

THE RUDDER

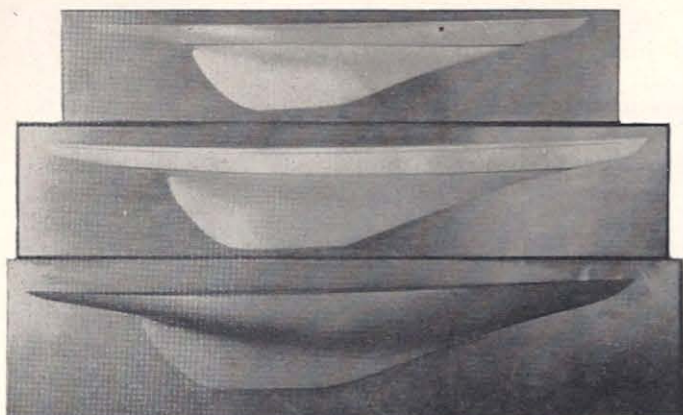
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Models for comparison's sake. Upper, twelve meter Matena. Center, M boat Istalena. Lower, J boat Whirlwind

THERE are a great many forms and types of model making, perhaps as many as there are different schools of painting, and that fact is a very fortunate thing, for tastes and skills vary so greatly that some can do best at one form of work while another's dexterity will allow him to enter the more artistic fields of the craft. But quite apart from the skills of craftsmanship or perfection of manual dexterity is artistic skill, which when present makes the model a joy forever, but when lacking (as I am sorry to say is the case with most models) then the model maker has produced only a gewgaw and a dust catcher, and his pains have all been wasted. Nevertheless all forms of model making are so much to be recommended that I do not want to belittle any of the types. Working on a simple model that can be completed before it becomes tiring is a most exhilarating, healthful pleasure. When the model is also durable (not easily broken), interesting, or even artistic, then it is really one of the most satisfying endeavors the sailor can attempt in the winter months.

After some experience at making models of different types, I am so much impressed with the advantages of the so called designer's half model that generally speaking it is the only type worthwhile. The half model can be hung on the wall like a picture, and it can stand a certain amount of judicious handling, dusting, etc. If a half model is nicely made, that is, shaped exactly like some existing yacht, then it has a personality and is of great value as a standard of comparison in evaluating the characteristics of other models or yachts. However if it is not accurately made, then it is of no value in these respects and we might even say it is an evil thing, for it is nothing but a lie that deceives the eye. While models of existing yachts are quite necessary for comparison's sake, and of decorative value if the prototype is beautiful, still making models of contemplated yachts is by far the most fun, for if the shape represents some carefully thought out combinations of curves to give stability, seaworthiness and grace with little head-on resistance,

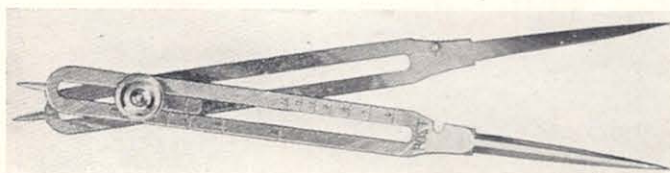


Fig. 1

Some Hints on Model Making

By L. FRANCIS HERRESHOFF

then the model represents a solution of these scientific and complicated problems. If the model maker or designer has made a logical shape to best perform the functions of some special type of yacht, the model at once becomes a piece of sculpture of absorbing interest. Not only will it have a never ceasing fascination to the sailor, but if it is graceful and functional it will also be of much interest to the artist.

The reader may wonder why I have used all these words in describing the difference in half models, but as they are only to represent shape, their shape must be very exact or they are worthless. So what I am to tell about are methods of securing correct and fair shapes, and while the description applies particularly to half models, much that is said is applicable to shaping up hulls for rigged models, or making sailing models.

The first thing to be considered is the scale of the model, and that is often affected by the size of the block of wood you have or can easily procure. Now, as this will often be a quite different size from the lines drawing you are to work from, it is helpful to have or use a proportional divider to change the scale. A proportional divider looks like Figure 1. These instruments change the scale to any proportion within their range by shifting the center pivot along the slot in their central portion, and for model making the cheapest variety will do as well as any other. Although proportional dividers are



Fig. 2

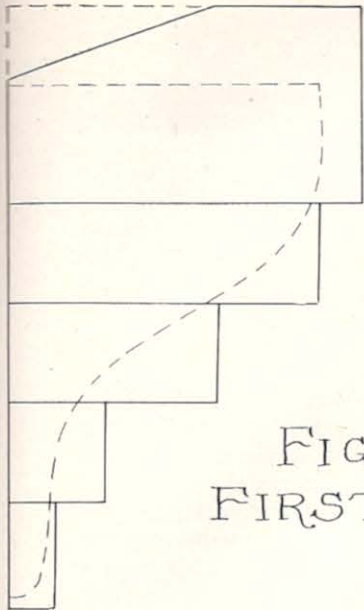


FIG 3
FIRST CUT.

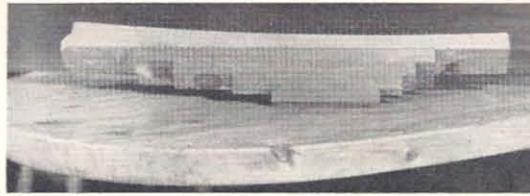


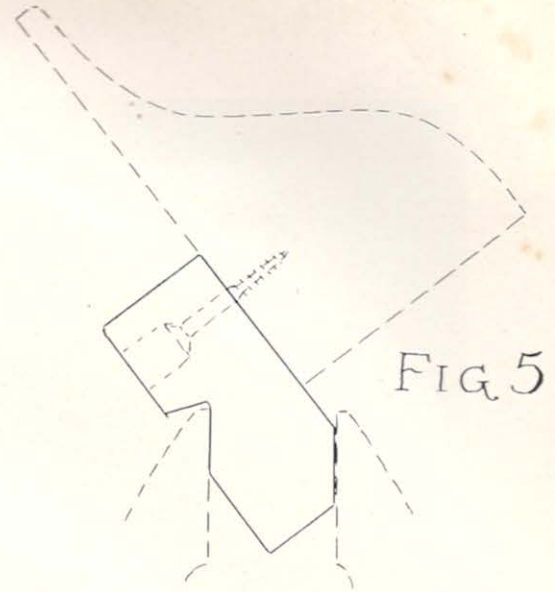
Fig. 4

not very common instruments, still they can usually be procured from any of the large dealers in drawing instruments, and it is not unusual to pick them up in antique stores.

The next thing to be considered is the vise to hold the work, and Figure 2 shows a carriage maker's vise which is the best sort for all wood work. The jaws are smooth inside and so will not mar the work. The carriage maker's vise also has high narrow jaws so cut away that they will not much interfere with the drawknife and spokeshave. Generally a vise with high narrow jaws requires a lower bench than usual, but in Figure 2 you will notice that the vise is attached to a stout piece of wood from under the bench so that the top of the jaws are at elbow level. I might mention that a slightly lower level is even better, particularly if the work is large and extends upward much. The vise must be very strongly attached to the bench, and the bench absolutely solid and stationary, for if there is the least movement or quiver it is very difficult to do nice work with a gouge.

The first operation on a half model is to plane up the back side for what represents the center line of the vessel, and this must be done accurately, for this center line will be the base line on which much of the later work will depend. Not only should this back side be straight fore and aft, but it must be at right angles to the top plank and the lifts or layers under it, so use a try square as you are planing, and keep the surface as straight and square as you can. This is not very easy until you have become used to rocking the blade of the plane crossways so it will cut most on the side that needs cutting. Now give the back side of the model a thin coat of white shellac, and after the shellac has dried several hours either go over it with a very sharp scraper, only pressing down enough to take off what we might call a little dust, or rub it lightly with fine sandpaper.

The next operation is to lay off the station lines of frame stations, which can be done by scratching lines in the shellacked back side of the model, guiding the scratch awl with a carpenter's square which is held at right angles by the upper edge of the top plank. After the frame stations are scratched in (and I use a scratched line instead of a pencil line because it will not rub out or so easily disappear), next with the proportional divider set to the difference in scale between the drawing and the model, lay off the heights that the sheer line is above the water



line at each station and then tack a batten along this line, using very small brads either through the batten or beside it. With the batten as a guide, scratch in the sheer line. After this scratch in the profile of the bow, bottom and stern, using the water line as the base line, but to get the exact profile of the bow, stern and after edge of rudder it is often necessary to make accurate drawings of these parts on a small piece of tracing paper which, besides the profile, also shows at least one frame station, the sheer line and water line.

Now when the tracing is put in exact place, take a sharp prick and prick a line of dots through the tracing onto the model to give the exact profile. Then with various curves, battens and straight edges scratch in the profile to the depths marked on the stations, and to the prick marks just mentioned. These scratched lines along the sheer line and round the profile as scratched into the shellacked back side of the model are very convenient, and exact lines to cut down to, for the eye can see them in various lights far better than a pencil line.

The next operation is to cut the sheer line, and the model can easily be held in the vise for this operation, for both sides are straight and parallel so far. The sheer is usually cut down roughly with a drawknife, and I often cut down on an angle at first, as shown in Figure 3. Then by using a try square, drawknife and various planes, make the sheer (or deck line) perfectly level crossways. The crown of the deck is not shown on half models. Because the sheer line is curved fore and aft it is convenient to do the last finishing off with a sharp scraper, and then sandpaper used on a block, and I must admit it takes considerable skill to produce a sheer line that corresponds with the scratched line on the back side and still is at

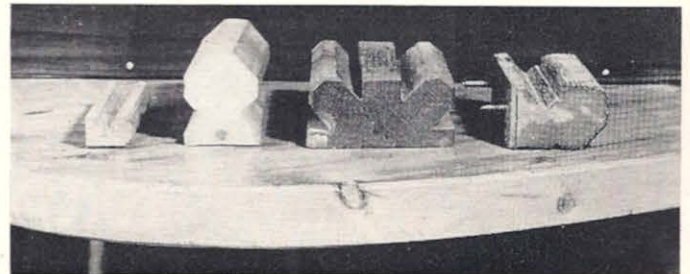


Fig. 6

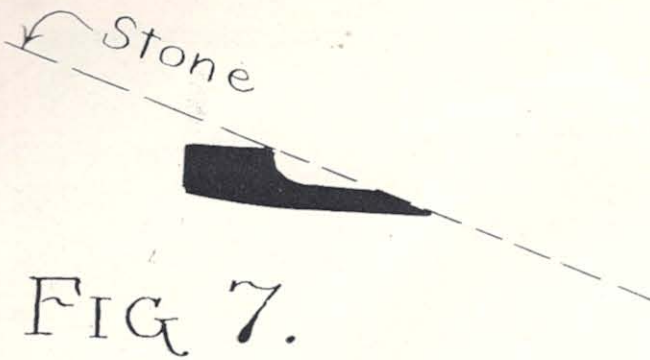


FIG 7.

exact right angles to the back side, besides being a fair sweep. Now give the deck one or two coats of thin white shellac and, after that has dried and been lightly scraped, carry the station lines athwartships on the deck, using the square and scratch awl as was done on the back side of the model.

Next with the proportional divider lay off the various widths at the stations, then spring a batten to these points and scratch in the deck line. In doing this it is well to have the batten outside of the line, then the marks of the

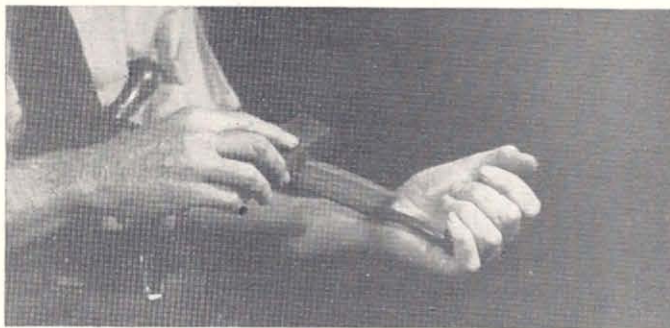


Fig. 8

brads which held the batten will be outside the deck line in the wood which will be cut away later. Figure 4 shows a model block in this state, i.e., the inner surface squared, the stations and profile scratched in, and the sheer cut.

The next step is to secure or screw the model to a block of hard wood so shaped that the model can be held in the vise at different angles. See Figure 5. Figure 6 shows several of these blocks for holding models of various sizes. Be sure the block is well secured to the model with good size screws, since at times with the drawknife or the gouge and mallet the model will be severely wrenched. (This, of course, is only in the first heavy cuts.) Now put the model over the vise so that the out-

side or side line is uppermost, for now with the help of the block just mentioned the model can be securely held at several angles, so that with the deck vertical and toward the workman (so he can see the scratched line that he is to cut down to) he can go to work without fear that the model will shift. The best tool for these first heavy cuts is a drawknife, and as the work is now securely held in place you can do great execution with this tool. Not only can you rip off enormous shavings, but with a little care you can cut down to about an eighth of an inch of the scratched deck line.

I would like now to say a few words about the drawknife, principally because it is practically useless unless kept very sharp, and because it is about the most difficult tool to sharpen. A good drawknife for model work should be fifteen or more inches between the handles. In the past the best ones were made in England or Germany, since in this country they were manufactured to sell but not to be used, so possibly you will have to find yours in some secondhand shop or among the tools of a boat builder or cabinet maker who lived when hand tools were used, for a drawknife that is made of steel that cannot be sharpened is worthless. The section of the blade should be something like Figure 7, and the bevel of the cutting edge about 18 degrees (never less than 15 degrees or more than 20), for the blade should have a splitting as well as a cutting action. The under side of the blade of the drawknife should be on about the same angle that the handles pull. The under side should be quite broad and slightly rounded off at its after end, as the section in Figure 7 shows.

In sharpening, the drawknife is held as shown in Figure 8, and a small stone called a pocket axestone is slid up and down the blade in a slightly rotary motion. These small stones, which have a coarse and a fine side, should rest on the rib at the back of the blade and bear down or grind at the cutting edge. With a little practice in this way the drawknife can be kept sharp and useful, but to get the best results the cutting edge must also be stropped with a piece of leather on a stick to remove the wire edge. This can be done on a rag wheel, but it is a dangerous operation. The drawknife when properly sharpened is a dangerous tool anyway, so the blade should either be kept in a wooden sheath or wrapped with an oiled rag. The drawknife should never be used on work that might slip, or be left where children can get at it.

I have given the drawknife these many words only because when properly sharpened and used it is capable of such execution that it will often take the place of power tools in heavy cuts, and still when properly controlled it will pull off a shaving as thin as a plane can.

After the model has been cut down to nearly the deck line, the last trimming can be done with a plane, prefer-

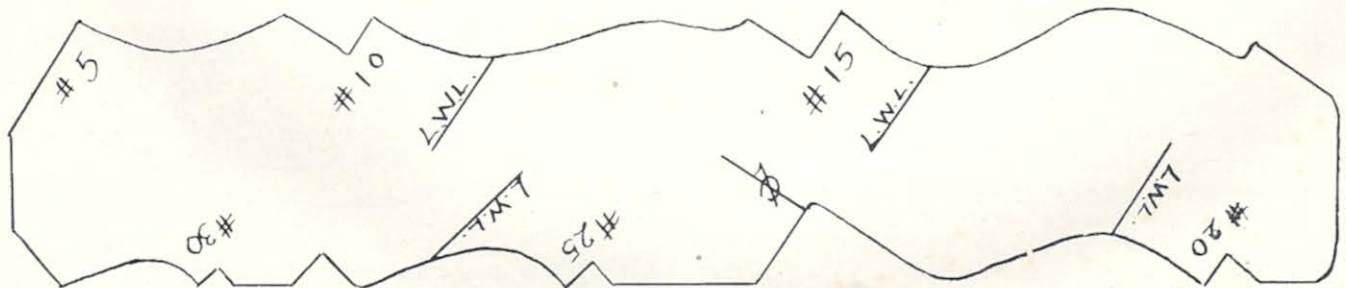


Fig. 9

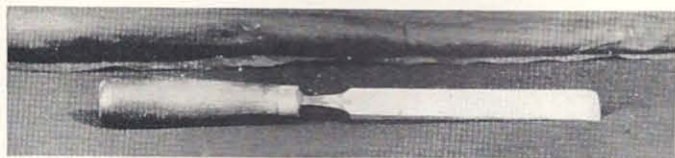


Fig. 10

ably a very small one that will follow the curve much better than a longer and heavier one.

The next operation is to make the templates that will guide the model maker in shaping the various sections. These templates are generally made of soft pine, about $\frac{1}{8}$ inch thick for models about 2 feet long, and comparatively thicker for longer models. The templates are made as follows: after determining what sections will be the most useful in giving the shape (say a midships section and two forward and aft, five in all), then draw these sections up on a piece of tracing paper brought down to the scale of the model either by using the proportional divider on the various water lines, or if you have the table of offsets of the yacht use the dimensions given therein, which of course is the most accurate method. Now lay the piece of tracing paper over the strip of wood to be used for the template and prick through along the line representing the section's shape, also the center line of the vessel, the deck line, and the l.w.l., the last three of which will be a series of dots on straight lines. After the tracing paper is removed, fill in with pencil lines the section line, deck line, center line, etc. This should be carefully done with French curves and a straight edge so that the pencil lines run right over the pricked points. Now with a very sharp pattern maker's paring knife, or a narrow sharp jackknife blade, cut out the part of the template which represents the body of the vessel. The last of this cutting out or shaping should be done with a small piece of medium sandpaper, rubbing down carefully so that finally you come to the marks the prick has made in the template. Some people make the template for each section on a separate piece of wood, but I prefer to cut them all out on one strip, so that it looks like Figure 9.

Mark the station number of each template and give the whole strip a light coat of white shellac. Now perhaps the model should be placed in the vise so that it lies at about 45 degrees, which our screwed-on block will allow. Then, after cutting away the superfluous wood at the ends and at the bilge, you are ready to commence working the rest down with what is called an inside sharpened paring gouge, like Figure 10. This sort of gouge with a little alteration can be the only gouge necessary in making small half models. The blade is $\frac{7}{8}$ inch wide and very flat. I prefer the very flat ones, say with a radius of about 8 inches, and when bought these gouges have a section near the working end like Figure 11A, but I change the section to that shown in Figure 11B by grinding off the outside lower corners on a wet grindstone.



Fig. 11



Fig. 12

Then by holding the gouge flat, or rocking it up on its side, curves of varying radii can be accommodated.

Another great advantage of the very flat gouge is that it can be sharpened on a regular flat oilstone, while sharpening the inside bevel of the smaller radius paring gouges must be done with curved slipstones of more or less appropriate curve. Perhaps the difficulty of sharpening this tool is what has made it rather unpopular or uncommon, but as it is capable of such fine work the paring gouge is indispensable to the model maker and the pattern maker.

When the model has been roughed to approximate shape (but of course oversize), with the paring gouge, we will commence to use the template to get the exact shape of each section. This is done by rubbing some blue lumberman's crayon (or dark colored chalk) on the curved part of the template which represents the curve of sections. Now if the template is put in place on the model with the upper part at the station mark on deck and its lower part at the station mark at the keel, moving the template about slightly, it will mark with transferred chalk the high spots to be chiseled away.

The work must now be slowly and carefully done so that you never cut too deeply, and as you go along cut down the high spots between the sections. Eventually with careful work you will have all the sections cut down so the chalk on the template registers in several spots on the section when the top of the template should be near the deck line and its center line near the profile. We can now put the template aside for a few minutes and take up a soft pine batten about $\frac{3}{16}$ inch square and nearly as long as the model. Rub one face or side of this batten with chalk as you did the template. Place the batten fore and aft on the model, and after springing the ends down to bear on the bow and stern, rub or move it about until it has marked the high spots between the sections. By alternating back and forth with the section template and chalked batten, and carefully cutting down with the flat part of the paring gouge, you will have the model down to approximate shape, and then the work can

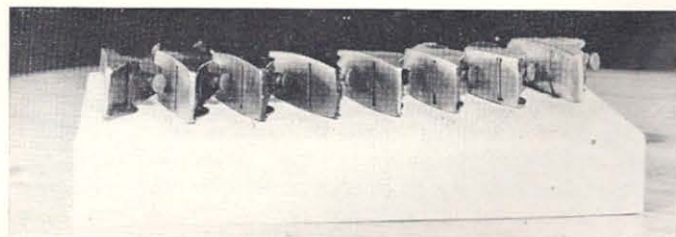


Fig. 13

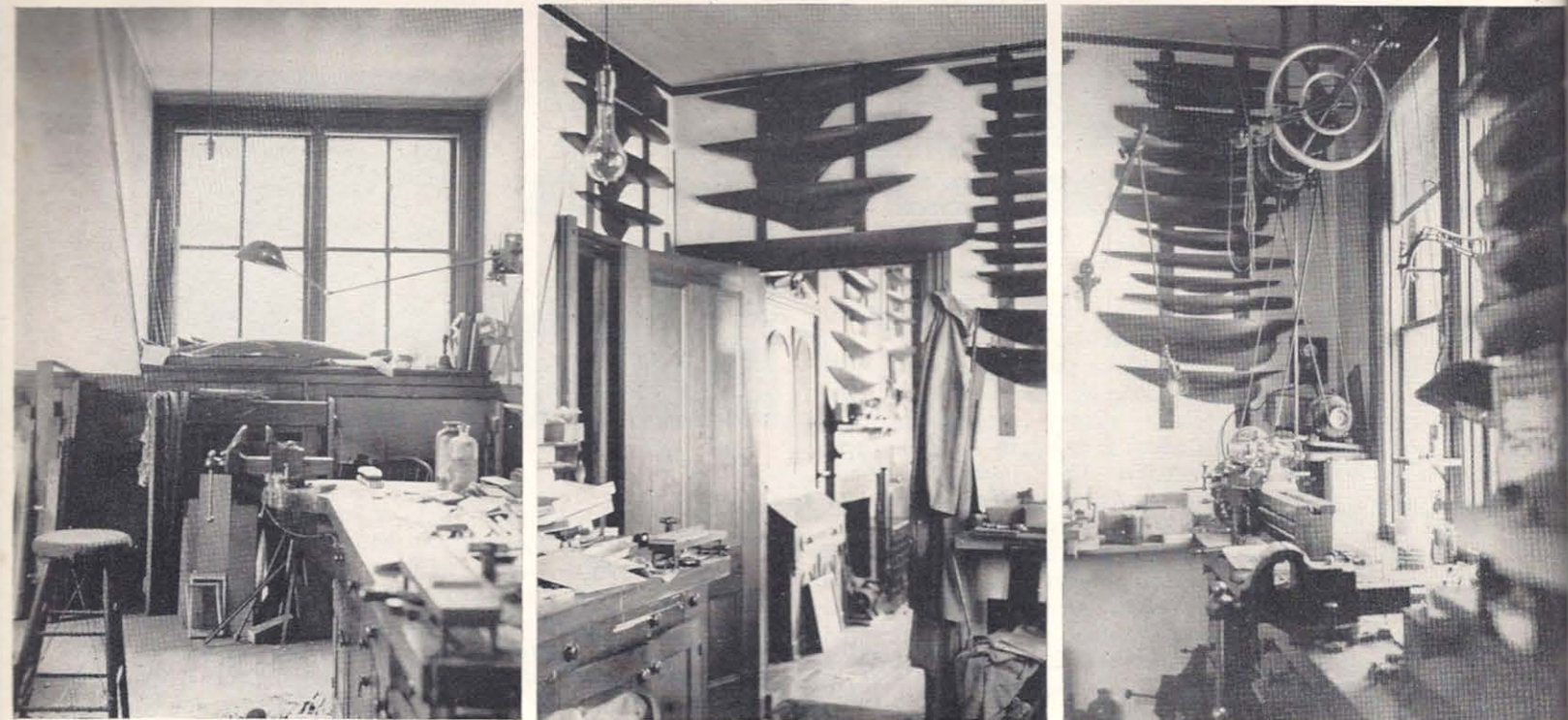


Fig. 14A, B and C

best be continued with a very small plane. (The larger planes are no good on a curved surface.)

These small planes are made by Stanley and are called No. 101. When I was a boy they cost about ten cents, but during two or three Democratic administrations their cost has jumped so that today I understand they cost sixty-five cents or more. Nevertheless they are the best buy of any tool, if you know how to sharpen them and set them. As for the sharpening, I generally grind a little off the heel with an emery wheel, touch up the cutting edge with a fairly fine oilstone, then strop the edge on leather until it is nearly as sharp as a razor. To set the blade I place the plane on the bench and slide the blade down until it touches the surface of the bench, then with a light piece of brass rod tap the blade down until it cuts as required, as shown in Figure 12. Needless to say, if the plane cuts too deep, tap the back of the plane and the blade will move up slightly. If one side or the other cuts too deeply, tap the upper end with the brass rod so the blade rocks sideways until it cuts properly. With some practice these little planes can be set very quickly and accurately in this way. Stanley also makes a similar plane called No. 100. This has a handle cast on and is better for heavier work, but not so good as No. 101 for working on half models where the plane is held between the thumb and fingers in such a way that it can run over a curved surface more freely. If much model making is to be done it is most desirable to have several of these small planes which have had their soles filed to be curved in different ways. Figure 13 shows several such planes.

After the model is all worked down with the gouge and the plane until it is perfectly fair fore and aft and like the sections, sandpapering can begin, but you must be sure that all traces of chalk or crayon or even pencil marks are removed (either scraped or planed off), for if not, the rolling action of the sandpaper dust will only smooch the model up and not remove the crayon as a shaving will. The sandpapering should be done with several grades of paper, first fairly coarse, then medium,

then fine, always excepting at the very last with the finest paper you should keep away from the deck line profile and ends, and this requires some skill. I must caution that the final sandpapering must be kept up a long time, at least an hour of steady work, until all parts are smooth, even and fair, besides being as nearly as possible the same appearance all over. If this final sandpapering is not well done the model can never be given a fine finish later that will not show some marks.

When the bare wood is complete the model should first be brushed off with a fine brush, and then carefully wiped with a clean rag until the wood is perfectly clean and bare. Next give the model a coat of very thin white shellac so thinned down with alcohol that it is almost like water. The wood will quickly absorb the first brushfuls, so it is well to go over the model rapidly three or four times until the brush starts to drag, then put the model aside ten or twelve hours to dry, at the end of which time you will find the surface quite rough, for the shellac has raised the grain of the wood.

Now this next sandpapering is more difficult than the previous ones, as the gums used in the modern shellac will soon ball or gum up the sandpaper so that the paper, instead of cutting evenly, will have a tendency to cut small grooves or depressions in the surface of the model. While these usually cannot be seen by the eye they will much affect the eventual finish, so it is best to use a piece of sandpaper only a very short time and then throw it away and take a clean piece.

After completing this sandpapering the model will appear almost as if it had never been shellacked, but the grain of the wood will be partly filled and hardened up. The next several coats of shellac should be of a thicker consistency, and rubbed down with steel wool excepting at the ends and edges. The model will in all probability require four or more coats, all well rubbed down, before a hard smooth surface is acquired. Then the polishing can be continued with wax in the same way that a wax finish is put on furniture. While it is true that a so called



Fig. 15. Three sides of Mr. Herreshoff's model room

French finish gives the highest gloss, I do not recommend this process for the amateur as it requires much skill and practice to polish the edges and ends the same as the central surfaces. A French polish is applied by saturating the rubbing felt or rag with both linseed oil and shellac and rubbing down with fine pumice, but only one with considerable practice can keep the proportions of oil and shellac just right so that the rag will polish and build up a surface at the same time. Also I must note that a French polish is not as durable as wax over shellac, for the French polish will often become cloudy and turn white (to make it attractive again it will have to be taken down to the wood), while the waxed surface can be improved by later rubbings almost indefinitely.

So you see that altogether the tools required for making half models are very few and inexpensive, and the principal secrets are to have the model held firmly at the right height and in such manner that it can quickly be shifted from being on its side to a bottom-up position or to an angle of forty-five degrees. Secret number two is the use of chalk on the templates and battens to mark the high spots. And finally, the great secret, only use very sharp tools!

The making of models of new shapes, where the modeler or designer uses no plans or drawings to work from, is in some ways much simpler, for he generally only uses a midship section template. On the other hand he must have an extraordinary and highly developed sense of proportion which I believe few today possess. In former days most American vessels had their lines developed from the model, and while this is a process nearly the opposite from that described above (where the model was made from the lines drawing), still I will say something about it. The layers or lifts of which the model was made were planed down to a thickness which represented the scale spacing of the water lines. These various layers were held together either with wood dowels running right down through the model from deck to bottom, as you will often see on old half models, or the layers were held in place by screws in the alternate layers. After the model was completed the layers or lifts were taken apart very carefully and each laid on a paper. A pencil was run around their borders and then, after the stations were drawn in, the offsets could be taken off. Many of these builders' models were later glued up or had their layers permanently fastened together, so that today they appear

as if they had never been taken apart. My father preferred to develop the shape of his yachts from models, and had developed an instrument or measuring device which took the offsets or builder's dimensions directly from the model. This, besides being a most accurate method, also saved much eyestrain. So it is a fact that there are no lines drawings of the several hundred yachts he designed. Figure 14A, B, C show views in the room where N. G. Herreshoff made his models, and Figure 15 shows a larger room where he kept many models and did his drafting.

Some people, and most yacht clubs, prefer the models to be painted, but to the real connoisseur this rather takes away from the simple representation of shape, just as a painted piece of sculpture would seem overdone. Also, to properly paint a half model the work must be so skillfully done that only a most expert painter can accomplish this feat. It is also interesting to note that the work of properly painting a half model will take longer or cost more than making the model itself, so that if paint only lessens the refinement of the model it is of doubtful benefit. However to some a painted water line, stripes, etc., help to establish the water line and visualize the proportions of freeboard, etc., more clearly.

Figure 16 shows a painted model as seen from below, but quite similar effects can be achieved by laying a layer of contrasting wood at the water line, and this saves the cost of painting. I have also made many models that were of soft pine below the l.w.l. and mahogany above, and some vice versa, but on the whole I much prefer one of nice clear soft pine throughout.

Next month I will give some hints on making the hulls of full models, such as are used for exhibition purposes or for model sailing yachts.



Fig. 16. Painted model of the twelve meter boat Matena as seen from below