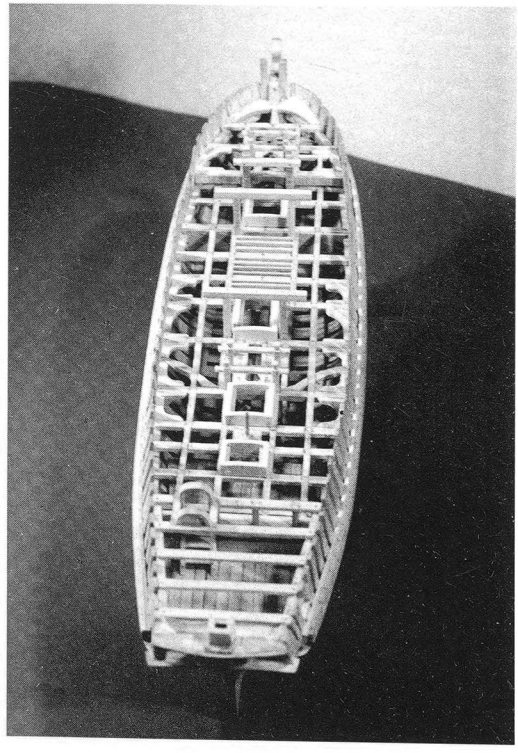
Photographs 42 and 44 show the deck before planking commences, complete with all hatches, bitts and gallows.

Deck Planking

The planking of a ship is a feature which can make or mar a model. An expanse of deck planking, laid bare to the eye as if to invite inspection, is perhaps more open to criticism than anything else about the ship. Care in







42. The completed underdeck structure of beams, carlings and ledges before the commencement of planking the main deck.

its laying is always worthwhile, and the choice of material and method of laying play an important part in achieving a satisfactory result. Then again, there are the technical aspects of king boards and joggled planks, margin planks and edging boards. Add to all this the uniformity of board widths and the neatness of the caulking lines and you have a good idea of what is involved.

It is not always possible to lay a deck once and be satisfied with it. It may seem to be out of character with the model, or the absolute symmetry of port and starboard sides may have been lost. Whatever the cause, a new start has to be made. Two or three boards a fraction wider on one side, and a like amount a fraction under on the other can cause havoc in this way. The lesson from this is careful planning and marking out across the beams, and the accurate cutting of the boards. As far as character and atmosphere are concerned, boards can look newly laid or weathered, holystoned or aged in aspect. This will depend on the nature of the ship. To put the same type of deck on a trading ketch from a West Country port, a Thames barge in the clay trade, a Cape Horner, or a Navy ship would be a mistake.

43. The unplanked deck seen from forward. Note that the bitts, gallows and hatch coamings are all in place before planking begins.

Lime is a clean white wood and very suitable for decking a Navy sloop, providing it is free of its blea, which can be a very dark pink. Bearing in mind what sticklers sailors were, and are, for everything to be spick and span, the decks would need to appear well holystoned. Thus lime for the decks in this instance would be ideal, especially if it is clear varnished on completion.

The best material for planking is sheet lime, apple or pear, obtainable in lengths a metre long by 3in wide, which does not run under on any edge; the thickness of the sheet depending on the scale used. The planks can be run off on a mini 3in circular saw fitted with a fine toothed blade, giving an even finished cut. Thus a flying start can be made with planks which are all of an even thickness and all of equal width. Should a mini circular saw not be to hand, lime sheet at least can be cut into accurate plank widths using a craft knife and a steel straight edge.

44. The unplanked deck seen from aft. The hanging deck for the master cabin has been fully planked and fitted with a ladder before the quarter deck beams are added.

There are various ways to represent the caulking. For the model of a period sailing ship there are two principal methods which can be used. The first is to cut a batch of suitable planking lengths and glue these edge-on to a strip of black paper of a type which will not peel off in layers when cut. Tests should be made beforehand as paper which peels away from its adhering layer will alter the thickness of the planks' caulking and be noticeable when they are laid. When the glue has dried, the planks can be separated by running a craft knife down between them. This should be done by holding the batch firmly against a thick magazine pad, with the black papered edges on the underside. One plank edge so treated should be sufficient. The top edge of the paper must be clean and sharp with no ragged tearing, so only a good sharp knife should be used.

The second method is to use a black marker pen, preferably water based, and most importantly, one with a chisel end to the felt tip. This can be run down a length of planking at one go. With this method both sides of the plank should be treated to produce a marked caulking line on the finished deck. The advantage of using the pen is that the butt jointing can also be given a caulked effect, providing the ends of the planks are first treated with white PVC wood glue and allowed to dry, to prevent the ink bleeding into the end grain of the wood, which would otherwise result in an unattractive staining.

Waterways

The first members of the decking to go on are the waterways (see Fig 31). These are strakes of timber a third or so greater in width than the deck planking, and a little over twice their thickness. They were flat and rectangular on their bottom reach, and concave in their section at this time. Their function was to seal the edge where the beam ends met the frames and filling pieces against the penetration of sea water. The inboard margin run of the waterway was the same height as the planking thickness and the margin plank, which was fayed into it. The upper part of the waterway rose up in the concave section to the same width as the first strake of the spirketting, into which it was also fayed. The waterway was caulked where it met the margin plank and the spirketting (see Fig 31). It underwent many changes in its history and is strongly indicative of a ship's period.

Margin Planks and Nibbing Strakes

In practice, the margin plank was fayed into the waterway, and followed it with a parallel curve for the full length of the gun deck. This plank was half as great again in width as the deck planking, and of the same thickness. Generally it was made up in 25ft lengths, each join being set with a long scarf. It acted as a transition plank between the curve of the deck on its outboard side and the straight laid planking on its inboard side. To facilitate this a practice termed joggling was used. Where the straight deck plank met the margin plank, to maintain the straight run of the deck planking, any overlap was cut into it by the overlap being tapered off to a fine angle and fitted into the margin plank. This taper was not joggled into the margin unless its length was more than twice the width of plank, in which case it was cut back to equal half the plank width at the butt end. This part of the plank was termed the nib, and the plank so fitted was termed the nibbing strake (see Fig 46). This joggling is not always carried out on models, but a neatly laid joggled deck will always impart a professionalism to any model ship, whatever the period. The simplest way to accomplish the joggling is to leave the margin plank free, but firmly fitted. The nibbed strake can then be laid over the margin strake, and with a fine pointed pencil the area of the margin plank to be removed marked out. The margin plank can then be lifted and the marked area cut away. Each nibbed plank should be fitted before proceeding to the next.

When dealing with the margin planks, the port side can be fitted first. The finished plank can then be turned over and presented to the starboard side, where it should be a comfortable fit, and then used as a template for the starboard one. When completed, both should be left loosely fitted so they can be lifted as required to cut the nibbing strakes into them.

Shift and Butt

For a large expanse of decking, a shift and butt plan will be required, in much the same manner as that used for the hull planking, since the decking planking was usually laid in three or four shift butts, as shown in Fig 47. With a small deck area there is little need for this exercise, as the span of uninterrupted decking is never extensive and a simple rule need only apply, namely that no two butts should land on the same beam centre without at least three continuous strakes between them.

The planking should be commenced on each side of a central pencil line marked up on each beam. One complete run should be fitted at a time. Provision should be made in the

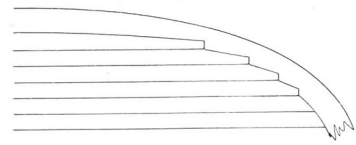


FIGURE 46. The method of joggling ends of deck planks into the margin plank.

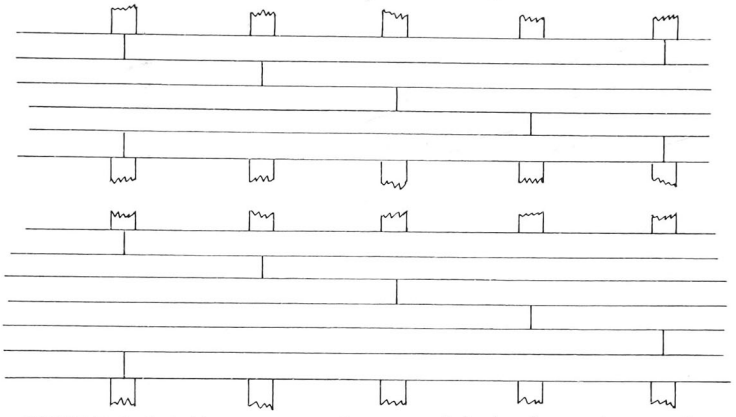


FIGURE 47. Deck planking: arrangement of shift of butts.
Top: Three-plank shift
Bottom: Four-plank shift

way of the hatch coamings to allow these to be fitted to the beams and carlings. All planking should be carefully cut round the bitt pins and the gallows' pins as they occur; the point of entry for the main mast must be maintained. It may be best if trennels are not fitted on a model at a small scale such as this as they may appear rather oversized and ugly. The strakes should be glued to the beams and carlings, and along their seams. When the glue has dried, the deck should be sanded and coated with Rentokil. Following this the cowling can be set above the master cabin entry port, before the quarter and forecastle decks are fitted in a similar way. There is a difference with the quarter deck, where a king board is always first-laid along the centre of the deck. This plank is a third wider than the rest. Edging boards should be fitted at both the quarter deck and forecastle deck breaks to give a 3in overlap over the main deck.

Spirketting

The spirketting strakes, the next items to be fitted, are the internal longitudinal timbers that run between the waterway and the quick stuff of the bulwark, following the sheer of the ship. They consist of two pieces each side, of a thickness twice that of the bulwark internal timbering, and to a combined height of about 12in. Where they cross a gun port, the port sill is cut into them, and the sweep ports are cut into them in every case. The lower spirketting timber should be bearded to fit snugly over the waterway. The upper spirketting timber sits square on the lower and is not caulked as is the lower to the waterway. These timbers run in 25ft lengths, the lengths being scarphed together. Scarphing is never done in the way of a gun port or sweep port.

Top Timbering

Next, the quick stuff can be run round all bulwarks, the gun port and sweep port positions being taken from the frame disposition draught (see Fig 18). The quick stuff or bulwark planking should be made 1½in thick and 12in wide. For the external planking on the bulwark, templates should be made to check the height, width and spacings of all gun ports and sweep ports, to ensure strict conformity. The bulwark external planking can then be carried round to the stem and back to the counter timbering, spacing being left for the covering pieces from the tafferal to the wales to be set there. These pieces can then be fashioned and placed.

Channels

The channels should be fitted in conjunction with the external bulwark timbering. These should be made with dimensions commensurate with the lower shrouds. A scantling formula exists for the channels, but this should not be taken too seriously if the final appearance of the shrouds is to look correct. The main concern is to ensure that the shrouds and backstays are not bent over the drift rail or bulwark top, nor set so far out as to appear splayed. They should just clear the top of the bulwarks in a comfortable way to allow for stretch, or the

lateral pull of the masts. Commander Alan Villiers' account of his voyage on *Mayflower* contains an excellent description of the movement of the hemp rigging and the masts on the ship's passage to the United States. According to his account this was not inconsiderable; at times he was most alarmed, and he was a very experienced seaman. The point is to bear this in mind when considering the dimensions of these fundamental parts of the rigging. The channels are not fitted with brackets or knees. A continuous batten is fitted on the underside of the channels, set at right angles between their back edges and the side of the ship. The shape of the ends of the channels took on many variations of design both at this time and back to the last quarter of the previous century. Those more common to the period of *Cruiser* can be seen in Fig 48. The channels of *Cruiser* should be set in line with the waist rail, and about half way up and against the edges of the gun port openings. Their positions are shown on the arrangement draught (see Fig 37).

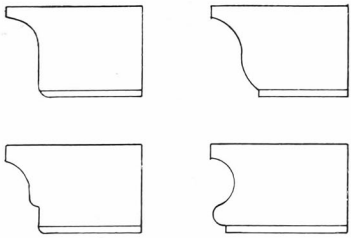


FIGURE 48. Channel end designs. Shown here are four of the many different designs for the ends of channels found in the eighteenth century. Few channel ends were square at this time, and top left is the simple design more commonly adopted. These four examples are all shown with a batten across the slot for the deadeye strop. Sometimes the edge of the channel was moulded, though not always carried right round.

Catheads

The catheads, next to be fitted, are the projecting arms of timber on the forecastle and used in securing the anchor, or catting the anchor to use the correct term – hence the cathead name. This name was enhanced by the carved head of a cat or a lion placed over the end of the cathead as a protection against sea water penetrating the end grain. Their right angled shape was constructed in one piece from compass oak, as they were required to sustain not only the weight of the anchor as it came home but the weight of the water sodden hawse attached to it. The inboard part of the cathead that was secured by bolts to the bulwark timbers was called the cat-tail. For a sloop the square section of the cathead was 9in for its entire length, inboard and outboard. On *Cruiser* the projection over the side should be 3ft 9in, with the projecting arm set at 40 degrees to the centre line of the ship on the horizontal plane, and canted upwards by 15 degrees. The end of the cathead is equipped with two vertical sheaves. On the model these can be made by drilling out with a No 70 twist drill a pair of vertical slots, which are then cleaned up square with a fine Swiss file. Both slots should then be drilled through laterally at their centres, and copper wire eased home through these lateral drill holes as a tight fit, cut off, filed flat and spot super-glued. These will act as firm sheaves on which to rig the anchors later. It is as well to anticipate these needs for future requirements, as a flimsy sheave arrangement which gives way when rigged can be a headache. The support for the cathead forms part of the head timbering, which will be described later. The cathead can be seen in Fig 49.

Hawse Holes

The hawse holes were usually in pairs at this time, one pair being set an equal distance from the other each side of the stem, with their openings aligned to the bites of the anchor bitts. The size of the opening was relative to the size of the cable that passed through it. The cable was a manufactured item which came in standard sizes, so the formula which was used for the size of cable required for any given vessel would need to be rounded up or down to suit the size of cable available. The formula to arrive at the size of cable required was that the circumference of the cable in inches was half the full breadth of the ship. For *Cruiser* this would give a dimension of 10¼in for the circum-

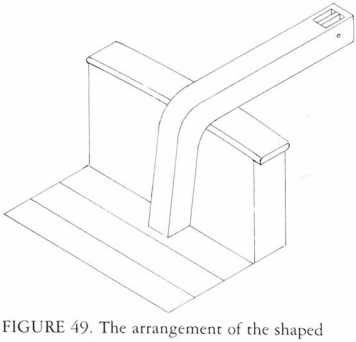


FIGURE 49. The arrangement of the shaped cathead on *Cruiser*.

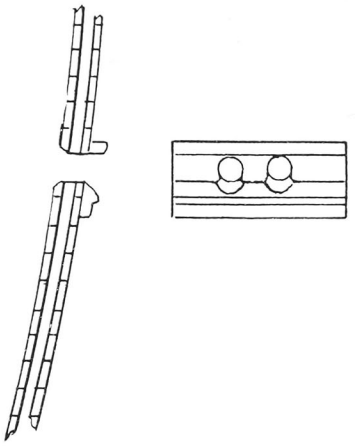


FIGURE 50. Hawse holes. The inner bulwark and the bolster are eased and lipped down to prevent damage to the cable. The inside of the opening would be lined. This was a typical arrangement for this period.

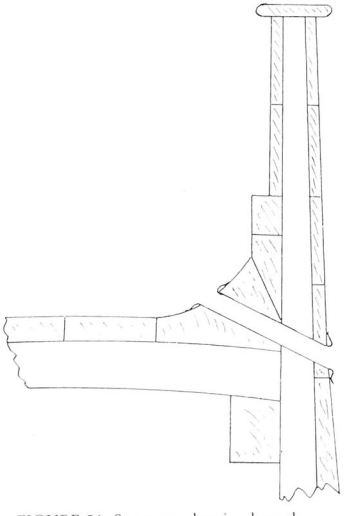


FIGURE 51. Scuppers, showing how the scuppers were cut through the waterway and out through the ship's side. *Cruiser* had five each side on the main deck.

ference of her cable. This divided by 3.14 (Pi) would give a dimension of 3½in for the diameter of the cable. The size of the hawse hole was ¾ of this, which would make the diameter for the hawse hole 8in. This is the size of hawse hole which should be fitted on the model.

A 3in thick section of planking should be fitted externally in the way of the hawse holes, together with a 3in square bolster along the bottom edge, before the holes are drilled through. In practice these holes would have already been set when fitting the hawse timbers. The hawse holes are never left with acute right angles at their opening, but are sloped down with a lip on their lower part (Fig 50).

Manger

A manger should be fitted just abaft the catheads and be made up with two double grooved stanchions set up 3ft apart on the midship line. A single grooved stanchion is set to the port bulwark just ahead of the centre stanchions, and another to the starboard bulwark. Nine inch boards are then slotted in the grooves between these stanchions, to form a low bulkhead. The after part of this should be on a lateral line to the ship, while the side members angle forward. A narrow waterway to act as a form of seal can then be fitted. An allowance should be made for the bowsprit heel to pass over the centre section.

On a two or three decked ship the manger would have been on one of the lower decks adjacent to the hawse holes, and thus covered by an upper deck. Its purpose was to contain the sea water as it fell from the cable as it was being hauled in. For this reason large scuppers were fitted by the fore part of the manger to drain this water away quickly. These scuppers were usually twice the size of those fitted elsewhere in the ship. The manger derived its name from the custom of keeping four legged livestock in this place, as it proved ideal for the purpose. With a single decked vessel with its hawse holes opening onto the forecastle top, this would not prove practical. On *Cruiser* it served in its original capacity and also acted as an early form of breakwater.

Scuppers

The scuppers for a sloop were 2½in in diameter, and five in number on each side of the main deck. Those for the manger had a diameter of 5in. At this time they were made by drilling a hole at a downward angle of some 30 degrees through the waterway to the outside of the ship. They were given leather sleeves which were bent back with a nailed collar, both to the entry and the exit of the bore hole. The external part of the scupper was fitted with a square leather flap, nailed by its top edge over the opening. This flap acted as a valve, preventing the re-entry of sea water.

With a diameter of 2½in, the scuppers on a model at 1/72 scale will not register anything more than a pin hole, and it would not be worthwhile to fit them. However, those for the manger, being of a greater diameter, can be fitted. The leathering can be represented with Humbrol saddle paint. This scupper arrangement is shown in Fig 51.

Rails

There are four rails on *Cruiser*. Two of them are shown on the profile draught as thin beading lines running with the sheer for the entire length of the ship. One is set midway between the gun ports, and is interrupted by them, the other is at the top of the timber line. Other lines shown are what are called the capping rails and fife rails. Great confusion can arise here as various books of reference seem to use

their own pet names for the same rails, and there is a vast difference amongst them as to what constitutes what. The first rail up, which bisected the gun ports, can be called the waist rail. This is 3in deep and 3in wide at the top, sloping back to ½in at the bottom as a moulding. The second rail up, which ran along the top timber line, can safely be called the sheer rail. This 3½in deep and 3½in wide at the top, sloping back to ½in as a moulding. Immediately above this is the drift rail or capping rail to the bulwark. This is 12in wide and 3in deep, with a moulding. This rail continues on the same line as the sheer rail as it passes both the quarter deck and forecastle breaks. There are two enhanced or raised rails above this. One begins with a scroll at the quarter deck break, and extends back to fay in with the tafferal, and the other starts with a turn down at the forecastle deck break and extends to just short of the stem head. These could be called the main drift rail for the quarter deck, and the fore drift rail for the forecastle deck. However, while that for the quarter deck is infilled with planking known as drift planking, so is a true drift rail, the fore drift rail is open, and tenoned over the timberheads. As such the fore drift rail could be called a fife rail. Both these rails are 6in high. Examples of moulding for all these rails are shown above (see Fig 34), but their sections can be found on large detail drawings, or discerned on small scales as they turn into the stem. Details of the timberheads used on the forecastle are shown in Fig 52. A further 6in high fife rail, with four timberheads, is set on the quarter deck above the bulkhead. These timberheads are square, as can be seen in Fig 53.

FIGURE 52. Dimensions of the timberheads on the forecastle. Note that they were rectangular, not square. ▶

Head Timbers

The head timbers can be one of the most interesting constructions to make on a late seventeenth-century to late eighteenth-century ship. Interesting, because the structure is the most demanding of a model shipwright's skills, inasmuch as there is no magic calculation by which a modeller can arrive at the design the ship in hand demands. It is more a matter of aesthetic sense and a feeling for the personality of the ship, and what the architect has tried to impart to her design.

The most important thing to bear in mind is that the head of such a ship is a culmination of the flow and grace of her lines, both of the sweep of the sheer and the mould of the framing.

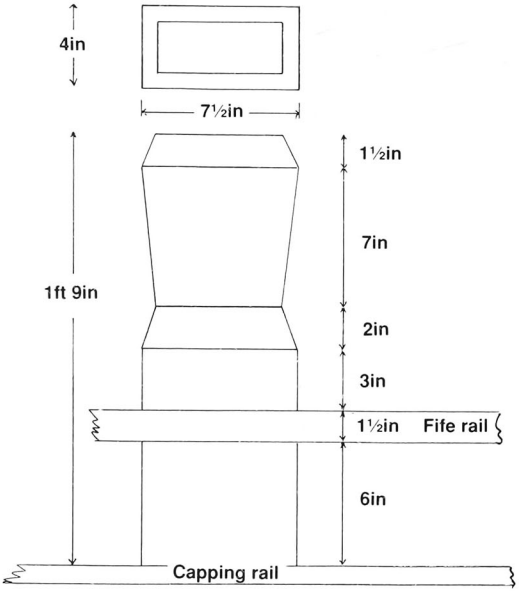
The timbers that make up the head are shown in Fig 54. In constructing the head timbering of *Cruiser*, the first members to go on should be the upper and lower cheeks which sit each side of the knee of the head. These should conclude the sheer line of the wale, and while their position can be ascertained from the draught, their shape is best determined with card templates. It is advisable to obtain an exact fit with the internal part of the cheek before the outside shape is carved back to it.

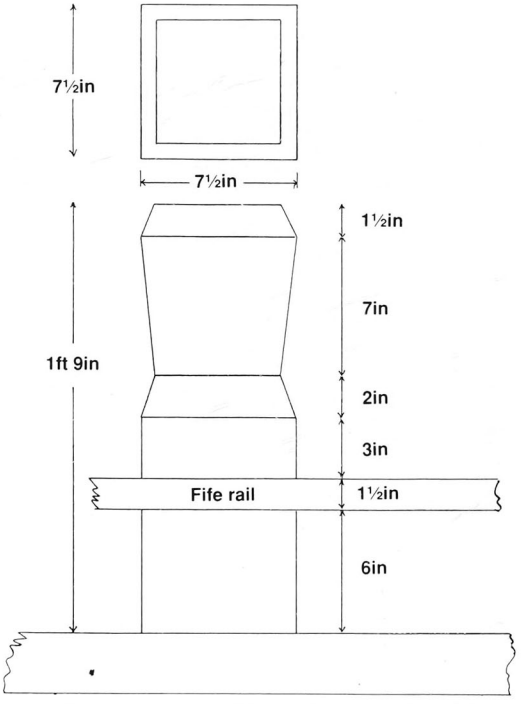
FIGURE 53. Dimensions of the square timberheads on the quarter deck. ▶▶

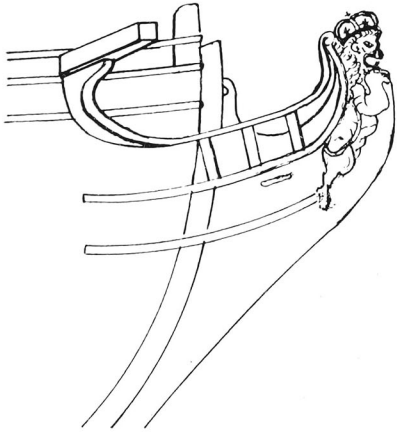
The head timbers are those straight, slightly curved pieces that sit on the upper cheek, and branch out to support the rails. They are also called brackets. With *Cruiser* there are only three of them, and as there is only one rail, they are very short. Viewed head on they should form a V shape. On Dutch ships they form a U shape, while on French ships they take the form of a bracket. It is wise to make these first in card, and also the rails, and make them up as practice mock assembly.

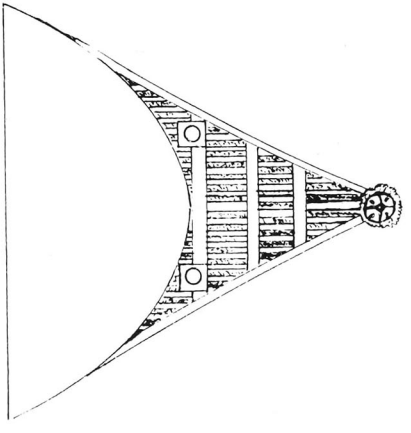
The single head rail on *Cruiser* forms part of, and is a continuation of, the cathead support, and is best made in card first to achieve both the downward curve and the correct outward

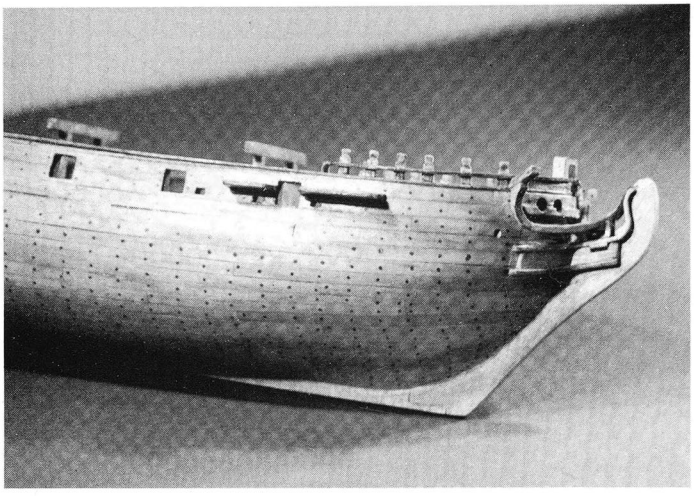
FIGURE 54. The head timbers.


4in
7½in
1ft 9in
1½in
7in
2in
3in
1½in Fife rail
6in
Capping rail


7½in
7½in
1ft 9in
1½in
7in
2in
3in
Fife rail
1½in
6in







45. The bow of the planked hull, showing the completed head timbers.

bow. Fortunately, a slender length of lime or box can be coaxed easily in the fingers to the shape required before being attached to the curved cathead support. Both port and starboard members should be made as a handed identical pair before assembly. A short S shaped rail, known as the hair bracket, and fashioned as a continuation of the upper cheek line, is the next item set, just forward of the cathead support rail where they should merge with the figure piece.

Trail boards 3in thick should be set between the upper and lower cheeks as filler pieces. Mostly these were carved and coloured, but at this time it was not a practice encouraged by the Admiralty on small vessels such as sloops. However, their decoration is a discretion which might be considered. The gammon lashing slot should be cut through these to sit between two of the head timbers. On larger two decked vessels they would incorporate the hawse holes.

The final pieces for the head assembly are the three beams set across the tops of the head timbers or brackets. A series of ledges should be set fore and aft between the beams. At this time on British ships gratings were also laid between the beams and carlings, but with *Cruiser* the space is rather limited for this. Provision should be made for the heads, or seats of ease. These are placed one each side of the knee of the head. Box shutes should be attached to clear the knee. As this was a precarious place to sit, a hand line, usually an iron bar, was normally rigged between the stem and the figure piece, supported in its centre by a short iron stanchion. The finished head can be seen in Photograph 45.

With this work on the hull completed, painting can then be considered. The bulkheads and other deck fittings as placed could be given a coat of light oak Cuprinol stain, applied with a No 1 brush. The internal bulwarks should be painted a dull flat red, as should the inside edges of the gun ports. The external hull might be spray finished or brushed with light oak matt polyurethane, and given a black wale.

6

Detail – Above and Below

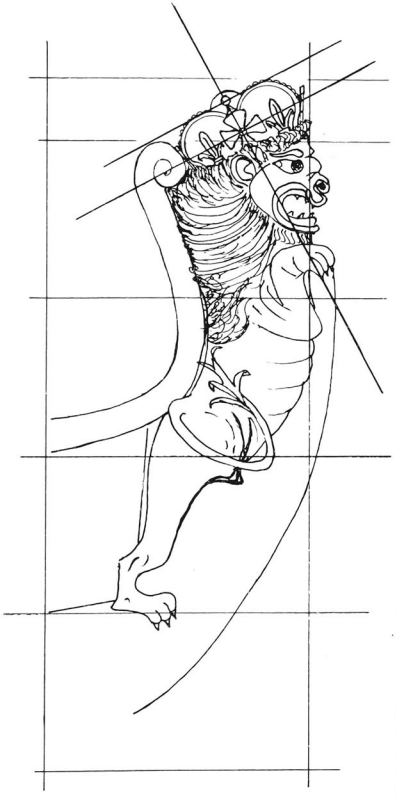


FIGURE 55. The figurehead. A grid layout has been marked out on the side view of the figurehead to allow its proportions to be obtained.

THIS CHAPTER COVERS all the pieces that are made off the model, the first of which is the figurehead. There is a very useful, inexpensive little book giving the history of these items in the Shire Album publication *Ships' Figureheads* by M K Stammers.

The research carried out on *Cruiser* did not reveal a particular figurehead. The most probable candidate, if there was to be one, would have been that of a rampant lion, which most navies of the time featured on their ships, and not least the Royal Navy. In any case, while the model is of a named ship, it is also deemed to be representative of her class, and for that the lion figure was an ideal subject.

The carving of figures is not a difficult task, nor is it simple, but it can be done satisfactorily by most. In essence it is sculpturing in miniature, which is no different from sculpturing in any size. The basics are the same in that the artist is dealing in proportion and form. There are numerous inexpensive publications on anatomical drawing for beginners, available currently, where all the basic principles are graphically outline. A start can also be made in studying the subject to be carved, and for the rampant lion the illustrations are extensive, and a synthesis of all the dominant features can soon be reached. This should be set into a proportional draught based on a figurehead piece, so that the 'Lion' can be contained within these dimensions. The most important points are that the crown has to be clear of the bowsprit, and the back run in line with the hair bracket. A graphed up lion can be seen in Fig 55. The lion can be fashioned from a small block of lime or box with a craft knife and needle files, the block first being outlined in the same way as the sketch. For such a small item, it may be an advantage to leave a 3in 'handle' of extra material at the base until most of the carving has been done.

Woodstock Anchors

Generally speaking, the design and proportions of the naval anchors changed little from the beginning of the seventeenth century to the start of the nineteenth. The proportions and numbers of these anchors were laid down by the Admiralty, and tables can be found in Sutherland's *Shipbuilding Unveiled*, which he compiled in the early part of the eighteenth century.

The Chapman draught shows the bower anchor as being 11ft from the crown to the square of the stock. Fig 56 shows the principal parts of the anchor, and a pair of typical

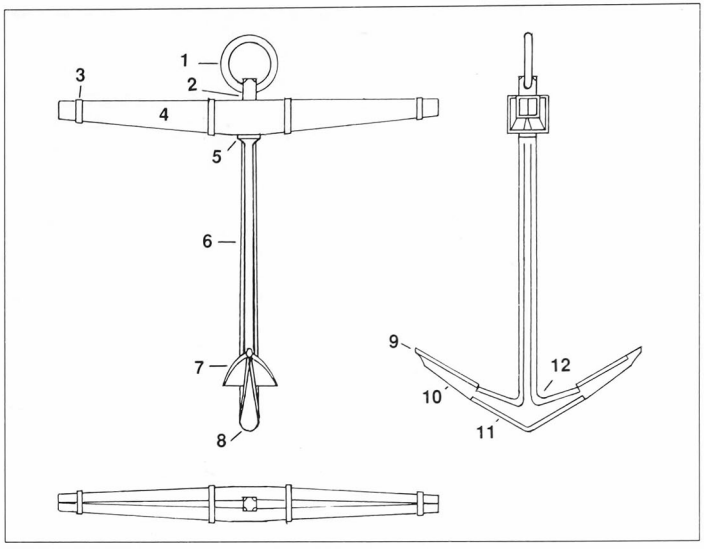
woodstock anchors can be seen in Photograph 46.

At this time *Cruiser* would have carried about five anchors: a sheet anchor, a best bower anchor, and a second bower, all roughly the same size, and a stream anchor and a kedge anchor, this last used when moored in a river or creek.

All the anchors were stowed in a recognised order in that the best bower was set on the fore part of the starboard fore channel, the shank being lashed, via a chain sling, to a convenient timber head. The second bower was stowed in a similar way on the port fore channel. The sheet anchor was lodged just abaft the best bower on the starboard fore channel and chain slung again to a timber head. The kedge and stream anchors would have been stowed below deck, or lashed to the sheet anchor. The sizes of these were: the stream anchor a quarter the size of the bower, and the kedge an eighth the size of the bower. Their design and proportions would remain the same, except that the kedge anchor may have been given an iron bar stock.

The anchor lining was a series of boards fitted on the hull where the anchors were catted, one set to port, the other to starboard. Usually they were set at an angle between the wale and the outer edge of the fore channel. They took the wear and tear of catting the anchor, that is, as it swung from the cathead to be fished up to the channel. The pointed bills of the anchor could cause great damage if banged against the side of the ship in a heavy swell.

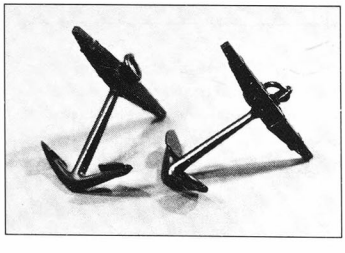
The position of the lining is found by taking an arc from the point of the bill of the catted anchor to the point of the sheer rail, which point would then be centre of the lining. The lining of *Cruiser* by this measurement came just forward of the fore channel, as can be seen from the arrangement



draught (see Fig 37). There were many variations in setting up this protective planking, the thickness of which was generally half that of the wale. Anchor lining can be seen in Fig 57(c).

There is very little metal work about an eighteenth-century ship compared, for instance, to an iron sailing ship of the late nineteenth century. However, the anchors do provide some exercise in this art, and brass is ideal for the purpose. One of two methods can be used. The first is to cut both shank, arms and blades as one blank from a suitable sheet of brass, leaving enough length on the shank for the square and nuts. After shaping, the palms are soldered on as separate pieces. For smaller work, such as those required for *Cruiser*, the second method would have to be used. In this the shank and arms plus blades could be beaten to shape from two pieces of annealed brass rod, the shank then being soldered to the crown of the arms with enough solder retained to form the throat. With the crown held in a vice, the palms can be soldered in place. The stock, in both

46. Two wooden stock bower anchors. The shank, crown, flukes and other parts were made from brass. The stock is of wood, bound with brass straps. (A metal anchor always seems to hang better on a model than one made wholly of wood or other materials.)



◀ FIGURE 56. Anchor with wood stock.
1. Ring
2. Square
3. Iron hoop
4. Stock
5. Nut
6. Shank
7. Palm
8. Crown
9. Bill
10. Blade
11. Arm
12. Throat

cases, is made from two pieces of wood rebated around the square as with the original, the pieces being secured with brass hoops.

The anchors can also be made in plasticard. The range of plasticard, tubing, rod and sections should not be ignored for those who have a liking for the ease of such work, for it is considerably less laborious and far more rapid to construct from plastic than brass.

Plasticard sheets, approximately A4 size, come in a range of useful thicknesses from 0.010in up to 0.080in and in white, black and clear. There is also a range of white butyrate tube, rod and sections from square to channel. It is easy to shape, file and sand, and can, of course, by subjecting to direct heat, be pressed and moulded. The anchors for *Cruiser* could be cut from this material but given limewood stocks and brass rings. Either of the brass construction methods can be used for this.

Brake Pumps

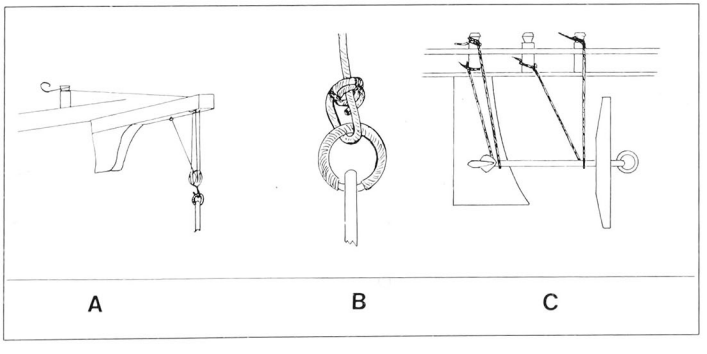
This pump was also known as the elm tree pump, being made out of an elm log, bored through with a 5in hole as a continuous pipe, reaching from the limber hole to the gun deck in the case of a sloop. It was used on larger ships to draw sea water directly from an intake outside the hull in the region of the keel, for the purpose of washing decks and for fire fighting.

As the chain pump required a large body of men for its operation, it was not a practical proposition for small vessels, and the elm tree pump was adopted throughout the navy at the time as an efficient appliance capable of being worked by one or two men. There were normally four such pumps fitted, though on the smallest of vessels such as cutters and sloops of the *Cruiser* class, only two were fitted. If the log was not bored through, it was split and hollowed, the two halves then being close fitted and bound with iron hoops shrunk on to make the joins watertight. Each pump was capable of lifting 25 gallons of water a minute.

The action of the pump was by simple suction, a moveable plunger being operated by an ash lever known as the brake, hence its name. The moveable plunger was set above a fixed one in the tube, both having leather flaps on their tops to allow the water to pass through them, but prevent the water from being pressured back. The lower plunger (box) was not exactly fixed, but tight wedged, to that it could be extracted to renew any worn parts. For this purpose it was fitted with a curved handle with which it could be hooked up and removed from the pipe. This action is shown in Fig 58. The pumps were sited just forward of the main mast so that they extended to the lowest part of the ship.

On the model the pump head is the only visible part of the pump sitting above the main gun deck. The pump head has an octagonal section body, with a slightly radiused iron plate top ½in thick; 2in down from this is a 2in wide iron band 3/4in thick. The body of the pump head stands 2ft high, with an outside base dimension of

FIGURE 57. Anchor gear.
A. Cathead
B. Anchor clinch
C. Anchor slings



14in. The bracket to support the brake lever rises some 20in about this, giving an overall height to the pump head of 3ft 8in. The brass handle is 3ft 7in long.

At 1/72 scale the body of the pump head would be 11/32in x 7/32in. The entire pump head could be fashioned from brass, as octagonal rod at this size can be obtained. Alternatively, the body of the head can be made from lime, with a turned off plastic ring to fit tightly over this, which can then be filed up to its octagonal faces. A plasticard bracket can be welded to this ring and a plasticard lever and copper wire connecting rod set into the bracket and head. The outlet spout can be cut from a piece of plastic rod. Before the final placing of the piece it is best to paint it black matt, with the brake given a wooden colour.

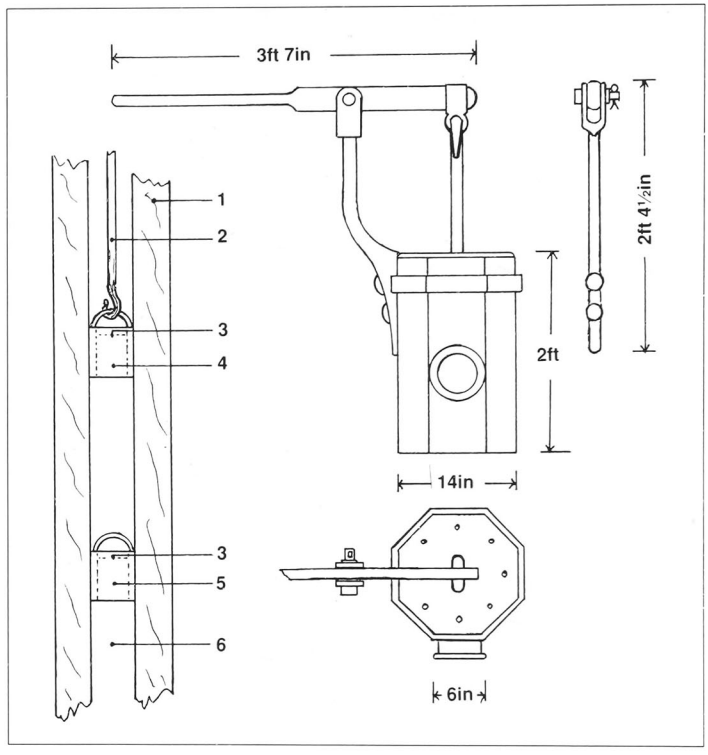


FIGURE 58. Elm tree or brake pump.
1. Elm tree log
2. Spear, or connecting rod
3. Leather flap valve, weighted.
4. Moving box, or piston
5. Fixed, or lower box
6. 5in diameter bore hole
7. Brake, with operating handle.

Swivel Guns and Pedestals

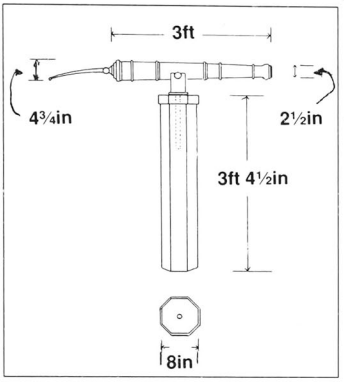
Cruiser was rated for ten swivel guns on the main deck, though there were only eight pedestals shown on the draught. This conforms with the usual practice of the swivels of the gun deck matching the number of carriage guns. However, there are placements on the draught for twenty pedestals, the dimensions of which are shown in Table 8. Presumably, with this arrangement, the ten swivels could be disposed according to the need of the moment, as they were easily carried and quickly mounted.

All the pedestals were octagonal in section with a 2in iron band reinforcement flush with their tops. On some ships the octagonals are equal sided, while on others they are shown flattened, with the broad side running fore and aft. All should be mounted external of the bulwarks to which they are bolted. For the model they could be fashioned from lime and given a brass support ring, being fitted after the final varnishing of the bulwarks, glued and cane dowelled.

TABLE 8: Swivel Gun Pedestal Dimensions

Width	8in, octagonal section	
Height at waist	2ft 3in	Four per side
Height at forecastle	3ft 1½in	Three per side
Height at quarters	3ft 4½in	Three per side

The last quarter pedestal was angled at base to run with the counter.



59. Dimensions of the swivel guns, and of the pedestal for those fitted on the quarter deck.

The swivels can be easily turned from brass rod, the tiller arm forming part of the turning. Where a tool rest is not used, needle files are ideal for this shaping. Both a pedestal for the quarter deck and the swivel dimensions can be seen in Fig 59. The iron yoke to hold the swivel trunnions should be made from 40 thou (0.040in) brass shim, drilled to take a short length of 1mm brass rod which is soldered at the join (to act as a firm pintle). With this arrangement, a modification can be made to make the modelling easier by drilling the gun through in the way of the trunnion placement, as with the shim yoke. With the gun barrel set in the yoke, a short piece of 1mm brass rod is passed through both yoke and barrel, and touched with solder on the outer side of the yoke, after which the rod is cut and filed flush; this acts as a secure pivot. The swivel was an anti-personnel weapon recently readopted by the navy during the century. It was operated by one or two men only, firing either ball or canister shot. The ball would have been of lead with a 1¼in diameter, propelled with a 3oz charge.

In the case of the pivot guns and the main cannon, as with the anchors, ready made items can be obtained from a supplier of good quality ship model fittings. For the most part such purchased items should not be a hit and miss affair, compromising scales and periods, but as in the case of the items mentioned, be both the correct size and period, with turned brass items of a very high quality. A word of caution may be appropriate here. Many societies, where a model is submitted for awards, will not accept any model unless every part has been made by the modeller, and will reject out of hand any model they suspect of having purchased parts built into it.

Gun Carriages

As with most aspects of a ship, the gun carriage design was improved with use and the passage of time. By the first quarter of the eighteenth century it had undergone many modifications since its initial inception on an English man-of-war. Around this time the bed of the carriage was no longer considered necessary, as the underslung axles were given a firmer integral fitting and a transom run between the cheeks. A platform was provided for the elevation quoin.

However, the essence of the carriage remained the same. That the gun could be run in and out of the port quickly for reloading, that it allowed the maximum projection of barrel beyond the carriage so that shot could clear the rigging in the fore part, and the minimum length of carriage on the aft part to lessen the deck space required on the recoil. Weight was also another factor that played a part in its design. A typical English carriage as fitted to *Cruiser* is shown in Fig 60. A further point of interest is that a truck was made of two circles of wood fayed and bolted together with their grains running in opposite directions to give maximum strength. Whether or not to show this refinement will depend on the scale. In model work such considerations are a constant problem.

Cannons

The 3 pounder cannon had varied in length and weight over the previous century, but by the mid eighteenth century it had settled down to a length of 4ft 6in with a weight of 7cwt 5qtrs. This length is based on those indicated by the English gun establishment of the time, namely, that the length of a gun is 18 times the calibre, hence 3in x 18 = 54in. For the model at *Cruiser*'s scale this would mean a length of cannon of ¼in, which could be comfortably turned from a 5/32in brass rod, fashioned with needle files against a

shaped template of brass shim to ensure all pieces were the same. The trunnions can be set into a slot filed on the underside of the barrel, with a short length of 1/32in rod soldered in, the solder filling the gaps. This will save drilling through to fit them, as it can be difficult to drill accurately on a round surface. Should you wish to do this, a flat should be filed on the round just slightly greater than the drill size, and centre punched, when the drill can be carried through without skidding off the surface and breaking.

Gun Tackle

The 3 pounder gun was handled by a crew of four men, which meant that during an engagement more than half the ship's complement would be engaged in working the armaments, and the rest attending to the needs of the ship. So it is understandable why such a small ship required such a large crew of eighty officers and men. The guns were handled by their crews with the help of the gun tackles illustrated in Fig 61. They consisted of three purchase tackles and an arresting rope for the recoil, known as the breeching rope. This rope was the heaviest, with a circumference of 4in. For larger guns it would, of course, have a greater circumference.

The breeching rope was seized to a ring bolt in the bulwark, passed through another ring bolt on the gun carriage, spliced over the cascabel of the breech, forward again through a ring bolt on the opposite side of the carriage, and seized again on the ring bolt in the bulwark on that side. When the gun was run out, this rope would be slack, as shown. As the gun ran back on its trucks due to the recoil, the rope would be stretched taut, halting any further backward movement of the carriage. The breeching ring above the cascabel did not appear until later in the eighteenth century.

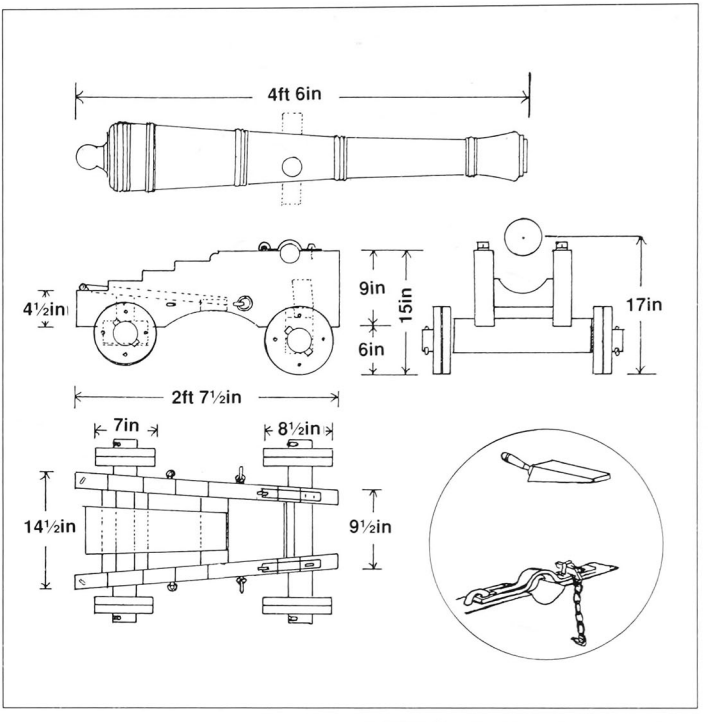


FIGURE 60. Mid eighteenth-century 3pdr gun and carriage, showing dimensions of component parts of the carriage. Inset: the quoin (*top*) and cap-square.

To run the gun out, two purchasing tackles were rigged, one each side of the carriage. A double purchasing block was seized to the bulwark on each side of the carriage, above that for the breech rope ring, and a single block seized to an eye bolt on each side of the carriage adjacent to the rear trucks. The standing part of the purchasing lines were seized to the lower strap of the carriage single blocks, run up to the first sheave of the bulwark double blocks, back through the sheave of the single blocks, and forward again to the second sheave of the bulwark double blocks. The falls then led back to midship. An even haul on both these lines would run the gun out with the front of the carriage up against the port sill. This arrangement was known as the

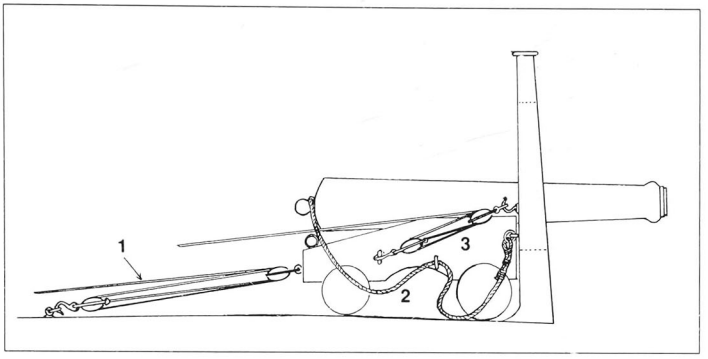


FIGURE 61. Arrangement of gun tackle.
1. Training tackle
2. Breeching rope
3. Side or gun tackle

gun tackle, as opposed to the train tackle which was used to haul the gun carriage out for loading the shot. The gun tackles were set up to an angle of 25 degrees from the centre line of the gun, both on their plan and side elevation.

The third purchase was rigged in exactly the same way as the others except that the double block was seized to a centre point immediately at the rear of the carriage. The single block was placed in line with this and seized to a ring bolt set in the deck at a point just inboard of the greatest extent of the breech rope, the fall of the purchase again leading inboard. This purchase was termed the train tackle. The circumference of the rope used on all three purchases was 2in.

It can be seen that by manipulating all three of the purchase tackles the gun could be trained on target, the elevation being achieved with the quoin, a wedge of wood with a handle projecting from its rear part, which was pushed in or pulled out from under the breech to change the elevation of the gun barrel.

All three tackles were also used for stowing the gun, when the muzzle would be elevated inboard to rest against the internal bulwark above the port. Here a further hook was provided to which the double block of the train tackle was seized, the single block with the standing part of the purchase being seized to a strop passed around the cascabel, known as the breech strop. A muzzle strop was also rigged in conjunction with the double block on the bulwark hook. The gun tackle purchase would retain their position for the double block on the bulwark, but the single standing block would be moved back to be seized to a ring bolt on the carriage by the cascabel. The slack of breech rope would be taken up by being passed around the rear axle of the gun carriage before being frapped to the gun tackle. Wooden wedges were inserted fore and aft under all four trucks. The falls were seized to their standing parts.

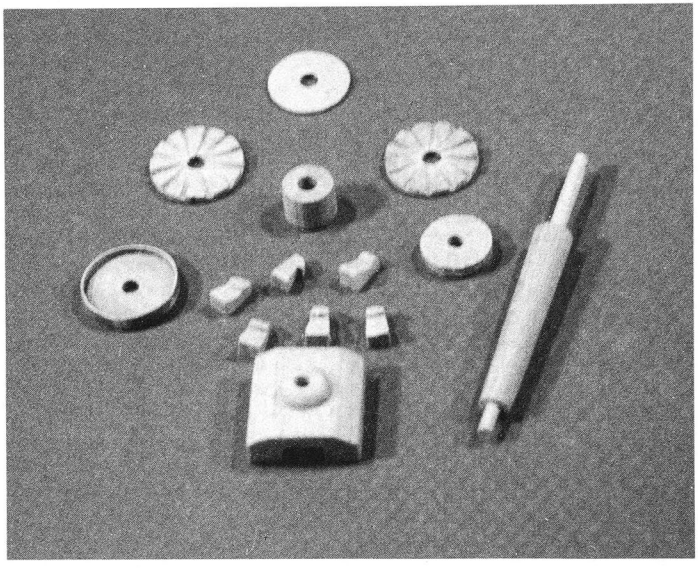
There were naturally variations in setting up all these rigs, the greatest differences being the stowing of the gun, which might be stowed run out or sideways on to the bulwark, but generally the principles remained the same.

Capstan

The capstan used on a mid eighteenth-century sloop had a short, squat shape, being 3ft high and a little over 3ft in diameter. The one placed on *Cruiser* just abaft the main mast had provision for twelve bars. This capstan and the parts which went into its construction can be seen in Fig 62 and Photograph 47.

All the component parts can be made from lime apart from the pawl ring which is made by bending a strip of 1mm ply around a lime disc. A further smaller disc is then set inside this to form the circular channel into which the pawls could fall. This unit is then glued to the base of the capstan spindle.

The drumhead is made in two parts, a lower and upper disc, into which the capstan bar sockets are cut before gluing the two parts together. This is set on the spindle top. A



47. Component parts of the capstan, all made from lime. The spindle was divided at deck level, the capstan assembled, and fitted in place after the deck had been laid.

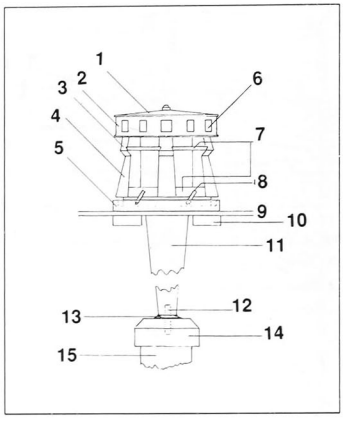


FIGURE 62. Capstan
1. Cover
2. Drumhead
3. Whelp
4. Surge
5. Pawl rim
6. Socket
7. Chocks
8. Pawl
9. Deck
10. Carlin
11. Spindle
12. Iron pin
13. Convex iron plate
14. Step
15. Keelson

chamfered down disc of lime is set above this as the cover. A suitable brass pinhead can be set into this for the central knob.

There are usually half as many whelps as there are sockets to the capstan, so six are set around the spindle, complete with the cut in surge before fitting. The top and bottom chocks are then fitted and the four pawls pinned to the lower chocks to rest down inside the rim. The complete capstan is shown in Photograph 48. The whole unit is treated with a brushed-on coat of Colron liquid wax. This polish has the added advantage of acting as a wood stain, and is sold in three shades for light, medium and dark woods. The medium shade gives to the lime capstan a medium oak finish. When the polish has dried, the piece can be burnished with a hand-held lambswool buff. This polish can also be used to give a pleasing finish to the blocks, and shows these items to good effect with the completed rigging.

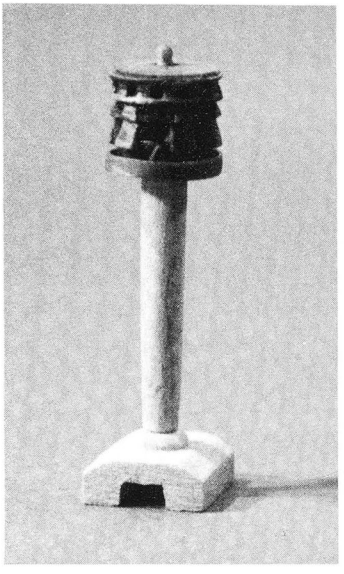
The capstan is strongly indicative of the period, changing its design dramatically from era to era. When fitting this item care should be taken to ensure it is not only the right period for the model but also of the correct type for the ship model being constructed.

Ladders

There were very few ladders on *Cruiser*, as can be seen from the arrangement draught, and those required were made individually by trenching the stringers and gluing the treads into the rebates. But bearing in mind that with another model, a greater number may be required, there is a method of making rapid progress. This is shown in Fig 63, as applied to the construction of wooden ladders.

The ladder is made up of a pair of stringers, either straight or curved, and a number of treads each with a 9in rise. Taking a flat wooden board of the required thickness of the stringer, the widths of the stringers are ruled off with horizontal lines, allowing a spacing saw cut between

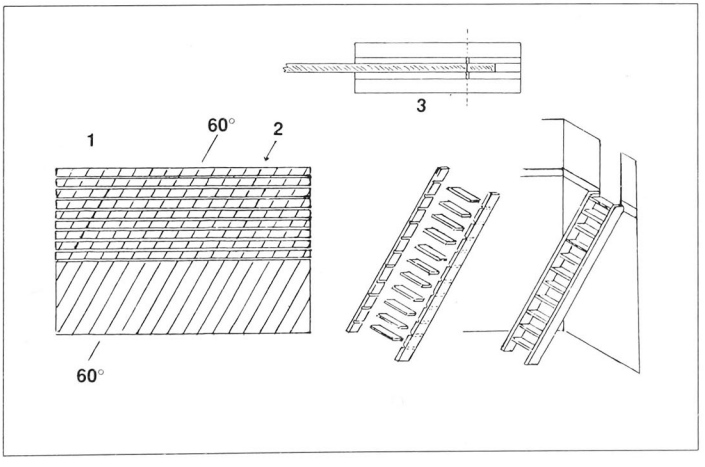
FIGURE 63. Ladders and their method of construction. ▶
1. Batch of stringers laid on top of sheet having lines marked on at an angle of 60°, their spacing equal to the distance (height) between treads.
2. Deep cuts made across the stringers along the 60° lines, the width of the cuts being equal to the thickness of the treads and made to half the depth of the stringers.
3. Jig for cutting treads to uniform length.



48. The assembled capstan.

each one. Lines at 60 degrees, or to the set angle of the ladder, are ruled across the face of these at the intervals of the rise of tread. The spacing of these lines must be absolutely accurate as they form the trenching lines for the tread tenons. The trenching is made with a fine toothed saw, cutting a score into the angled lines. The stringers are then parted with either a knife cut or a saw. Two sets of stringers will be required, one set being cut at an opposing angle to form a pair of corresponding trenching rebates. A pair of stringers, taking one from each set, should form a corresponding V cut when placed side by side.

The treads are formed from a strip of wood cut to the depth and thickness of the tread. A simple jig is made to cut the treads accurately to their width, by forming a channel from three strips of wood into which the tread material can be slid as a firm fit. A stop is placed at one end of the channel, and a right angled cut made across the channel sides at a distance from the stop to the width of the tread, inclusive of the tenons to fit into the rebates of the stringers. This is best done by setting the top and bottom treads in first, and allowing the glue to dry, after which the remaining treads can be slotted home. With curved or shaped stringers, a wider saw cut margin is required between them to accommodate the extra material for the shape of the curve. Batches of right 60 degree angles and left 60 degree angles will be required, of course, in the same way as those for the straight ladders.



A further consideration are the ladder rails, which in most instances for the period would be of made of wood. The purpose of these was more than decorative, concern for safety of life and limb always being in the minds of those who put to sea. Man-ropes were rigged wherever possible for the safety of the crew, and while rarely seen on models, would be rigged on the ship in the face of threatening or expected foul weather. Those rigged for a quarter deck ladder are shown in Fig 64, the man-ropes being run down from iron stanchions to eye bolts in the main deck.

Access to the ship was at this time always a perilous business if boarding from a small boat. The steps fitted to the side of the hull seem to be an innovation of the late seventeenth century, rope ladders being used before this time. The ledge type steps were narrow and had no finger-holds. For this reason man-ropes were usually rigged, one each side of the steps, to assist those climbing aboard. Again, these are rarely shown on models, as they would probably be unshipped when not in use. However, the ring bolts or short stanchions used to set them up would remain, and should be shown. An example of this arrangement can be seen in Fig 65.

Bulkheads

Generally speaking, the bulkheads below the waterline were of a heavier construction than those above it. This was because those deep in the ship

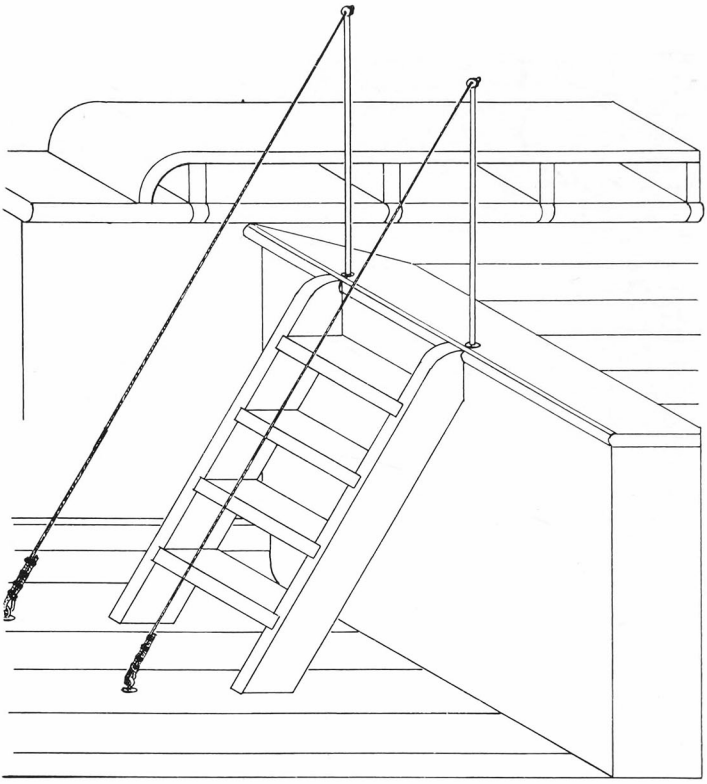
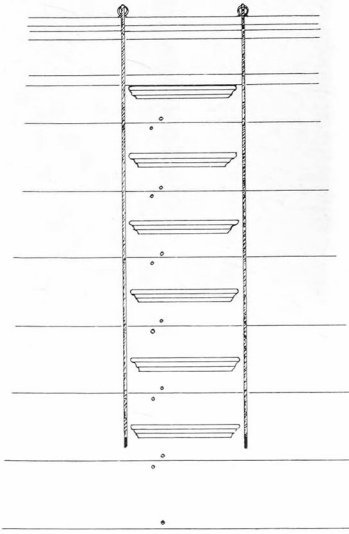


FIGURE 64. Man ropes at the quarter deck ladder. The stanchions at the head of the ladder were iron. The rope was secured to an eye at the top of the stanchion, with the lower end secured to a ringbolt in the deck.

FIGURE 65. Man ropes at the ship's side.



were to partition off storerooms, where security was a main consideration, while those in the upper part of the ship were used to divide quarters and cabin space. While the storeroom bulkheads were boarded with pine or fir nailed over a heavy frame and rabeted to form a tight fit, with the seams battened over, those for the cabin accommodation could have been canvas in some cases, stretched over a light wood frame, and easily removable. None of this framing was supportive of the ship's structure, all the bulkhead work being supported, in fact, by the structural timbers of the ship, the stanchions for the bulkheads being fitted into the deck beams.

A typical construction of a bulkhead as fitted across the galley to the main hold is shown in Fig 66. A simpler form of construction to this is to use a piece of 1mm ply being shaped to the internal face of the frames and reaching across the beam of the gun deck and down to the keelson. If this method is adopted it should be glued into place and the galley side faced with planking. A dummy door can be fitted leading to the hold. This arrangement can be seen in Photograph 49. The door should be made of the same stuff as used for the planking, but set in a vertical rather than horizontal position. Alternatively, the ply could be battened only and the door scored on the ply face. These decisions depend on the degree of detail desired.

Panelled Bulkheads and Doors

Many of the upper deck bulkheads were fitted panels which could either

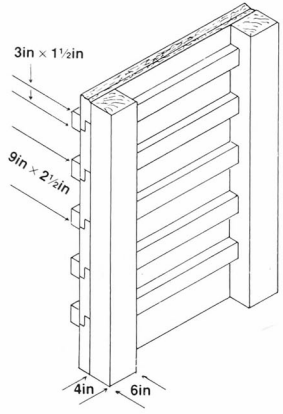
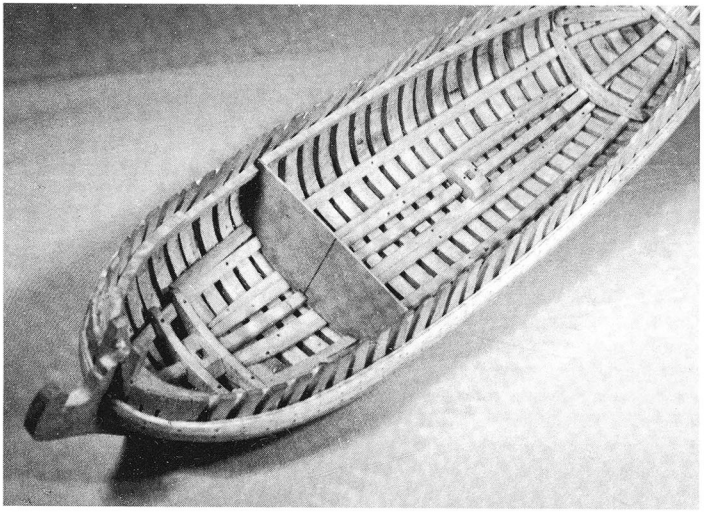


FIGURE 66. A section of main bulkhead showing the half check lap joint of the planks and the position of the horizontal stiffeners.



49. Arrangement of the artificial bulkhead of 1mm plywood. This should be cladded and a false door positioned before the deck beams are fitted. In full size practice bulkheads relied on the hull structure for their support, but with plywood bulkheads the effect is reversed, for they strengthen the structure.

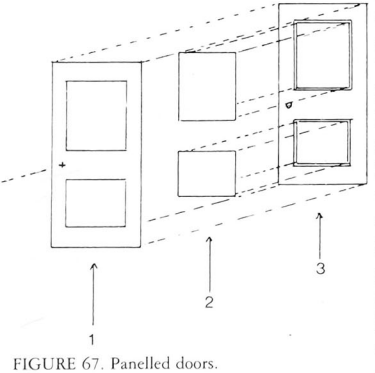


FIGURE 67. Panelled doors.
1. Outer frame
2. Inner panels
3. Completed door
This method of construction can also be used for panelled bulkheads.

be removed or hinged up. These panels, as with the doors, can be constructed in Bristol card or thin plasticard laid over a 1mm ply base as shown in Fig 67.

The panelled frames should be carefully drawn on the card, and the top and bottom panels removed from the sheet with a craft knife, before the outer panel frame is cut out. The frames so formed can then be laid over complete blank frames in laminations, to form the recessed panels. Where the top panel of a door or bulkhead is glazed, or fitted with inset lattice work, the panel can be made from clear plasticard, the lattice or lead lights being put on the plastiglass with a ruling pen loaded preferably with a thin cellulose paint. If the ply base behind these glazed or latticed panels is left solid the area can first be painted matt black and left to dry before fitting the frames. Door handles, which can be conspicuous by their absence, can be represented by suitable size pin heads. The colouring of the panel should be done before the completed panel is stuck on to the ply base.

Quarter Deck Bulkhead

The quarter deck bulkhead is shown in Chapter Five (see Fig 42). There are various ways to make this structure, one being to interset the pillars with the window frames and panels. Another is to make the whole bulkhead from plastiglass and face it with the pillars and panels. The windows formed from plastiglass for the bulkhead should be lined first with a ruling pen before fitting. The paint used should be a thin cellulose, the sizes of the windows first being scored on to the plastiglass. The pieces should be tacked to a drawing board with a strip of reversed Scotch tape so the work can be done accurately.

The windows for the quarter badges (see Fig 68), and the stern windows (see Fig 69) can also be treated in this way. Where windows are free fitted, and not placed between laminations, they should be given a ⅓ 2in edge frame, both inside and outside the glazing, to ensure a firm fix.

An alternative way to make the window frame is to use card. Old greeting cards are worth saving for this purpose, as they can supply a variety of thicknesses. Only those of good quality should be used, the remainder being ideal for templates and marking off sunken measurements, such as may be required when measuring into the hold. For the windows the frame should be accurately drawn up on a board, and with a very keen craft knife glazed areas removed, leaving just the bare frame. Care should be taken not to nip any part of the frame with the knife, as this will always show and mar the effect. Once the card frame is free of the board, it can be either wood stained on both sides or treated with Colron liquid wax stain polish to give a wood effect. When completely dry, the frame can be fixed to the clear plasticard with Pritt or a similar adhesive that will not squeeze out from under the frame to mark the glass.

Chimneys

The galley chimney of *Cruiser* would have been the usual truncated pyramid type found on most vessels at this time, being made of wood and metal lined, standing about 3ft high with an 18in square base. A selection of these is shown in Chapter Five (see Fig 39). That for *Cruiser* is the first of those shown, being fitted with a cowl arrangement so that the whole structure could be lifted and the vent turned to the lee of the ship. It can be made either from a small block of lime, the vent opening being drilled out and filed square, or formed from 1/32in wood strips in the same way as a box, the curved cowl being made from a strip cold bent round a mandrel.

Decorative Work

The Admiralty took the first effective steps towards limiting the excessive amount of decoration on its ships by an order of 1700, the maximum cost of decoration on a sloop not to exceed £25. A more drastic order of 1703 dictated that the figurehead be restricted to that of a lion and stern decoration to a trail board, and eventually that for a sloop the decoration of the stern should be confined strictly to the tafferal and quarter badge. These restrictions were resented and opposed by the rank and file of the navy, and by the middle of the century the Admiralty had relented to some extent with regard to the first and second rates, and eventually even frigates, but the orders were still enforced for sloops and small craft.

There is no direct reference in the source material to the decorative work of *Cruiser*, but based on the regulations noted above, and the design of the stern and quarter badges on the Admiralty draught, a safe assumption can be made for the decoration as shown in Figs 68 and 69, which is baroque in style and in keeping with the period. The monogram (Fig 70) of the reigning monarch, in this case George II, was often placed as shown, and may well have been repeated above the quarter badge. The symbolism of the simple decorative work shown around the tafferal is in keeping with the time, being bowers of oak depicting strength and endurance, interspersed with bowers of laurel, standing for nobility and kingship. All this work in former times would have been gilded, but due to the restrictions on cost, by 1750 an ochre paint or plain varnish had to suffice. It would have been set on a cobalt background. The space beneath the bowers arching over the three windows would have been infilled with dark red. The ribbons on the supports between the windows would again have been gilded.

All this work can be done on the model by using highly malleable metals such as 1.5mm core solder and copper wire down to 0.025mm, both of which can be easily shaped up with round nosed and flat pliers. Solder cores are especially ideal for the leaf work as they can be compressed flat, curled and filed to shape giving a good carved effect. The pieces are best fixed in position with Uhu glue. When the pieces have set, the whole tafferal can be given a cobalt blue wash and the detail of the decoration picked out in a rather dull gilt,

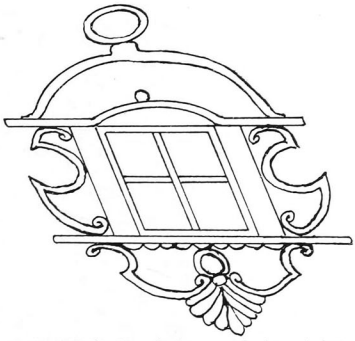


FIGURE 68. Detail of quarter badge windows and their surround.

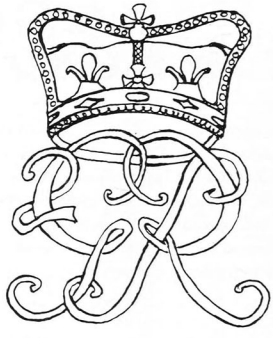


FIGURE 70. Monogram of George II. This was fitted at the centre of the taffrail.

FIGURE 69. The stern windows and stern decoration.

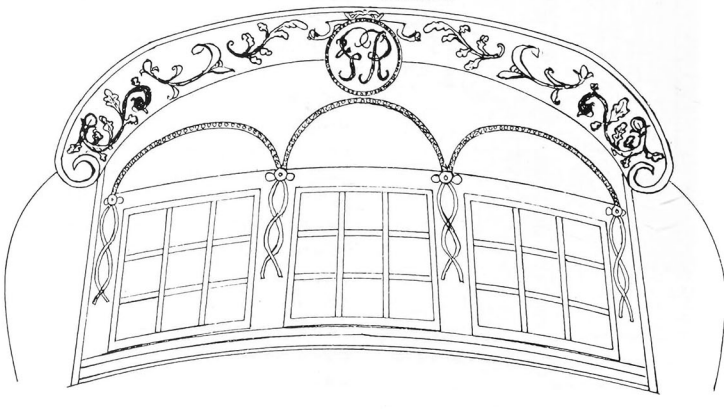
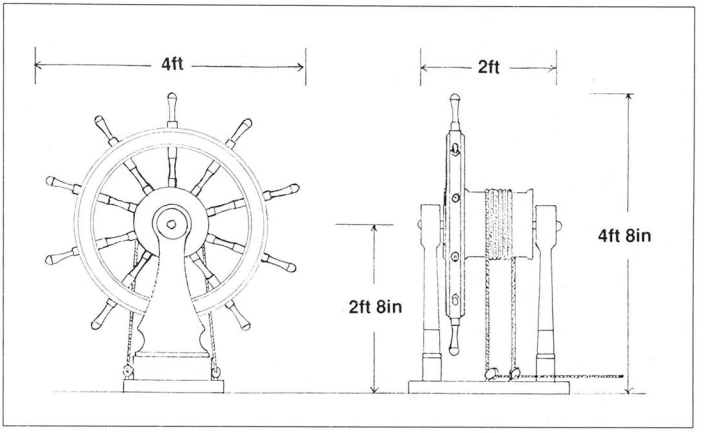
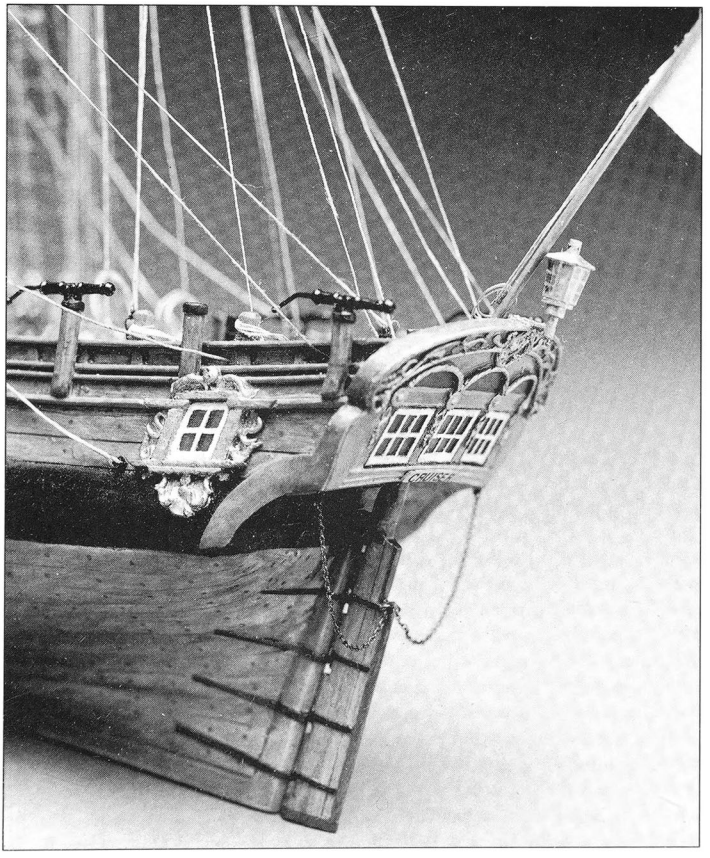


FIGURE 71. Helm dimensions.



50. Stern and quarter decoration, and rudder details. The fitting of a name plaque was not a common practice in this period.

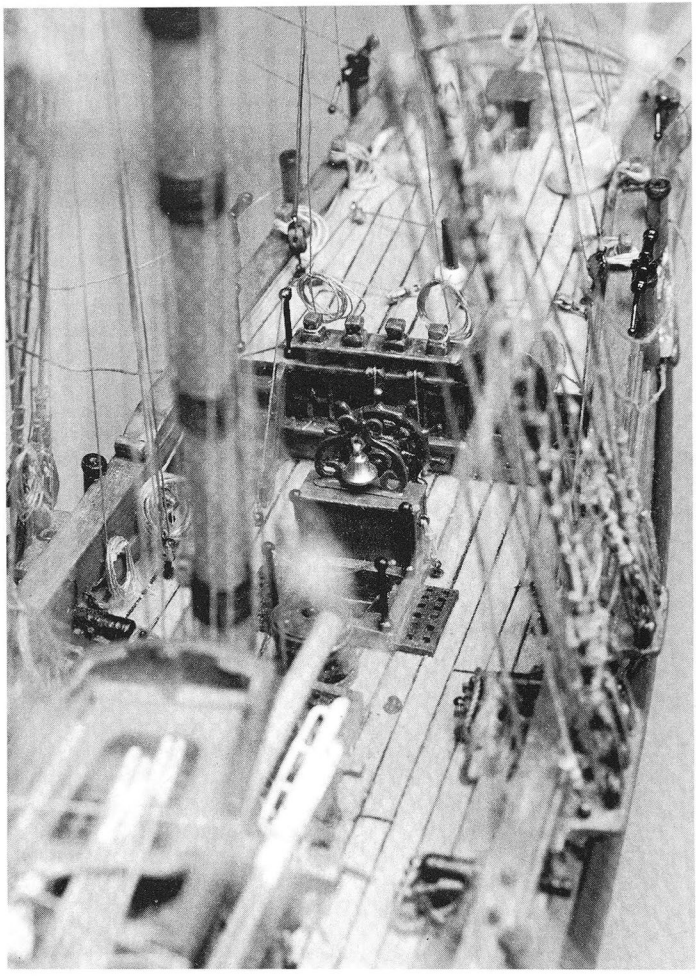


knocked down from Humbrol gold. The complete stern and quarter decorations can be seen in Photograph 50.

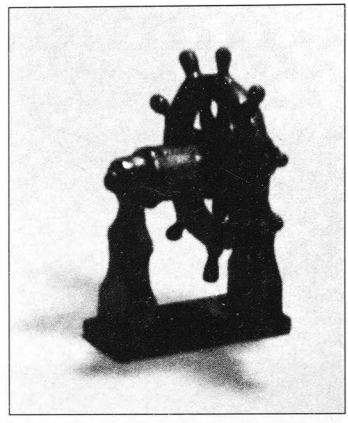
Wheel

The helm is made with ten spokes (Fig 71), as was usual at this time, and measures 4ft in diameter, over the handles.

Two brass rings are turned off from ½in tube and ten notches files on one side of each. The spokes are turned from 1mm brass rod, and the spindle or axle formed from a short length of 1.5mm brass rod. This rod is set vertically into a wood block for soldering. The hub of the wheel is formed by sliding an 8BA and one 10BA washer over this, onto which the heel of the brass spokes rest, while their tops rest on the notches of one brass ring. The second ring is then placed over the spokes and a second 8BA and 10BA washer is slid on top of the spoke heels. The spokes and rings are held in place with bent steel pins. It is essential that no movement takes place when soldering these parts as an intense heat is generated throughout all the metals of the structure. When the wheel has been cleaned and painted it is assembled with the whole stand, the



52. This view of the completed model shows the wheel and binnacle just forward of the quarter deck break.



51. The completed helm.

spindle running through from front to back. The finished item can be seen in Photograph 51. The lime wood parts of the stand are finished with Colron liquid wax polish. The helm is set on the main gun deck aft of the main mast and just forward of the quarter deck break (Photograph 52).

Rudder

The design of a sloop rudder at the time is shown in Fig 72. It comprises a main oak piece which was fronted with an elm board into which the rebates were cut to take the pintles; see Fig 73 for pintle and gudgeon arrangement. The trailing part of the rudder is furnished with a double hance made from fir, while the sole plate at the foot of the rudder was of elm. The head is usually bonded with several iron bands, two running around the head and two banded over it. A socket is cut in the head to

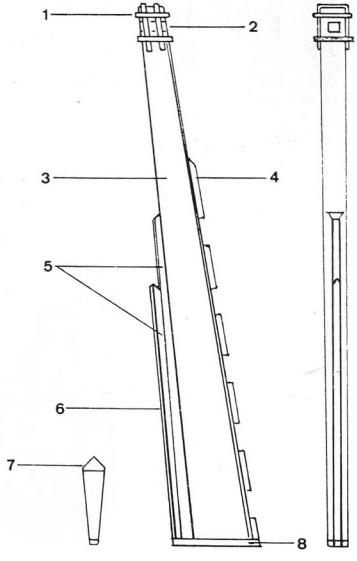
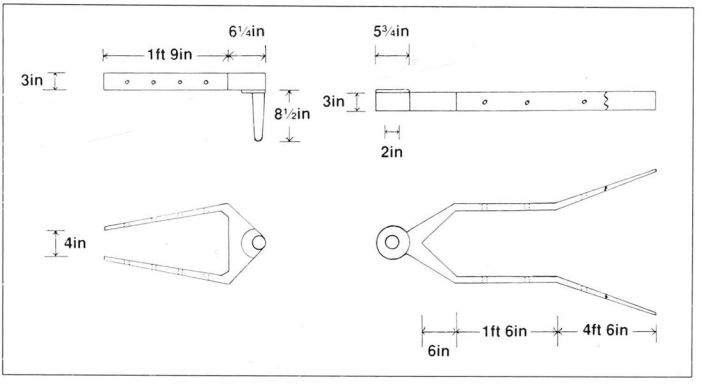
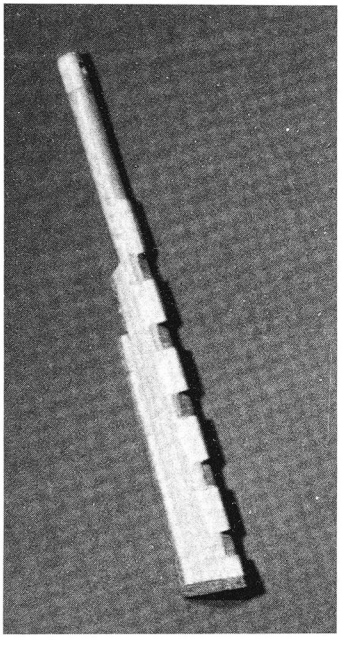


FIGURE 73. Rudder gudgeon and pintle. The dimensions shown are for the bottom gudgeon and pintle.





53. The rudder. Normally constructed of elm and oak; these have been represented here by mahogany and lime strips and footing. Five pintles were usual, though there may have been fewer.

◀ FIGURE 72. Rudder construction. This arrangement is typical of that on an eighteenth-century sloop.
1. Iron bands to head of stock
2. Mortice for tiller
3. Oak main piece
4. Elm front piece
5. Fir boards of hance
6. Elm back piece
7. 45° bearding to elm front piece
8. Elm sole plate

receive the tiller tenon. *Cruiser*'s rudder can be seen in Photograph 53, and the finished assembly in Photograph 50.

Tiller

Most small vessels of the eighteenth century were slow to take advantage of a wheel, being content with a tiller. There is no evidence to support the fact that *Cruiser* was equipped with a wheel, but considering the high exposed position of the quarter deck, it is most probable that one was fitted. This is reinforced by the growing practice by the mid eighteenth century of using this form of steering for sloops, if not for the smaller cutters and schooners. The arrangement of placing a wheel in the protected space on the main gun deck aft of the main mast and just forward of the quarter deck bulkhead and connected by messenger ropes to the tiller would afford the helmsman protection not only from enemy shot but also the worst of the elements. This arrangement can be seen rigged on many models of the smaller class of vessel of the period, one such being *Endeavour* in the Plymouth Naval Base Museum. With *Endeavour* the argument still rages as to whether or not Captain Cook had the tiller gear boarded over before he set sail for his Pacific voyage.

The tiller on *Cruiser* would have been about 8ft long and, if a wheel had been carried, rigged as in Fig 74. The roller fairleads are also shown in the bulkhead draught in Chapter Five (see Fig 42).

The messenger ropes were seized to the neck of the tiller close to its junction with the casing, and set up with lanyards before being led forward to spectacle eye bolts on the tiller end. From there they passed to single sheave blocks at the sides of the quarter deck, set abaft and at the extreme ends of the arc of the tiller. From there they led forward to another pair of single sheave blocks set at the sides of the quarter deck just forward of the tiller end, and from there to a pair of blocks set midships in line with the drum of the helm on the main gun deck. The messenger ropes were led to the drum over the roller fairleads, down to two single blocks on the deck at the quarter deck break, and thence to the single blocks beneath the helm drum, around which they were given several turns before their ends were nailed to the drum. The whole arrangement on the completed model can be seen in Photograph 54.

Binnacle

A typical binnacle case is shown in Fig 75. This comprised a cabinet fitted with three compartments, the centre one of which housed a lamp to light

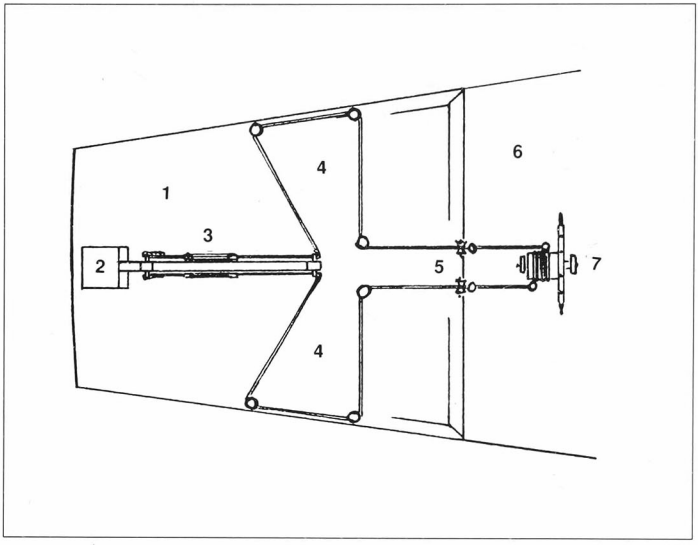


FIGURE 74. Steering gear arrangement. Lead of messenger (ropes) between helm and tiller.
1. Quarter deck
2. Tiller
3. Messenger line tension lanyard
4. Single sheave blocks
5. Roller fairleads
6. Main deck
7. Helm

54. The quarter deck, showing the run of the lines from the helm to the tiller. The curved canopy over the entrance door in the quarter deck bulkhead can be seen on the left. Note the master cabin chimney passing through the king plank, which is wider than the other planks.

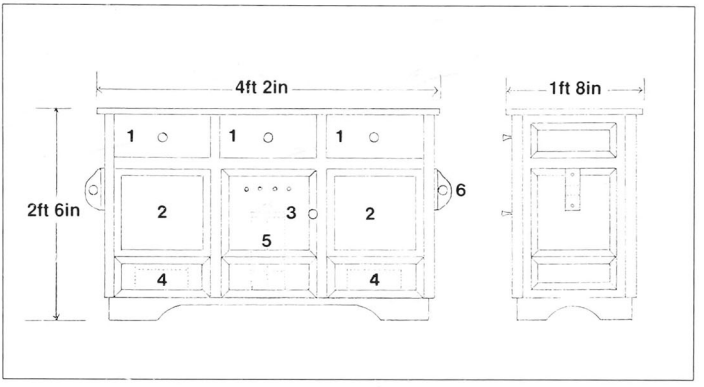


FIGURE 75. Mid eighteenth-century naval binnacle.
1. Drawers for navigational aids
2. Glazed panels to compass chamber
3. Solid door to lamp chamber
4. Compass (shown by dotted outline)
5. Lamp (shown by dotted outline)
6. Lugs for lashing binnacle to deck

FIGURE 76. An example of a basic eighteenth-century compass card. While the centre circle and points of the card are shown plain here, they were usually coloured in with allegorical or religious figures and motifs.

the two compartments set either side of it, which in turn housed a pair of compasses exposed through glazed doors. The lamp chamber was ventilated with holes in the solid door and at the rear of the cabinet. Some variations of this show a cabinet with a top flu or chimney. All iron fitments were excluded from the construction of the cabinet, so that the shackles for securing it to the deck would have been bronze or brass. The one shown has wooden lugs for this purpose. This arrangement of lamp and compasses is peculiar to the navy. Merchant vessels of the period had a similar cabinet, but with a single compass housed in the centre chamber with a lamp each side of it, housed in the outer chambers. A typical compass card of the time is shown in Fig 76. The cabinet for *Cruiser* should be set before the helm on the main deck. A second cabinet compass was stored below as a replacement should the operating one be lost, while the captain would have a personal portable compass in his quarters.

Oar Port Lids

The oar port lids are flush fitted to the outside of the bulwark, and hinged forward of the sweep with a continuous hinge radiused at its aft end in the form of a horseshoe. The hinge is made of iron and bolted to the lid by five through bolts, the one on the radius of the shoes serving to hold the ring bolt on the inner side of the door. The lids were made from a single piece of timber to the same thickness of the bulwark planking. The collars of the hinges rested on a pair of pintles which were formed with a lateral bolt passing through the bulwark, and having their ends riveted over a washer (Fig 77).

On *Cruiser* the oar ports were cut through the thickness of the spirketting, the depth not allowing the inside of the lid to be seen. In this case false doors can be scored onto the external bulwark planking, and dummy hinges, 3/16in wide, fitted. These are made from 0.50mm brass wire, on which flats have been filed on both sides, and these are attached to the lids with Uhu glue. The pintles and hinge pin lugs are also formed from wire as one piece, the right angled pin being fitted flat on the top surface, and pushed home through a hole drilled into the bulwark. The whole hinge is painted black. A typical sweep as carried by *Cruiser* can be seen in Fig 78.

Gun Port Lids

Although *Cruiser* was not fitted with gun port lids, it would be remiss not

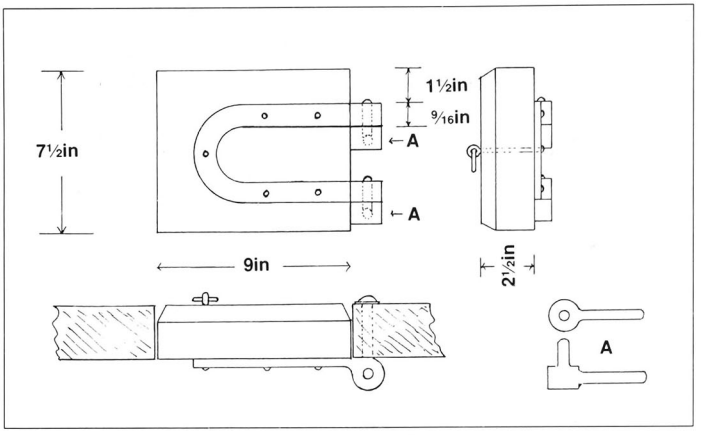


FIGURE 77. Oar/sweep ports. Showing details of construction of port lids and hinges.

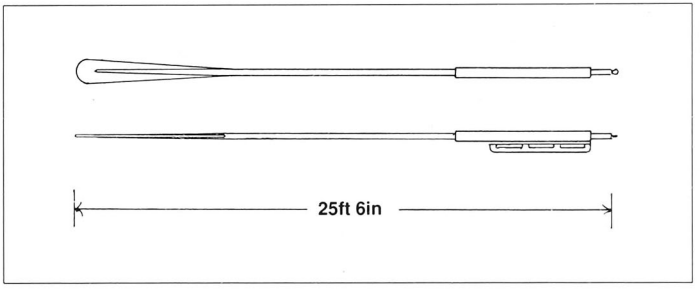


FIGURE 78. Oars or sweeps. This is a typical form of oar or sweep that could have been in use on *Cruiser*.

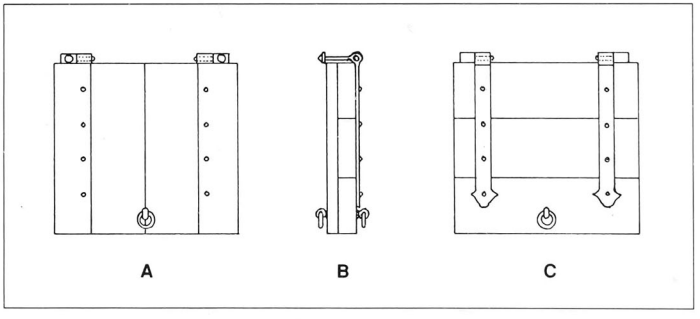


FIGURE 79. Gun port lid.
A. Inboard view of lid showing the four 1/½in thick boards set vertically, and securing ringbolt.
B. Side elevation showing pintle clench bolt (*top*).
C. Outboard view of lid with three horizontal planking boards and lifting ringbolt.

to mention them. A conventional eighteenth-century lid, as shown in Fig 75, the type usually fitted to Royal Navy ships at this time, consists of seven boards, four vertical boards on the inside and three horizontal boards on the outside. These were set at 90 degrees to each other to form a solid structure when bolted through. The four internal boards were about 1½in thick, the two inner boards being wider than the outer ones.

The three external planks were usually of the same scantling to the external strakes, and would be so constructed to run in line with them. This

practice of external alignment was carried out when a gun port lid pierced a wale, so that the lower plank of the lid could be of the wale thickness, and so give a contour to the lid on the external face.

The lid shown would be that for a small port, having only a single ring for housing the lid, and a single internal ring for lashing it shut. Larger lids would have a pair of such rings, usually placed at the ends of the hinges. For hoisting the lid, lines would be seized to the outside rings and led inboard through apertures above the port, or on some small ships, simply passed up and belayed to a rail. The design of the hinges varies enormously, and each navy would have its own distinctive pattern. All hinges worked on the gudgeon and pintle arrangement, the bolt of the pintle being set over with a rove once it had been passed through the planking, and the rove hammered over.

Earlier gun port lids had the inner vertical boards set in from the edge of the outer boards to from a recess which fitted into a rebate in the gun port rim. Later some gun port lids were fitted with a vent hole to admit some light and air to the gun deck in foul weather. At times gun port covers took the form of a pair of doors, if the ports were in the way of the rigging, the outward opening doors acting against the scorching flash of the shot, and so protecting the rigging.

Gratings

Gratings are made up with three main scantlings of the frame, ledges and battens. The ledges are the same depth as the frame. The battens are half the depth of the frame. A section of a grating can be seen in Fig 80 showing how the ends of both ledges and battens are tenoned into the frame, and the battens recessed into the ledges.

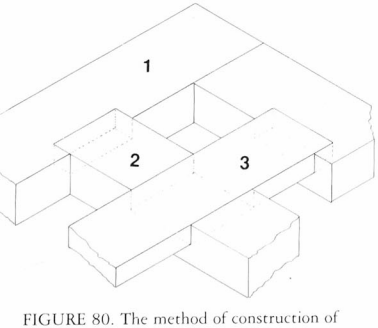


FIGURE 80. The method of construction of gratings.
1. Framing
2. Ledge
3. Batten

For model work it is best to cut all the ledges for a particular grating, and clamping them together, file in all the rebates for the battens. The frame can be made up with or without the rebates. With the frame made up as a good fit to its hatch, the ledges can be glued in, and when set the battens glued into the rebates of the ledges.

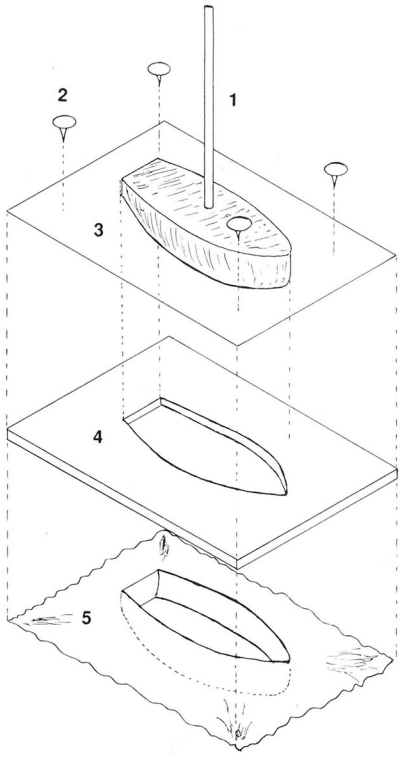
Suitable machine milled sections of grating material can be obtained from model suppliers, which can be built up into large areas of grating. The sizes range form 1mm squares up to 7mm squares, but there is no distinction of ledges, frames or battens, as one section crosses to intersect with another, leaving the grating with an overall thickness top and bottom. This is of little consequence if the grating is glued into a hatch, but if employed on an exposed position, such as the head timbers, it could look too heavy and wrong.

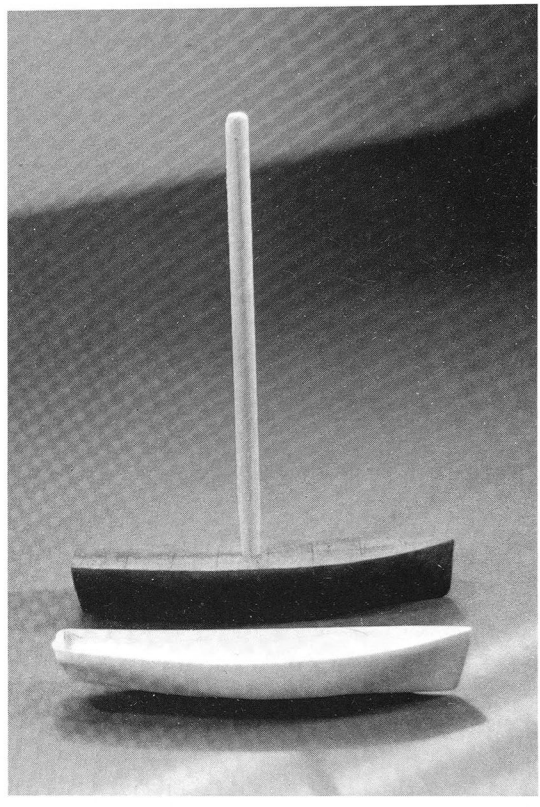
Ships' Boats

A well tried process for making ships' boats is the pressed mould method. This is illustrated in Fig 81. A solid wood plug is carved from a close grained wood such as mahogany to the internal dimensions of the boat, into which a dowel handle is fitted. This forms the male former of the moulding.

The female part of the former is made from a suitable piece of 1/8in ply, which should not be less than 2in wide all round the plan size of the boat, when this is cut from the centre of the ply.

For the 24ft cutter, which at 1/72 scale measures 4in overall, a sheet of 20 thou plasticard should be pinned by the four corners to the ply former, this plasticard card being the approximate size of the ply board. This should be gently heated before a radiant heat fire until the plasticard becomes floppy. Care must be taken so





55. Construction of a ship's boat. At the top is the wooden former for the boat, with its handling stick, and below a plasticard shell formed by pressing the mould into a sheet of warmed plasticard.

that the plasticard does not blister or buckle. While heating the card the male boat should be left to warm, so that it will not make a cold contact. When the plasticard is sufficiently pliable, that is, when held flat it begins to sag through the hull form of the ply, the male former is pressed firmly and squarely into the female former to its full depth. The male mould should be left in this position until the plasticard has again grown hard and cold, when all excess plasticard can be cut away and the male former removed from the moulded boat shell. This stage of the operation can be seen in Photograph 55.

The shell can now be cut in half down the line of the stem and keel, and the transom part removed. The two halves are then welded with liquid polystyrene to a precut plasticard combined stem and keel piece, and a fresh transom piece. These should be left to dry and harden overnight, after which the whole can be trimmed to a true shape.

The majority of the navy boats were carvel built, including the longboat (Fig 82). But one exception to this was the cutter (Fig 83) which for some reason was always clinker built. With the longboat, fitting the thwarts, knees, decking and ribs can proceed with the shell as it is, but the cutter will have to be planked both externally and internally. This is done in the same way as the planking on

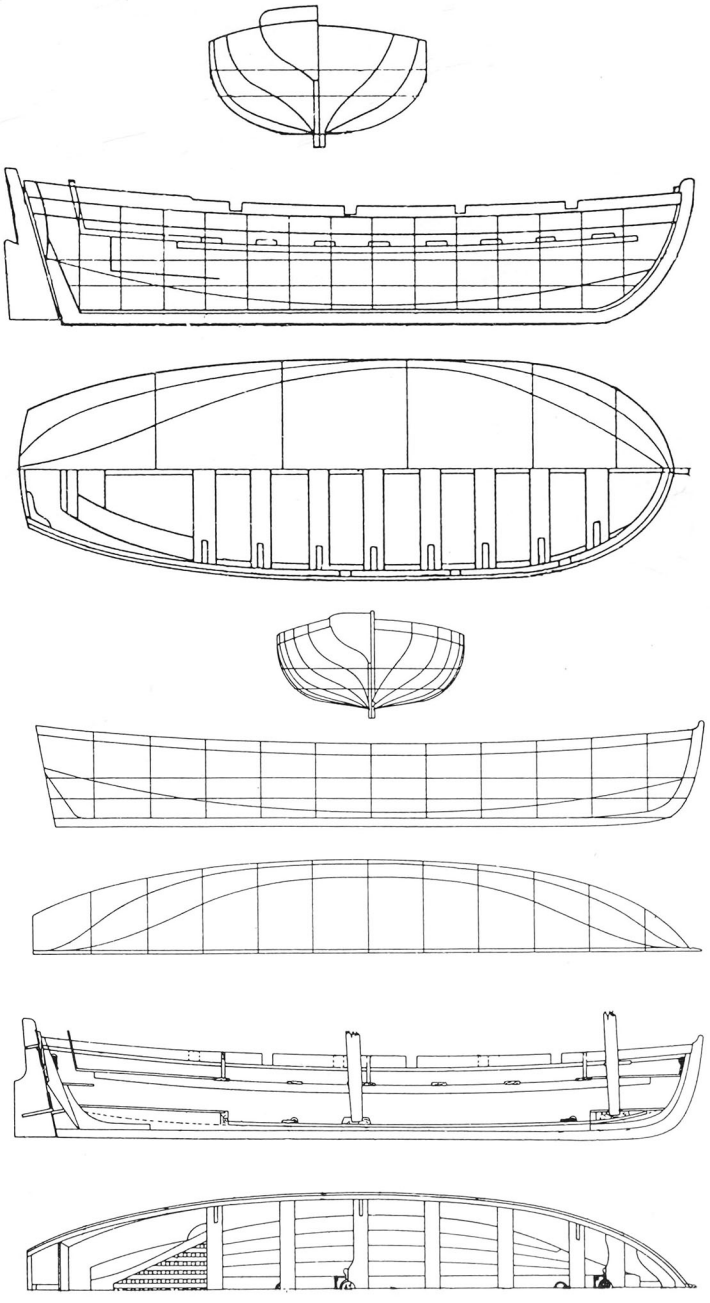
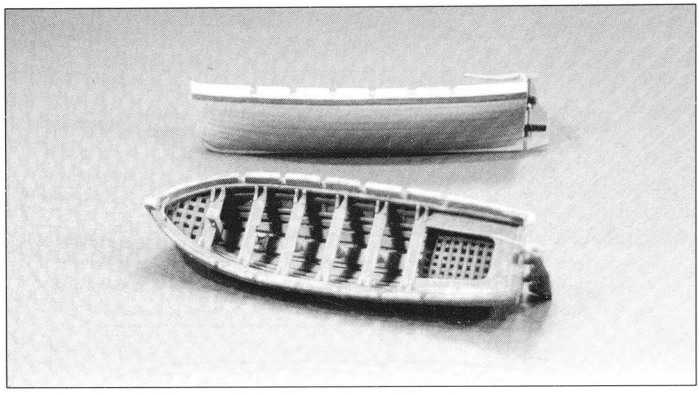


FIGURE 81. Boat construction. The boat shell is formed by pressing a mould of the shape of the boat into a sheet of warmed plasticard placed over a mould with an opening in it just fractionally larger than the outline shape of the boat.

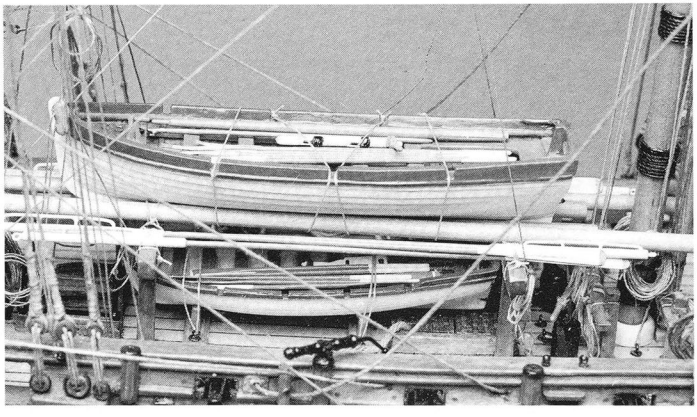
1. Carved wooden plug, with handle.
2. Drawing pins for securing plasticard to female mould.
4. Female mould, made of plywood.
5. Moulded or pressed boat hull, before removal of surplus plasticard.

FIGURE 82. 16ft longboat. This boat was stowed on chocks beneath the gallows.

FIGURE 83. 24ft cutter. The cutter was stowed on the gallows, along with the spare spars. The six-oared boat shown here would have been used by *Cruiser* when on Channel duties, in accordance with Admiralty Directives of the 1750s.



56. Two finished plasticard boats. The one at the top has been painted, while the other has been varnished.



57. Boat stowage. The 24ft cutter is stowed on the spare spars on top of the gallows, with two sweeps in the foreground. Note that its securing lashing passes through alternating rowlocks to avoid slip. Below is the 16ft longboat. The sweeps were made in the same way as the oars.

the ship model, except that a good quality typing paper is used in place of wooden strips.

Starting again at the keel on the outer surface of the shell with a garboard strake, the strips of paper are overlaid with even spacing up to the gunwale, where an extra strip is laid for the gunwale plank. This spacing can be determined with proportional dividers, or as described for planking the ship. When placing the clinker planking on the inside of the shell, it should start at the gunwale and work down to the keel, as here the upper edge of the clinker boarding will be exposed. The same number of strakes should be used on the inside as were put on the outside. White PVC wood glue is suitable for this as it allows some movement of the paper strip to adjust its position. When all this work has been completed and the paper dried out, the hull is given a generous coating of knotting inside and out. All the internal fittings can be installed in the usual way. Two 1/72 scale clinker built boats made in this way can be seen in Photograph 56. The oars can be made from 1mm brass rod, the ends of the rod being heated and softened, and squashed flat in a vice to form the blades, which are filed to shape with needle files. Photograph 57 is a detail of the finished model amidships, showing boat stowage.

7

Masts and Spars

THE MASTING OF A ship can usually be completed for all the dimensions from a rigging plan, coupled with a sheet, drawn to a larger scale, showing the detail of tops, hounds, and other arrangements for the masts, together with their full dimensions at the partners, and up by quarters to the cap. The caps can be shown as separate items, for these varied considerably from period to period, and during those periods, from country to country. A good masting draught will also show all the relevant yards, gaffs, bowsprit and jibbooms, together with all their arrangements.

However, there are many masting and rigging tables available, and those for the eighteenth century can be found in the libraries of the Science Museum and the National Maritime Museum. Among these are David Steel's *Elements of Mastmaking 1794* and James Love's *An Exact Table of Proportions for the Thickness of Mast According to their Length 1735*. There are also some fundamental rules for the time, one of which could be applied to *Cruiser* as a small ship. This is the ship's greatest beam multiplied by a figure of 2.28 for the height of the lower main mast from partners to the head tenon. The full beam of *Cruiser* being 20ft 7in x 2.28 would give a lower main mast height of 46ft 9in, which agrees with the Chapman rigging draught, excluding the cap. All other proportions of masts should be taken from this figure and accordingly all spars. There are also many other basic rules which may be applicable for the period. Where such figures apply, they will be used in the following details of the masts and yards under construction.

The timber used for mast making in the yards at the time was pine. Before the American War of Independence, this came mostly from New England. Masts were not built from a single tree but made up for greater strength in sections which were recessed and coaked together (Fig 84). These sections, apart from being fitted with coaks, were also bound with top wooldings, the number according to the length of the mast. Wooldings were rarely used on the mizzen or upper masts, though for *Cruiser* three were given to her bowsprit. When masting a ship, the bowsprit is the obvious place to start.

The overall length of the bowsprit was 33ft, with 23ft 6in of this extending beyond the knightheads. If the tenon to fit in the heel block housing is included, the model length would be 5.11/16in, with a diameter of 7/32 in. This basic part of the bowsprit should be turned, and sanded to a fine

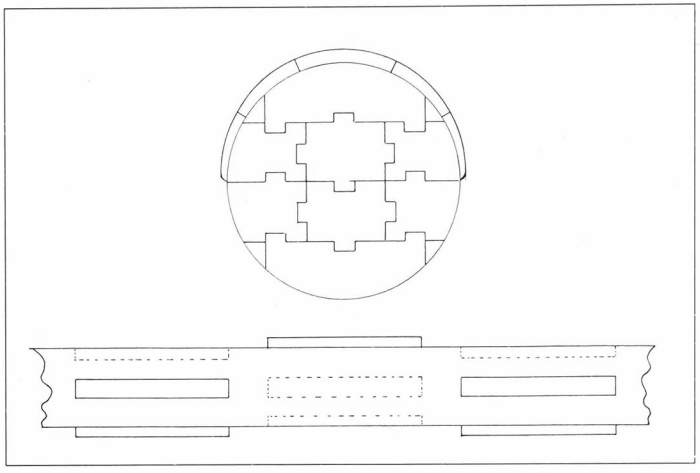


FIGURE 84. Built-up mast. Above is a cross section through the built-up mast, showing the method of construcion with sections which were rebated and coaked.

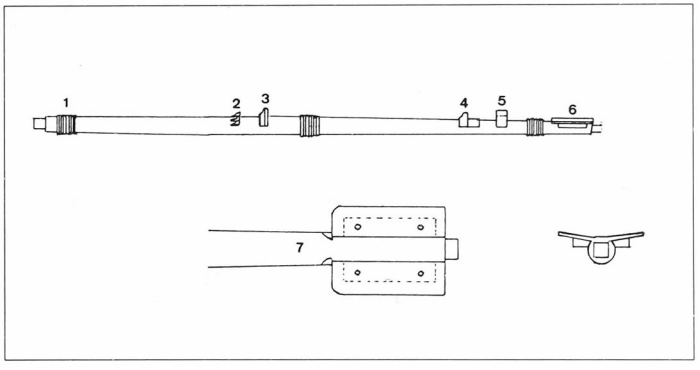


FIGURE 85. Bowsprit.
1. Rope wooldings
2. Gammon cleats
3. Fairlead saddle
4. Spritsail yard sling saddle
5. Jibboom saddle
6. Bees and bees block
7. Detail of bees

finish. The tenon for bowsprit cap, and that for the heel housing, should then be cut and the piece laid between the knightheads. From there the five stops for the gammon lashing can be marked on to line up with the slot in the knee of the head. Other positions can then be taken from the rigging draught, such as the saddle for the spritsail yard sling, which was lead lined. This lead can be effected with Humbrol paint after varnishing. The saddle for the housing of the jibboom heel can be fitted, and also the fairlead saddle. The bees should be fitted close up to the tenon as they butt onto the cap. This arrangement for the bees and bees blocks is in keeping with the period. Before 1745 they took on the shape of a letter B and changed again towards the end of the century. The fore hole in the starboard bee is for the fore top mast stay, and the aft hole in the port bee for the fore top mast preventer stay. The other two holes are spare. The saddles should be made from box or other suitable close grained wood. All this bowsprit furniture can be seen in Fig 85. The woolddings should be fitted once the finishing pine varnish has been applied. Copper wire can be used to simulate the wooden hoops at the tops and bottoms of the woolding bands.

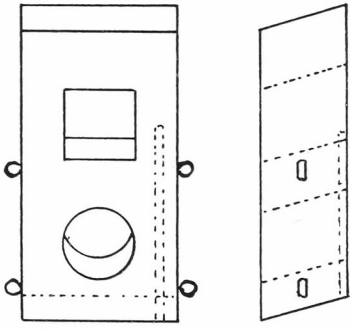
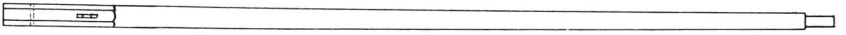


FIGURE 86. Bowsprit cap. The cap is set perpendicular to the waterline, hence the angled top and bottom faces and holes.

FIGURE 87. The jibboom.



The bowsprit cap (Fig 86) differed from the mast head caps in that it sat at 90 degrees to the waterline, while its top and bottom surfaces were in line with the steeve of the bowsprit. The square hole on the lower part should be a close fit over the bowsprit tenon, but the round hole for the jibboom to pass through should be a loose fit as space has to be left for the inner surface of the hole to be leathered, this leathering being splayed back and nailed to both the front and rear of the hole rim. The top eye bolts on each side, port and starboard, are for the man-ropes, and the two lower eye bolts are for the jibboom foot ropes. The round hole should be one and a half times the diameter of the jibboom, and the distance between that and the square hole should be two-sevenths of the diameter of the bowsprit. A groove was cut on the rear starboard side of the cap for the jack staff.

The jibboom was 23ft 3in long with a diameter at the heel of 7½in (Fig 87). For the model it would be 3⅞in x 7/64in. It should be tapered, with the diameter at the end being two-thirds of the diameter at the heel. The jibboom should be turned from a close grained wood such as box or lime. The octagonal section at the heel is best done with paper strips at this scale after fitting on. The length of the octagonal portion should be three and a half times the diameter of the heel. A sheave should be cut into this on the horizontal plane for the heel rope, and a fid hole placed just abaft of this midway between the sheave and the heel for the heel lashing. A straight shoulder should be formed at the outer end of the jibboom as a stop for the rigging collars. The length of this is one and a half times the diameter of the jibboom end. When the piece has been pine varnished the paper octagonals should meld in with the wood.

The spritsail yard proportions should be based on the rules applicable to all Royal Navy yards for the period (Table 9). This should be used in conjunction with Table 10, for the mast and spar dimensions for *Cruiser*, from which all the yards for the sloop can be made. The spritsail yard can be seen in Fig 88. It had an overall length of 26ft with a diameter of 6in, which for the model would read as 4⅜ in x 3/32in. Paper strips should again be used for the octagonal section in this scale, and when varnished, should meld in as the colouring of the pine finish. The sling cleats should be glued to the wood of the spar, and not to the paper, the octagonal strips being set each side of the sling cleat pair. This spar should, of course, be turned, but as with all masts and spars, they should be turned from wood which has been split down the natural grain and not from pieces which have been sawn. All masts and

FIGURE 88. Spritsail yard. All the other yards on *Cruiser* follow this configuration.

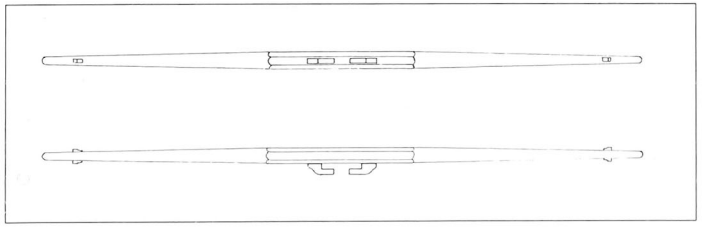


TABLE 9: Royal Navy Yard Proportions, mid Eighteenth Century

	Diameter per 3ft length
Spritsail	⅛in
Lower fore	¼in
Lower main	¼in
Fore topsail	⅛in
Main topsail	⅛in
Fore topgallant	⅛in
Main topgallant	⅛in
Stunsail boom	1in per (5ft length)
Stunsail boom	1in per (5ft length)
Proportions pertaining to all yards 1752	
Taper to yard arm from second quarter:	⅐ diameter at slings
Length of yard arm:	1/24 length of yard
Yard arm cleats:	
Length:	½ diameter of yard
Width:	¼ length of cleat
Depth:	⅔ of width of cleat
Number of cleats per yard arm:	2 lateral
Length of octagonal section:	¼ of yard length
Cleats of sling:	
Length:	1/20 length of yard
Divisional spacing:	½ diameter of yard
Breadth:	¼ of cleat length
Width:	⅔ of cleat breadth
Cheek blocks were not fitted at this time.	

TABLE 10: HMS *Cruiser* Mast and Spar Dimensions

	Length	*Greatest diameter*
Bowsprit	33ft	13½in
Jibboom	23ft 3in	7½in
Spritsail yard	26ft	6in
Lower fore mast	36ft	12¾in
Fore topmast	33ft 3in	10in
Fore topgallant mast	18ft 6in	3⅛in
Fore lower yard	39ft	9¾in
Fore topsail yard	27ft	5¾in
Fore topgallant yard	18ft 9in	3¾in
Stunsail boom	20ft	4in
Stunsail yard	10ft 6in	2⅛in
Lower main mast	47ft 6in	15in
Main topmast	33ft 6in	10in
Main topgallant mast	19ft	3 1/16in
Main lower yard	42ft	10½in
Main topsail yard	27ft	5¾in
Main topgallant yard	19ft 9in	4in
Trysail mast	43ft 6in	7¼in
Trysail gaff	16ft 6in	3⅜in

Table 11: Royal Naval Lower Mast Proportions, mid Eighteenth Century

Length of main mast for a sloop is greatest beam × 2.28

Maximum diameter of sloop masts (at partners)

Main	15/16in per yard of mast length
Fore	as main
Mizzen	8/13in per yard of mast length

Mast taper as a fraction of diameter at partners

Heel	5/6
1st quarter	60/61
2nd quarter	14/15
3rd quarter	6/7
Hounds	3/4
Head	5/8

Cheeks

Length	to reach halfway between stop at hounds and partners at gun deck

Front fish (or rubbing paunch) did not come into use until 1773

Hounds

Length	2/3 length of mast head
Width at top	1/3 of trestle tree width
Width at base	1/3 of trestle tree top width

Bibs

Length	1/3 length of hounds
Breadth	2/3 length of bib
Width	1/2 that of trestle trees

Iron Hoops to head (usually five in number)

3in wide, evenly spaced between cap and hounds

Rope wooldings (number varied between six and nine)

Always one more to main mast than fore mast. Wooden hoops top and bottom of rope woolding to keep position were 1½in wide. Depth of woolding was 12in. Mizzen woldings were two fewer than the number on fore mast

Mast head battens (usually eight per mast)

Length	2/3 of length of head (bottom seated at the hounds)
Breadth	1/8 diameter of head
Width	1/2 of breadth

Main mast caps

Length of cap	4 times diameter of round hold
Breadth	2 times diameter of round hole
Depth	2/3 of breadth

Fore and aft ends were square

Trestletrees

Length	to within 1½in of the edge of the platform top rim

Mast head length

Fore	4¼in per yard of mast length
Main	5in per yard of mast length
Mizzen	3¾in per yard of mast length

Note: In all other respects mizzen proportions were the same as fore and main masts

spars should be made from split timber in this way, as this will prevent warp.

Fore and Main Lower Masts

The lower masts should be made to the dimensions as specified by the masting detail draught if one is available. A table of mast proportions for the period can be seen in Table 11. This may not always accord strictly with a rigging draught, but such a table will provide a good guide to the proportions most commonly in use at the time.

A drawing of the fore lower mast for the sloop can be seen in Fig 89, and that for the main lower mast is shown in Fig 90. You will note that the lengths of both heads are the same at 4ft 9in, as shown on the Chapman draught. Note that the cheeks of the masts extend down to half the length of the mast and are carried up to the cap. The hounds and bibs are set into the cheeks to carry the trestletree and bolster (Fig 91).

The cheeks are bound in with several rope wooldings below the top, and several iron hoops above the top. The iron hoops are spaced around with eight wooden battens to protect the sails from chafing. The number of iron hoops was usually five, and the number of wooldings varied from nine to six for the main mast, according to its length. The fore mast always carried one less woolding than the main.

Some careful carving will be involved in the construction of these masts. The central spindle of the mast can be turned, though this is not vital if it is rounded in a systematic way. This is done by starting with a perfectly square section, reducing the corners first to give an octagonal section, then again to give a sixteen sided section. This is finished to a consistent round section. In this way a straight length to the mast can be maintained at all times.

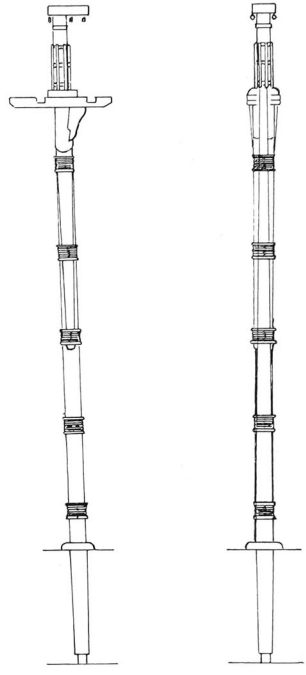


FIGURE 89. Arrangement of the lower foremast.

FIGURE 90. Arrangement of the main lower mast.

The dowel so obtained should then be tapered back from a point at the partner to the head, using a pair of external callipers to ensure the correct diameters are being kept for the relevant quarters. Following this, the taper for the heads can be formed. The tenons for the step and the cap should not be cut at this time, as they need to be lined up with the square of the trestletrees and hounds.

While the cheeks in practice reach up to the head, it is not strictly necessary to do so on the model, as the cheeks and the hounds can be made in one piece. The lowest reach of the cheeks should be marked as a line circling the mast spindle, and the points to the height of the hounds marked at the top of the spindle. A pencil centre line should be run down

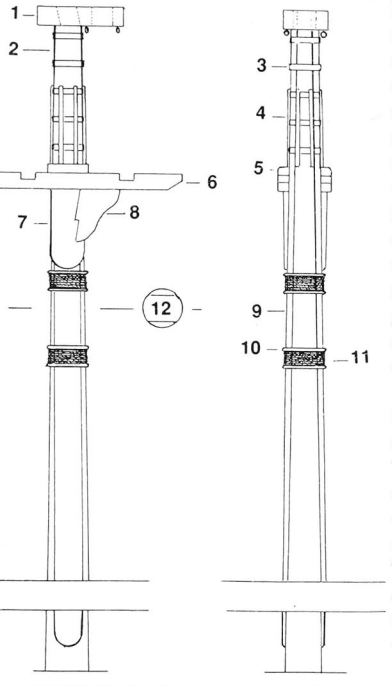


FIGURE 91. Detail of mainmast, as in the Royal Navy *c*1752.

1. Cap
2. Head
3. Iron bands
4. Wood battens
5. Bolster
6. Trestletrees
7. Hounds
8. Bib
9. Cheek
10. Wood hoop
11. Rope woolding
12. Section

between these, both front and back of the spindle. A cut should be made each side of these top markings to a depth of one quarter of the mast diameter at that point, and the mast spindle given a flat taper on these two sides to the depth of the cut at the top, running out to feather into the full diameter of the bottom pencil circle. Two strips of wood to the full thickness and width of the hounds and the length of the cheeks should be glued to these flat surfaces, and left to set. These strips will form both the cheeks and the hounds.

Once the glue has set hard, the hounds can be marked on and the strips carved back to form the cheeks. The bottom parts of the cheeks should sit just proud of the mast spindle, while the bottoms of the hounds should sit just proud of the cheeks. The tops of the hounds are left with enough wood to a depth of a fraction under the width of the trestletrees when fitted.

The bibs can now be placed. It is best to make these up complete with the scarfs, present them to the hounds and pencil the scarf line onto the hounds, which can then be cut away. At this point the angle of the trestletrees should be confirmed from the draught and the model, the latter by setting the mast into the model, to be confident that the tops, when fitted, will lie parallel to the waterline. Any adjustment to this angle can be made once the bibs have been glued in and the glue set firm.

The trestletrees (Fig 92) should be about an inch shorter in length than the rim of the top, and those for the main mast of sufficient length to accommodate the housing of the trysail mast. The bottom of the fore and aft ends of the trestletrees are cut off, or shaped, at an angle, the length of the forward shape being one and a half times the depth of the trestletree, and the after one being the depth of the trestletree. In plan both ends are rounded. The trestletrees were chamfered on their undersides. An iron plate should be set into the top surface of the fore part as a bearing for the topmast fid. With the trestletrees squared, the top tenon for the mast cap and bottom tenon for mast step can be cut, ensuring that they are square to the trestletrees.

A pair of bolsters are set above the trestletrees to take the strain of the shroud gang throats, the edge in the way of these being bevelled to a quarter circle. Their length would be from just abaft the fid hole to the aft edge of the aft crosstree. Except for the rounded edge it was a square section with a width 1½in greater than that of the trestletree.

The proportion for all caps should be: length four times the diameter of the round hole, breadth twice the diameter of the round hole and the depth two-fifths of this.

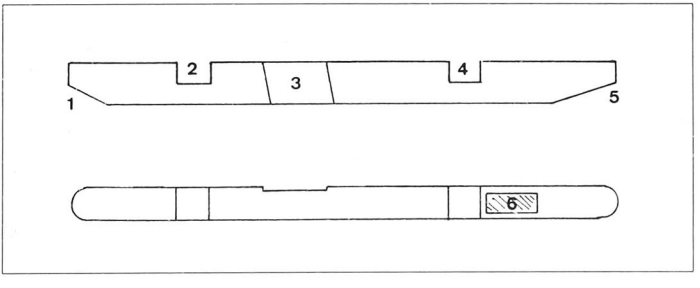


FIGURE 92. Detail of lower trestletree.

1. After snape
2. After crosstree tenon
3. Rebate for mast
4. Fore crosstree tenon
5. Fore snape
6. Iron plate for topmast fid

Stunsail Booms and Yards

Cruiser is shown rigged with two lower stunsails on the foremast only. At this time they should be rigged with the lower boom held to the lower fore yard by figure-of-eight irons, one set on each end of the yard arms and one other set on the yard one third of the length of the stunsail boom in from the iron at the yard arm. Both inner and outer irons should sit at an upward 45 degree angle to the fore part of the yard. During the *Cruiser* period the yard part of the inner iron was open ended. A typical example of the inner iron of the period is shown in Fig 93 and that for the outer iron in Fig 94. These figure-of-eight irons should be made from suitable brass tube, either turned off or cut with a tube cutter. The connecting pieces can be brass square and flat section, and preferably with the component parts silver soldered together for strength, as such delicate work can easily be damaged.

The stunsail boom should be of a round section throughout. The given diameter runs parallel for the first third of its length from the inboard end, and from there tapers to two-thirds of the full diameter at the outboard end. The inboard end should be set with a ferrule and a hook. A rigging hole should be drilled in the outer end in a fore and aft direction, the hole being set in a distance of one end diameter of the boom. Both the hook and the hole are essential rigging requirements. The proportional length of the boom should be five-ninths of the lower fore yard, while the proportional diameter should be 1in for every 5ft of the boom length. If the stunsails are to be set, it would be wise to turn these slender booms from brass rod, as apart from avoiding warp, the brass rod will give a firm foundation on which to rig the sail. Both the stunsail boom and yard are shown in Fig 95.

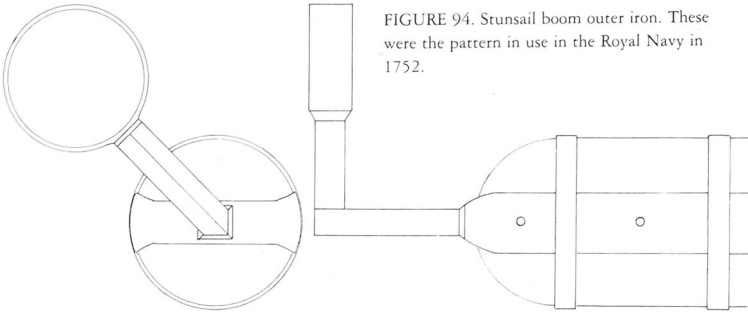


FIGURE 94. Stunsail boom outer iron. These were the pattern in use in the Royal Navy in 1752.

The stunsail yard length should be four-sevenths of the boom's length and the yard should be of a round section for its entire length. Its diameter is the same ratio as for the boom, being 1in for every 5ft of its length. This yard, too, should be made from brass rod. In *Cruiser*'s time it was slung from a point one-third of the way out from the inboard end, the sling cleats being set on the forward face of the yard at this point. It should be tapered in the same way as the topsail yard, from the centre out to the yard arms where the diameter should be three-sevenths of its greatest diameter. The yard arm cleats were also set as for the topsail yard.

Trysail Mast

The trysail mast should be a parallel sided pole with a diameter not greater than half that of the main mast. It is positioned directly abaft the main mast to which it should be attached at the head by being housed between the after part of the main trestletrees and the after mast crosstree. A short form of crosstree or chock to arrest its movement should be set between the trysail mast head and that of the main mast. The mast should be further secured by a double fid arrangement, one being placed immediately across the top of the trestletrees, and another beneath it. The gap between the two masts must be large enough to permit the free run of the trysail gaff parrel.

The heel, with a tenon, should be

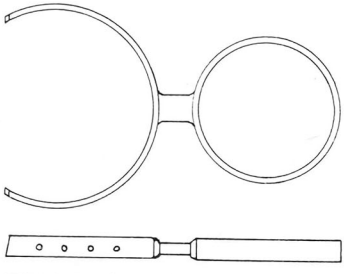


FIGURE 93. The iron for the inner stunsail boom.

FIGURE 95. Stunsail boom and yard.
Top. The stunsail boom: length 20ft, diameter 4 inches at inboard end.
Bottom. Stunsail yard: length 10ft 6in, diameter at centre 2⅛in.

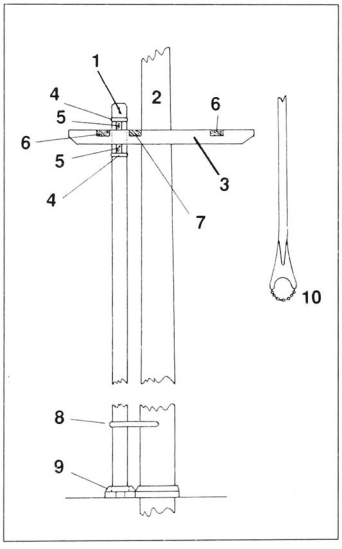


FIGURE 96. Arrangement of trysail mast.
1. Parallel trysail mast
2. Mainmast
3. Trestletree
4. Iron band
5. Fid
6. Crosstree
7. Short crosstree lodging block
8. Figure-of-eight iron support
9. Trysail mast step
10. Plan view of gaff jaws

set into a step fastened to the gun deck just abaft the main mast partners. The mast can again be secured either by a figure-of-eight iron, one part encompassing the trysail mast and the other part encompassing the main mast, or a similar arrangement made from wood. In some instances the main mast part of the eight can be cut short, so that it runs to only half the circumference. These brackets are set about 18in up from the deck.

The purpose of the trysail mast was to afford an unimpeded run to the trysail gaff and the trysail luff attachments, either lacing, cringles or hoops. It was a feature of the rig which designated the ship a snow, and differentiated the rig from that of the later brig. On some ships, a rope horse took the place of the wooden mast, but in all respects served the same purpose. An example of the wooden mast is shown in Fig 96.

Trysail Gaff

The greatest diameter of the gaff should be at a ratio of ⅝in for every 3ft of length, tapering to a width at its outer end of half that.

The outer end of the gaff is fitted with a metal ferrule, with an eyebolt used for hoisting signals. Two cleats should be placed laterally on the gaff end as rigging stops in the same way as those for the yardarms.

The inboard end of the gaff is fitted with horseshoe shaped jaws, usually leather covered on the inner surface to ensure an easy passage when being hoisted or lowered on the trysail mast. The leathering can be simulated with Humbrol saddle paint. The jaws should be cupped to a little over half the diameter of the trysail mast, and angled internally to 45 degrees to sit square on the mast when hoisted. The length of the jaws' scarphing on the gaff should not be less than two-ninths of the gaff length. The scarphing should be reinforced with three iron bands (Fig 97). The jaws should be made as a separate piece and scarphed to the pole of the gaff, being glued and dowelled through.

You will note that the jaws are provided with two lateral holes for rigging a basic parrel. The parrel consists of several wooden balls, called trucks, strung like beads on a rope. This forms a holding collar when passed around the trysail mast with the ends of the rope parrel seized through the holes of the gaff jaws. Enough slack should be left in this for the gaff to be freely hoisted and lowered as required. The dimensions of *Cruiser*'s gaff are given in Table 10.

Tops

The history of tops is an interesting one, perhaps in a way encapsulating in their development the sobering influence imposed on the mariner by both religion and law. From the high mounted castle set on the top of a single pole mast, from which all manner of death was hurled down, they evolved into an essential work place and a means of making safe the rising heights of the masts until, in time, their awful origins remained only as a vestige of fighting tops on a man-of-war.

The tops began to forsake their round form at the end of the seven-

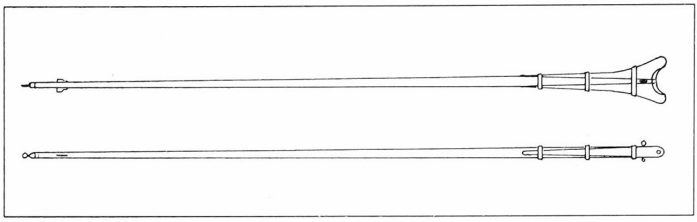


FIGURE 97. Arrangement of trysail gaff.

teenth century, with a gradual movement to squared aft ends and elliptical foreparts by the mid eighteenth century, on all masts. A typical main top is shown in Fig 98, and the crosstrees which help support it in Fig 99. For this period the proportion of the top should be: length fore and aft seven-ninths of the width. The lapped planks of the platform (Fig 100) should be no greater than 2½in thick, those running athwartships being lapped over those running fore and aft. These joints were nailed through and the nails clenched over a rove. This construction will form the centre square hole, or lubber hole. Bear in mind when making this that the platform is not made to the overall dimensions of the top. Allowance should be made for the broad board which extends out over the platform of the top by 4in all round.

The lubber hole should be a little wider athwartships than fore and aft. The proportion should be that the aft edge of the lubber hole should reach back to within one-fifth of the width of the top, while the width of the hole should be about two-fifths of the width of the top.

The next part of the construction should be the broad board. This runs all the way round the outer part of the top. It should be given a 4in overlap to the platform edge. The board should not be greater than 7in wide and 4in deep.

Once the broad board is on, the battens can be placed. The arrangement of the battens varied enormously

FIGURE 98. A typical main top of the period. While four stanchions are shown here, on smaller vessels such as *Cruiser* only three were used.

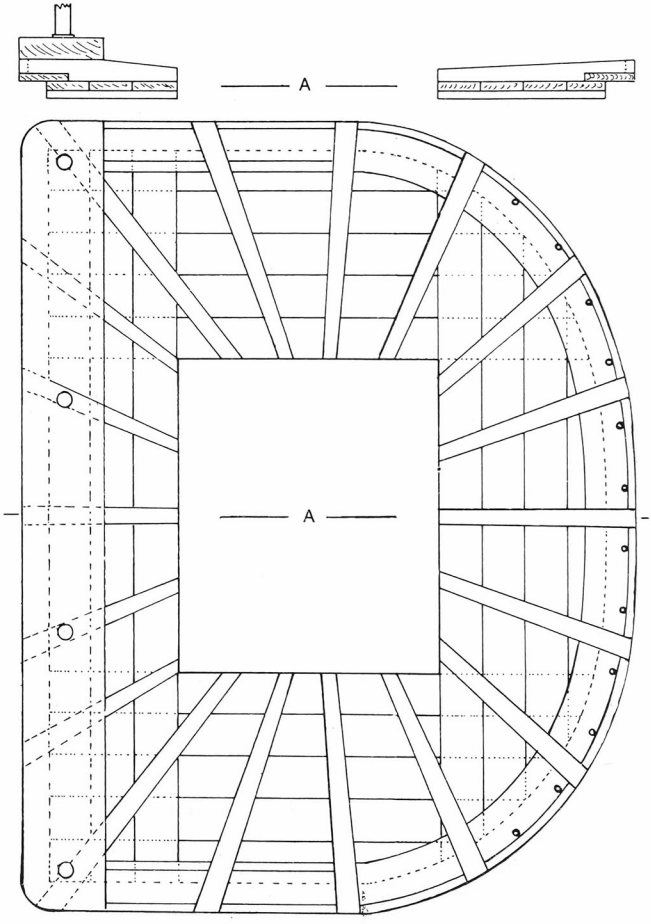
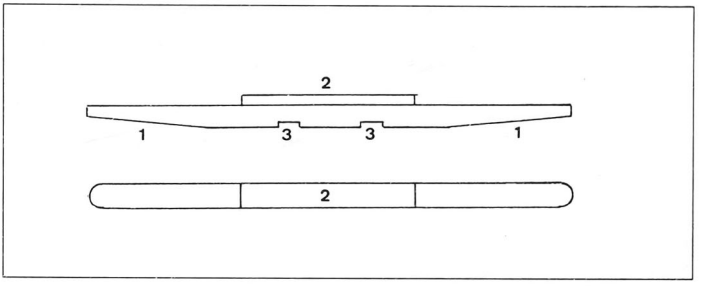


FIGURE 99. Detail of crosstree.
1. Quarter taper
2. Lubber wood
3. Tenon for trestletree



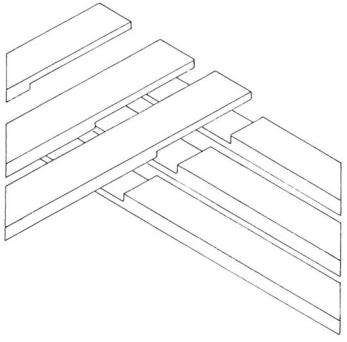


FIGURE 100. Planking of tops. Method of forming rebates for the top planking.

from ship to ship, but generally at this time they can be accepted as shown, being 4in high on the fore part, sloping back in this way on the plan elevation. They should be cut to fay in over the broad board, and finish flush with its edge. Once the battens are placed, filling pieces to the height of the batten and about 1in wide can be fitted between them to form a continuous rim, except on the aft edge, which remains open. This aft part is covered with another broad plank termed the gunwale plank.

The gunwale plank was about 1ft wide and 3in thick. On the mizzen top, if one were carried, it would be somewhat less than this. Its purpose was to carry the stanchions for the rail. On large ships these would be turned pillars set with a wooden rail. On small ships they were often iron stanchions set with an iron rail. For *Cruiser* an iron rail can be made up with brass rod and wire, the rod being turned with an end ball, which is drilled and the wire passed through and soldered. There should be four stanchions for the fore and main tops, and three on the mizzen. Both wood and iron rails should be to a height of 3ft.

The futtock plates are iron strips placed flat on the broad plank, in the way of the top mast shroud deadeyes. These can be represented with black painted card or paper, painted and then glued in place. Three holes should be drilled through for the deadeye strops. The fore one should be set in line with the head of the main mast. The aft one set about 6in from the aft edge of the plate, and the third set exactly in the centre of these two.

The final holes to drill are for the crowsfoot rigging. There are twelve of these, evenly spaced along the fore part of the top just inside the filling pieces.

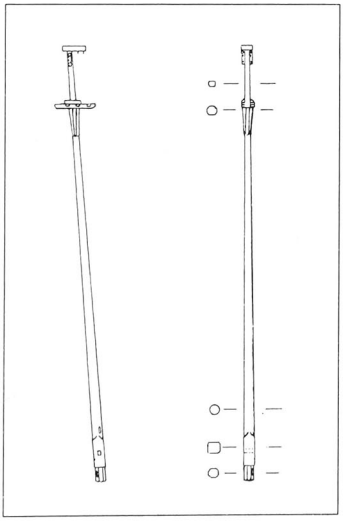


FIGURE 101. Arrangement of main top mast.

Topmasts

Cruiser's fore topmast was 3in shorter than the main topmast. Both are of the same construction and proportions, and the detail to follow represents what is commonly accepted for these masts as built in the Royal Navy in the mid eighteenth century. The main topmast is shown in Fig 101.

The diameter at the lower cap should be $^{9}/_{10}$in per 3ft of the mast length. The main mast cap hole through which it passes to sit on its fid should be $^{3}/_{4}$in greater than this to allow for the leathering. The taper to the lower part of the head should be to seven-tenths of the diameter at the main mast cap hole, while the diameter at the top of the head should be eleven-twentieths. At this time the head was left square, often with chamfered edges. The length of the head should be one-tenth part of the mast's length. Top cheek blocks were fitted athwartships each side of the head to sit just beneath the topmast

cap. Each block had two sheaves, one beneath the other for hoisting the staysail halliards and stays. Two eye bolts were set beneath the cap, one each side of the topgallant mast hole, for rigging the topsail reefing tackle.

The hounds were octagonal, with a length two-thirds of the topmast head and a top width twice that of the top mast head. These should be angled down to fair in with the pole of the mast. It is on these that the top mast trestletrees and bolsters will rest.

The mast is round until it reaches the heeling block, which should be square at this time for a sloop. The block should have chamfered edges and be one-seventh part of the main mast head long. The block is that part of the mast which sits between the main top trestletrees and the fore crosstree. A fid hole is placed in the block athwartships, about half way up. The height should be one-third the diameter of the mast and the width one-quarter diameter of the mast. The fid is passed through this to sit on the main top trestletrees iron plates, and holds the top mast in position. A filling chock is set behind it and against the main masthead to prevent movement. The block, together with the heel, should have the same length as the top mast head, that is, one-tenth part of the top mast length. The heel at this time was octagonal and the diameter of the mast at the main mast cap hole. A topping sheave should be set in diagonally from the fore part face to the aft starboard face. A second topping sheave should be set 6in above the block running in the opposite diagonal direction.

A groove should be cut in the block above the sheaves so that the topping rope can run out free once the mast is hoisted. These sheaves were not left rigged.

The top mast trestletrees (Fig 102) on *Cruiser* sat 4ft down from the top of the masthead. The draught dimensions agree with their formula which is that their length should be one-fifth of the length of the topgallant mast, and depth $^{25}/_{26}$in for every foot of length, the breadth three-quarters of this.

There were three top mast crosstrees, their length being four-fifteenths that of the topgallant mast, and depth half that of the trestletrees with the same breadth as these.

While these masts can be turned, they can just as easily be made from the square reducing to octagonal method. With this the piece should be cut exact to size with the square section to the finished dimensions of the block, and the length to the finished height of the mast inclusive of the cap tenon.

The piece should be divided for the block placement and again for the hounds, being marked around with a try square and then lightly scored in with a fine toothed jewel saw. A central pencil line should be marked on all four faces of these areas, which should be strictly maintained as work on the mast progresses. The round part of the mast can then be reduced from the square by forming the octagonals, the straight line of the mast being maintained by the pencilled centre lines, the taper and the roundness on all surfaces being checked as work proceeds, with a pair of external callipers.

The octagonal can be set into the heel with a hand Swiss file, and the head squared off with the same tool. An iron band should be set on the lowest part of the heel. A hand file can be used to set in the octagonal tapers for the hounds. Following this the topping sheaves can be set in. As these are not rigged they can remain as being suggested, in that they need not be cut right through, but just to a depth to indicate their presence.

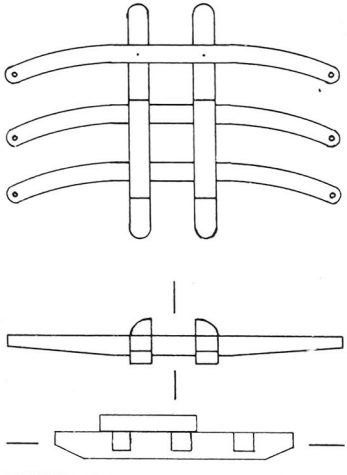


FIGURE 102. Top mast crosstrees and trestletrees.

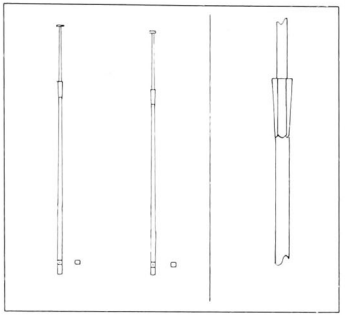


FIGURE 103. The position of the hounds on fore and main topgallant masts.

The tenon for the cap can then be cut, and the cheek blocks placed. There are two ways of dealing with the cheek blocks, depending on the scale. For very small work solid pieces can be glued in place and the double sheaves drilled through and eased out with a fine rat-tail to simulate the sheaves, or each cheek can be formed in two parts. This is by gluing a flat side to the masthead with the length and width of the cheek, but only to the thickness of one side of the sheave hole. The second part of the cheek should be of sufficient thickness to incorporate the full width of the sheaves. The sheave holes should be filed out with a square Swiss file to form an E profile. The sheave pulleys can be set into this piece before gluing to the side already set on the mast. The assembled pieces should be drilled through both sheave pulleys and pinned, the fine pin heads forming the spindle heads of the pulleys. Finally, the trestletrees, crosstrees, bolsters and caps can be set on to complete the masts.

Topgallant Masts

There is a difference of 6in in height between *Cruiser*'s fore topgallant mast and the main topgallant mast. This difference is shown on the Chapman draught as being between the topmast cap and the topgallant hounds, the main topgallant mast being the greater. Apart from this both masts have the same dimensions in all respects. The mast is shown in Fig 103.

The taper to the hounds is to ten-thirteenths of the diameter of the mast at the topmast cap. The greatest diameter of the mast is to a ratio of 1in per 3ft of length.

The heeling should be square to a proportional length of two and a half times the diameter of the mast.

The hounds are octagonal, being half the length of the top mast hounds, and to a width at the top to just clear the top mast cap hole. A vertical sheave should be cut in the centre of the hounds running fore and aft for the topgallant halliard and tie.

Between the hounds and the heeling, the mast is round with a round terminal beneath the heeling, and a round head above the hounds. However, if the head is set with trestletrees and crosstrees for a royal mast or flag pole, the head would be square. On *Cruiser* this is not the case, the topgallants being terminated with a bun set with a pair of fore and aft sheaves for the flag halliards.

A single topping sheave should be set running diagonally from the starboard forward face to the port after face just above the heeling. The length of the sheave is just over the diameter of the mast at the lower head. The fid hole is the same as that for top mast, being set athwartships half way up the heeling to a length of one-third and a width of one-quarter of the mast diameter.

The construction of these masts should follow the same procedure as that for the top masts.

8

The Standing Rigging

ONLY GOOD QUALITY hemp, linen thread, polyester or nylon should be used for the rigging. Materials such as domestic cotton thread will rot quickly. Fishing line nylon should be boiled to remove the protective wax and then dyed, either steel or hemp.

Tables for comparative rigging sizes are available, like those for the masts and spars. Any modeller is strongly advised to become well acquainted with them. Among them, and the most consulted for eighteenth-century Royal Navy ships, are John Davis's *The Seamen's Speculum* of 1711, Sutherland's *The Ship Builder's Assistant*, and his work *A General Proportion for the Rigging of a Three Mast Ship*. For later in the century there is Steel's *Elements of Mastmaking, Sailmaking and Rigging* of 1794. There are also general rules for all rigs of the period, giving proportions of the rigging based on the main mast, as the scantlings for the hull are based on the dimensions of the keel.

When attempting to rig a model, strict observance should be made of all these relative proportions, not only for the standing rigging but also the running rigging, which is equally important. Otherwise the rigged model may look hideously wrong, all the work so carefully done on the hull construction set at nought.

Tables giving some basic proportions for *Cruiser*'s rigging will be shown as work proceeds, starting with that for the bowsprit (Table 12). Along with this is the recognised order of dressing the masts (Table 12 shows the order for the bowsprit). While this order may not necessarily have been strictly adhered to, the variation from vessel to vessel was not extensive. All the standing rigging is shown in Fig 104.

The Bowsprit

Gammon Lashing

The first item of rigging to fit should be the gammon lashing. The diameter of the stuff used for the lashing should be one-fifth that of the bowsprit, with a length of 1½ times that of the bowsprit. It is set up with a close pulled hitch to the inner part of the sprit above the aft end of the gammon lashing hole in the head. From there it should be led forward to pass through the starboard side of the foremost part of the gammon hole, so that the lashing is taken back to the port side of the sprit and wound over hard against the fore part of the first wind of the hitched loop, before being taken forward again on the starboard side, to be bent again through the gammon hole tight against the aft part of the first gammon hole wind. This exercise

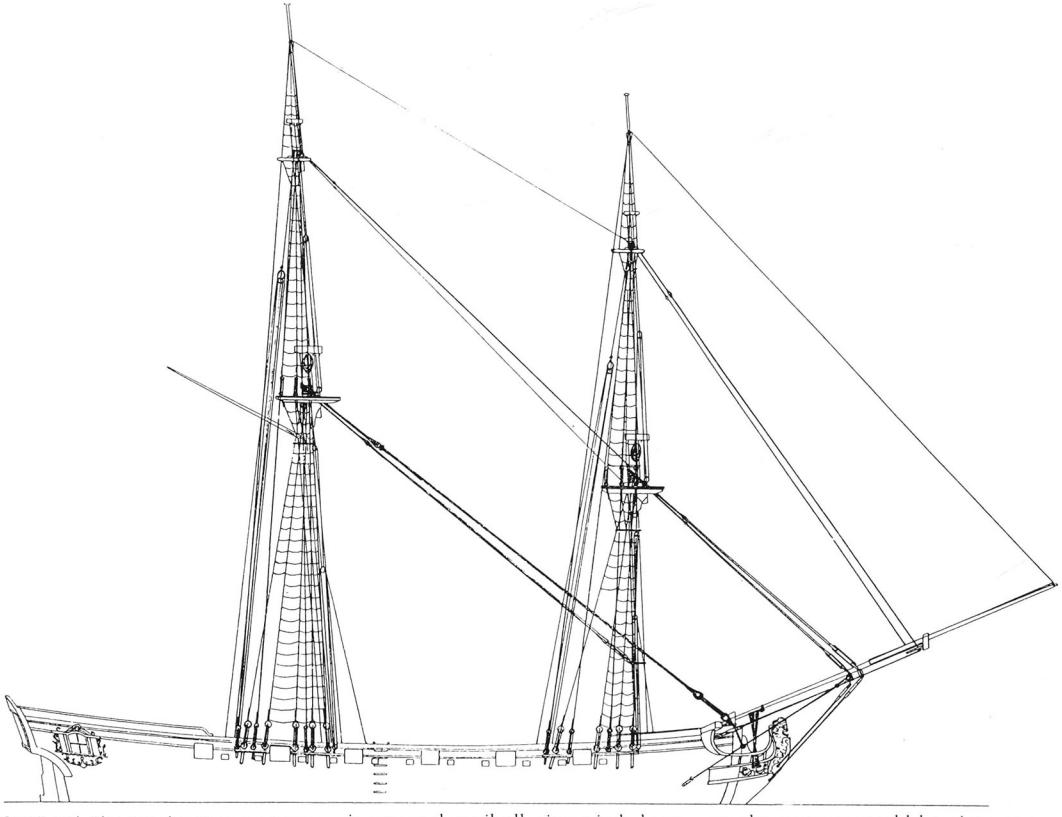


FIGURE 104. Elevation showing arrangement of standing rigging.

is repeated until all nine winds have been taken up, each of the winds on the sprit top sitting immediately in front of the last wind, and each of the winds passing through the gammon hole sitting immediately behind the previous gammon hole wind.

It will be found that if the rig has been carried out correctly, all the lines will be crossed in their centre to form a fan effect top and bottom of centre, or a propeller twist aspect. An exploded view of this procedure is shown in Fig 105.

The lashing should be completed by frapping the end of the line around the crossed over centre section with the same number of turns as were passed around the sprit, namely nine. The final part of the line is then seized to the top of its last turn. On a small scale, this can be simply glued. These are the turns as would be given to a sloop. A larger vessel would have more, a 90 gun ship having up to fourteen or fifteen. The completed lashing is shown in Fig 106. At this stage it might be advisable to fit the gammon lashing blocks as shown in Fig 107. These provide essential fairlead holes for future runs of the rigging, which will be explained in due course. The two blocks are seized about the gammon lashing just abaft the gammon lashing hole.

These should be made from boxwood, the insets top and bottom being taken out with a three-sided needle file. The number of fairlead holes for *Cruiser* should be six per side. The easiest way to rig this is to seize the lower part first, hold it up under the bowsprit, and seize the upper part in position.

TABLE 12: Royal Navy Proportional Diameters of Bowsprit Standing Rigging, mid Eighteenth Century

Bowsprit gammoning	1/5 of bowsprit diameter
Horse	1/2 of gammoning
Woolding	1/2 of gammoning
Bobstays	1/2 of fore stay
Bobstay collars	As bobstay
Shrouds	1/5 of bowsprit diameter
Shroud collar	4/5 of shroud
Worming	1/10 of rigged stay
Lanyards	1/2 of rigged stay or collar
Fore stay collar	1/2 that of fore stay
Fore stay	1/6 of fore mast
Fore preventer stay	7/10 of fore stay
Fore preventer stay collar	1/2 of fore preventer stay

Note: An alternative proportion for the gammoning rope was 9/10 of the fore stay

Order of dressing the bowsprit

1. Fore stay collar
2. Inner bobstay collar
3. Starboard and port shroud collars
4. Outer bobstay collar
5. Fore preventer stay collar

Bobstays

The bobstays were those parts of the bowsprit rigging which prevented its upward movement by the pull of the fore stays. In *Cruiser*'s time, two were usually rigged, an inner and an outer, and in accordance with the formula would have been half the thickness of the fore stay, with a length a third of the bowsprit length. They were formed as a continuous ring of rope, the ends being spliced together after

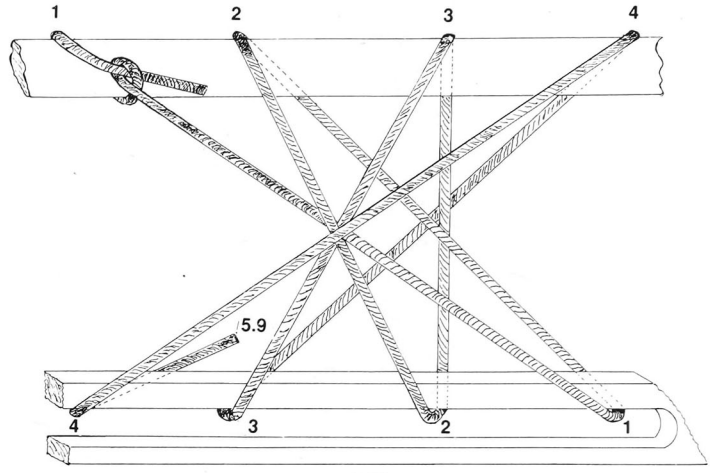


FIGURE 105. Expanded view showing the sequence of fitting the gammon lashing. The standing part is hitched to the starboard after side of the sprit and taken forward to pass through the gammon hole on the fore part. All the following windings are taken forward to the previous one on the sprit and then aft to the last one in the gammon hole. Winding in this way will produce a propeller effect.

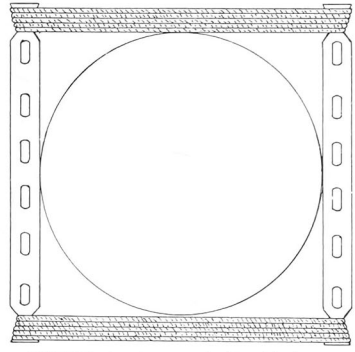


FIGURE 107. Gammon lashing blocks.

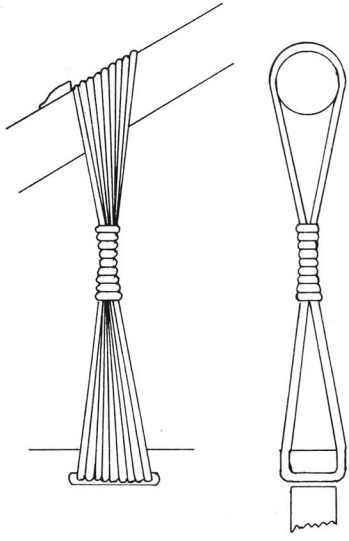


FIGURE 106. The appearance of the completed gammon lashing.

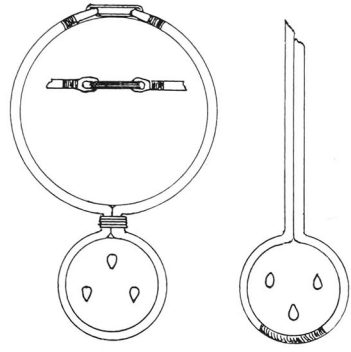


FIGURE 108. Bobstay collar and deadeye. Note the positions of the lanyard holes.

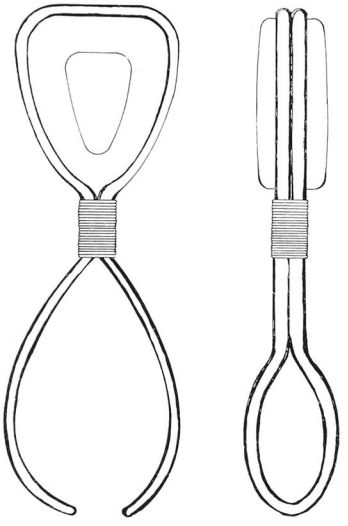


FIGURE 109. Forestay and fore preventer stay collars.

being passed through a hole in the stem. In this way, each of the two bobstays formed in itself a double stay. The spliced part of the rope should rest in the score of the deadeye, which was fitted in the bight of the doubled rope and eventually rigged to the bobstay collar matching deadeye with a lanyard. The stay should be parcelled and served for its entire length. The collar should be of the same rope thickness as the stay. The positions of the inner and outer bobstay collars can be determined from the rigging draught. The collar is formed by seizing a wormed strop around a deadeye, leaving two equal legs with an eye spliced into each end. The strop is passed completely around the sprit, where the eyes should be seized together tightly.

The collar is shown in Fig 108. A safe proportion for deadeyes is just slightly more and never less than half the diameter of the mast or spar to which they are rigged. It would be incorrect to use hearts at this time, as they did not come into general use for this purpose until much later in the century. The thickness of lanyard should not be more than half that of the stay, or the seizing more than half that of the collar.

The forestay collars are set up with hearts, and are formed with a continuous double strop. That is, a length of rope of a diameter half that of the fore stays and long enough to pass twice round the heart and twice round the bowsprit at this point of rig is spliced to form a continuous ring. This should be parcelled and served all through. The ring of rope is then pulled straight with the splice bent over one end. A heart is then seized into a bight so that the splice rests in the top of the heart groove. Two grooves were scored around the heart. The two looped tails so formed should then be seized right around the sprit. Both the collar for the forestay and that for the fore preventer stay are dealt with in this way. The collar is shown in Fig 109.

Shrouds

Shrouds had a thickness one-fifth of the bowsprit diameter, and are shown on the Chapman draught as being the same length as the bowsprit.

The shrouds were rigged to the bowsprit collar with deadeyes at this time. Two shrouds were usually set one each side of the sprit to harness any lateral movement. They should be set up on the bow with a hook arrangement cast through an eye bolt, one to port and one to starboard, the eye bolts being set about 3ft abaft of and in line with the lower head cheek. The shrouds should be parcelled and served for their entire length, the bow hook being set in a metal thimble.

The shroud collar was formed from a single strop, two deadeyes being seized into it to sit one each side of the sprit between the inner and outer bobstay collars. The tails of the strop should be fitted with spliced eyes through which the lashing can be passed to secure the collar as a snug fit around the sprit. Wooden stops should be fitted to the bowsprit at the rear of the first collar from inboard to prevent any backward movement. The shroud collars and shroud arrangement is shown in Fig 110.

Man-ropes

Mention has already been made of man-ropes as rigged for ladders, and with stanchion supports, around the coamings of open hatches. They were even more vital when working the spars. The bowsprit should be rigged with two of these ropes, one to port and one to starboard. They should be rigged between two pairs of ring

bolts, one pair fitted to the knightheads and the other to the upper part of the bowsprit cap.

The Jibboom

Traveller

This was an iron ring set on the jibboom as a loose fit so that it might ride the tension of the jib sheet stay. It should be given at least ¼in clearance and in practice was completely covered in leather to avoid friction and wearing of the jibboom timbers. The diameter of the rod ring metal for a sloop was 1¼in. For the model it can be made from brass wire turned around a pair of round nosed pliers. Before soldering the joint it should be fitted with a free moving metal loop and hook (Fig 111).

The jib stay is bent to the loop while the hook carries the eye of the outhaul, which enables the jib sheet to be kept taught. The rigging of the traveller will be explained when describing the fore mast rigging.

Horses or Footropes

The horses were footropes for seamen to stand on when working the jibboom, and were rigged as follows. Two lengths were spliced with an eye to fit snugly over the jibboom end stop, being the first of its rigging to be fitted, and should be laid hard against the stop shoulder. The inboard ends were led back to loop below the jibboom by about 3ft, or waist height, and belayed by being spliced around the jibboom heel just abaft the bowsprit cap, or in the case of *Cruiser*, spliced into eye bolts each side of the cap on its upper part. Before fitting, figure-of-eight knots should be worked along its length at 2ft intervals to help maintain a foothold (Fig 113). The rope had a thickness one-quarter part of the fore stay diameter. Photograph 59, a detail of the finished model, gives a clear view of the footropes.

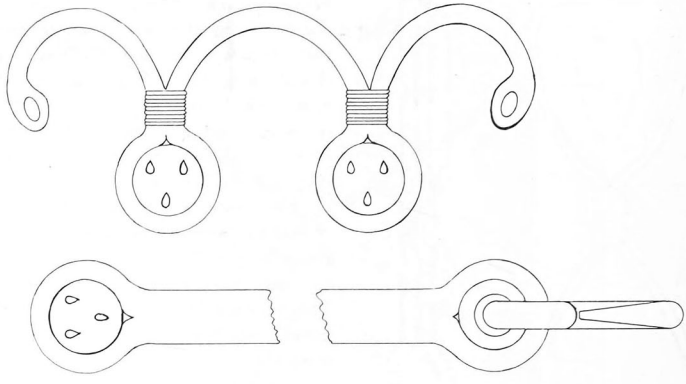


FIGURE 110. Detail of bowsprit shroud collar and bowsprit shroud rigging.

Topgallant Stay Collar

This should be the second item to fit over the jibboom end stops, and should rest snugly against the foot rope eyesplice. The collar should be made up as one continuous strop, into which three thimbles should be seized, the centre one to sit on the top of the stop. The thimbles are the fairleads through which the topgallant stay and the topgallant sail bowlines run, the centre thimble being for the stay (Fig 112). The collar should be fitted to the end stop by easing it over the strop as a snug fit. The thickness of the rope for the strop should be equal to that of the stay, and parcelled and served all round. The simplest way to model the thimbles is from a suitably sized length of boxwood dowel, which should first be end drilled to the size of the inside diameter to a depth beyond that required for the thimble. The score can be set on the dowel with a fine rat-tail file. The thimble can then be separated from

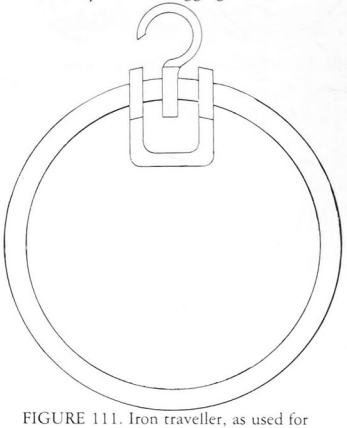


FIGURE 111. Iron traveller, as used for rigging the fore topgallant stay jibsail.

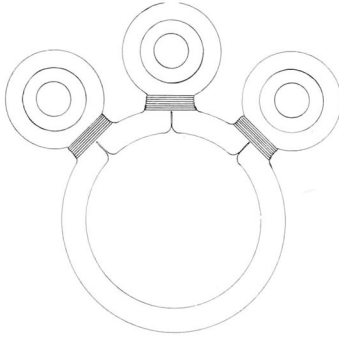
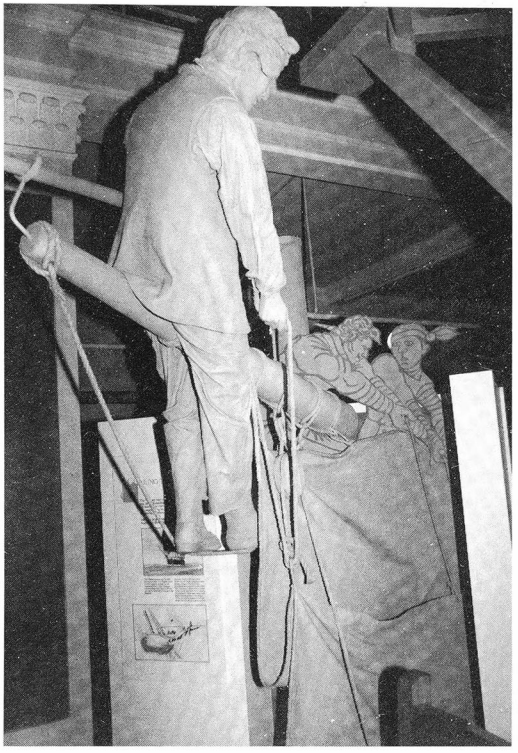
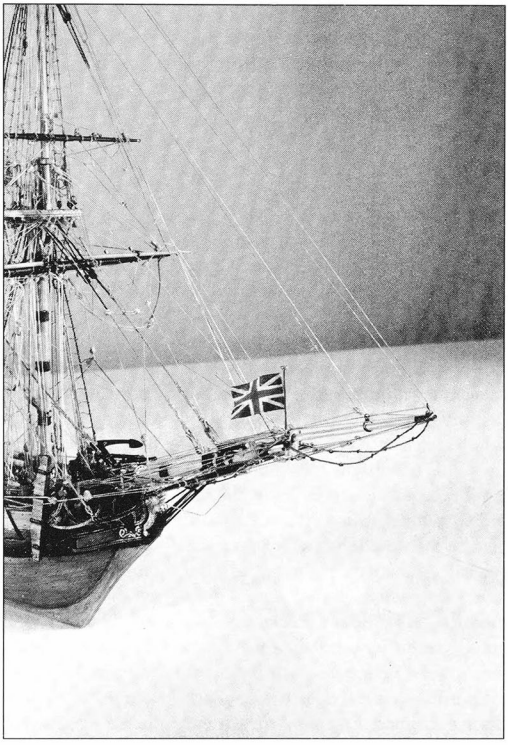


FIGURE 112. Topgallant stay collar.



58. Seen in Portsmouth Naval Base Museum was this figure of a seaman reefing a topsail with the aid of a Flemish horse.



59. The fully rigged head. Note the iron traveller on the jibboom, with outhaul and inhaul toggled together. The fore course port sheet block, clew block and tack are made fast together and suspended by the clew line. The jack does not carry the Cross of St Patrick at this time.

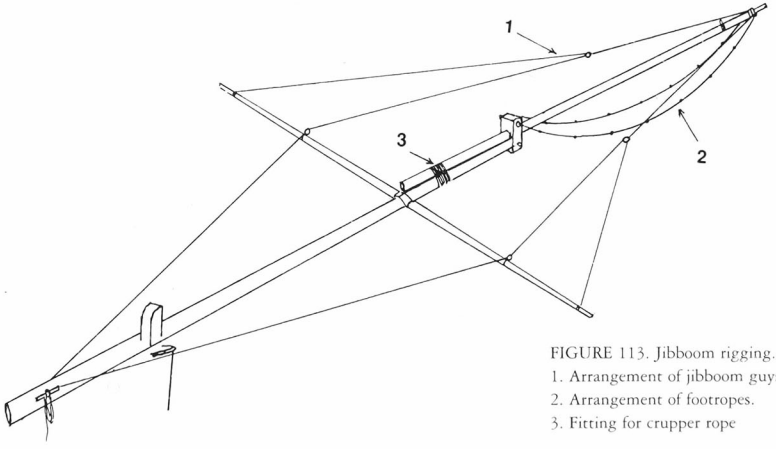


FIGURE 113. Jibboom rigging.
1. Arrangement of jibboom guys
2. Arrangement of footropes.
3. Fitting for crupper rope

the dowel length with a jewel saw, care being taken not to exert too much pressure in case the thin wall of the formed thimble should collapse.

Guys

The jibboom should be set with two lateral guys only for this period. The guys should be made up with pendants and falls, and for the era of *Cruiser*, rigged in the following way. The pendants should be eye spliced over, or hitched around the jibboom end stop, to form an equal pair from where each is run back to a point mid way between the end of the jibboom and the spritsail yard, port and starboard. Each pendant end should then be spliced onto a single sheave block.

Two single sheave blocks should then be set on the upper part of the spritsail yard quarters to act as fairleads. At a later period these were thimbles. The four blocks so set should be no larger than four times the diameter of the pendant rope.

The standing parts of the pendant falls, or runners, are spliced around the spritsail yardarms, one to port, the other to starboard, led up through their pendant blocks, back through the blocks set on the yard, and belayed to cleats on the bowsprit heel, or suitable timberheads. This rig is illustrated in Fig 113.

Crupper Rope

The crupper rope was the lashing to make fast the jibboom to the bowsprit, and should have a cordage diameter the same as that of the shroud lanyards. Its standing part should be seized through a lateral hole in the jibboom about 2ft out from the heel, and be given at least seven turns to outboard about the bowsprit and the jibboom, the end being seized to the final turn (see Fig 113). Heel lashings were not practised at this time. Proportional rigging diameters for the jibboom and the order of dressing are shown in Table 13.

Lower Masts

For sixth rates, including sloops and cutters, only two tackle pendants should be fitted, set one each side of the mast. They should be the first items fitted over the masthead and be bedded over the bolsters. In practice, the bolsters would first be padded out with strips of canvas and tarred over. On a model this could look messy but can be suitably represented by painting the top surface of the bolsters a matt black before fitting the rigging over them.

The tackle pendants should descend no further than the line of the futtock shrouds and upper catharpins at this time, and if left unrigged, the ends seized to each side of the mast, or as was more usual, to the inner side of the first shrouds. Their thickness should be a little over half that of the relevant lower stay, and the same diameter as the respective shrouds. See Table 14 for proportional sizes of the lower mast rigging.

Each of the four pendants for the sloop should be made separately, and each given an eyesplice to fit around the mast. The throat of the eyesplice should come no lower than the bottom line of the bolster, and the seizing should be in line with the trestletree. The pendant was parcelled and served for its entire length (Fig 114 details parcelling and serving). A single block for the tackle runner should be seized into the end of each pendant, whether or not they are to be rigged. The two mast pendants are bedded down in the same order as the shrouds, the first being passed over the head to starboard, and its partner to port.

There are various ways to simulate the serving aspect of these items, depending on the scale being used. For a small scale a white PVC wood glue

TABLE 13: Royal Navy Proportional Diameters of Jibboom Standing Rigging, mid Eighteenth Century

Pendants	½ of bobstay
Guy falls	⅓ of pendants
Horses	¼ of fore stay
Topgallant stay collar	As topgallant stay
Heel lashing	As bowsprit shroud lanyard
Iron ring traveller	1¼in

Order of dressing

1. Traveller
2. Footropes
3. Guy pendants
4. Top gallant stay collar

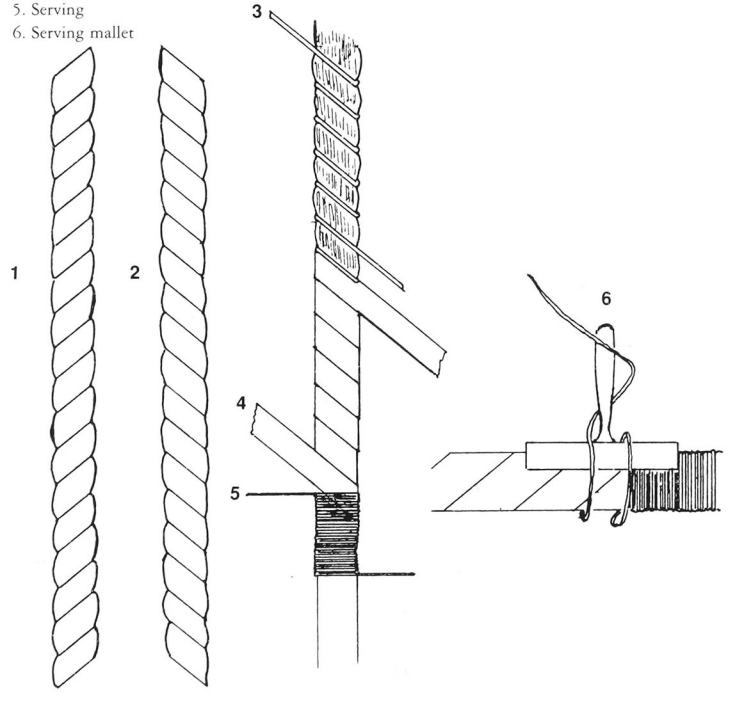
TABLE 14: Royal Navy Proportional Diameters of Lower Mast Standing Rigging, mid Eighteenth Century

Pendants of the tackle	6/10 of relevant stay
Runners of the tackle	13/20 of pendant
Falls of the tackle	13/20 of runners
Shrouds	6/10 of relevant stay
Shroud lanyards	½ that of relevant shroud
Stays	⅙ diameter of relevant mast
Main stay collar	8/10 of main stay
Preventer stays	7/10 of relevant stay
Preventer stay collars	8/10 of relevant preventer stay
Stay lanyards	⅓ of stay
Upper catharpins	¼ of shroud
Lower catharpins (not rigged)	¼ of shroud
Ratlines	1½in
Crowsfeet	1½in
Euphroe tackle	1½in

Order of dressing the lower masts

1. Pendants of tackle
2. Shroud gangs
   (fore mast: 1st pair to starboard, 2nd pair to port, 3rd pair to starboard, etc; main mast: as above, but 1st swifter to starboard, 2nd swifter to port)
3. Stays
   (for *Cruiser* these should follow the preventers)
4. Preventer stays
5. Upper catharpins
6. Lower catharpins
   (not rigged at this time)

FIGURE 114. Parcelling and serving rope.
1. Shroud laid rope (right down to left)
2. Cable laid rope (left down to right)
3. Worming
4. Parceling, using strips of tarred canvas
5. Serving
6. Serving mallet



filling between the lays of the cordage may be sufficient, and is done by passing the line of stuff through the thumb and finger loaded with a token amount of glue. When the glue has dried, a single coat of thin black paint can be applied which will finish the job and give to the rigging the appearance of being parcelled and served. For larger scales the serving can be a very fine thread wound on over the glue treated cordage. Similarly, the bight of the eyesplice about the masthead should be leathered, which can be represented by winding the gummed strip of a cigarette paper around the cordage, and painting with Humbrol saddle paint.

The working part of the fore and main tackles consists of a runner and falls. The runner's thickness should be just over half that of the pendant. A double block is spliced into one end, and the other end is then rove through the single block on the pendant and the end fitted with a hook, which was usually belayed through an eye bolt fitted on the fore part of the adjacent channel. This was the hoisting part of the tackle.

The purchase and falls had a thickness slightly more than half that of the runner. For the model, the cordage for all the tackle could be 1mm for the pendant, 0.75mm for the runner, and 0.5mm for the purchase.

A single hook block should be seized into one end of the falls and hooked into the eye bolt used for belaying the runner hook, or to an eye bolt close to it. The other end of the fall then roves through one sheave of the double block of the runner, down through the single sheave of its own block, and up through the second sheave of the double block. The end of the fall should be triced up and belayed to an adjacent timberhead or cleat (Fig 115, and see Photograph 61). This is the usual way of rigging the mast tackle, though of course variations will be found with all purchase tackle. It should be rigged so that it is seen to work: the double block of the runner should not come up hard against the single block of the fall before loads can be safely swung inboard. A good indication of this is that the runner should be two-thirds and the fall one-third of the shroud when the fall block is belayed on the channel.

Shrouds

Cruiser had four shrouds per side on the fore mast, and five per side on the main mast. These should be put on in pairs. The cordage length can be determined by taking it up from ½in below the channel around the head of the mast and down again to its starting point on the channel. This should afford enough material to turn into its deadeyes. The diameter of the shroud material should be six-tenths that of its relevant stay (see Table 14 for proportions).

The shrouds were usually of shroud laid rope, in which case the deadeyes should be turned in so that the short leg is on the left side viewed from outboard, both port and starboard. If the shroud is cable laid, the short leg should come up on the right side when viewed from outboard, both port and starboard. The throat of the turn should be seized as close and as tight about the deadeye as possible, to avoid having a gap at this point when rigged and stretched. It is best in the final stages of the rigging to stitch the crossed parts of the shroud with a fine needle and thread, pulling them tight, rather than leaving it as a tied seizing. The short leg should reach up to three times the diameter of the deadeye. It is important to maintain all the shroud short legs at a uniform height throughout for neatness. Two further seizings should be placed above the throat seizing, one to centre, and one just below the top. Fig 116 illustrates the whole arrangement. It is also

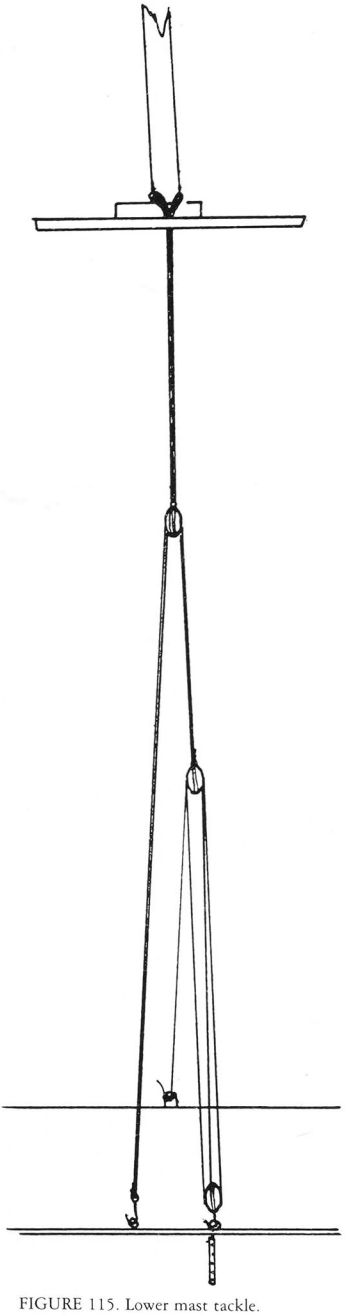


FIGURE 115. Lower mast tackle.

60. The bowsprit and lower foremast in position. The footropes running from bowsprit cap to the knightheads have been fitted, and the bowsprit collars for the forestay and fore preventer stay set up with their hearts. Below the bowsprit the lower and upper bobstays are in place, and its starboard shroud has been set to the wale just abaft the lower beak knee. The foremast tackle pendants and falls, the first items to go over the masthead, have been fitted.

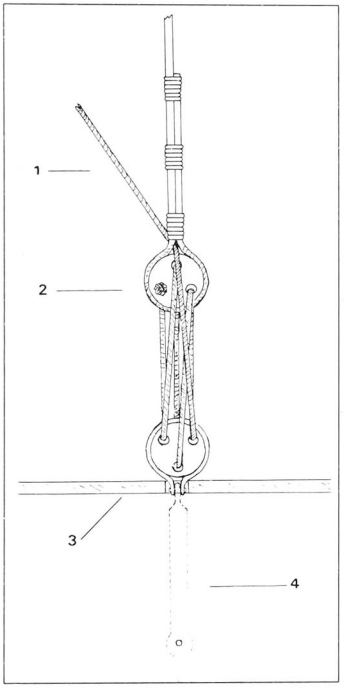
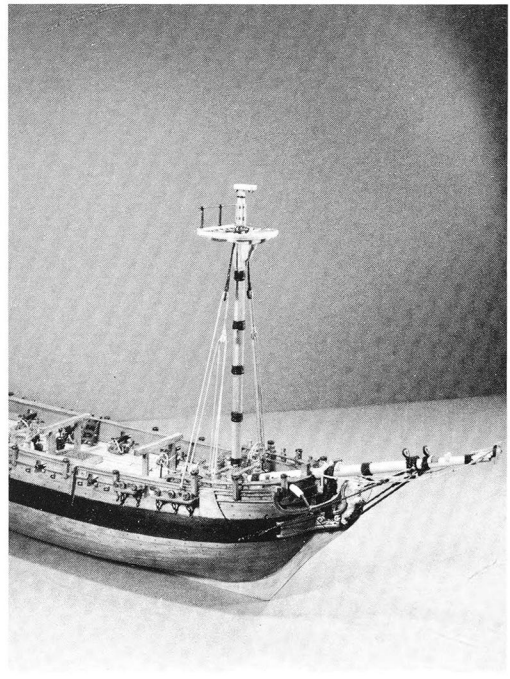
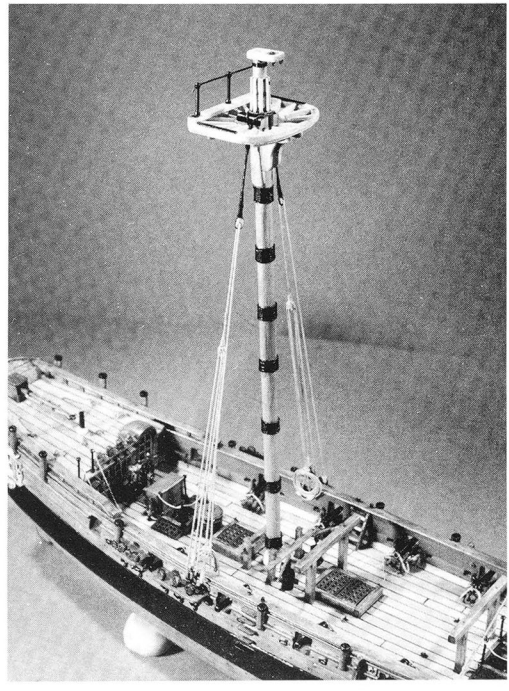
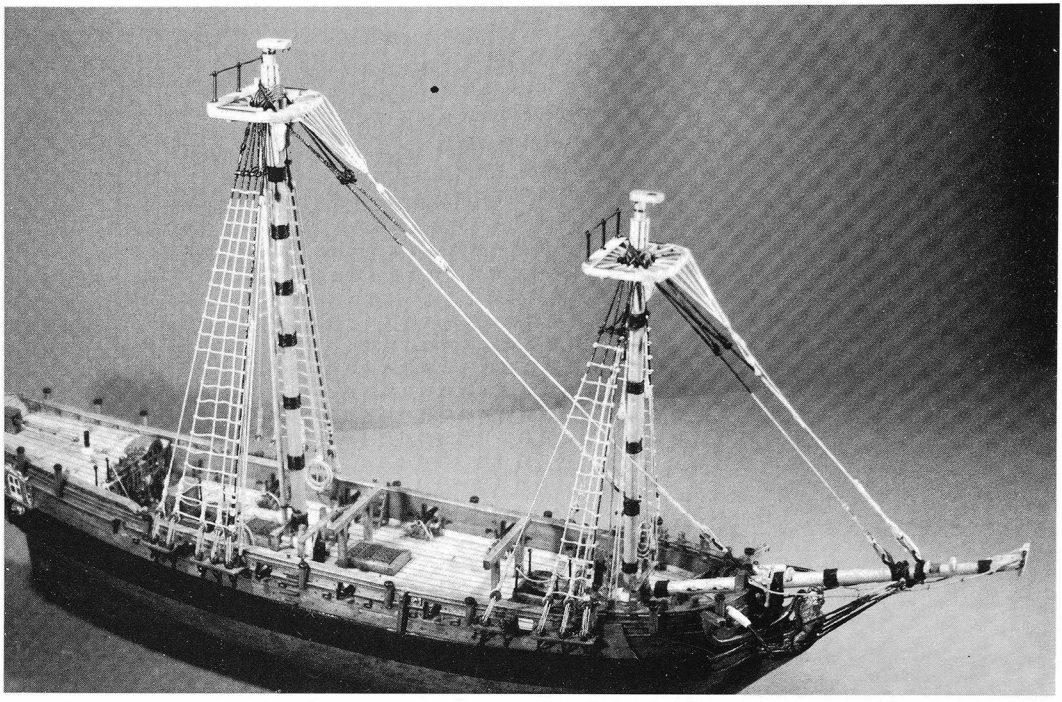


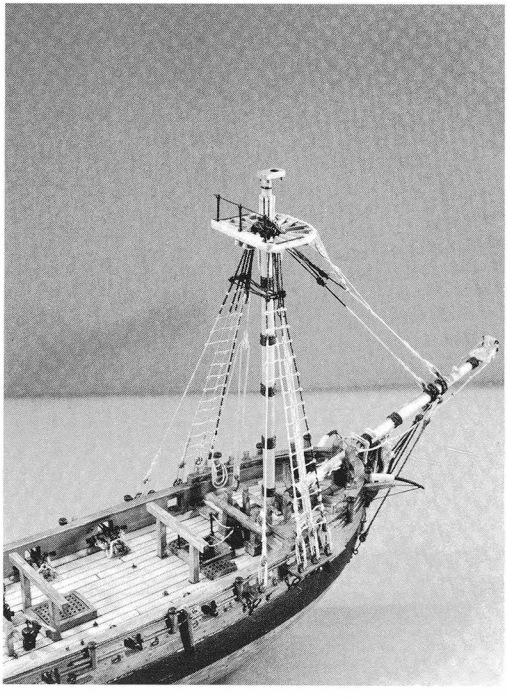
FIGURE 116. Setting up shrouds. Deadeyes and lanyards viewed from inboard side.
1. Purchase of lanyard frapped to shroud
2. Knot at end of lanyard
3. Through channel section
4. Chain plate

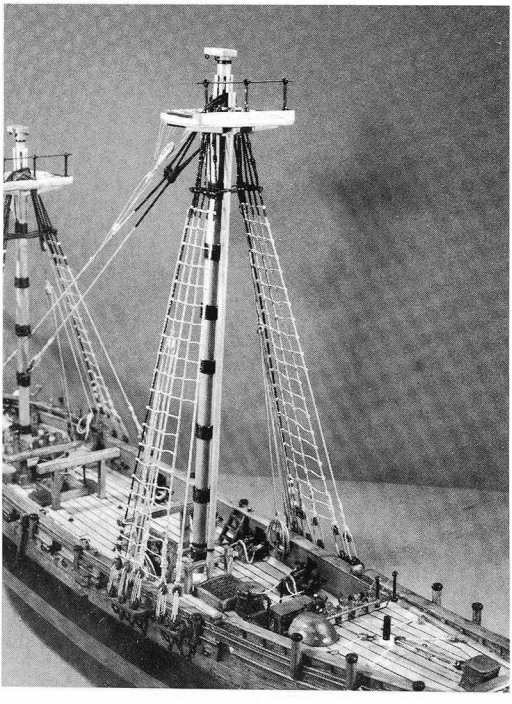




61. The lower mainmast, with fully rigged mast tackle, in place. Note the length of the pendants in relation to the purchase. A triced up end of the falls lies above the cleat on the port bulwark. The eyebolt above the gunport opening, used for lashing the gun muzzle against the bulwark when the cannon was not in use, has yet to be fitted.







62. With the mast tackle fitted, the fore and main shrouds are set up, followed by the lower mast stays, though in this case the preventer stays were first. On larger ships this order of placing the stays would be reversed. The main stay is led forward to be set up on the starboard side by the knightheads. The crowsfeet have been fitted to the fore and main stays by means of a euphroe. The ratlines are set 15 scale inches apart, and completed at the head by a futtock stave.

important to make sure that all the rigged deadeyes of the shrouds are a uniform height above the channels. Any misalignment will look not only very untidy but also unprofessional. For this a card template marker should be used when setting them up. The shroud deadeyes for *Cruiser* should be 9in in diameter. The deadeyes are best made from boxwood dowel, in much the same way as described for hearts, the holes first being end drilled, and the score set in, before parting the piece from the dowel length with a fine jewel saw. The faces should then be given a convex shape, common at this period.

The pairs of shrouds should be placed over the head to snug down on the bolster in the practised procedure. The first pair to starboard, the second pair to port, the third pair to starboard and the fourth pair to port. Each should be served down from around the head to a distance of 8ft, and wormed for the rest. The first shroud of each pair should be served for its entire length. The bights of the shrouds should also be leathered in the way of the head and bolster. The paired shrouds should be seized into a bight 1 ¼ time the diameter of the masthead.

When dealing with the single shrouds on the last of the main mast gang, they should be eyespliced separately to pass over the head, the first to starboard and the second to port. These single shrouds were known as swifters. In all other respects there is no distinction between them and the paired shrouds.

Once all the shrouds have been served and set with their bights over the masthead, the deadeyes can be set in, starting with the first shroud of the starboard fore mast gang. In the first instance it is best to tight hitch the shroud around the deadeye to a height clear of the channel deadeye by about 2ft, or twice the diameter of the deadeye. This exercise should then be carried out on the first of the shrouds on the port side, using the card template to ensure an exact spacing. It is essential throughout the rigging of the shrouds that the mast maintains its true position for rake and vertical alignment. The shroud deadeye and its channel deadeye can be loose rigged with the lanyard, as shown in Fig 117.

All the shrouds for the fore mast should be rigged provisionally in this way, tensions being taken up with the deadeye shroud hitches and lanyards until a satisfactory even tension, and a straight uniform run for the deadeyes, is achieved. The permanent seizing of

◀ 63. The lower foremast. The shrouds have been bowsed in with catharpins. The guys for the starboard bumkin have been fitted, as have the gammon block and fairlead saddle, drilled ready to take the running rigging, on either side of the gammon lashing. Just visible is the hook and eyebolt arrangement for the standing part of the bowsprit starboard shroud.

◀ 64. The lower mainmast from aft. Note the euphroe and tackle. The trysail mast has been stepped, with its fid through the head and box housing the heel.

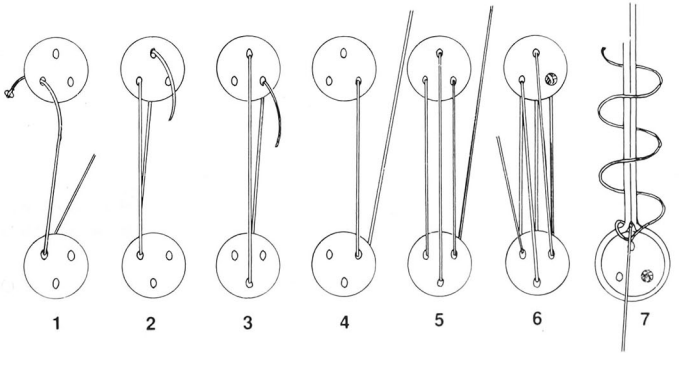
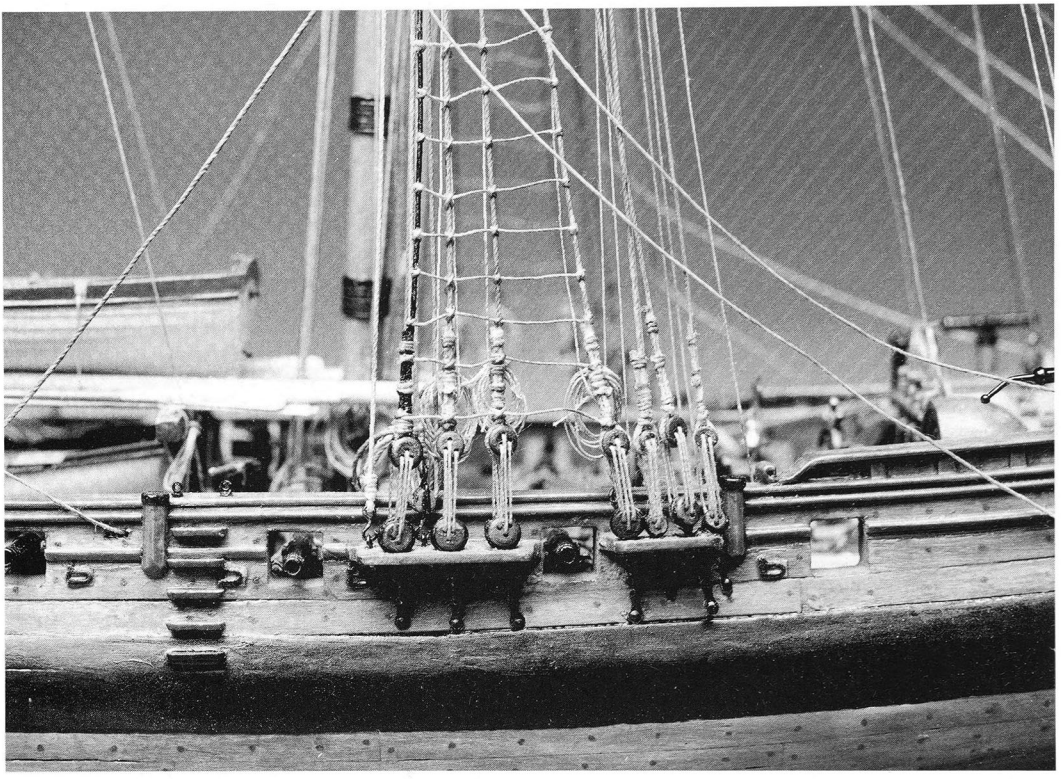


FIGURE 117. Sequence for reeving lanyards.
1–4. Sequence of threading lanyard through deadeye holes
5. Threading completed, seen from outboard side
6. Completed threading seen from inboard side
7. Lead of lanyard purchase end for frapping to shroud



65. Close up detail of rigging of deadeyes and lanyards to shrouds.

this rigging can then proceed, ensuring while doing so that nothing is pulled out of true. Photograph 65 shows a detail of the completed shrouds, deadeyes and ratlines.

Ratlines

The ratlines on a model only appear correct when they are rigged in the practised manner of being clove-hitched to every shroud across the gang, no matter what the scale. Any other method of fixing them across can only serve to diminish the final result of the finished model. Care should be taken when rigging the ratlines never to bowse the shrouds in, but to maintain uniform loops across the gang without distorting the straight run of the shrouds.

Technically, they were made from a standard 1½in line for all ratlines of the rig, and spaced from 12in to 15in apart. Each should start with an eyesplice seized to the first fore stay, be clove-hitched across, and conclude with an eyesplice seized to the last stay. In small scale model work, no one will mind much if the eyesplice is omitted and the run of the ratline starts and ends with a clove-hitch. Apart from this, an eyespliced bank of ratlines on a small scale can appear very much an overstatement, even when the eye is pulled straight with the lashing, and disappears from view, only to leave an irritating blob. It is better to stick with the clove-hitch, and be without knobbly shrouds.

There are many knots to be used

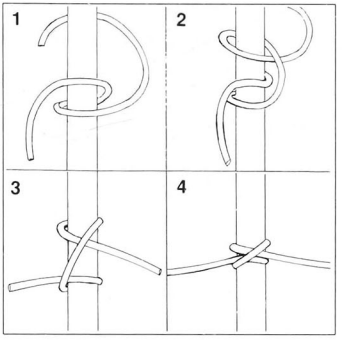


FIGURE 118. Four steps in making a clove hitch around a shroud.

on a ship's model, and while it may have been a help here to have thumb sketches of them in the text, it would be far wiser for the modeller to purchase a volume exclusively devoted to knot making and rope work, where each stage in forming a knot is graphically explained. In the long run it makes the task much simpler, and far more interesting. A clove-hitch is shown in Fig 118.

Upper and Lower Catharpins

The catharpins are an arrangement of short ropes which run athwartships, to bowse in the lower shrouds. The upper set are four in number, both on the fore mast and the main mast, and are rigged individually from the fore shroud back, immediately between the futtock staves. The diameter of the rope is one-quarter that of the shroud, and is served for its entire length. Each catharpin has an eyesplice at both ends by which they are seized to a shroud. This arrangement of the upper catharpins came into vogue about 1735, and remained until the early part of the next century. Before and after this, other arrangements prevailed. Those for *Cruiser* are shown in Fig 119. The lower catharpins were not rigged after 1730.

Stays

On most rigs the preventer stay sits above its main stay. However, on small vessels this was sometimes inverted, and the preventer stay sat under its main stay. On the Chapman rigging draught, *Cruiser* is shown as being rigged in this way. For this reason the preventer stays should go over the masthead first, both on the fore mast and the main mast.

All four stays for *Cruiser* should be rigged over their mastheads in the same way, the differences being their lead and setting up on their lower parts. All four stays in other respects should be the same.

The stays were more usually cable laid, the circumference of the main stays being half the diameter of the respective mast (or their diameter approximately one sixth that of the mast) while the preventers were seven-tenths the diameter of their respective stays. Their collars were formed with an eyesplice and a

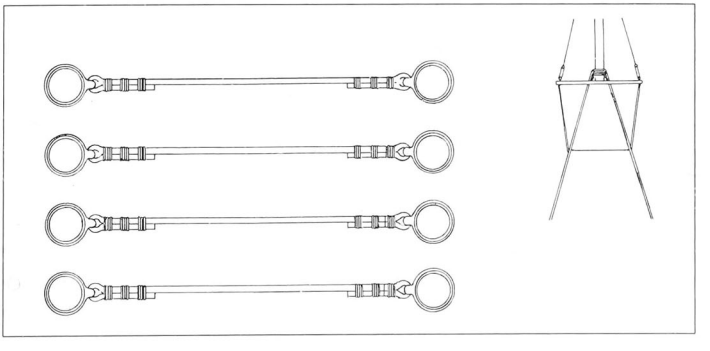


FIGURE 119. Rigging of the upper catharpins.

mouse, the eye of the splice being just large enough for the stay to pass through. The mouse was raised on the stay as a stop for the eye, so that with the eye hard up against the mouse, it formed a loop or bight. When set up the eye and the mouse should be about 6ft forward of the fore part of the lubber hole. Or alternatively, the length of the bight should be at least one and three-quarters times the length of the trestletree. The head loop was served all through, and the stay for some 6ft down from the mouse. The remainder of the stay was usually wormed. This arrangement can be seen in Fig 120. In times of conflict, such as the Seven Years War of 1756–63, the preventer stay and its main stay may have been snaked together as shown in Fig 120(3).

The pear shaped mouse should have a length and diameter three times that of the stay. In practice, it was made up with spun yarn, which was parcelled and tarred over. It was then pointed with ¾in rope. For small model work it may be easier to form the mouse from a piece of shaped boxwood, drilled through, and glued in position. The boxwood mouse should then be darned over with a fine black thread, starting by passing a stitch through the stay at the base of the mouse, carrying the thread up and over the mouse to pass it through the stay at the top of the mouse. This exercise should be continued until the mouse is covered all round with evenly spaced threads running from top to bottom. The thread should then be woven laterally into the longitudinal threads to form a netted darn, the final stitch being passed through the stay and tied off. The whole can then be given a thin coat of black paint.

Both the fore preventer stay and the forestay were set up to the bowsprit with hearts and lanyards, as described with the bowsprit furniture, the matching hearts being on the stays as shown in Fig 120(2).

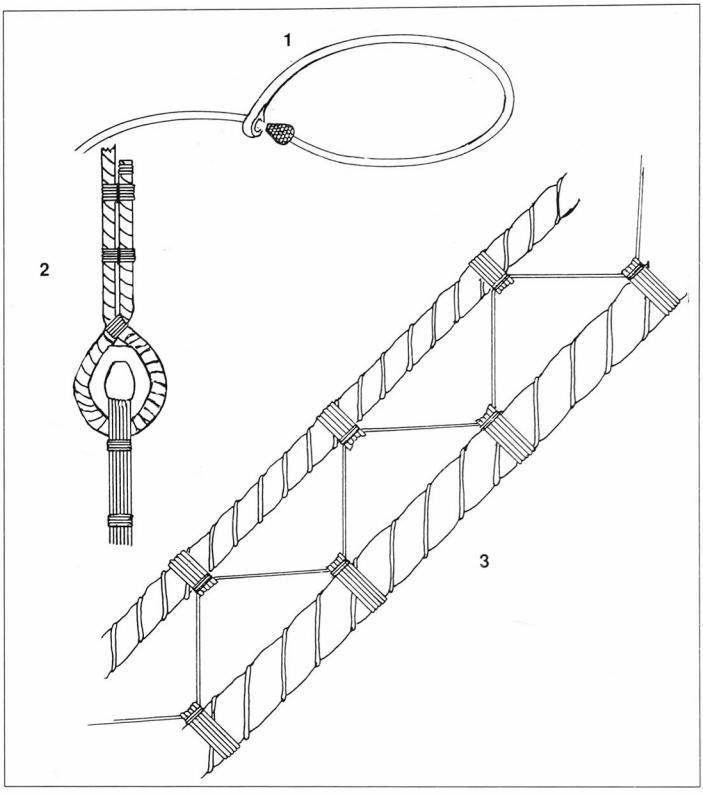


FIGURE 120. Rigging details – forestay and bowsprit.
1. Forestays: mouse and loop for rigging to head
2. Heart and lanyard arrangement for rigging to bowsprit
3. Method of snaking preventer stay and forestay in wartime

The main preventer stay is shown on the Chapman draught to run to a point about 2ft below the main stay as it crosses the fore mast. This suggests that the preventer head loop should be passed over the masthead before that of the main stay. A heart should be bent into the end of the stay to match that of the collar. The collar consists of a strop into which a heart has been seized, to leave two equal legs, eye spliced at each end (Fig 121). The legs should be long enough to circle the fore mast, where the eyes are seized together with a rose knot. The height of the collar should be about 9ft up from the forecastle deck.

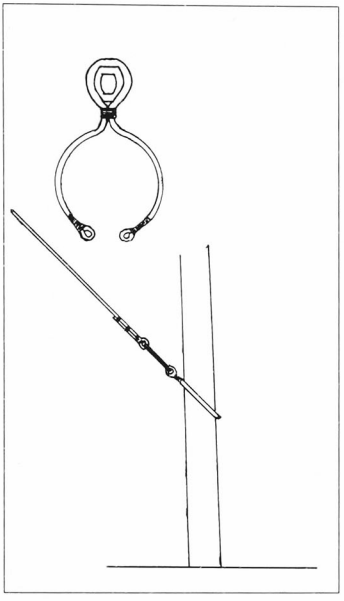


FIGURE 121. Main preventer stay collar arrangement.

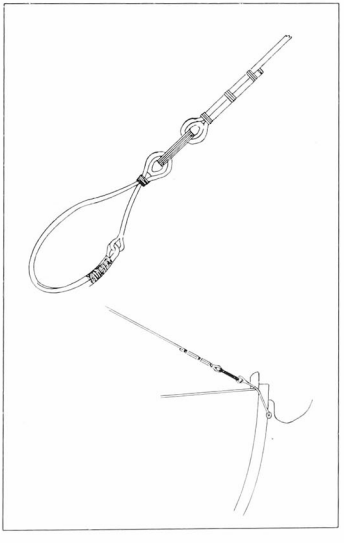


FIGURE 122. Setting up the main stay to the prow.

The heart of the stay and that of the collar should then be seized together with a lanyard which should have a diameter one-third that of the stay.

The lower end of the main stay should be bent onto a heart in the same way as the preventer stay, the heart to reach a point just abaft the starboard knighthead, where it will meet the heart of its collar.

The collar consists of a long strop with a heart set into the bight at its top, to leave a short leg and a long leg, the short leg being one-sixth the length of the long leg. An eyesplice should be set in the short leg, which should rest on the port side of the bowsprit. The long leg is passed to the starboard side of the bowsprit immediately by the stem, passed through its hole in the cutwater and gammoning knee, and up through the eye of the short leg on the port side of the bowsprit, and seized back on itself to form the collar. This arrangement can be seen in Fig 122. The collar and main stay should then be seized together with a lanyard, the heart of the collar resting immediately abaft the starboard knighthead.

Euphroe

The euphroe was a cod shaped block scored all round its narrow rim with a series of evenly spaced holes drilled through its flat surface. The fore part should be twice the width of the aft part, both ends being rounded. On the plan elevation the sides ran parallel, although the ends were again rounded. The euphroe block was rigged to the stay just below the mouse with a single purchase tackle, the upper block of which should be seized to the aft part of the euphroe strop, the lower block being seized to the stay. The standing part of the purchase was seized to the upper block, led down through the sheave of the lower block, from where the end should be frapped around its own run between the blocks.

The crowsfoot roping was one continuous line of 1½in stuff, the standing part of which was seized to the euphroe strop fore part, led up to the top rim to pass through the central hole from the upper side to the underside. From there it rove upwards through the next hole to starboard, down to the upper hole of the euphroe block, and from there down through the innermost hole on the port side of the top rim, and so back to the second hole of the euphroe. This exercise of moving from port to starboard continued until all the holes on the euphroe and the top were taken up. The crowsfoot should be completed with the last hole on the starboard side of the top, where the end of the rope should be double hitched around the last threaded loop on the underside of the top (Fig 123). There should be six holes provided for the *Cruiser* euphroes, and thirteen for the top.

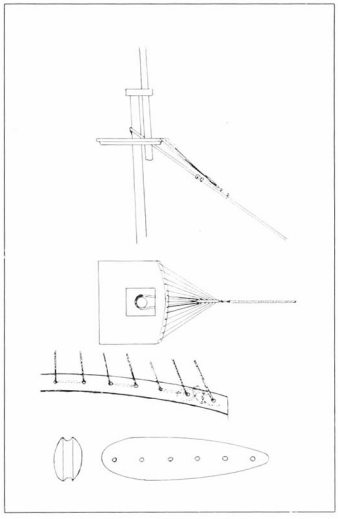


FIGURE 123. Arrangement of rigging of the crowsfeet and euphroe.

The Topmasts

Burton Tackle

For hoisting sails, swivels and other heavy items to the tops, a permanent tackle was rigged. This was known as the burton tackle, and was much the same as the tackle of the lower masts. The two burton pendants usually used were made up by two lines eyespliced together, the eye being passed over the top mast head to be bedded down on the bolsters as the first item to be fitted. The pendants extended down each side of the top mast to about one-third of the way down the shrouds. A single block was spliced into their ends. The proportional diameters of the topmast rigging are shown in Table 15, as well as the order of dressing the topmast. If the pendants are not rigged, they should be seized to the fore shrouds.

The topmast burton fall had its standing part seized to the pendant block strop, from where it passed down to reeve through the sheave of a single block hooked to an eye bolt in the top up through the sheave of the pendant block and so down to the top. The fall should be belayed to a cleat on the fore topmast shroud at shoulder height, and the end of the fall triced up to its own part. Photograph 66 shows the fore topmast burton tackle being set up.

Shrouds

The topmast shrouds were rigged over the head of the topmast in the same way as the lower shrouds. The lower ends should be seized into proportionate deadeyes and secured with lanyards to the lower deadeyes. The ratline rope was 1½in in diameter with 15in spacings. *Cruiser* had three shrouds per side on both fore and main topmasts.

Futtock Shrouds

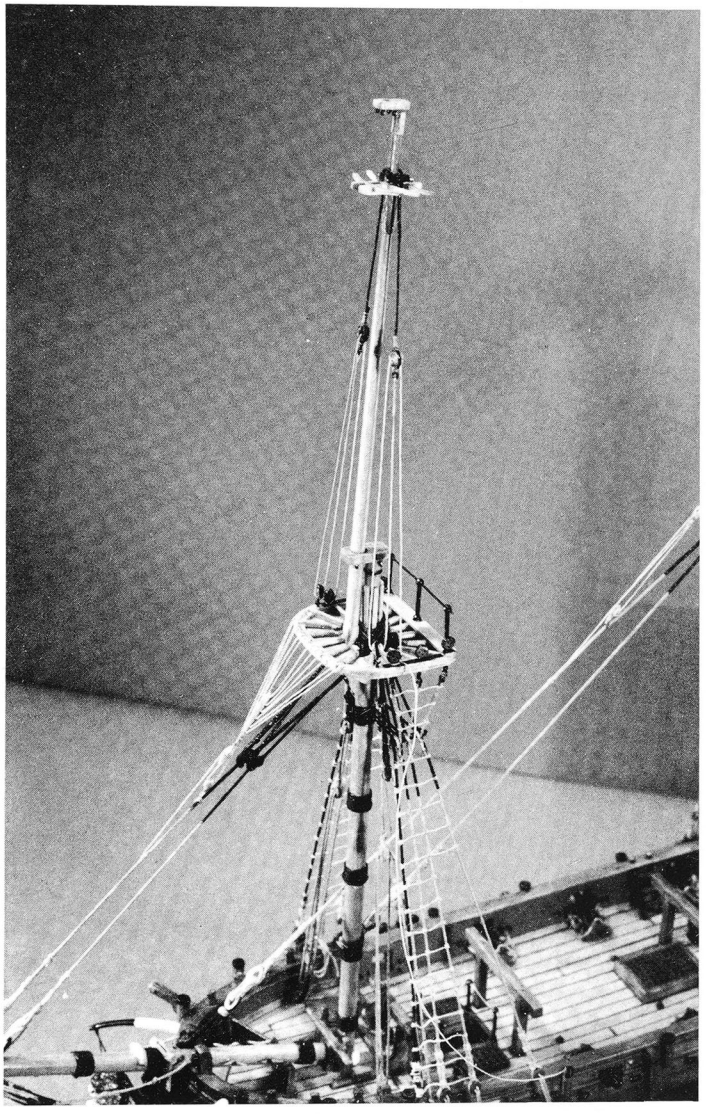
The lower deadeyes of the topmast shrouds should be given wire strops terminating in eyes. The eyes should be passed through holes in the top, the deadeyes sitting on the iron plate, the strops reaching below the top rim. The futtock shrouds are of the same number as the topmast shrouds, and should appear a continuation of them. The shroud should be about 6ft long

TABLE 15: Royal Navy Proportional Diameters of Topmast Standing Rigging, mid Eighteenth Century

Burton pendants	
Main	¾ of topmast shrouds
Fore	7/10 of topmast shrouds
Mizzen	7/10 of topmast shrouds
Burton tackle falls	
Main and fore	⅔ of shrouds
Mizzen	7/10 of pendant
Stays	½ that of lower stays
Collars	
Main	¾ of topmast stay
Fore	⅘ of topmast stay
Shrouds	7/10 of lower shrouds
Futtock shrouds	As topmast shrouds
Standing backstay	As shrouds
Lanyards	½ of backstay
Shifting backstay pendant	7/10 of standing backstay
Shifting backstay falls	½ topmast shrouds

Order of dressing the topmasts

1. Burton pendants
2. Shrouds
3. Shifting backstay pendant
4. Standing backstays
5. Preventer stay
6. Stays



66. Setting up the fore topmast burton tackle, the first item to go over the masthead. The burton fall, bent about a deadeye and hanging below the top, will be triced up to the first topmast shroud when these have been set up. Note the futtock shrouds and crowsfoot rigging. The main topmast burton tackles are fitted in the same way.

and reach to a level with the lower yards. A hook should be seized into the upper end to connect with the eye of the lower topmast deadeyes. The lower part should be given an end seizing.

The futtock stave can consist of a short length of brass rod, which should reach across all the lower shrouds at a point where the futtock shrouds end, and be seized internal of all shrouds. The brass should be painted black before fitting the futtocks.

The lower ends of the futtocks are then bent around the futtock stave, the ends being seized down their lower shroud (Fig 124). The ratlines of the futtock can then be rigged in the usual way. The upper catharpins should run laterally from the futtock stave. The futtock shrouds are shown clearly in Photograph 67, a view of the completed main top area of the model.

Shifting Backstays

Shifting backstays can be rigged. Considering the height of the masts, it is as well to fit these stays as shown. Two should be set on the main topmast, and two on the fore topmast, that is, one each to port and starboard.

The diameter of the pendant should be seven-tenths that of the standing backstay.

The pendants of the two stays should be joined with an eyesplice, and seated over the shrouds on the top mast masthead. They should extend down half as much again as the burton pendants. A thimble should be turned in their ends, to which long tackle blocks should be hooked.

The fall of a shifting backstay should be fitted with a hooked single block belayed to an eye bolt set in the deck just abaft the standing backstay. The fall should then lead up to the

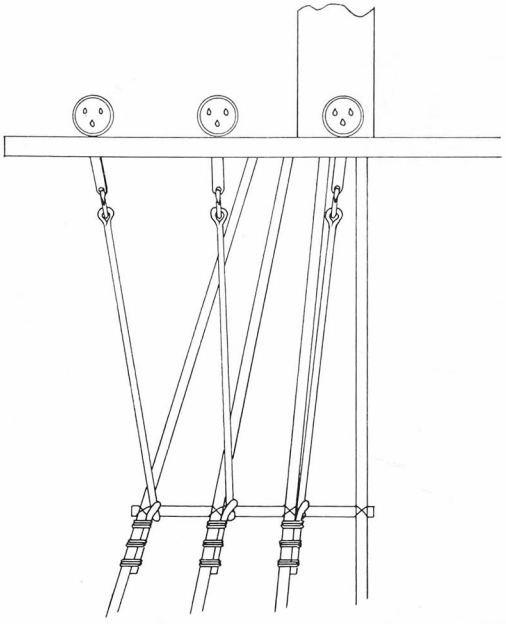
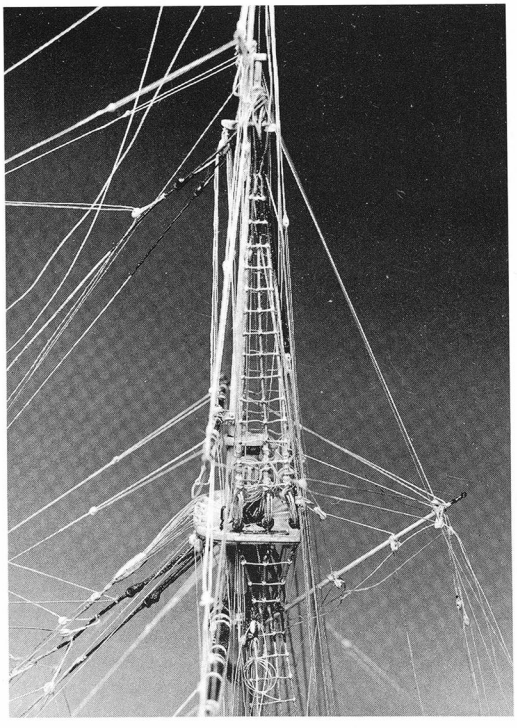
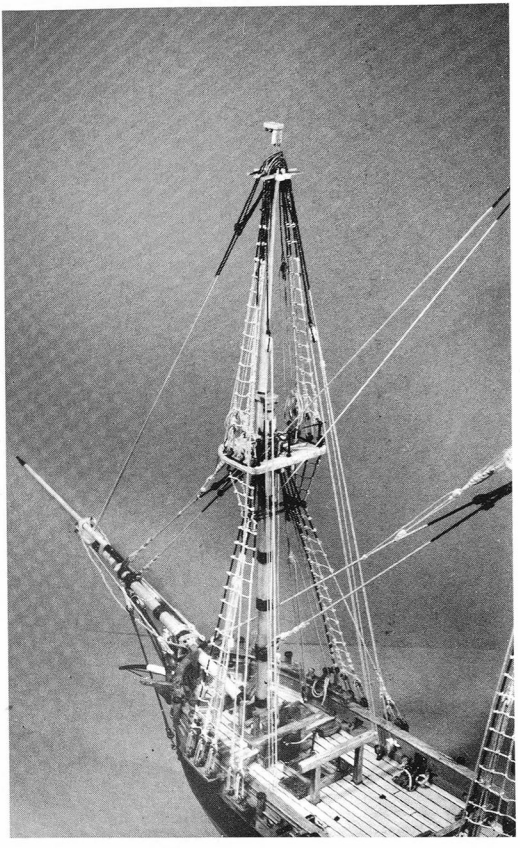


FIGURE 124. Rigging of futtock shrouds and staves.



67. The main top and rig of the gaff. Note the main topsail and topgallant yard braces led aft to the gaff peak. On a merchant vessel these would be led forward.



68. Showing the fore topmast shifting backstay. Thimbles for the topsail yard halliards' strops are in place. The main topmast rigging has been set up in the same way, and its stay and preventer stay lead blocks can be seen.

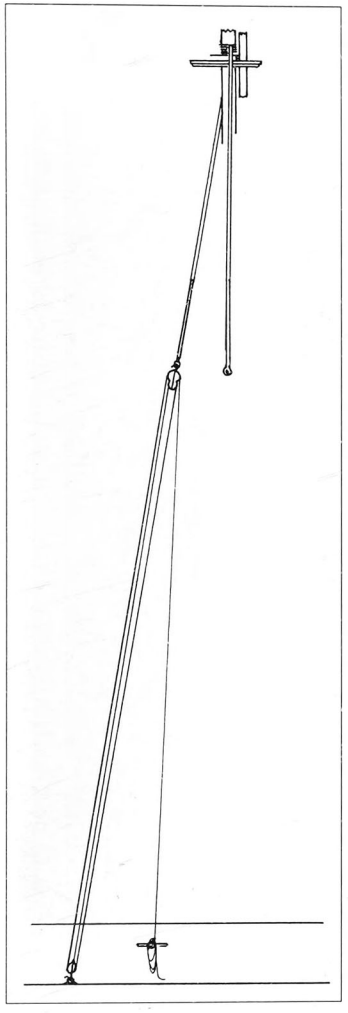


FIGURE 125. Rigging of the shifting backstay.

bottom sheave of the tackle block, down through the single sheave block, up to reeve through the upper sheave of the long tackle block, and the fall belay to a cleat near its run on the inner bulwark. This is shown in Fig 125. Normally, the falls were only rigged when under sail, but for the model it is as well to show them rigged whether or not sails are set. The diameter of the falls should be half that of their relevant topmast shrouds. Photograph 68 gives a clear view of the fore topmast shifting backstays.

The Chapman draught shows two pairs of standing backstays to both fore and main topmasts. However, other sources show a single pair set up from the aft channel for both fore and main. As the latter conforms with the Admiralty draught, this is how the model was rigged. They should be rigged as for the shrouds, the lower ends being set up with deadeyes and lanyards to the channels. The standing back stays should be the same diameter as their relevant shrouds.

Fore Topmast Stay and Preventer Stay

Both the fore topmast stay and fore topmast preventer stay were set over the masthead as the lower stays. The lower end of the fore topmast stay passed through the fore starboard sheave of the bees (Fig 126) after which a heart should be turned into its end. The stay should run back along the starboard side of the bowsprit to within 5ft to 6ft of the stem. A stropped eye bolt should be set into the prow close to the bowsprit, and a heart on a short strop seized to the eye bolt, and laced with a lanyard to the heart bent to the stay.

The preventer stay should be dealt with in exactly the same way, except that it should pass through the aft hole of the bees on the port side, and be set up with hearts and lanyards on the port bow. Photograph 69 shows the fore topmast standing rigging completed.

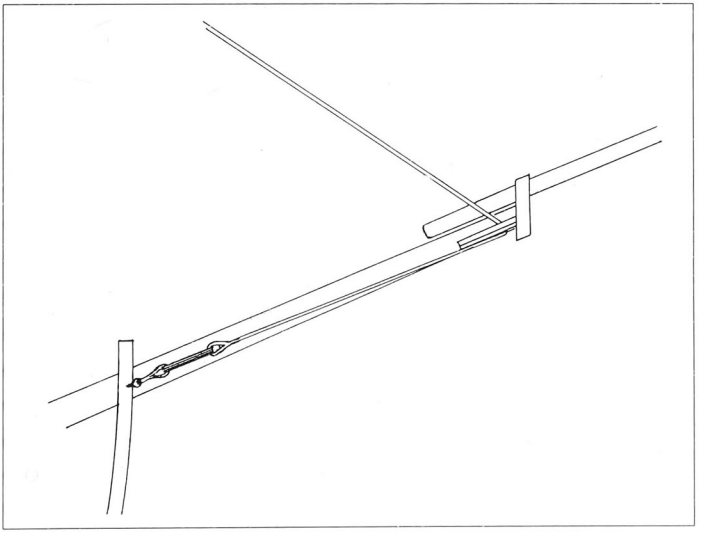


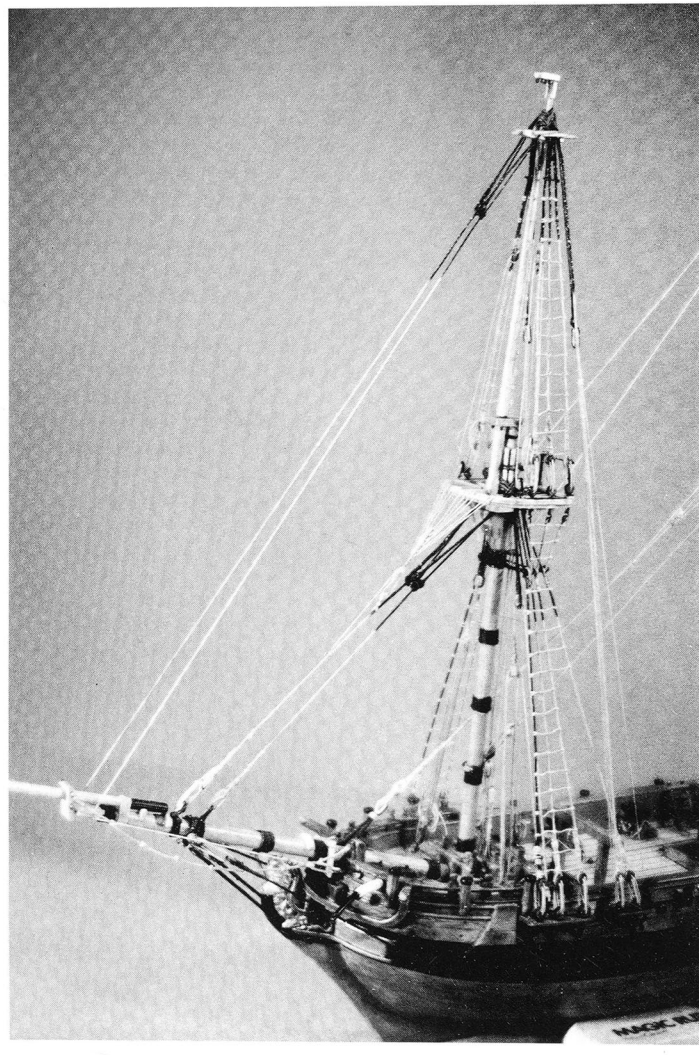
FIGURE 126. Rigging of the fore topmast stay.

Main Topmast Stay and Preventer Stay
Both these stays were set over the mastheads in the same manner as the lower stays. The lower ends of both stays were set up on deck. The lead block of the main top mast stay should be set to a collar, the collar being set just above the fore stay on the foremast head, by passing the long leg of the collar around the head from the starboard side, and through the eye of the short leg on the part side of the masthead. The end of the long leg is then bent back to be seized to its own part.

The preventer stay collar should be fitted in a similar way, but on a line with that of the bib. Single blocks should then be seized to each of the eyes of the stay collars.

The main topmast stay should be rove through the top collar block, and a long tackle block seized into its end. A single hooked block should be belayed to an eye bolt in the deck immediately behind the starboard side of the fore mast, to which the standing part of the main top mast stay tackle falls has been seized. The fall then runs up to reeve through the top sheave of the long tackle block, down through the sheave of the single block, and up through the bottom sheave of the long tackle block. The end of the fall is frapped about its own part, and seized off.

The preventer stay should be rigged in exactly the same way through the block of its collar by the bibs of the foremast. The preventer stay tackle falls should be set up on the port side of, and just abaft, the fore mast.



The Topgallant Masts

Fore Topgallant Stay
The first item placed over the fore topgallant masthead should be the forestay. This should be done with a simple eyesplice fitted over the head. The lower end of the stay should be passed from fore to aft through the centre thimble of the three rigged over the jibboom stop, passed back to the prow via the bowsprit fairlead centre hole, and belayed to a cleat on the starboard side of the inboard part of the bowsprit on the forecastle top.

69. The rigged fore topmast. The fore topmast stay and preventer stay pass through the bees and are set up with hearts and lanyards on the prow. The burton tackle falls are triced up to the topmast shrouds. The shifting backstay has been fitted.

Main Topgallant Stay

The upper part of the stay was fitted as for the fore topgallant stay. The lower end passed through a block seized to a strop fitted to the fore top mast head above the fore top mast stay collar. From this block it ran abaft the mast to the collar of the main topmast stay lead block, to which it was belayed with a double hitch.

Shrouds

Three shrouds per side were fitted to the topgallant masts at this time. The upper parts of the shrouds should be rigged as those for the lower shrouds. The lower parts of the shrouds passed through their respective holes in the extremes of the topgallant crosstrees and were set up as futtock shrouds by seizing to a futtock stave seized to the inner part of the topmast shrouds about 4ft down the topgallant hounds. The seizing to the stave was exactly the same as that described for the lower futtock shrouds. Ratlines were not always fitted at this time, but if fitted they would be no more than six per side up from the crosstrees. The topgallant futtocks were given ratlines in the same way as the lower futtocks.

The standing backstays were one per side on both the fore topgallant and main topgallant masts. They should be eyespliced together and be the last items placed over the head. They should be set up to deadeyes and lanyards as the shrouds. A table of proportional sizes for the topgallant standing rigging and the order of dressing the masts is given in Table 16.

TABLE 16: Royal Navy Proportional Diameters of Topgallant Mast Standing Rigging, mid Eighteenth Century

Stays	½ of topmast stay
Shrouds	As topgallant stay
Shroud lanyards	½ of shroud
Standing backstays	As topgallant shrouds

Order of dressing the topgallant masts

1. Stays
2. Shrouds
3. Standing backstays

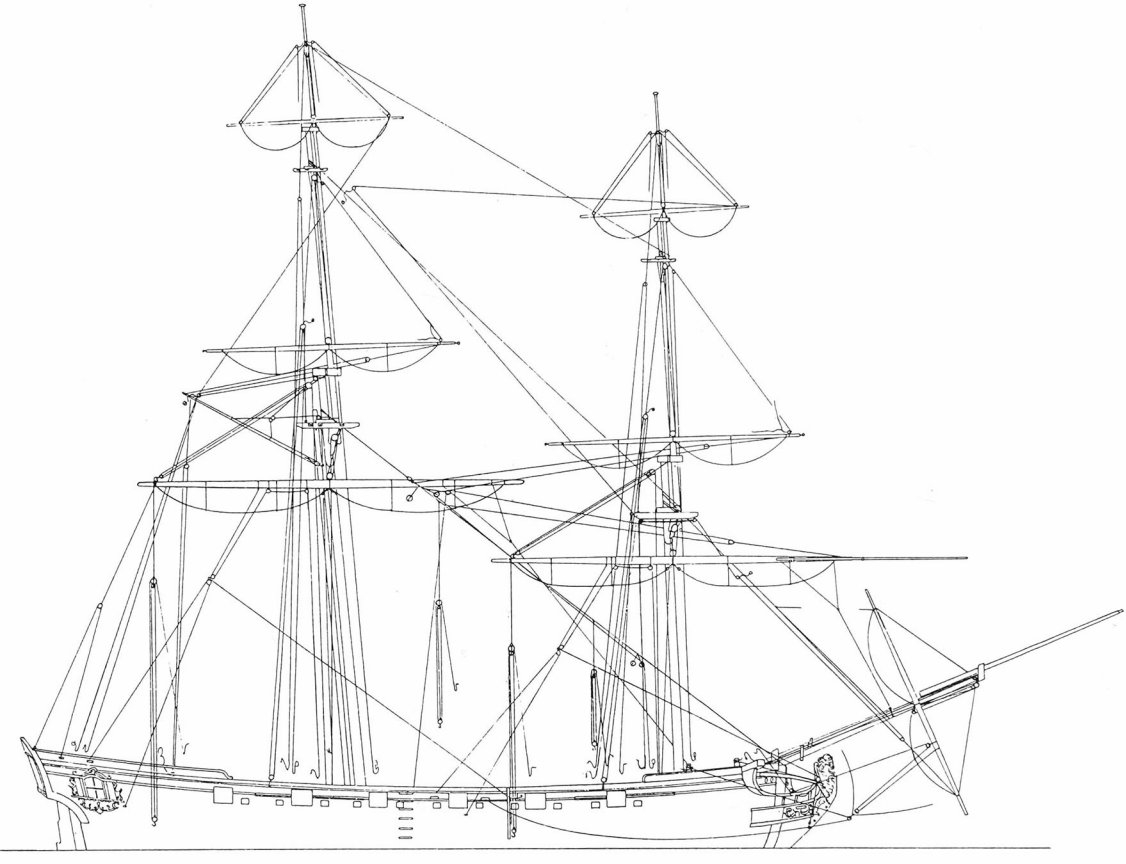


FIGURE 127. Draught of the running rigging.

9

The Running Rigging

IT IS ADVISED that before attempting any part of the running rigging, all its runs should be carefully studied from the following draughts and descriptions, to predetermine the required fairleads, eyebolts for standing parts, and cleats where falls are to be belayed.

The Lower Yards

The lower yards were held fast to their masts by jeers and parrels at this period. These items were in part a residual arrangement from the previous century, when the lower yards were lowered to the deck in order to furl the courses. During the period the ties were abandoned in favour of the jeers, and the parrels retained as a means of securing the yard to the mast in a permanently hoisted position. Table 17 gives the proportional sizes of the lower yards' rigging relative to the appropriate mast stay. The table also shows the order of dressing the yardarms. Figure 127 gives an overview of the running rigging, while Photographs 70, 71 and 72 show details of the rigging as completed.

Jeers

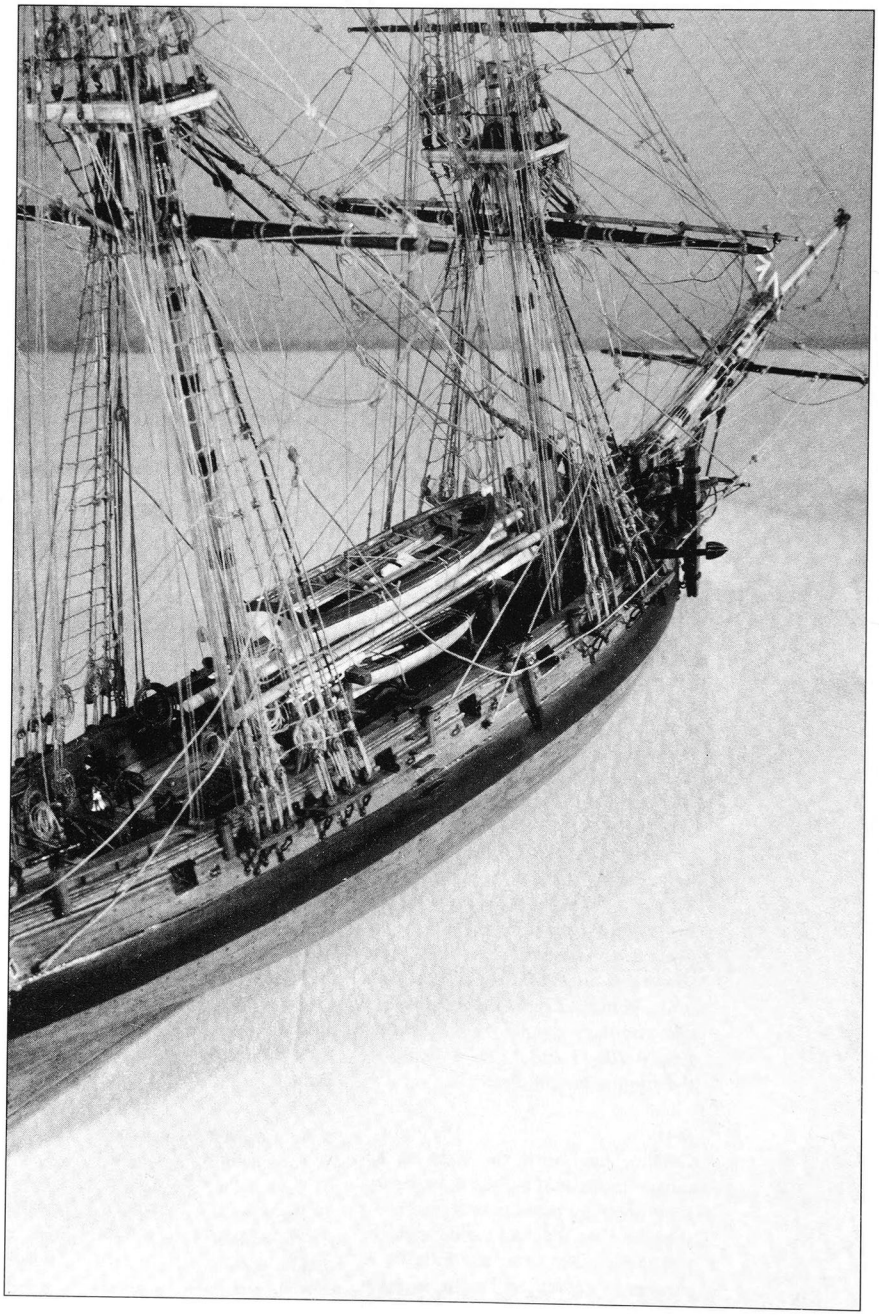
Dealing first with the jeers as arranged in the mid eighteenth century, their principal purpose was to act as a sling for the yard, and varied with the size of the ship as to the number of sheaves to a block, and to the number

TABLE 17: Royal Navy Proportional Diameters of Lower Yard Running Rigging, relative to the Mast Stay

Jeer strops	7/10
Jeer falls	1/4
Parrel rope	1/10
Lifts	1/5
Lift cap span	1/5
Footropes	1/4
Footrope lanyards	1/10
Stirrups	1/5
Brace pendants	1/5
Brace	1/5
Yard tackle pendant	2/5
Yard tackle falls	1/4
Leech lines	1/5
Bunt lines	1/5
Bowlines	1/4
Bowline bridles	1/4
Reef pendants	1/4
Reef tackle	1/20
Reef lines	1/10
Clew garnets	1/5
Sheets	2/5
Tack maximum	1/2
Earings	1/20

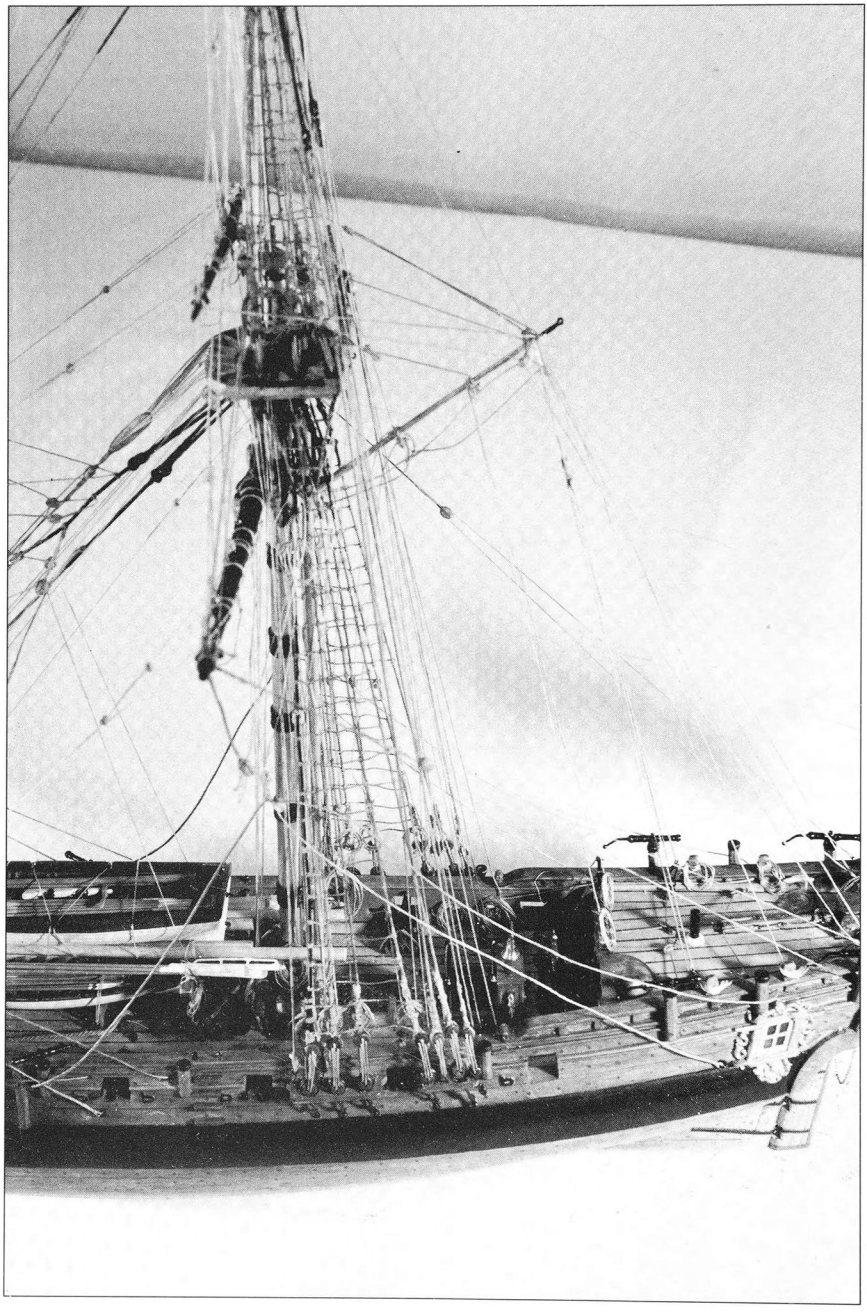
Order of dressing the lower yards

1. Footropes
2. Yard tackle
3. Brace pendants
4. Topsail sheet block
5. Lift block



70. Starboard quarter, showing the lower yards and spritsail yards rigging, together with that for their sails. Note the heavy lines of the tacks passing through the starboard chesstree and bumkin lead block from the suspended clew blocks.

71. Many of the items of rigging described in the text can be seen here. Note the extensive use of spans seized about the stays, such as that for the fore topgallant bowlines. The slacked off stay and toggled outhaul and downhaul of the main topgallant staysail allow the sail to be stowed on the fore top.



72. Rigging of the gaff and trysail. The lead of the main, topsail and topgallant braces, and the standing and running parts of the main course sheets are visible. Extra timberheads, two port and two starboard, have been placed on the quarter deck rail to accommodate the vang falls and those of the main topsail yard braces. These are additional to those shown on the original draught, and such modifications have always formed part of shipyard practice when dealing with practical applications of gear, tackle, etc.

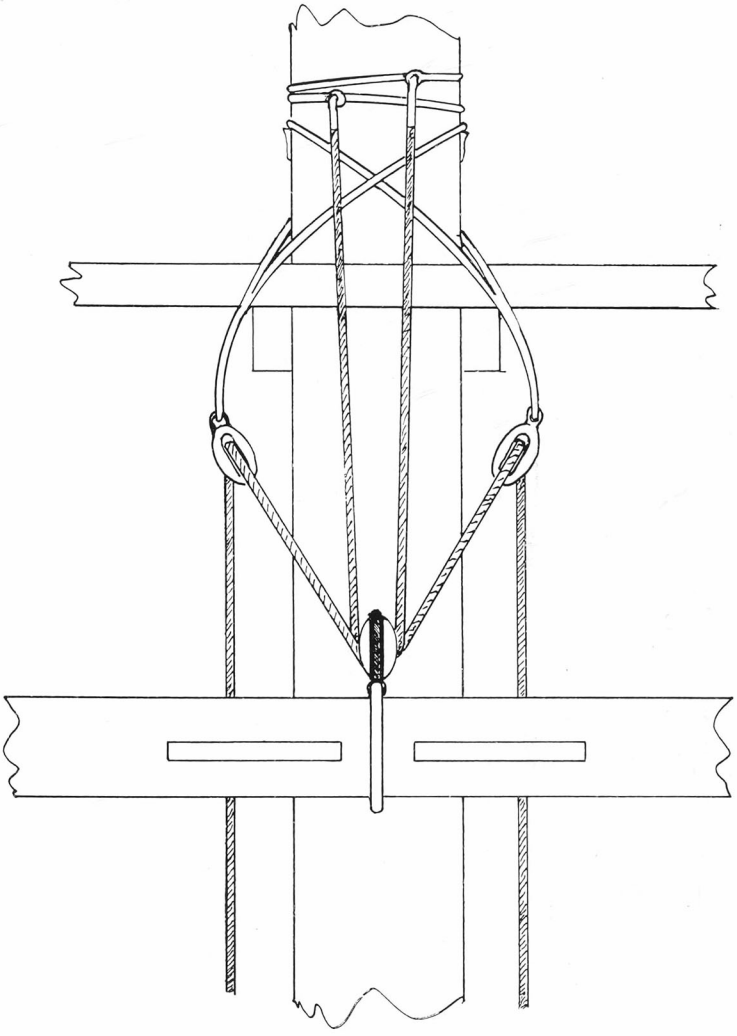


FIGURE 128. Rigging of jeers to lower yard. The topsail yard ties are rigged in a similar way.

of blocks used. For the largest vessels two treble sheaved blocks were hung by long strops from the masthead, and two double sheaved blocks were seized to the slings of the yard. The standing part of the jeer rope was eye-spliced to the yard just outboard of the double block, taken up to the fore of the outermost sheaves of the treble block, and down to the double block, until all sheaves were taken up with the end set up on deck.

For a sloop the tackle was much lighter and can be set up as follows (Fig 128). Two single blocks were hung by a long strop from the masthead to rest just below the trestletrees. A double block was stropped to the centre of the yard slings. The standing parts of the jeer ropes were

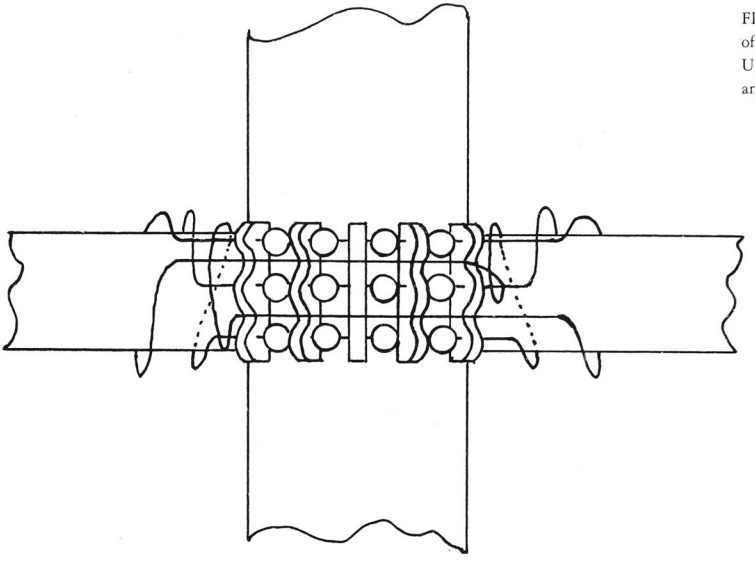


FIGURE 129. The arrangement of the parrels of the lower yard.
Upper yards would have two rows of trucks and a reduced number of ribs.

eyespliced around the masthead, the starboard rope reeving through one sheave of the yard double block and up through the sheave of the port mast block, and down to belay on the bitt. The port jeer rope should be rove through the second sheaves of the double yard block from port to starboard, reeving through the sheave of the starboard mast block, and so down to belay on the bitt. At a later date the lower ends were set up with a double purchase tackle.

Parrels

The parrel (Fig 129) was made up with a series of trucks and ribs. The trucks were round wooden balls of a uniform size drilled through to take a line. They should be about 2in in diameter, and can be made up from a boxwood dowel, end drilled for the thread, filed to a ball, and parted from the dowel stick. In this way they can be made uniformly and rapidly.

The ribs should be made from a strip of boxwood, the concaves filed out with a half round needle file, drilled through for the thread, and parted from the strip, when the ends can be rounded. There should be three convex parts to the rib, and a truck should be strung against each one, followed by another rib. The number of ribs and trucks so assembled will depend on the diameter of the mast. The parrel should span the mast from immediately abaft the yard on the port side to immediately abaft the mast on the starboard side, starting and ending with a rib.

After the parrel has been assembled and the ends of the parrel ropes tied off, enough rope should be left on both ends to rig the parrel to the yard and mast. This can be done in a number of ways, the usual method being to give the ends a turn around the yard, back over the concave parts of the ribs, taking one end from left to right and the other from right to left, until the whole line has been expanded. When reeving the line from the yard to the parrel, the line should be looped over a neighbouring line before passing over the ribs to bowse the whole into a tight fit. The ends should be seized together on the fore

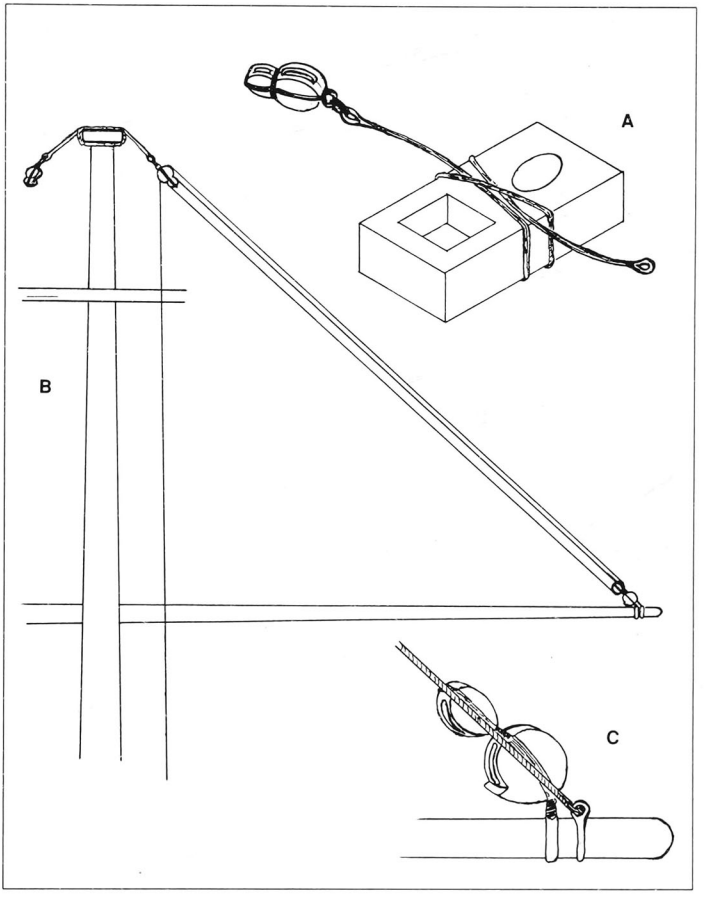


FIGURE 130. Lower yard lifts.
A. Clove hitched span
B. Run of the lift
C. Topsail sheet block and lift block with standing part of lift with eye spliced strop

part of the yard. Truss pendants and falls took the place of the parrels on the lower yards during the later part of the century.

Lifts

The lower yard lifts were an arrangement of tackle to hold the yard in a horizontal position to the mast (Fig 130). They were so designed to cant the yard if necessary, as opposed to the standing lifts in the next century, which were fixed spans. While the principle of the lifts remained constant, their rig suffered many changes during the sailing ship era, as was common with most rig arrangements. By the mid eighteenth century the lower lifts were rigged as follows as shown.

A long strop, with an eye spliced into each end, should be turned around the cap to provide two short pendants, one to port and one to starboard. A long tackle or fiddle block is then seized to each eye of the pendant

(Fig 130A). An alternative method is to bend the long tackle block directly to the strop, dispensing with the eye lashings. A decade later, eye bolts were fitted under the caps, to which double blocks were seized.

A single block, set above a topsail sheet block, with the common strop being given a seizing between them, is seized around the yard arm. A small collar with a seized eye is then set beside the blocks on the yardarm (Fig 130C).

The standing part of the lift is seized to the eye of the collar, passed up to rove through the bottom sheave of the tackle block from the top, down to the single block on the yardarm to rove up through the sheave, up again to pass through the upper sheave of the tackle block, and so down to the deck. The fall can be belayed and triced up to either the aft bitt or to a cleat on the mast. The mast cleats were the precursors of the spider bands, and should be set about 4ft above the deck.

Footropes

Two footropes or horses should be fitted to all yards at this stage, the rigging arrangement on their inner ends being pertinent only to the mid eighteenth century on Royal Navy ships.

The footropes, as their name implies, were ropes rigged to fall 3ft below the yard for the seamen to stand on while handling the sail (Fig 131). They were introduced during the latter part of the previous century. The outer ends were spliced around the yardarm throughout the period, but the inner ends suffered change. By the time of *Cruiser* the inner ends were spliced around a deadeye, each footrope extending from the yard arm to the slings, one to port and one to starboard. The two footrope deadeyes were then seized together with a lanyard, which in turn was usually seized up to the centre of the yard (Fig 131A).

Each footrope should be supported by at least two stirrups on the lower yards, with one each for the topsail yards. They should not be required for the topgallant yards. The stirrups were plaited ropes ending with an eyesplice. In practice they were given a couple of turns around the yarn at the quarters, and nailed in position (Fig 131B). The stirrup eye should hang down about 3ft on the fore part of the yard. The footrope is passed through the eye in its rigging, the stirrup serving to hold the footrope up to a working height.

Flemish horses are short footropes rigged to the yardarms to assist seamen when reefing a sail. They should only be rigged on a yardarm when its sail can be reefed, and so were mostly confined to the topsail yard. The outboard part of the horse should be seized to an eye bolt in the yardarm end, the inner end set up with deadeyes (Fig 131C). The fitting of this feature should be guarded as they did not become common until the 1760s, though they were known to be used occasionally before this time.

Braces and Brace Pendants

The length of brace pendants for all yards were about three-tenths of their respective yards. All were rigged in the same way by being eyespliced over their yardarm at one end, and fitted with a single common block on the other.

The lead of the braces can be found in the Chapman sail and rigging draught (see Fig 8), and in Fig 127.

Dealing with the lower fore yard first, a short strop should be clove-hitched around the main stay, three-quarters of the way up, to hang 3ft down each side of the stay. Eyesplices should be turned in each end of this.

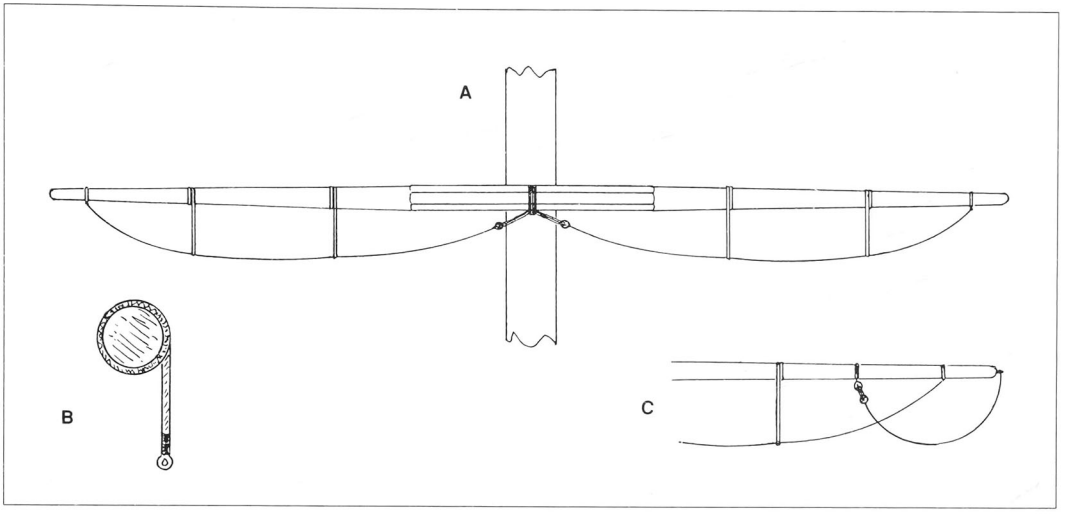


FIGURE 131. Rigging footropes.
A. Method of rigging footropes to lower yards
B. Stirrup bent to yard
C. Flemish horse

A similar strop, but with a common single sheave block spliced into each end, should be clove-hitched to the stay about 4ft back from the eye-spliced strop. An eyesplice should be made on the end of the standing part of the brace, which should then be seized to the eye of the lower strop. The brace will then lead through the block of the yard pendant, back to rove through the block on the stay strop, and so down to the deck, where it should reeve through a single lead block just aft of the main hatch. The fall should be belayed on the main topsail bitts.

When tricing up the falls on the bitts, enough cordage should be given to the coil so that it can be convincingly paid out, when the yard is close hauled from a square position. This, of course, will apply to all yards, and the falls of all running rigging.

The standing part of the lower main yard braces should be seized or bent to an eye bolt on the aftermost part of the quarter deck rail, port and starboard. From there they should rove through their respective blocks of the yardarm pendants, and back through sheaves set in the bulwarks just abaft the quarter badge. From there they are taken inboard and belayed on cleats set on the internal quarter deck bulwark. The falls should be coiled on deck. This can be neatly done by flat winding a length of the same cordage onto a pre-glued piece of card. When the flat coil has dried on firmly, the card is trimmed away to leave the coiled rope exposed. The coil is then glued over the short tail of the fall.

Yard Tackle

The yard tackle was an arrangement for lifting heavy loads inboard or, in conjunction with other tackle, boats in and out of the water. One was set to each of the fore and main lower yardarms. They came into use during the latter part of the previous century, and continued in the described form well into the next.

The tackle should consist of a long pendant a quarter of the yard's length. The standing part of the pendant should be spliced around the yardarm, the other end being given a long tackle block. The falls of the

tackle should be long enough to lower a boat into the water, and a hooked single block should be bent to one end of the falls for this purpose. As the block would be used for lifting such heavy weights as cannon it is highly probable that it would be iron stropped and not rope stropped, the iron strop being between a ½in and 1in thick. The falls should be belayed with the hook of the falls block being seized to the futtock stave.

The run of the falls should have its standing part seized to the hook block strop, from where it should rove through the lower sheave of the long tackle block, down through the sheave of the hook block, and up through to the top sheave of the long tackle block from where it should be triced up to hang below the yard at the third quarter.

Tricing lines were rigged to hoist the tackle up for belaying. The lines were unshipped when this had been done, but the means of rigging them should remain. These should consist of a single common block seized to the yard immediately above the hoisted long tackle block, and a further single common block seized to the yard at the slings. A small metal cleat will be required, set on the fore rim of the top. Fig 132 shows them belayed, and the running rigging draught Fig 127 shows them lowered over the side.

Leechlines

Leechlines replaced the complicated martinets around the middle of the previous century. Their purpose was to spill the air from the sail for furling.

The leechlines are a good example of how a modified rig was first introduced into small ships long before being adopted by the larger vessels. The run of the leechlines as described below were rigged to sloops and cutters as early as the first quarter of the eighteenth century, but were not rigged like this throughout the navy until the last quarter of the eighteenth century.

For a sloop, one leechline should be rigged per side to the courses, whereas for a sixth rate two would have been rigged. Dealing with the double leechline first, the standing part should be seized to the upper leechline cringle on the sail, up through a single block on the fore of the yard, set a quarter of the way in from the arm, up through the outer sheave of a double block set under the fore part of the top. It continues aft along to the outer sheave of a double block set under the aft part of the top, down through the upper block of two single blocks stropped together bottoms up, up again to the inner sheave of the aft double block under the top, forward to the inner sheave of the fore double block under the top, down to a second block seized to the yard, just inboard of its partner, and the end is seized to the lower leech cringle of the sail. The lower block of the two single blocks stropped together should be rigged as a simple whip.

The single leechline should follow the same run as the first lead of the double leech line, its standing part being seized to a single cringle on the sail, and the inner sheaves of the double blocks under the top being taken up eventually with the outer buntline. The double stropped single blocks would not be required, one single sheave block taking their place, to which the single leechline should be bent. The whip would then be rove through this block. A variation of this arrangement is to omit the whip, when the leechline would run directly to the deck. In each case, the fall of the whip or that of the leechline should be belayed to a cleat on the mast, or to the bitts. This run is shown in Fig 133.

Should the model be completed

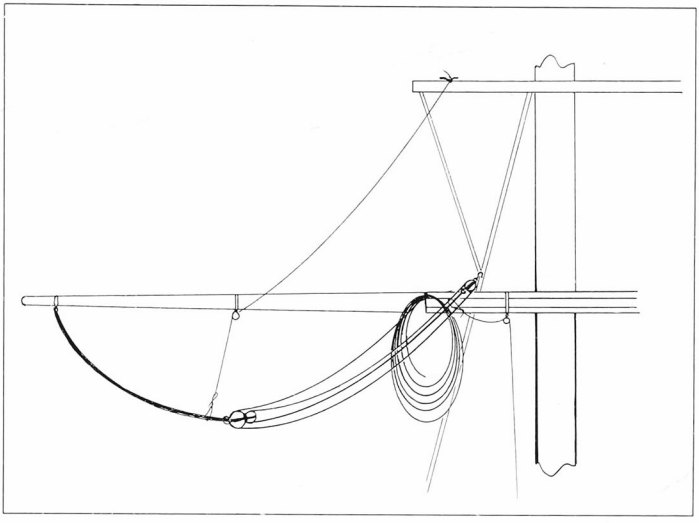


FIGURE 132. Lower yard arm tackle and tricing lines.

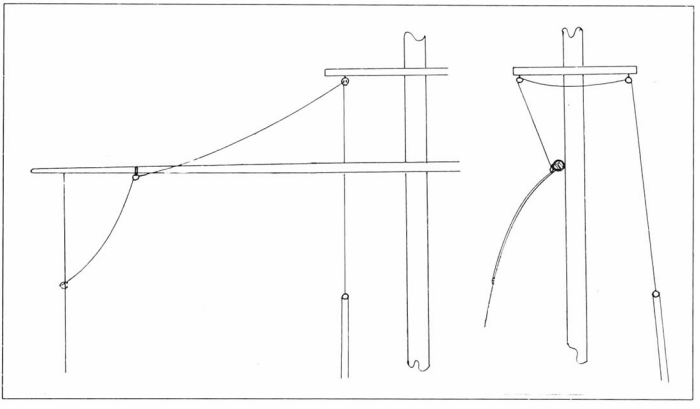


FIGURE 133. Lower fore and main course leech lines and leech line whips.

without sails, but with the sail rigging not sent down, the standing part of the leechline should be wall knot stopped, or given a toggle, and pulled into the block set upon the yard. The remainder of the leech run and the whip, if fitted, would remain the same.

Buntlines – Fore Course

The rig and number of buntlines varied with the size of the course. For a sloop of the mid eighteenth century, two per side of the course should be carried (Fig 134). Their run was much the same as that for the leechlines. Eye bolts should be fitted to the top of the yard at this time, to which the buntline blocks should be seized. Two bolts per side of the yard should be set in the region of the second and third quarters.

The standing part of the outer buntline should be attached to the

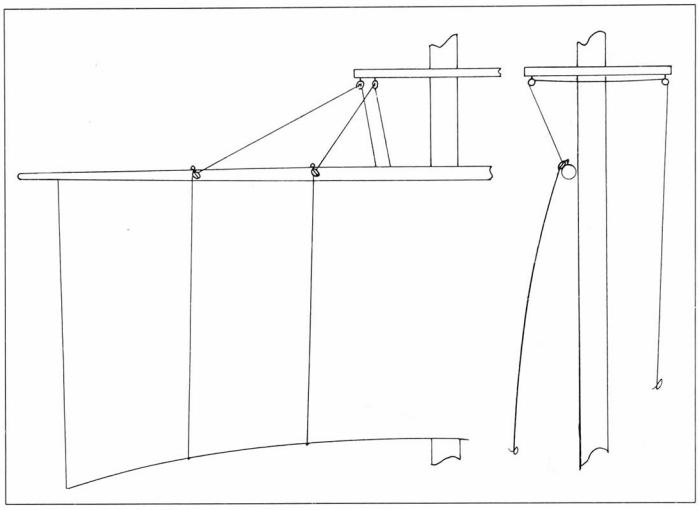


FIGURE 134. Arrangement of fore course buntlines.

buntline cringle at the foot of the sail, about a third of the way in. The line should lead up to the block seized at the second quarter of the yard, up through the inner sheave of the leechline; fore double block on the underside of the top, aft through the inner sheave of the aft leechline double block under the top, and so down to the deck where it should be belayed on the topsail bitts.

The standing part of the inner buntline should be attached to the cringle at the foot of the sail some two-thirds of the way in. From there it should lead up to rove through the block set at the third quarter of the yard, up through a single block set on the fore part of the top on the underside, aft through a single block set on the aft side of the top on the underside, and down to the deck. It should be belayed on the topsail bitts.

Should the courses not be bent to the yard but the sail buntline rigging blocks remain rigged, the standing part of the buntline should be wall knot stopped, or toggled and pulled up to the yard block. The remainder of the buntline should be rigged as before.

As with the leechlines, the rigging of the buntlines were transitional at this time. Larger vessels may still have been rigged with a shoe block and buntline falls. For sloop and cutters, the rig should be as described.

Buntlines – Main Lower Course

These should be rigged on the yard in the same way as those for the fore course. However, the lead differs in that the bunt legs are led forward of the course and are set up with a shoe block and buntline falls. They should be rigged as shown in Fig 135.

The outer buntline leads up from the yard block to the inner sheave of the double leech block on the fore part of the underside of the top, down through the upper sheave of a shoe block on the fore of the sail, up through a single block on the fore part of the top, on its underside, and down through the second bunt block on the yard, and so down to the foot cringle of the sail.

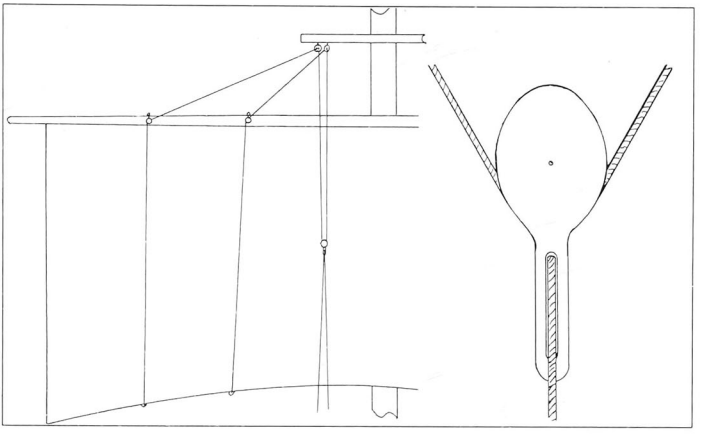


FIGURE 135. Main lower course buntlines. Arrangement of buntlines and buntline falls. *Right*. Typical shoe block

The standing part of the fall should be bent to an eye bolt in the forecastle deck by a timberhead adjacent to the stem, up through the lower sheave of the shoe block, and so back to be belayed on the timberhead by the stem near its standing part. Both port and starboard buntlines are dealt with in this way.

Bowlines and Bridles – Fore Course

Bowlines were used to support the leech of the sail and hold it firm to the wind. For this rig, bowline cringles were fitted to the leech. In the case of a sloop where only a single bridle would be used, two cringles should be fitted to each side of the sail, about half way along its length, to accommodate the two bridles and their bowlines (Fig 136). One end of a short strop forming a bridle should be bent to the upper cringle, and passed through a thimble seized into the end of its bowline, when the free end of the bridle should be bent to the lower cringle.

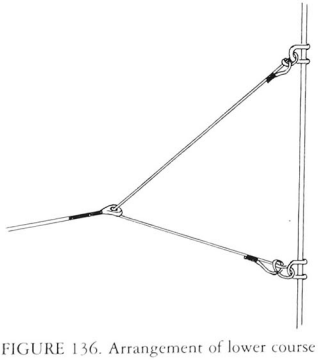


FIGURE 136. Arrangement of lower course bowlines and bridle.

Each of the two bowlines should then be led forward to two blocks seized to the bowsprit, just abaft the fore stay collar, from where they should lead back to the forecastle top via a fairlead on the gammon lashing, or a pair of holes on the bowsprit saddle fairlead. The ends should be belayed to cleats on the internal forecastle bulwark adjacent to the stem, one to port and the other to starboard.

When the sail is not fitted, the bridles should be timber hitched about the yard just a foot or two inboard from the cleats. The bowlines and bridles are otherwise rigged in the same way.

Bowlines and Bridles – Main Course

These were rigged in exactly the same way as those for the fore course, except that the bowlines were belayed directly on the fore jeer bitts at this time. Reef tackle and pendants to lower yards were not rigged at this time. While the courses may well have had reef bands, reefing points and cringles, the sail was shortened by hauling it up by hand, the reefing cringles acting as earing cringles which were seized to the yardarm.

Clew Garnets

There is no distinction between the clew garnets of the courses and the clews of the upper sails.

The standing part of the clew garnet should be timber hitched about the yard one-third of the yard's length from the centre. From there it should lead to the shoulder clew block at the clew of the sail, back to a shoulder clew block seized to the yard underside just in from its standing part, along to a common block seized to the yard on its underside by the top sail sheet or quarter block, and so down to the deck to be belayed on the top sail bitts (Fig 137). The clew block has a distinctive shoulder built into it, and were rigged as described at this time. The second inner block on the yard always remained a common block. It can be done, of course, by building the shoulders as integral parts and then drilling through for the strop. The clew block should be seized to the clews as shown in Fig 137 detail. The sizes of wooden blocks in relation to the size of rope for which they are being used are shown in Table 18.

Fore Course Sheets

For the topsails, a sheet block, or shoulder block as it was sometimes known, should be used. This block is shown in Fig 138. It is distinctive in having an anti-nipping break formed in its lower part to give the sheet an unimpeded run. It should be seized to the clew of the sail. For the courses, a round sheet block should be used without the beak, as the sheet will not be impaired by a yard. Should the sail not be bent to the yard, it should be rigged by passing the strop over that of the clew block, when the wall knot head of the tack should be passed through the strop of the clew block, so joining all three parts of the sail clew arrangement together. The clew lines, tack and sheets can then be rigged in the usual way, the combined tackle being suspended about 9ft below the quarter blocks of the yard (Fig 139, and see Fig 127 for the arrangement).

The run of the sheets was a simple arrangement. The standing part should be bent to an eye bolt in the side of the hull, in line with and about 10in below the sill of the third gun port back from forward. A sheave should be set in the bulwark aft of this on a line with the centre of the gun port and about 18in aft of it. The

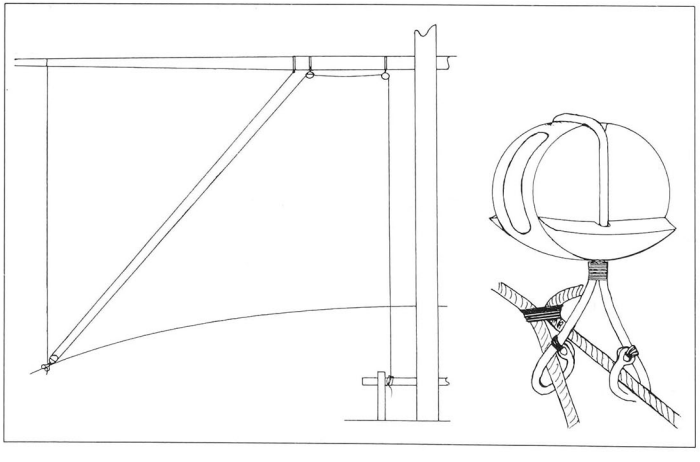


FIGURE 137. Arrangement of clew garnets. *Right*. Detail of clew garnet block.

TABLE 18: Common Wooden Block Sizes, Relative to their Ropes

Rope	*Block dimensions*	*Single sheave*	*Double sheave*	*Triple sheave*
¼	Height	3	3	3
	Width	2½	2½	2½
	Breadth	1⅜	2¼	2¾
	Sheave	1⅜	1⅜	1⅜
⅜	Height	4	4	4
	Width	3¼	3¼	3¼
	Breadth	2⅛	2⅞	3½
	Sheave	1¾	1¾	1¾
7/16	Height	5¼	5¼	5¼
	Width	4½	4½	4½
	Breadth	3	3⅞	4⅞
	Sheave	2½	2½	2½
½	Height	6¼	6¼	6¼
	Width	5¼	5¼	5¼
	Breadth	3½	5½	5¾
	Sheave	2¾	2¾	2¾
⅝	Height	7⅜	7⅜	7⅜
	Width	6½	6½	6½
	Breadth	4¼	5⅝	7
	Sheave	3½	3½	3½
¾	Height	9⅛	9⅛	9⅛
	Width	7⅜	7⅜	7⅜
	Breadth	5	6⅞	8⅜
	Sheave	4¼	4¼	4¼
1	Height	12	12	12
	Width	10	10	10
	Breadth	6½	8⅞	11
	Sheave	5½	5½	5½
1¼	Height	15⅜	15⅜	15⅜
	Width	12⅞	12⅞	12⅞
	Breadth	8⅜	11¼	14 1/16
	Sheave	7	7	7
1½	Height	18¼	18¼	18¼
	Width	15¼	15¼	15¼
	Breadth	10	13⅜	16¾
	Sheave	8⅜	8⅜	8⅜
2	Height	24½	24½	24½
	Width	20⅛	20⅜	20⅜
	Breadth	13½	18	22½
	Sheave	11¼	11¼	11¼
2½	Height	30¼	30¼	30¼
	Width	25¼	25¼	25¼
	Breadth	16⅜	22⅛	27¾
	Sheave	13⅞	13⅞	13⅞
3	Height	36½	36½	36½
	Width	30⅜	30⅜	30⅜
	Breadth	20 1/16	26¾	33⅜
	Sheave	16¾	16¾	16¾

All measurements are in inches.

Notes

The diameter of the strops in all cases is commensurate with that of the rope of the block

The width of the sheave slot can be taken as being 1/10 of the block height in all cases

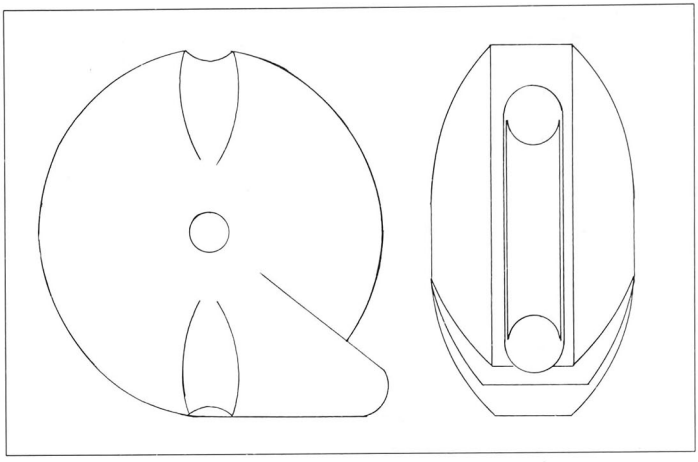


FIGURE 138. Sheet or shoulder block.

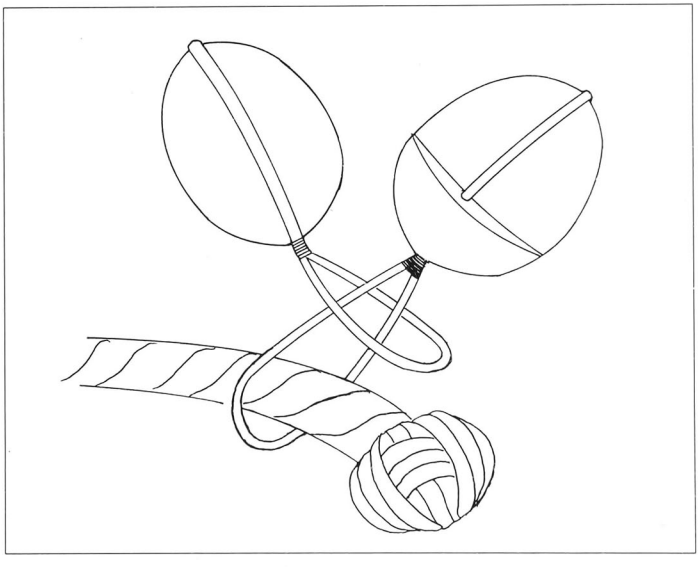


FIGURE 139. Arrangement for linking together the lower plain sheet block, clew garnet block and tack wall knot when a sail is not rigged.

sheave should be set into a horizontal slot. From the standing part of the sheet the line should run forward through the sheet block, back through the sheave in the bulwark from outboard, and be belayed on a kevel or a cleat inside the bulwark.

The main course sheets standing part should be bent to an eye bolt set on the lower line of the quarter badge window, rove up through the main course sheet block, and back through the sheave set in the quarter deck bulwark on a line just forward of centre

above the quarter badge, where it should be belayed to a cleat or kevel set inside the bulwark.

Tacks

With regard to the square sails, tacks were only rigged on the courses. The fore tack was set to a bumkin, which was first introduced into small vessels in the early part of the eighteenth century, to become general practice in all vessels by the middle of the century. By *Cruiser*'s time it had taken a round form on the outboard end with an octagonal form on the inboard end, the change taking place in the centre. The length for the sloop would be about 7ft with a diameter of 7in. The bumkin should have a downward curve and a taper from the heel to the end, the end being about a quarter diameter less than the heel. It should be rigged with the curve pointing downwards. A necking should be scored on its outer end for the strop of the tack block.

The inboard end should be set high in the prow above and outboard of the outer hawse hole, and line up on its outer end with the clew of the fore course when the sail is tacked hard over. To support the bumkin against the upward pull of the tack, a fore shroud and an aft shroud should be fitted. Both shrouds should be set on the neck of the bumkin with eye-splices. The other end of the shrouds should be set up with deadeyes and lanyards to ring bolts on the knee of the head. The fore shroud just above the inner bobstay, and the aft shroud about 3ft below the outer bobstay. This is illustrated in Fig 140.

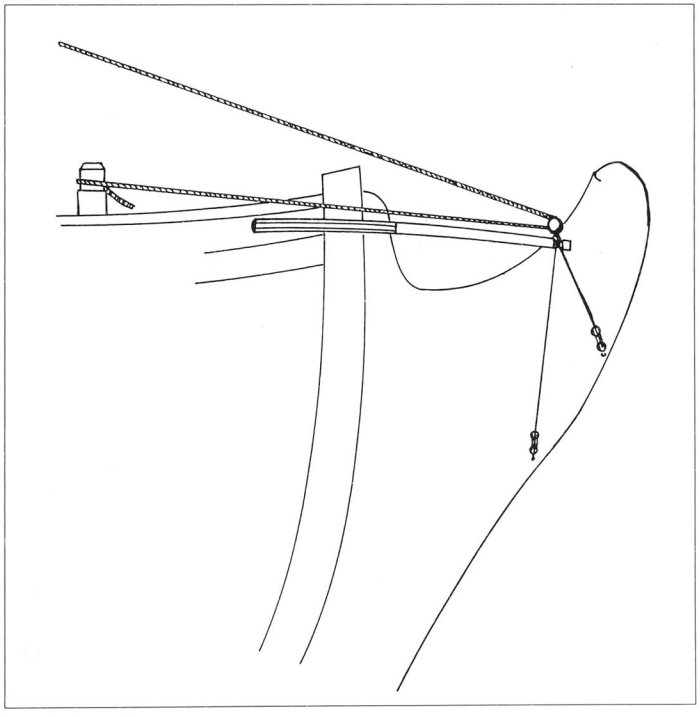


FIGURE 140. The method of setting up the bumkin for the fore tack.

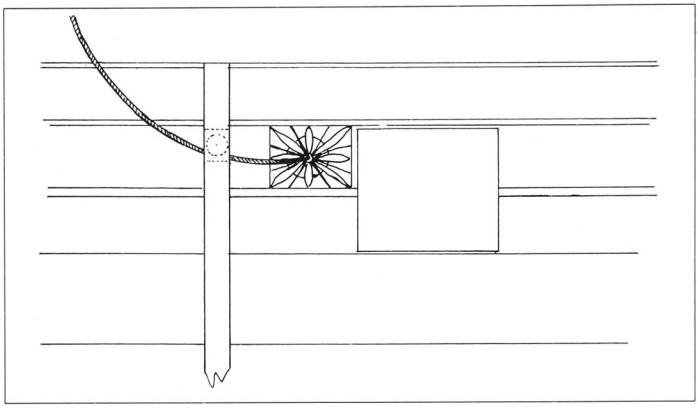


FIGURE 141. The method of rigging the tack block and chesstree for the main course tack.

The tack should be given a large wall knot to hold it in the clew, and from 10 yards down taper to half the diameter of the head. This can be done by separating the lays of rope and running a little white PVC wood glue into the remaining lays. As the tack is rather a heavy line, an absence of tapering would be noticeable on any scale.

From the wall knot in the clew, the tack roves through a shoulder block on the bumkin, and is taken back to belay on the first timberhead on the forecastle top by the stem. At this period the tacks were not crossed as previously, before the introduction of the bumkin, the port going to port and the starboard to starboard.

According to the Chapman draught and the Admiralty draught, a tacking block for the main course tack was placed just abaft the second gun port from forward. The tacking block was usually decorated. A skid or fender set with a chesstree sheave should be set immediately abaft this (Fig 141). From the clew of the sail, the tack should reeve through the sheave of the chesstree, through the hole or port in the tacking block, and belay on a cleat or kevel inside the bulwark just aft of the tacking block port.

Main Stay Tackle

By the mid eighteenth century the garnet tackle had been replaced by a pair of permanent main stay tackles, one being rigged over the main hatch and the other over the fore hatch.

These consist of pendants and falls. They were not rigged with runners. The main hatch pendant should be about 9ft long, eyespliced at one end, the eye being just large enough for the pendant rope to pass through. The pendant is secured to the stay by being looped over it, the pendant passing through the eye and being pulled tight, forming a collar around the stay. A fiddle or long tackle block should be seized in its end (Fig 142).

The fall has its standing part seized to the strop of a single hook block and reeves up through the lower sheave of the fiddle block, down through the sheave of the hook block, and up through the upper sheave of the fiddle block, and so down to the deck (Fig 143).

The tackle is belayed by the hook of the lower block being seized to the stay just abaft the fore mast with a bill hitch, the fall being triced up the stay with it.

The fore hatch tackle is rigged in

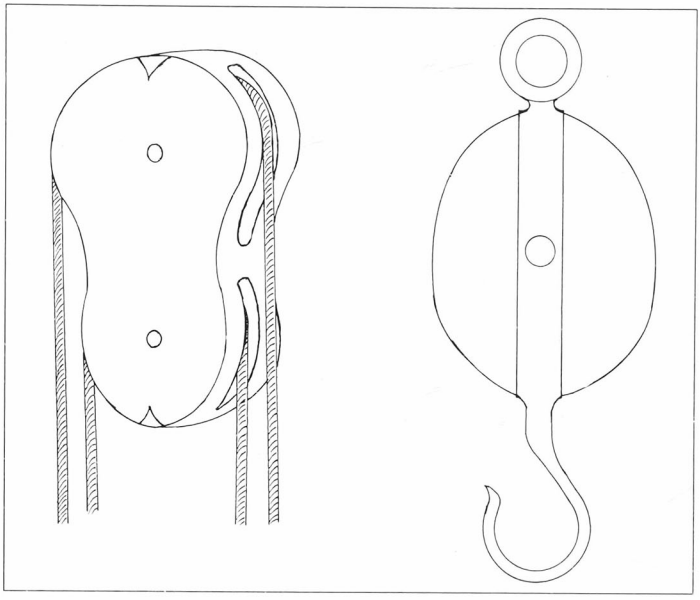


FIGURE 142. Fiddle and hook blocks.
Left. Long tackle or fiddle block.
Right. Iron stropped hook block with ring.

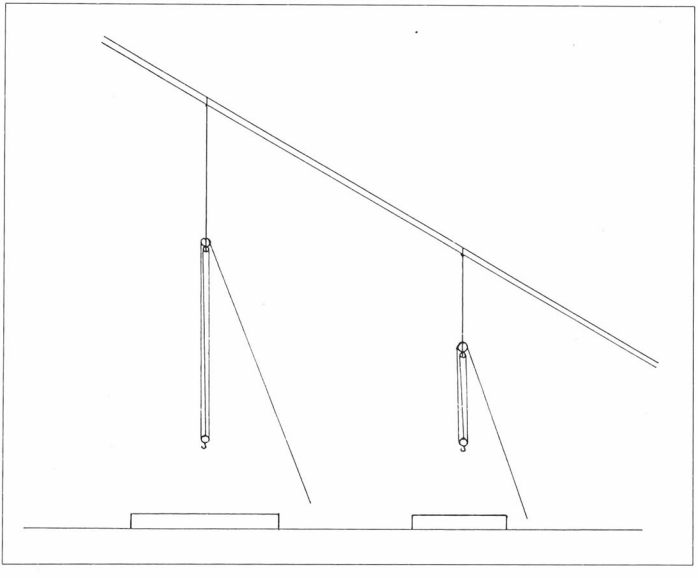


FIGURE 143. Arrangement of main stay tackle.

exactly the same way, except that the pendant is only half the length of the main hatch pendant.

Reef Points and Robands

These were usually made from braided rope. The length of the points

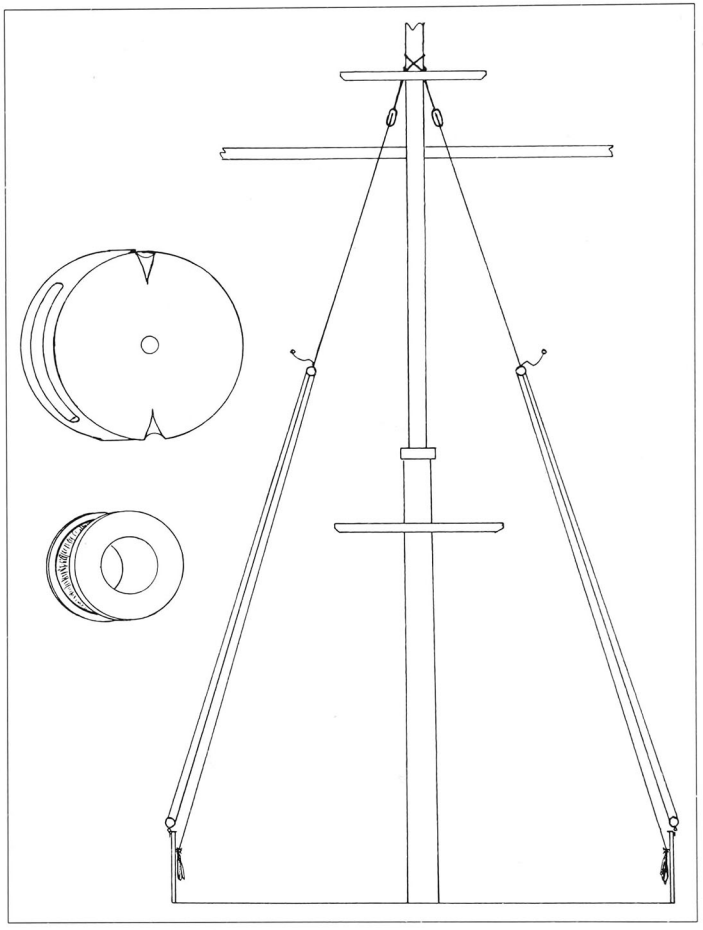


FIGURE 144. Arrangement of the topsail ties and halliards, with details of the tie flat block and thimble.

should be twice the circumference of the yard, threaded through a hole in the reefing band, and knotted on both sides of the hole. There should be two points to each cloth. Two-thirds of the reef point should hang abaft the sail, and one-third on the fore of the sail.

Each roband should be set to the yard separately, each being served through a hole on the head of the sail, its length three times the circumference of the yard. It should be given two complete turns around the yard and through the hole of the sail, and be finished with a reef knot on the top of the yard.

Gaskets

By the mid eighteenth century, gaskets, or ropes for holding in the furled sail to the yard, had taken the form of a number of separate lines evenly spaced along the yard, the number depending on the size of the yard. For a sloop, four gaskets per yard would be about right for the lower yards.

The standing end was nailed to the top of the yard. With the sail furled the gaskets should wind around it and the yard, starting from the nailed standing end and winding out towards the arm. Special harbour gaskets for dressing the yard did not appear until the next century.

When the sail is set, the gaskets should be coiled, and hang down the front of the sail.

The Topsail Yards

Ties

These should be rigged in a similar way to the jeers of the lower yards. The difference is that they were rigged with a halliard. Two independent halliards should be rigged, one for each tie, port and starboard.

The end of the tie should be bent to a flat round halliard block (Fig 144 detail). Another such block should be hooked to an eye bolt high up on the outside bulwark on a line with the top mast backstay. The standing part of the halliard should be seized to the strop of the upper halliard block, led down through the lower block, up again to the block on the tie, and down to the deck. The fall is belayed on a cleat set to the inside bulwark by the lower block.

On the fore mast, the falls should be rigged to haul aft, while on the main mast they should be rigged to haul forward.

To hold the halliards into the side, a short strop of about 1ft long should be seized to the tie just above the block. The end of the strop is seized around a bullseye, free running along the top mast backstay. It would be ideal to fit the bullseye when rigging the backstay. However, should this be overlooked the bullseye can be halved, and the two pieces glued around the stay, maintaining its free running aspect, and the joint reinforced with the seizing of the strop. The tie and halliard arrangement are shown in Fig 144. The proportional sizes of the topsail rigging in relation to the mast-stay are shown in Table 19, while the relevant sizes of belaying cleats for their appropriate rope size are shown in Table 20.

Parrels

These were fitted in the same way as described for the lower yard parrels, except that only two rows of trucks were needed to form the parrel, with only two holes required in the ribs for the parrel ropes. As this yard was lowered and hoisted in use, the parrel should be loose fitted, with enough play in it for a full tack.

Lifts

It was the practice at this time to rig the topgallant sheets integrally with topsail lifts.

Two blocks should be seized to long strops clove-hitched to the top mast head. The blocks should hang each side of the mast just below the trestletrees. The standing part of the lift is seized to the clew of the topgallant sail, through a single block eye spliced to the topsail yardarm, up through the sheaves of the stropped block at the head, and so down to the deck. The fall should be set to the lower shroud pin rail, or to a cleat seized to the second lower shroud back. When the topgallant sail is not bent, the lift is seized to a pair of donkey's ears set to the foremast cap, and then toggled in these ears or in stropped eyes.

Footropes

These were fitted to both fore and main topsail yards as described for the lower yards, except that the deadeyes were omitted on the inner ends. These should be given eyesplices which are rigged to the parrel seizing about the yard. One stirrup only is fitted to each

TABLE 19: Royal Navy Proportional Diameters of Topsail Yard Running Rigging, relative to the Topmast Stay

Ties	8/10
Ties halliard	3/4 of tie
Parrel rope	9/20
Lifts	As topsail yard halliards
Footropes	11/20
Stirrups	1/3
Lanyards	1/4
Flemish horses	2/3
Brace pendants	11/20
Braces	1/3
Leech lines	1/3
Bunt lines	9/20
Staysail stay	1/2
Staysail sheet pendants	1/2
Staysail sheets	1/2
Staysail whips	1/3
Staysail halliards	1/2
Staysail tacks	9/20
Downhaul	1/4
Brails	1/3
Stunsail halliards Sheets and tacks	7/20

TABLE 20: Sizes of Rigging Cleats, relative to the Belayed Ropes

Diameter of rope	*Length*	*Height*	*Width*
1/4	4 7/8	1 5/8	1 1/4
3/8	6 3/8	2 1/8	1 5/8
1/2	8 7/8	3	2 1/4
3/4	10 7/8	3 1/2	2 3/4
1	12 1/2	4 1/8	3 1/8
1 1/4	14 1/4	4 5/8	3 1/2
1 1/2	15 1/4	5	3 7/8
2	18 1/2	6 1/8	4 5/8
2 1/2	21	7	5 1/4
3	23 3/8	7 3/4	5 5/8

Note: All measurements are in inches.

footrope which should rest down to 3ft below the yard.

Flemish horses can be fitted as described when dealing with the lower yards. It should be borne in mind that these items were not common practice until 1760.

Brace Pendants

These should be rigged as described for the lower yards. The length remains the same at three-tenths the length of the yard.

Fore Topsail Yard Braces

The standing part of the brace should be seized to the main stay just below the collar, led through the sheave of the pendant block on a short strop clove-hitched about the main stay, immediately beneath the standing part of the brace, down to a lead block seized to a short strop about the main stay just abaft the fore mast, and so down to belay on the fore jeer bitts (Fig 145). This rig varied at this time in that the standing part of the brace could be seized to the main stay collar.

Main Topsail Yard Braces

With most merchant snows this rigging was led forward, but with naval sloops the practice was to lead the topsail braces aft. This is shown in the Chapman draught (see Fig 128).

The standing part of the brace should be set on the end of the gaff, from where it is passed up to rove through the block of the pendant, and down through the inner sheave of one of a pair of double blocks bent to a short span clove-hitched to the peak of the gaff. From this block the brace

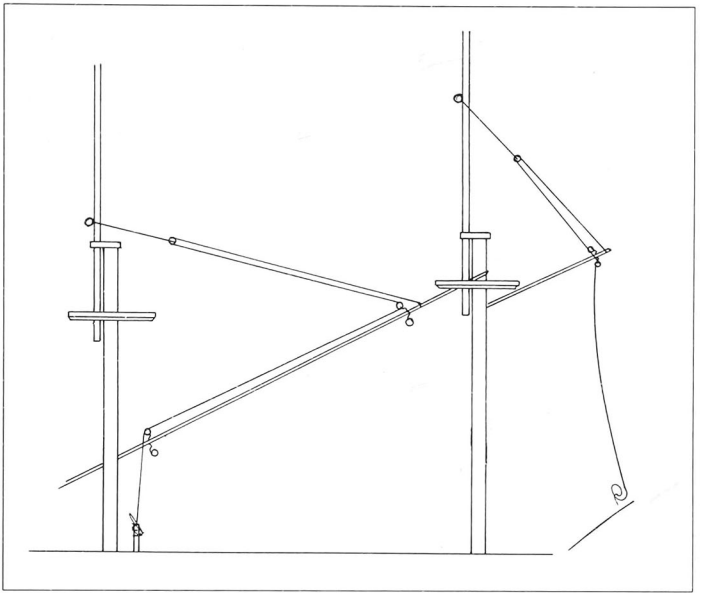


FIGURE 145. The run of the braces of the fore and main topsail yards.

passes down to the quarter deck bulwark where it is belayed on a cleat.

The outer sheaves of the double blocks on the gaff are for the topgallant braces which were more usually rigged aft. However, the Chapman draught shows the topgallant braces leading forward. If this is adopted only single blocks would be required on the gaff peak for the topsail braces.

Leechlines

The leechlines were rigged in conjunction with the buntlines (Fig 146). Two leechlines should be rigged: one to port and one to starboard on both main and fore topsails. The standing part should be seized to the upper bowline cringle, let up through a block a quarter of the way in from the yardarm, up through the second lead block seized to the head of the tie block strop, up through the inner sheave of a double block seized to an eye bolt under the top mast trestle trees, and so down to the deck via a shroud thimble. The falls should be belayed to a cleat on the lower shrouds, or to the pin rail seized to the shrouds, just above the upper deadeyes.

Buntlines

Two buntlines should be set, one each side of the sail. The standing part should be bent to the bunt cringle on the foot of the sail, rove up through a single common block seized to the yard about two-thirds in from the yardarm, and up through the outer sheave of the double block set under the top mast trestletrees, and from there to the deck via shroud thimbles. The falls should be belayed beside that of the leechline.

Bowlines – Fore Topsail

The bridle should be rigged as for the fore course. A single span with a block

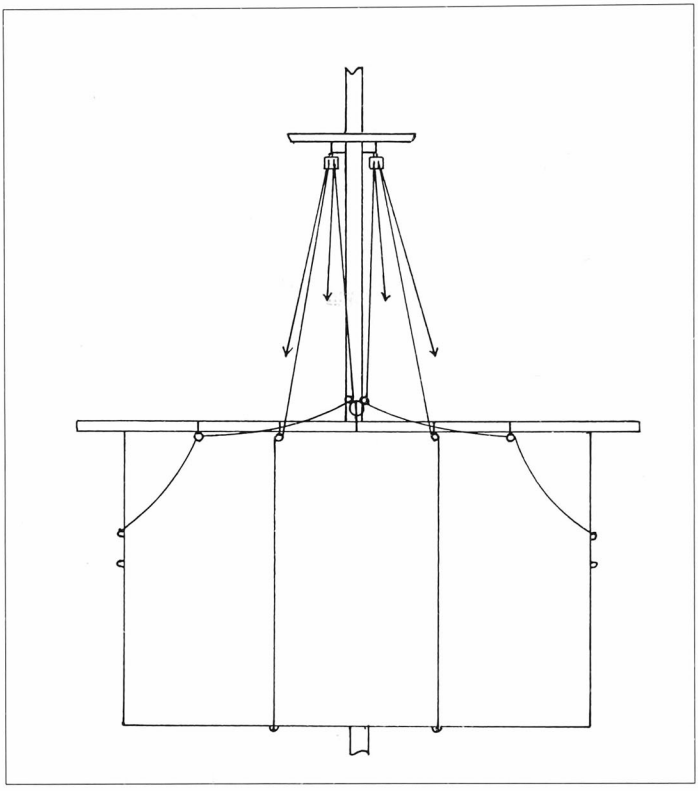


FIGURE 146. Arrangement of the bunt lines and leech lines of the fore and main topsails.

bent to each end should be clove-hitched about the topstay on a level with the fore top. Two further single blocks should be rigged to the top eye bolts on the side of the bowsprit cap.

The bowline should run from the bridle, through the blocks on the fore top mast stay, down to the blocks on the bowsprit cap, back through the top hole of the gammon lashing block. From there it should be belayed on a cleat nailed to the bowsprit heel on the forecastle top.

Bowlines – Main Topsail

Two single lead blocks should be seized to eye bolts on the aft end of the fore top trestletrees. The bowlines should reeve from the bridles to these blocks, and down to the deck to be belayed inside the pins on the riding bitts cross piece.

Reefing Tackle

Two reefing bands were set on the topsails at this time, the reefing tackle cringle being about 3ft below the lower band (Fig 147).

The reefing tackle pendant is a line bent to the reefing cringle of the sail, roves up through a vertical hole in the yardarm, and should extend to a

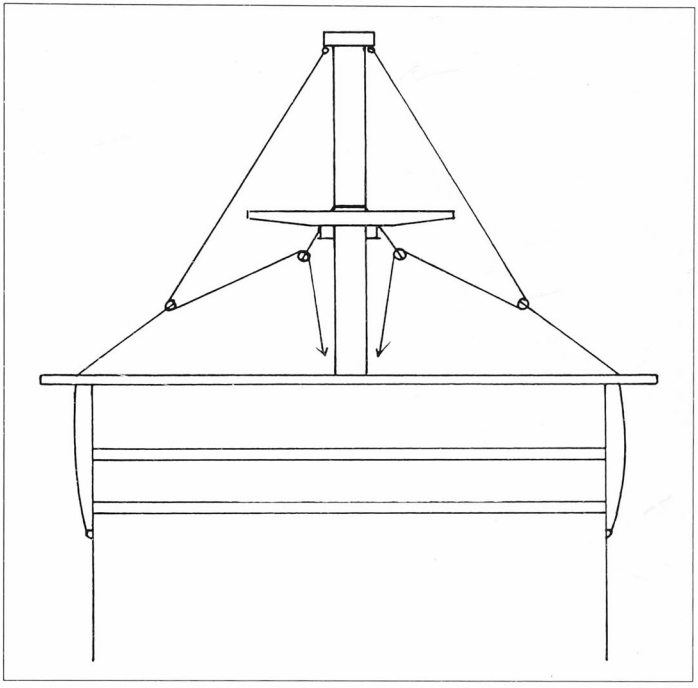


FIGURE 147. Arrangement of the reefing tackle for the fore and main topsails.

length half way along the yard. A single block should be spliced into the end of this pendant.

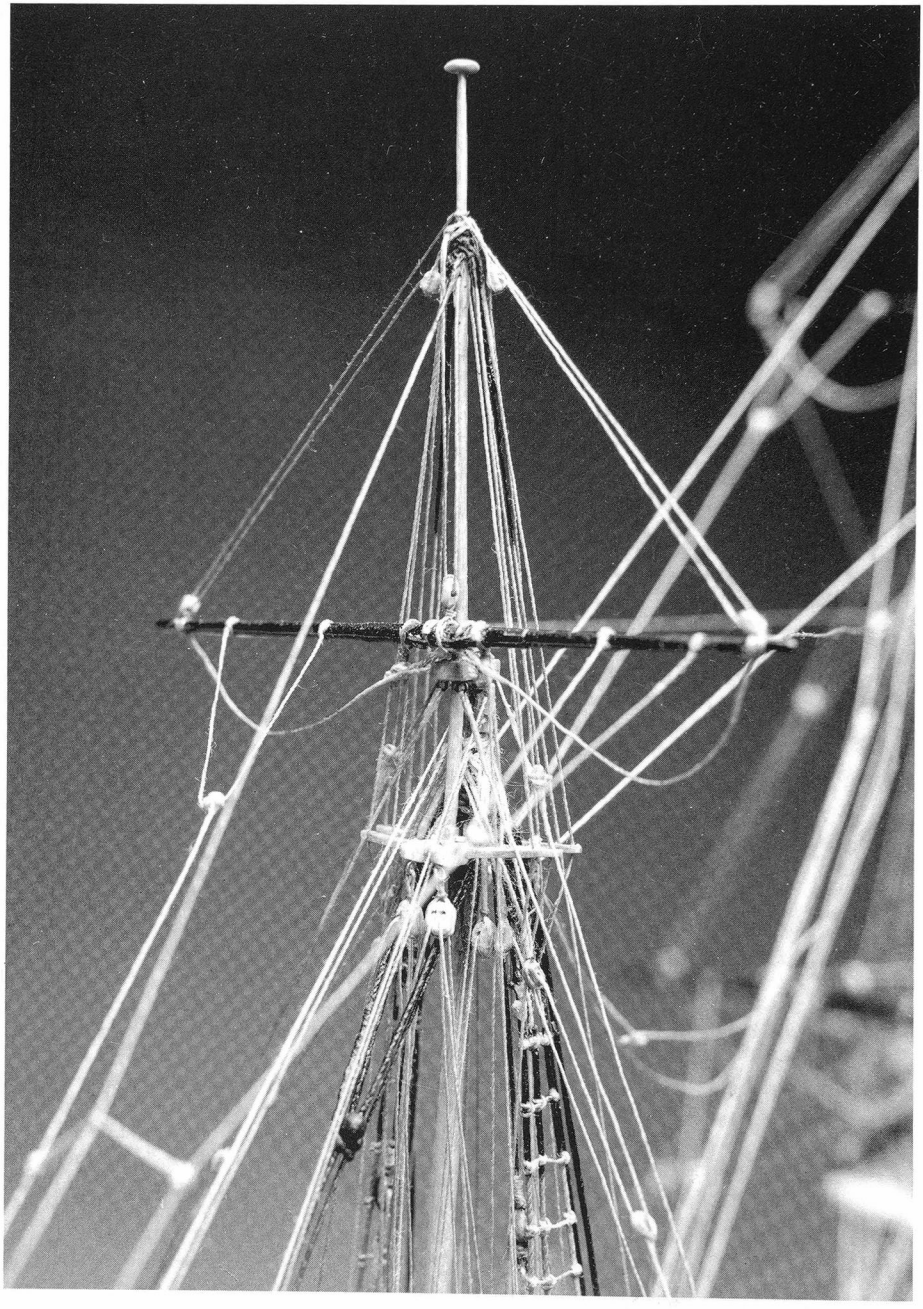
To rig the reef tackle falls, an eye bolt should be set into the underside of the top mast cap on its fore part, port and starboard. A short span set with a single block in each end should be clove-hitched around the top mast head, the blocks to hang each side of the mast below the trestletrees. The standing part of the fall should be bent to the eye bolt under the cap, led down to rove through the block of the pendant, and up through the block under the trestletrees. From there it should pass through the lubber hole, through thimbles set on the catharpins, and belay on a mast cleat, the cleat being set about 4ft up from the deck, and aligned with other cleats set around the mast at this point.

Clewlines

The mid eighteenth-century rig for the topsail clewlines had returned to its simplified form of the previous century, and consisted of a clew block set in the clew of the sail, and one other clew block set two-thirds of the way in from the yardarm on the yard. The standing end of the clewline was seized to the yard just outboard of this second block, rove through the clew block on the sail, back through the sheave of the block on the yard, and down to the deck via the lubber hole. The fall was belayed to the topsail sheet bitts.

Sheets

The rigging of these sheets was no more complicated than the rig of the clewlines. The standing end of the sheet should be given a wall knot, by



73. The fore top hamper, showing the rig of the fore topgallant mast and yard.

which it is held in the clew of the sail. The sheet should then reeve through the shoulder block set with the lift block on the lower yardarm, pass inboard along the lower yard to the slings, through one of two sheet blocks set beneath the lower yard with the strops inside the sling cleats, and belay on the topsail sheet bitts.

Reef Points, Robands and Gaskets
All these items should be fitted as for the courses.

The Topgallant Yards

Ties
A single tie block was stropped to the centre of the yard for a sloop at this time. The tieline should have an eye spliced into its standing end, through which the tieline can pass to form a collar, which should sit over the topgallant masthead. The tieline then leads down to reeve through the sheave of the block on the yard from starboard to port, up through the fore and aft sheave set in the topgallant mast hounds from fore to aft, and from there leads down to the deck, to belay on the jeer bitts. The tie can be seen clearly in Photograph 73, a detail of the completed fore top area.

There is a variation to this arrangement in that the tie can be given a simple whip. For this the tieline is shortened to reach behind the mast to a level about 6ft below the top mast trestletrees when the topgallant yard is lowered. A single block should then be spliced into this shortened end. The standing part of the halliard for the whip should be bent to an eye bolt in the aft rim of the lower top, lead up to rove through the sheave of the tieline block, and so down to the deck to belay on the jeer bitts. There are other variants of this rig for larger and heavier topgallant yards. The relevant sizes of the topgallant sail rigging are shown in Table 21.

TABLE 21: Royal Navy Proportional Diameters of Topgallant Yard Running Rigging, relative to the Topgallant Mast Stay

Halliards	½
Lifts	7/10
Footropes	As lifts
Brace pendant	As lifts
Braces	½
Bowlines	As braces
Clew lines	As braces
Sheets	As lifts

Parrels
These should be rigged as for the topsail yards.

Lifts
Two single blocks should be seized to the ends of a short strop, which should then be clove-hitched about the topgallant masthead. A single block should then be stropped to each topgallant yardarm. The standing part of the lift is eyespliced around the topgallant masthead, leads down to rove through the block on the yardarm, up to reeve through the block on the masthead by its own standing part, and down to the lower top. The fall is belayed to a cleat seized to the aft top mast shroud, and triced up.

Footropes
Footropes should be rigged as for the topsail yard, but without stirrups.

Brace Pendants
These may or may not be rigged on sloops. If rigged, they would follow the same procedure as other yards. In the case of brace pendants not being rigged, the standing part of the brace would be eyespliced directly to the yardarm. It would be a matter for the master's discretion.

Braces – Main Topgallant Yard
These can be led aft as for the topsail braces, running through the outer sheaves of the double blocks set on the peak of the gaff. With pendants, the standing part of the brace would also be seized here. The falls would belay on the taffrail. If led forward without pendants, two single blocks should be bent to a short strop which is clove-hitched to the main topgallant stay, about one-third up from the fore top mast trestletrees. The standing part of the brace is eyespliced directly to the topgallant yardarm, reeves through the lead block on the stay, through a thimble set on the aft fore top mast shroud, and so down to the deck. The fall is belayed to the cross piece of the riding bitts.

When pendants are rigged, the standing part of the brace would begin on the main topgallant stay next to the lead blocks.

Braces – Fore Topgallant Yard
A short span with a single block bent to each end should be clove-hitched to the main top mast stay just below the mouse. A double block is set to the centre of the aft part of the fore lower top. If the brace is eyespliced directly to the topgallant yardarm, it leads from there to the lead block on the main top mast stay, down to one sheave of the double block on the lower fore top, and is belayed on the cross piece of the riding bitts. When a pendant is used, the standing part of the brace begins on the main top mast stay by the span for its lead block, is taken through the pendant block, and led as before.

Leechlines
These were not rigged to the topgallant sails.

Buntlines
These were not rigged to the topgallant sails.

Bowline Bridles
The topgallant sails should be rigged with bowlines. The bridles should be fitted as for the lower sails.

Bowlines – Fore Topgallant Sail
A span with thimbles seized into both ends should be clove-hitched a quarter of the way down the fore topgallant stay. The bowlines should lead from the bridles to reeve through the stay thimbles, and from there to the outer thimbles of the three set in a collar on the necking of the jibboom end. The bowlines then lead back to reeve through the second holes down on the gammon blocks each side of the sprit, and from there to the forecastle top to belay on cleats nailed to the bowsprit heel on or by the topsail bowline falls.

Bowlines – Main Topgallant Sail
The bowlines should run from the bridle to reeve through lead block seized to eye bolts in the aft end of the fore topgallant trestletrees. From there they continue down to the fore lower

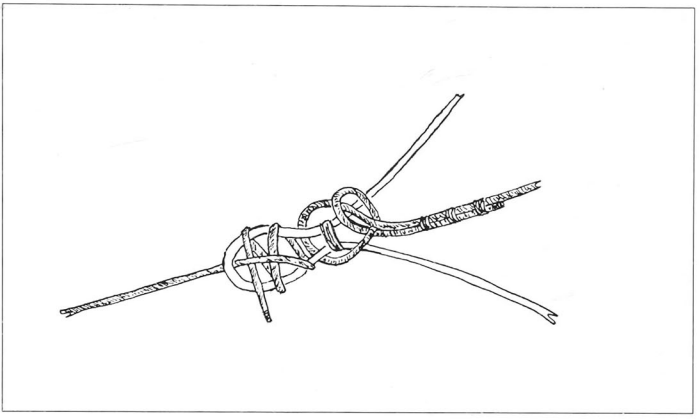


FIGURE 148. Method of seizing sheets and clewlines on topgallant sails.

top, and belay on cleats seized to the centre top mast shroud, the ends of the falls being triced up.

Clewlines
These lines should be eyespliced directly to the clew of the sail (Fig 148), led up from there to a single block stropped to the slings, and from there led down to the lower top, where they are belayed on a cleat seized to the first top mast shroud.

Sheets
As explained, these were integral with the topsail lifts at this time.

The robands and gaskets should be rigged as on the lower sails.

The Sprit Sail Yard

Slings
The sprit sail yard parrel gave way to slings in the mid seventeenth century. The slings should be made up with a long rope wormed and parcelled all through, long enough to pass twice around the bowsprit and once around each side of the yard positioned under the sprit. An eye should be spliced in each end. One end should be taken around the yard, and seized back to its own part. The other end is taken over the sprit, around the yard on that side, and seized back on its own part. The remaining end is brought back over the sprit and the two eyes seized together (Fig 149, detail). Photograph 74 shows the completed rigging of the entire fore part of the model.

Halliard
The standing part should be spliced to the strop of a single block set under the centre of the yard. From there it roves through the lower sheave of a long tackle block seized to an eye bolt under the sprit cap, leads back through the single block under the yard, forward through the top sheaves of the long tackle block, back through a hole in the starboard gammon block, and is made fast inside the forecastle bulwark.

Standing Lifts
These relics of the spritsail top mast era were not usually fitted after 1745.

Brace Pendants
These should be fitted as other yards.

Braces
The braces comprise one length of rope, middled and clove-hitched half

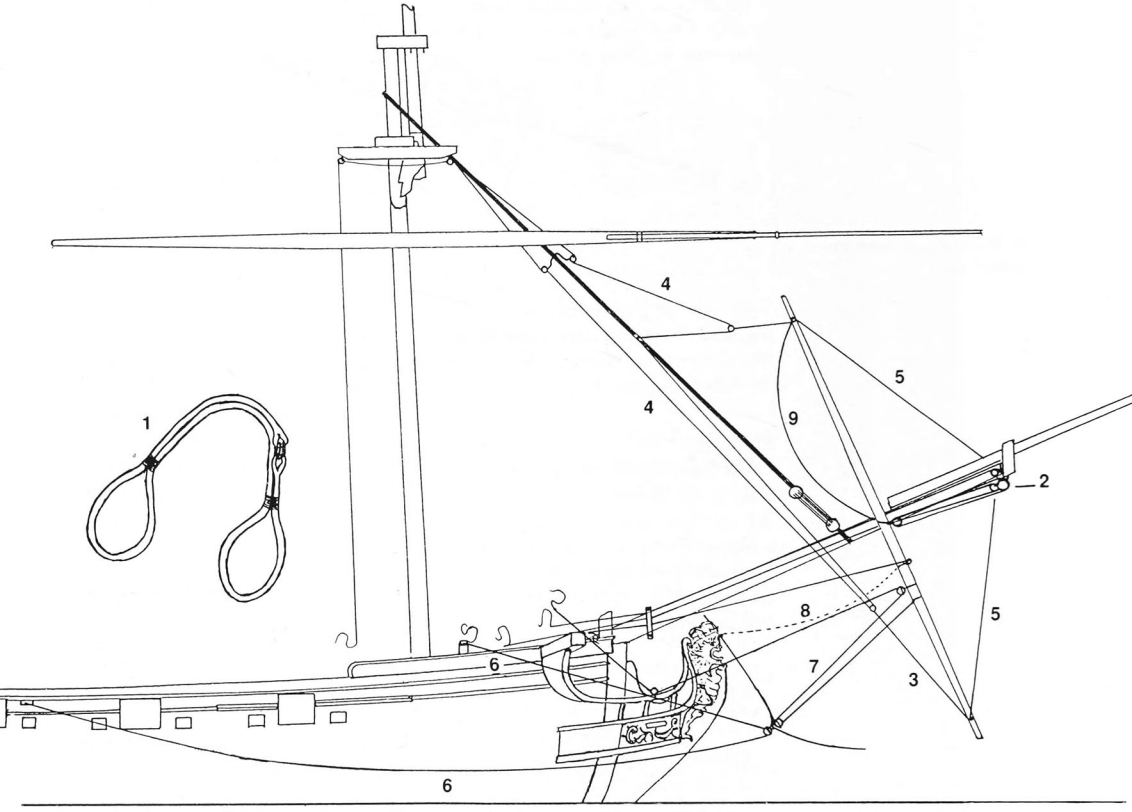
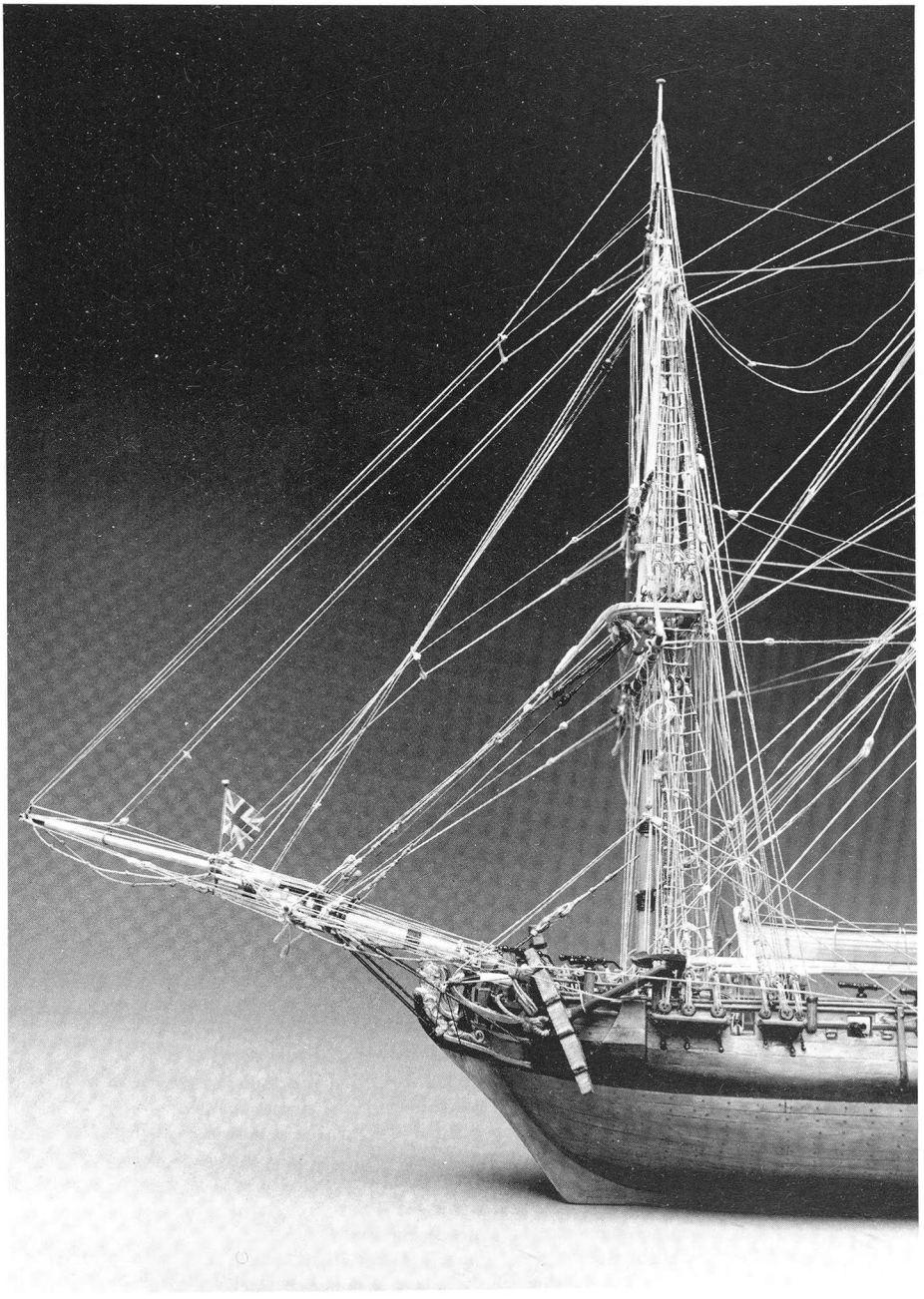


FIGURE 149. Spritsail rigging arrangement.
1. Slings
2. Halliard
3. Brace pendants
4. Braces
5. Lifts
6. Sheets
7. Clewlines
8. Buntlines
9. Footropes



74. Port bow, showing bowsprit rigging, catted anchor, and figurehead.

way down the forestay. Each leg is then roved through its pendant block, and leads from there up to one of a pair of single blocks bent to a short span clove-hitched to the forestay two-thirds of the way up. From there each brace is led to a single block seized to eye bolts under the fore part of the fore lower top, and led from there to the deck. The falls should belay on the fore topsail bitts.

Running Lifts
The standing part should be eye-spliced to the yardarm, and lead from there to one of a pair of single blocks seized to each end of a span, clove-hitched to the bowsprit immediately abaft the cap. From there they should lead back to rove through the fourth holes in the gammon block, and belay to cleats on the forecastle inside bulwark.

Sheets
The standing part should be made fast to a timberhead by the first lower fore mast shroud. The sheet block on the clew of the sail was always a specially shouldered block akin to a clew block in that the strop passed through a shoulder to prevent its wear on the sail (Fig 150). The lead of the sheet, after roving through this block, led back to a sheave in the bulwark, just forward of the third gun port back, and belayed to a cleat or kevel inside the bulwark, adjacent to the sheave.

Clewlines
The standing part was seized to the yard two-thirds in from the yardarm. From there it rove through the clew of the sail and back to a block seized to the yard just inboard of the standing part. From there the clewline led through a block seized to the top head rail just abaft the gammon lashing, from where it leads to the forecastle. It is belayed to a cleat inside the fore bulwark.

Buntlines
One buntline per side should be rigged to the sprit sail. The standing part is seized to the bunt cringle at the foot of the sail, passes up through a thimble seized to the yard 3ft from centre, and passes through a hole in the gammon block, from where it leads up to the forecastle. It is belayed to a cleat inside the fore bulwark.

Reef Points
Reef points were as on other sails. One reef band was usual on the sprit sail. Reefing tackle was not rigged, the sail being shortened by hand.

Footropes
The footrope comprised one continuous span eyespliced to each yardarm, and seized up in the centre of the yard to the strop of the block. Stirrups were not rigged.

Robands and gaskets are as on other sails. Details of all these rigging arrangements are shown in Fig 149.

Rigging to the Gaff

The gaff parrel is explained under standing rigging, and under masts and spars.

Topping Lift
A span should be roved through the lower sheave of a leg and fall block, which is similar to a long tackle block, only with parallel sides. The span should then be seized to the gaff, the fore part one-third of the way along, the aft part two-thirds of the way, the span bridging the middle third of the gaff. A single block should be stropped to the masthead just under the cap. A second single block should be stropped to the masthead just above the trestletrees. The standing part of the lift is then eyespliced over the peak of the gaff, roves through the upper block by the cap, through the upper sheave of the long block, through the sheave of the lower block

FIGURE 150. Spritsail sheet block.

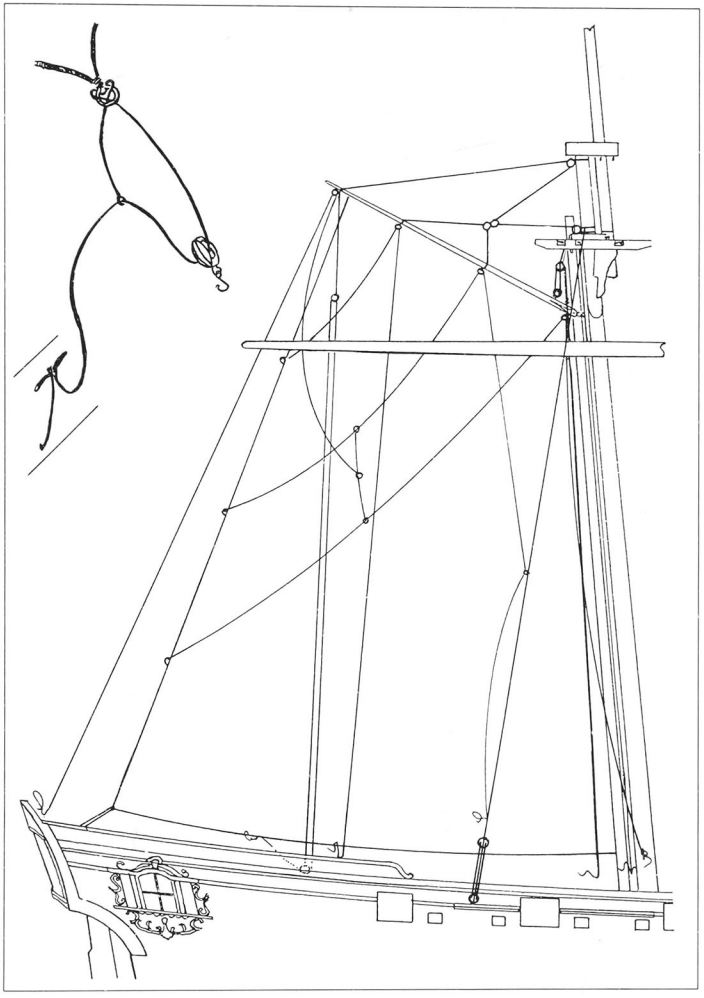


FIGURE 151. Arrangement of the rigging of the gaff and trysail, with detail of the trysail sheet.

by the trestletrees, and so down to the deck. The fall is belayed to a cleat on the port side of the mast, or to the jeer bitts. All details of gaff and trysail rigging are given in Fig 151.

Vangs and Falls

The vang pendants should be made up with one length of rope, middled, and clove-hitched to the peak of the gaff. Their length is three-tenths that of the gaff. A block should be spliced into each end. A single hook block should be fitted to an eye bolt in the deck quarters on both sides.

The standing part of the fall should be seized to the single block strop, pass up through the pendant block, down through the deck block, and belay to a cleat on the taffrail.

Throat Halliard

A single hook block should be set by the hook to the eye bolt in the upper side of the gaff jaws. A second single common block seized to a long strop should be set to the masthead to hang between the trestletrees. The fall should be seized to the strop of this block, rove through the block on the gaff jaws, through the block on the masthead, forming a single purchase tackle, and belayed on the starboard side of the main jeer bitts.

Rigging to the Trysail

This was a transitional period for the trysail, which began life as the mizzen lateen sail and evolved into the spanker of the nineteenth century. The sail on a snow was free footed, which distinguished the rig from the later brig, whose sail was fitted with a boom. Much of the rigging practised with the snow trysail at this time was still that of the earlier lateen sail. The rigging given here is its most simplified form.

The sail is bent by being seized to the peak of the gaff by its peak earing cringle, and to the throat of the gaff by its throat earing cringle, and laced by a continuous line to the gaff, and another continuous line to the trysail mast or horse. The horse was an alternative form of rig to the wooden mast, and was more prevalent on naval ships than merchantmen (see Fig 152). The foot of the trysail was twice as long as the head.

Three pairs of brail blocks should

be set on the gaff, each block of the pair to sit each side of the sail, the first pair one-third back from the gaff peak, the second pair two-thirds back, and the third pair seized to an eye bolt under the gaff jaws. Three brail cringles should be set on the leech of the sail, the first a quarter down from the peak, the second half way down, and the third three-quarters of the way down.

The peak brails lead from the top cringle on the leech to rove through the first brail blocks. The falls are belayed to cleats set on the bulwark of each quarter.

The middle brails lead from the second cringle down to rove through the second pair of blocks on the gaff, lead through thimbles seized half way up the aft main lower shroud, and are belayed to cleats seized to this shroud just above the deadeyes.

The throat brails lead from the third leech cringle, through the gaff throat brail blocks and down to the deck. The falls are belayed to cleats on the main mast.

Sheets

The sheet consisted of a long length of rope with a thimble spliced in one end. The rope should be bent to the clew of the sail with a sheet-bend. The thimble end should be one-third of the rope length. A hook block should be set to an eye bolt in the deck in the quarter. One such bolt should be fitted to each quarter. The long part of the sheet then roves through the block, through the thimble on its short end, and is belayed aft of the deck block to a cleat in the bulwark. See the detail in Fig 151.

Tack

The tack should be a long length of rope seized to the tack cringle, and leads forward to rove through a ring bolt set in the deck abaft the trysail mast. It is rove like this until three turns have been taken up, the fall being frapped about the centre of the turns.

Fancy Line Tackle

This tackle should be rigged to hold the lee brails free of the sail when set. The rig consists of two blocks stropped to the peak of the gaff. Two fancy lines are set, one each side of the sail, and comprise a long span with a thimble bent in both ends. These should be looped between the throat and middle brails, the brails passing through the thimbles. Before this, the spans themselves should pass through thimbles seized on the end of a pair of lines, the falls of which reeve through the two blocks on the gaff peak, and belay to the taffrail.

Rigging to the Fore Top Stunsails

Cruiser carried stunsails on the fore top mast only (Fig 153). As few records survive of the rig of this sail, alternatives are given where applicable.

Halliards

The stunsail yard should be rigged with a halliard, the standing part of which is seized to the yard one-third of the way along the yard from inboard. The halliard then roves through the block with a thimble which is seized to an eye bolt in the end of the topsail yard arm. From there it leads through one of a pair of single blocks bent to a strop clove-hitched about the top mast cap, and from there leads to the deck to belay on the topsail bitts.

Sheets

The sheets are double, one leading forward to the forecastle deck, the other leading aft to the deck at the waist; both should be belayed on timberheads. Sheet blocks are not used,

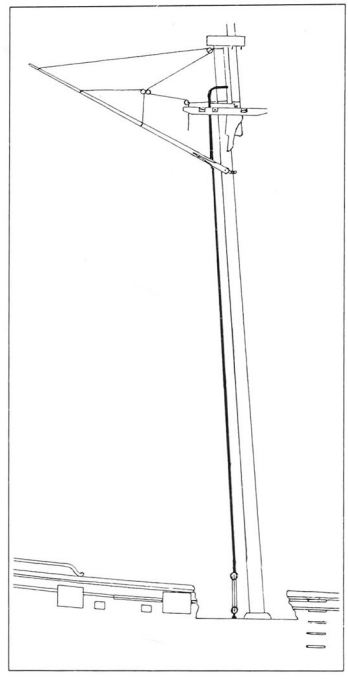


FIGURE 152. Trysail. There were times on active service or in times of war when the trysail was set up on a horse. The horse was a heavy rope spliced with an eye round the masthead. It passed over a bolster on the crosstrees and down the after side of the mast to the deck, where it was set up with deadeyes and lanyard to a ring bolt in the deck. When a horse was set, the gaff jaws sat directly on the mast.

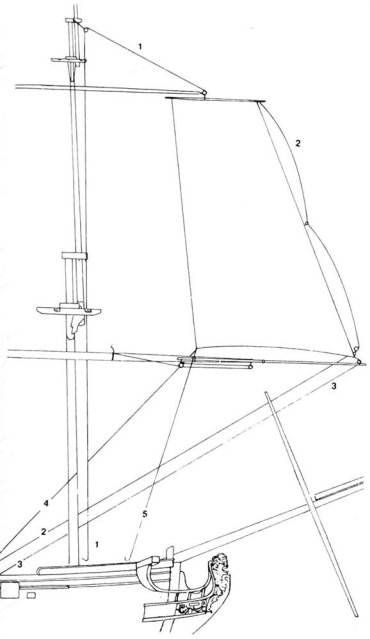


FIGURE 153. Rigging of the fore top stunsail.
1. Halliard
2. Downhaul
3. Tack
4. After sheet
5. Fore sheet
6. Stunsail boom tackle

the sheets being bent directly to the clew of the sail. Nor are there any lead blocks rigged according to some sources, though other authorities show a lead block rigged to the first quarter of the lower yard, with another seized to the yard in the region of the slings. The aft sheet roves through these blocks, and leads to the deck to belay on the fore topsail bitts. The fore sheet leads and belays as before. This may have been a matter for the master's discretion at the time, but model builders have no such option.

Downhauler

This line is eyespliced to the end of the stunsail yard, led down to pass through a thimble seized mid way on the leech of the sail, roves through a block in the outboard clew of the sail, and so down to the deck to belay in the region of the waist.

Stunsail Boom Tackle

Most small vessels manhandled the boom in and out for setting or hauling in the sail. However, there were various rigging arrangements for this. One is from the lower yard. Here a double block is seized to the boom iron, and another to the hole in the inboard end of the boom. The standing part of the purchase is seized through the boom hole, and leads forward to the block on the boom iron, and back through the block seized to the boom hole until all sheaves are taken up. The fall is hitched inboard to the lower yard.

The second method is to have a single block on the boom iron with the standing part of the purchase rigged through the boom hole. The purchase runs forward to rove through the block on the boom iron, back to another lead block seized to the third quarter of the lower yard, and from there down to the deck. The fall belays on the fore topsail bitts.

Rigging the Staysails

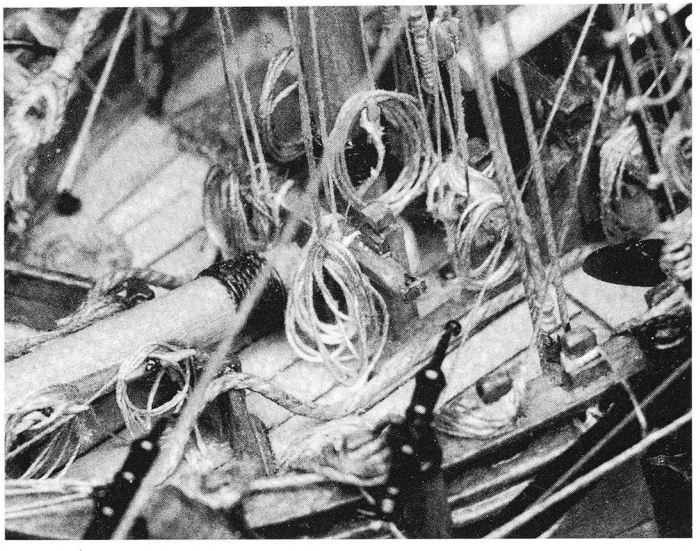
By the 1750s staysails had evolved from being set flying to being set on stays. For the *Cruiser*, all these stays were additional stays to those supporting the masts, with the exception of the main topmast staysail, which was set on the preventer stay.

There were four principal staysails on a sloop: the jib, the fore topmast staysail, the main topmast staysail, and the main topgallant staysail. In addition to these, there may have been a main staysail, though this was rarely carried at this time.

Each of these staysails required a halliard, downhaul, sheets and a tack. Some of the sails had distinctions which are outlined here.

For the fore topmast staysail, a net was set up to contain the sail when it was lowered. This comprised two battens strung athwartship between two lines run from the knightheads through eyebolts, to those of the upper part of the bowsprit cap. A fore and aft line was passed backwards and forwards between the battens by some ten stretches to form the netting. The width of the battens would be equal to the overall width of the knightheads. See Photograph 74.

The jib stay for a sloop at this time was set up to the thimble of the traveller, from where it rove through the starboard upper sheave of the fore topmast cheek block, then down to belay on the aftermost starboard timberhead on the foc'sle top. The jib outhaul should be seized to the shackle of the traveller. This rove through the sheave cut in the jibboom end, ran back along the underside of the jibboom, where it should be spliced to a long tackle block. This should be rigged as a purchase to a single hooked block attached to an eyebolt beneath the sprit cap. The standing part of the purchase is seized forward to rove through the lower sheave of the long tackle block, back



75. Base of foremast, showing bitts, etc and rope stowage.

through the sheave of the hooked block, forward again the upper sheave of the long tackle block, and belayed in the foc'sle via a fairlead in the gammon lashing block. Another item which requires special mention is the main topgallant staysail stay.

The standing part of the stay was spliced into the main topgallant stay 6ft down from the collar, from where it rove through a lead block stropped to the aftermost fore topmast crosstree on the port side. From the lead block the stay passed through the fore top lubber hole, and was hitched around the port trestletree, the fall being triced up to the rail.

If a sail is rigged on the stay it would need to be set up taught. Without the sail, or with the sail furled, it would be more accurate to set it up slack, the bight coming in line with the top. The reason for this was that when furling the sail, the stay needed to be slackened off, as the sail was stowed on the fore top. This is featured on the *Cruiser* model, where not only the stay hangs down in a bight, but the toggled together outhaul and downhaul, which follow the same run.

For the most part the staysail stays, having passed through their appropriate topmast cheek block sheaves, would be set up with a simple purchase tackle or lanyard and thimble arrangement to keep them taught. In the case of a sloop, all downhauls and outhauls would be bent directly to their staysail head cringle, the outhaul being given lead blocks, or passed through the lower sheaves of the cheek block. It would belay on a top or the deck. The downhaul would pass through a few hanks to support it down to a lead block seized to the stay collar or as appropriate. The fall would belay on a top or the deck. With the sail unbent, and the downhaul and outhaul remaining rigged, they should be toggled together to form a continuous line.

10

Some Basics on Sails

THE SAIL PLAN OF *Cruiser* (Fig 154) is based on that of *Caroline*, which took to the water just a few years before *Cruiser*, from the same yard. Sails are always rigged in accordance with the captain's preference, but generally speaking a suit of sails consists of the following for a snow rigged sloop.

The square sails, those bent to a yard, would be the spritsail, the fore course, the fore topsail and the fore topgallant. The main course, the main topsail and the main topgallant. The appropriate stunsails may have been carried on these yards, though the Chapman draught shows only the topmast stunsails, with only that for the fore drawn in.

The courses (Fig 155) should be given a single reef band, while the topsails (Fig 156) should be given three. The topgallants (Fig 157) were not reefed, but taken in. The spritsail (Fig 158) had a reefing arrangement of its own, together with one other feature: it had three circular holes set in its foot, each the width of one cloth, reinforced with narrow bolt ropes around their circumference. One hole was in the centre of the foot, the two others set by each leech. They were known as water holes and served to drain sea water from the cupped sail. Also for this reason the reefs were set diagonally in the form of a flattened X to drain off water when the sail was reefed.

The fore and aft sails consisted of two head sails, which were the jib and fore top mast staysail (Fig 159). Sometimes an extra fore staysail may have been rigged but this was far from the general practice. Behind these came the main topgallant staysail, the top mast staysail and the main staysail (Fig 160). The last sail in the group is the trysail (shown in Fig 151).

Sail Dimensions

Only general directions can be given for the size of sails as they were all traditionally made by the sailmakers using their own ideas of form and design, much as tailors do. The sails were in fact tailor made for the ship, often by the ship's own sailmaker, whose workshop can be seen on such vessels as *Warrior* and *Victory* at Portsmouth. That said, they were all designed with regard to strengthening and wear about a top or mast, or in the way of cringles and clews, where extra reinforcing cloths were sewn on. Successful model sails can be made with a little careful thought.

The first job is to determine the size of the sail relative to the ship. Generally, the head of the course or topsail would reach across the yard to

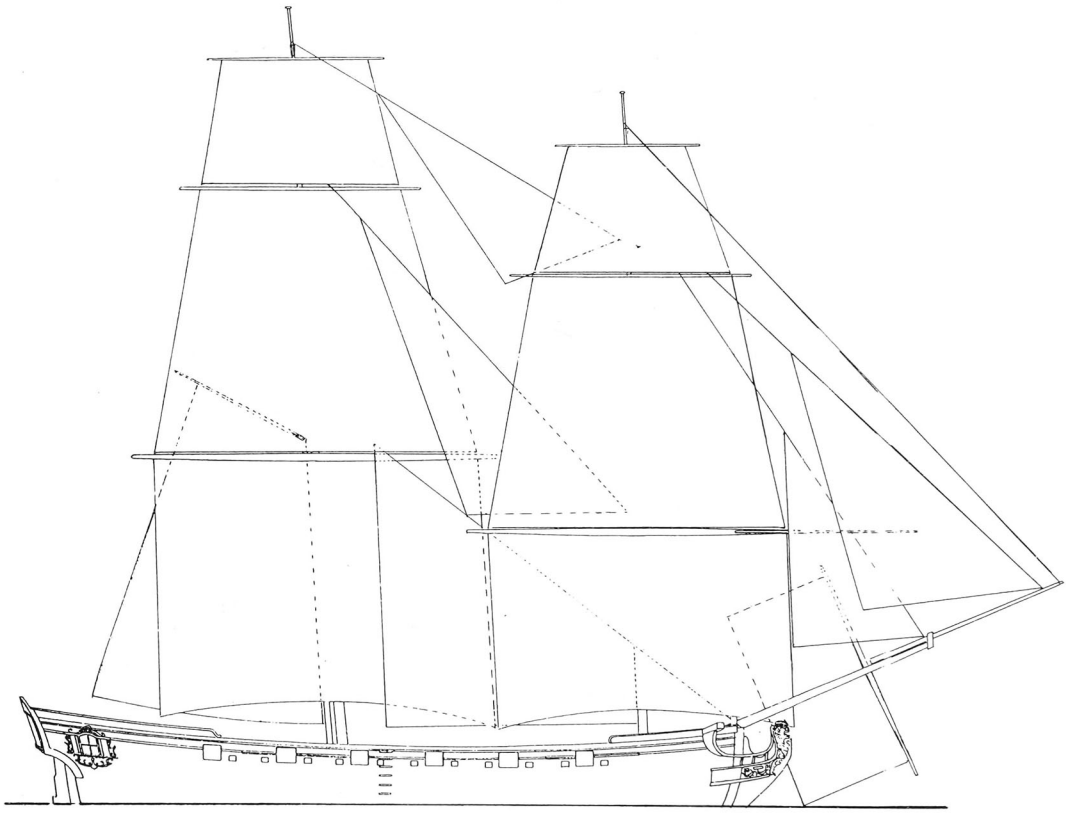
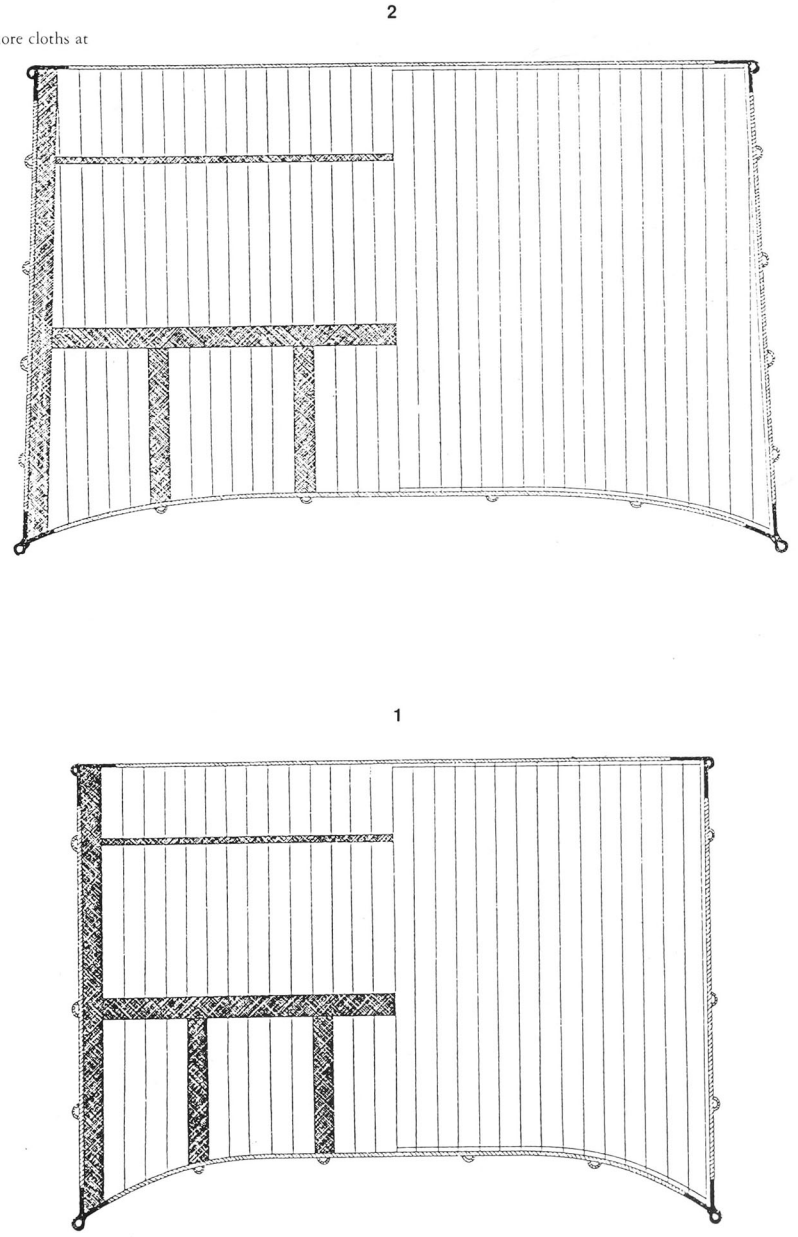


FIGURE 154. *Cruiser*'s sail plan as in 1752.

FIGURE 155. The courses.
1. Fore course.
2. Main course. This has two more cloths at the foot than at the head.



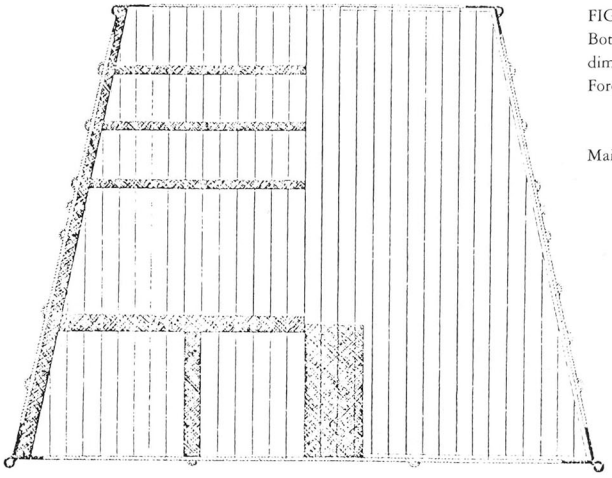


FIGURE 156. Fore and main topsails.
Both sails were similar, but with the following dimensions:

Fore topsail:	Head	22ft 6in
	Leech	27ft 6in
	Foot	34ft 0in
Main topsail:	Head	23ft 0in
	Leech	30ft 3in
	Foot	37ft 0in

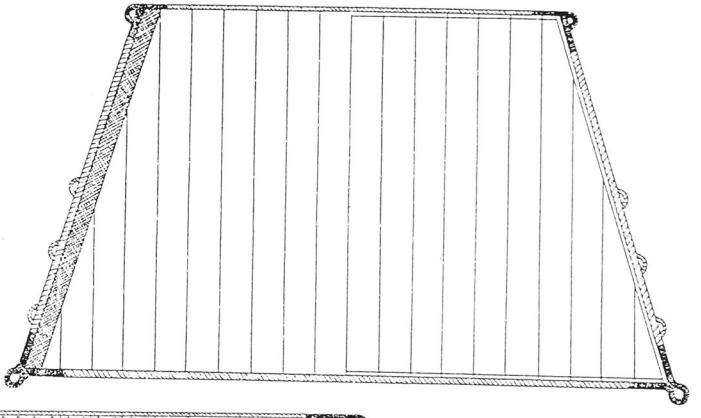


FIGURE 157. Layout of the topgallant sail.

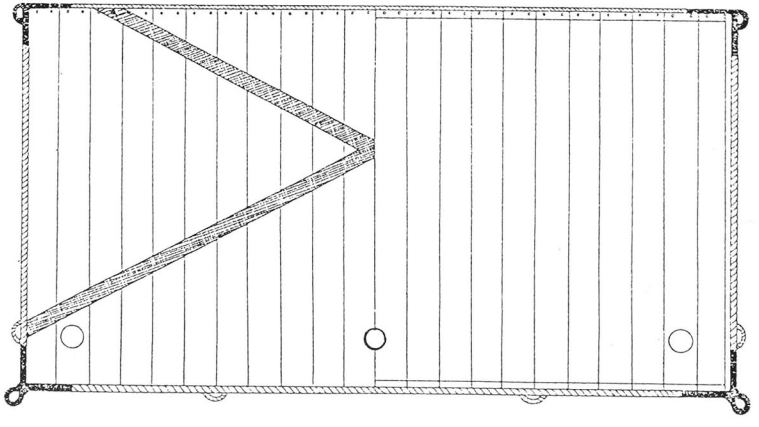


FIGURE 158. Spritsail. Note the crossed reefing bands and the three water holes in the foot of the sail.

FIGURE 159. Head sails.
1. Jib. This sail, and also the flying jib, have a convex curve to the foot, which distinguishes them from other head sails.
2. Fore topmast staysail.

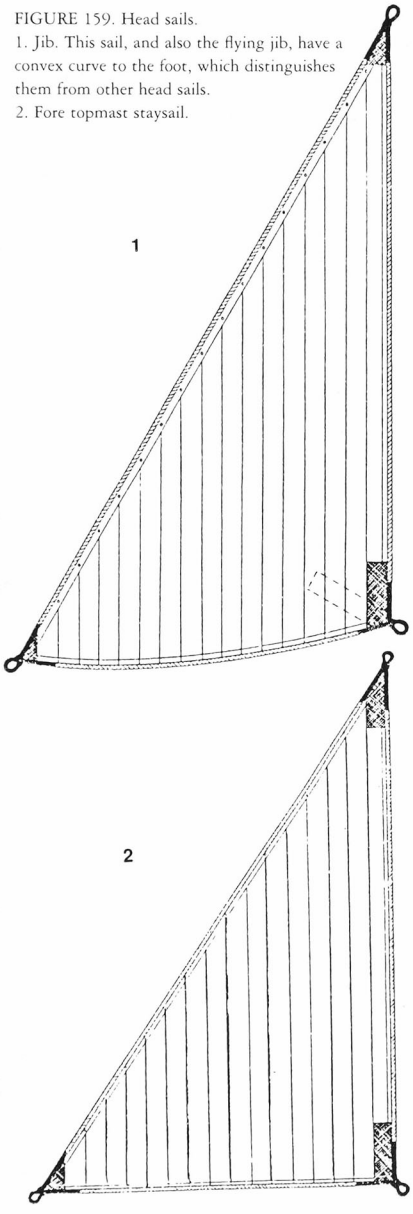
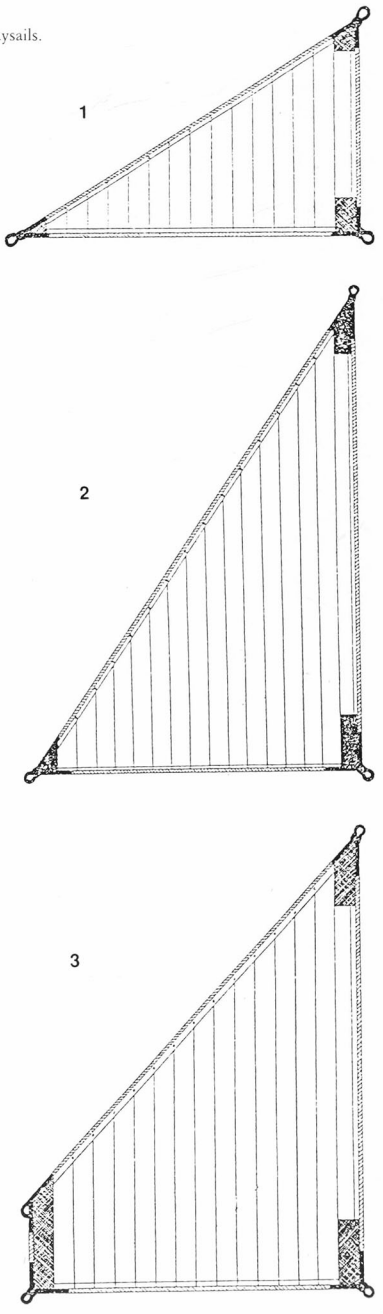


FIGURE 160. Main staysails.
1. Topgallant staysail
2. Topmast staysail
3. Main staysail



within 18in of the ends, this being the usual length of the yard arm. The topgallant would reach to within 6in of the ends, the royal being a little less.

The width of the foot for the fore course was the same as the head, and that for the main course should be two cloths wider. The topsails and topgallants should be to the cleats of the lower yard to which their sheet blocks have been set. The depth of the spritsail should be just over half its width.

The depth of the sail at the leech for the two courses should be within 5ft of their respective decks. These were the only sails to be given a roach. All other sails were square or straight footed. The topsail depth should be from the bottom of the top mast hounds to the reach of the main yard-arms, and the topgallant from beneath the mast stop to the reach of the topsail yardarms.

The proportion of the fore and aft sails can be counted as follows. The leech of the jib was the same as for the fore topsail, with the foot two-thirds that of the leech. The leech of the fore staysail was relative to that of the fore course, the foot being two-thirds of this. The main staysail leech was as great as that for the main course, the foot being two-thirds of this. The leech of the main top mast staysail should be 6ft greater than that for the main topsail with a foot just half of this. The topgallant staysail should have a leech four-fifths that for the topsail, with a foot just over half of this. The head of the trysail reached to within 2ft of the peak end, the foot being twice that of the head.

TABLE 22: Royal Navy Proportional Diameters of Bolt Ropes, mid Eighteenth Century

Square sails	
Foot and leech ropes	
Courses	1/3 of respective stay
Topsails	2/3 of respective stay
Topgallants	1/2 that of respective topsail
Head ropes on all square sails	2/3 that of respective foot and leech ropes
Staysails	
All ropes	
Lower	2/3 topmast stay
Topmast	1/4 topmast stay
Topgallant	1/4 topmast stay
Royal	1/3 topmast stay
Flying staysails	As for hanked staysails, but with luff rope twice the thickness
Square staysails post 1760	As for flying staysails
Trisails	
Head rope	2/3 topmast stay
All others	1/3 topmast stay

Note: These proportions are only acceptable for small scale work; large scales require more precise measurements.

Sail Construction

The sails were made up from bolts of cloth at a constant width of 24in. The seams ranged between 1½in and 2½ in, changing as the sail was moulded to shape. All sails were given a tabling, that is a hem or fold on all edges. For the course, the tabling was 4in to 6in for the head, and 3in to 5in for the leech and foot. The spritsail and topsails were 3in to 4in at the head, with 3in for the leech and foot. The topgallants had 3in for the head and 2½in for the leech and foot. The stunsails were much the same, though the canvas was comparatively lighter in weight. The tabling of the staysails ranged between 2in and 3in for the leech, with 1in greater on the stay and 2in on the foot. All cloths of the fore and aft sails ran parallel to the leech at this time. All tabling and ropes were set on the port side of the sail.

The mast cloth was an extra cloth stitched on the aft side in the centre of the courses and topsails. They extended set from the foot of the sail up as far as the middle band. The middle band was about a third of the way up

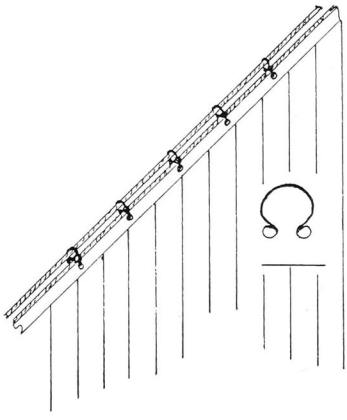
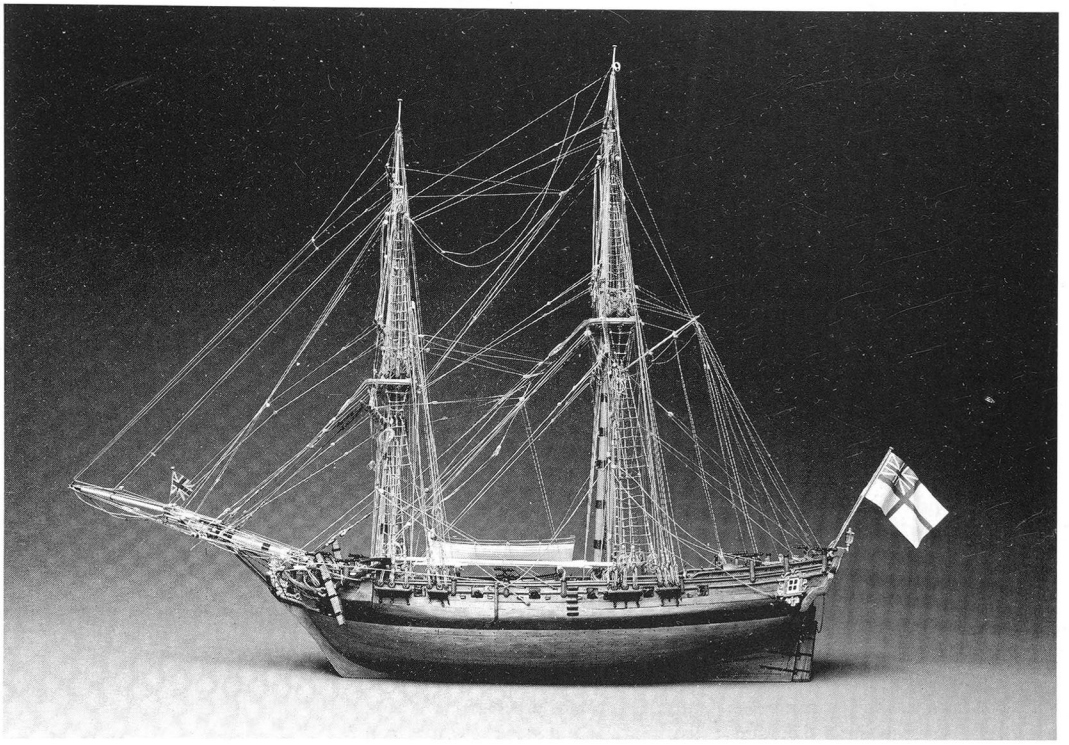


FIGURE 161. Detail of staysail hanks. That shown was made of iron, but sometimes they were made of wood. The eyes were seized through eyelets in the edge of the sail.



76. The completed model. While a work log was not kept, the construction took some two thousand hours.

the courses, and were a full cloth across the sail from leech to leech. The leech linings were an extra full cloth sewn to each leech on the fore side on the courses, tapering to half a cloth on the topsails. Where sails carried reefs, a reef lining was added on the fore side, reaching from leech to leech, one-third of a cloth wide. At this time foot linings had not been introduced. Bunt linings were used on the fore side of the sails in the way of the buntlines up to the height of the middle band. Stunsails were only afforded extra corner cloths, as were the staysails. Bolt ropes were stitched to all edges to take the strain of the wind and relieve the canvas. Each bolt rope is named after its position on the sail, for example the head rope. A table of bolt rope proportions is given in Table 22.

Cringles were about ½in smaller than their bolt rope. An earing was made by extending the leech rope and splicing it back on itself to form the loop, the ends of the head rope being spliced into it.

The clews were made up from two slightly thicker ropes than their bolt ropes, one being spliced into the leech rope and the other into the footrope. The two ends were then spliced together to form the loop and wormed and served all over.

The staysails were run on their stays with hanks (Fig 161). The downhauls and outhauls were seized to the head earings.

I have found the best results are obtained in modelling sails by assem-

bling the component parts in the order in which the original sail was made. For a choice of material, I find superior quality typing paper ideal, though I have also had success with very fine polyester cotton fabric.

Cruiser's main yard measures 6in between the cleats at 1/76 scale, which gives the width of the main course. A measurement from the yard to about 5ft (scale) above the deck gives a depth to the leech of 5in. The number of cloths can now be calculated, allowing a scale 2in seam for each: 36ft width (scale) divided by 22in gives twenty cloths, plus two extra cloths for the angled leeches on the course. Each cloth should be ⅓in by 5in, and these should be cut using a craft knife and steel rule.

The glue used to join the strips should be water based, and slow-drying. Work should begin at the centre cloth of the sail, proceeding outwards in equal measurements. As work progresses, the belly of the sail should be moulded in, as should the billowing back of the lower leeches toward the clews; the head should remain straight. When the glue is dry, the sail can be cut. Scissors are necessary to trim the head square to the cloths and to cut in the curve of the roach, to a height of about one twelfth the depth of the sail. The two extra cloths can now be added to form the angled leeches.

The sail is completed by gluing the tabling strips to the aft side and the middle and reef bands to the fore side, with leech linings and bunt linings glued across these. The bolt ropes can now be glued on, with bunt line cringles and reefing cringles spliced in as appropriate, and the ends of the leech ropes then spliced into the head and foot ropes to form the earings and clews.

I have found Windsor-Newton solid white water colour tablets ideal for painting sails as it gives a suitable matt effect and fine consistency. At least two coats should be applied to each side of the sail, avoiding the rope work. The clews and earings should be painted black to simulate serving. Finally, the holes for the reef points and robands should be drilled, after which the sail is complete. All other sails can be made in the same way.

Conclusion

Completion of the sails and their rigging marks the natural end of the process of building an eighteenth-century model ship, just as in effect the bending of the sails was the final operation carried out on board a real ship before its active service began.

The sequence of modelling operations outlined in this book for *Cruiser* are typical, and illustrate the most logical and practical – as well as the most authentic – way to approach building a model of any sailing vessel of reasonable size from the seventeenth to nineteenth centuries. Every type of vessel, however, and indeed every single model, inevitably presents particular problems of construction, and a book of this type cannot hope to provide guidance on all details. It is in the application of the general principles outlined here (and in all of the excellent and invaluable earlier guides to ship modelling by many outstanding modellers of the past) to the demands of a particular project that the individual skill of the modeller comes to the fore.

Such skill is acquired only with patience and persistence and with time, but the satisfaction to be found in each completed model is all the greater for the sense of developing experience in the art of model shipwrightry, and every model – even the first – is a worthy achievement. A model sailing ship may grace home or museum for many years, both the proof of an individual modeller's skill and the product of a long tradition of the highest craftsmanship.

Recommended reading

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