

MISSILE

a 19-Ft. Racing Sailboat

Small craft designed for
the backyard boatbuilder
who wants competition or
just plain speedy sailing
at minimum cost

C. T. ALLEN
Designer

SPECIFICATIONS

Length 19 ft.-6 in.
Beam 50 in.
Sail Area 116 sq. ft.
Draft 30 in.
Capacity 2 persons
Depth 21 in.
Ballast 200 lbs.

CONSTRUCTION $\frac{3}{8}$ -in. exterior
plywood over sawed and glued
frames.



MISSILE is designed to be the first boat around the finishing buoy, regardless of the competition or varying wind conditions. To do this consistently, the underwater hull design has been chosen to give maximum speed and maneuverability. And, because top speed and close maneuvering each depend on your boat's ability to hang on the wind and be stable at any angle of heel, a fin keel was used.

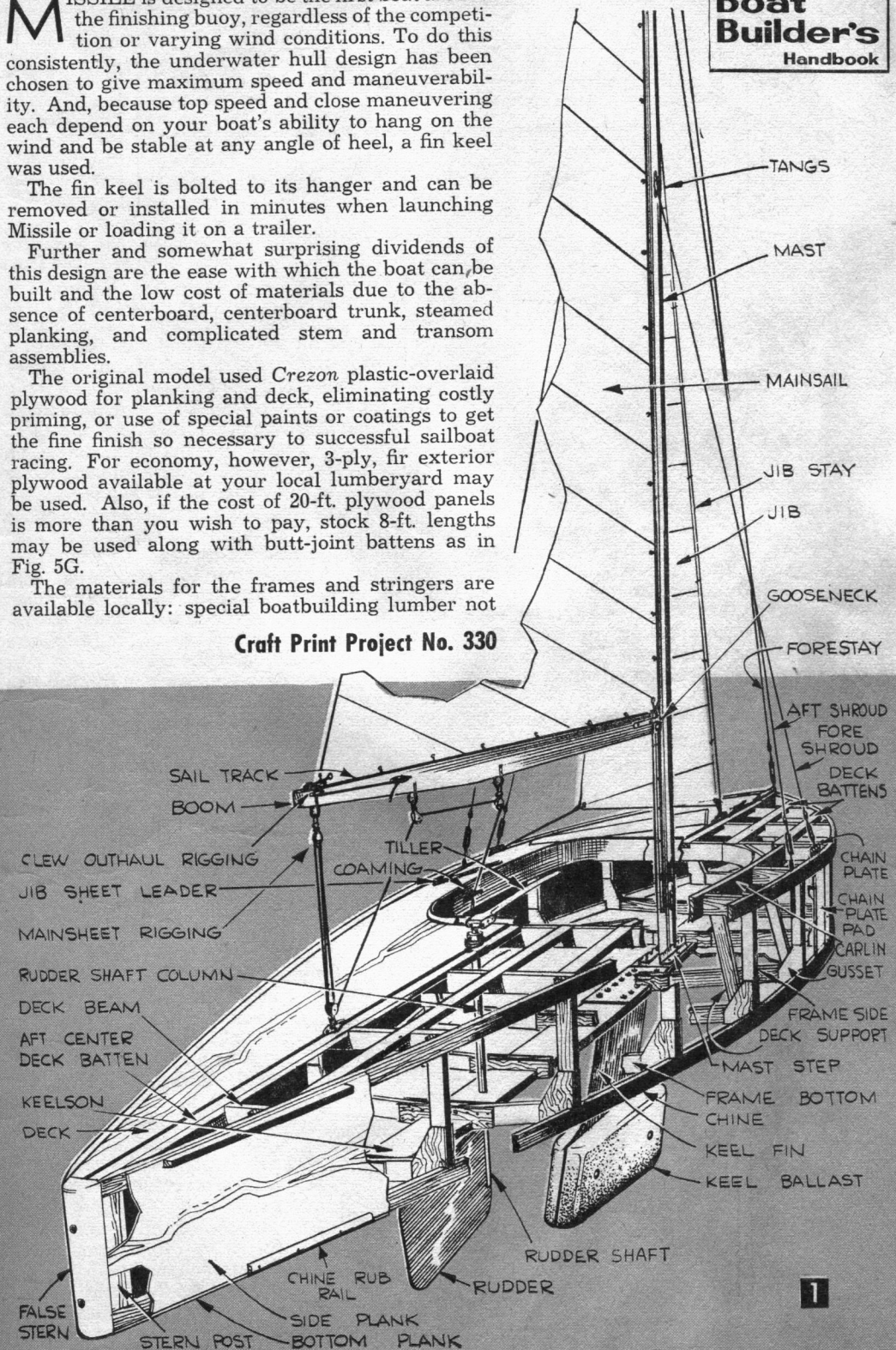
The fin keel is bolted to its hanger and can be removed or installed in minutes when launching Missile or loading it on a trailer.

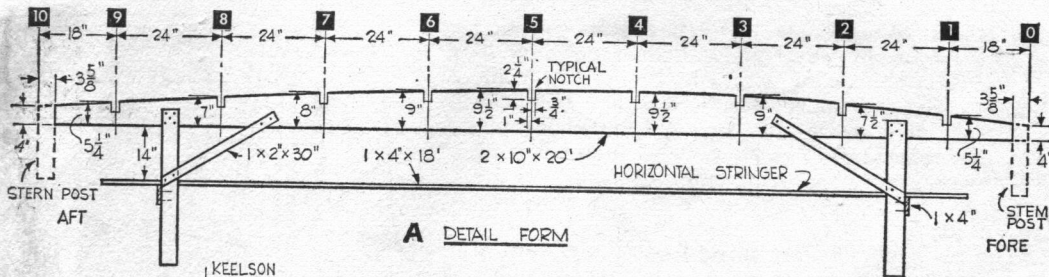
Further and somewhat surprising dividends of this design are the ease with which the boat can be built and the low cost of materials due to the absence of centerboard, centerboard trunk, steamed planking, and complicated stem and transom assemblies.

The original model used Crezon plastic-overlaid plywood for planking and deck, eliminating costly priming, or use of special paints or coatings to get the fine finish so necessary to successful sailboat racing. For economy, however, 3-ply, fir exterior plywood available at your local lumberyard may be used. Also, if the cost of 20-ft. plywood panels is more than you wish to pay, stock 8-ft. lengths may be used along with butt-joint battens as in Fig. 5G.

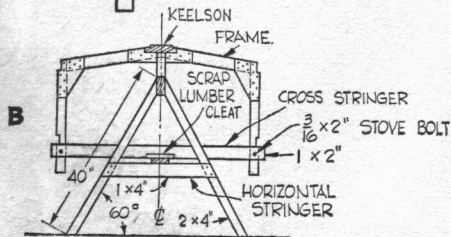
The materials for the frames and stringers are available locally: special boatbuilding lumber not

Craft Print Project No. 330





A DETAIL FORM



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being required. Galvanized fastenings and fittings were used where possible, but for salt-water use bronze fittings and bronze or monel fastenings should be substituted.

The sails can be made according to the specifications in Fig. 16, using 4-oz. Egyptian cotton or Wamsutta sail cloth. They can, however, be purchased on order from the Alan-Clarke Co., 75 Chambers St., New York 7, N. Y., who will duplicate the sails they made for the original boat. Include a copy of the sail plan (Fig. 16) or mention this article when ordering.

Frames. Start construction by drawing full-size patterns of each frame on heavy wrapping paper, using the dimensions in Fig. 4. All dimensions are given from base lines or vertical centerlines which should be drawn in first. To simplify setting up the frames on the building form (Fig. 2), the side members of each frame extend 12 in. beyond the sheer

line. The extra material is cut off when the hull is planked and ready to be removed from the building form to install the deck.

To simplify marking the frame stock, make a gauge as in Fig. 3A. Place a 10-ft. length of stock on the pattern along the inside of the bottom frame line so that an end of the stock is over the centerline of the pattern (Fig. 3B). Use the correct size stock for the bottom and side frame members and allow for the 12-in. extensions. Place the marking gauge on the left side of the centerline and mark the stock at the right edge of the gauge.

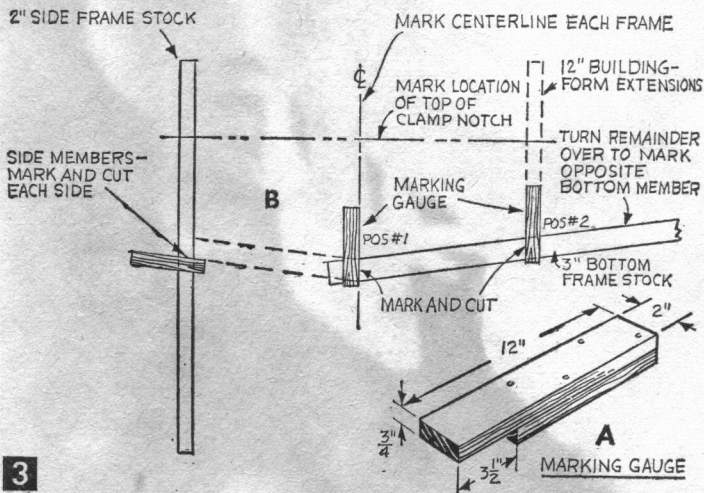
Next place the gauge along the inside of the side frame line and mark the stock on the side of the gauge nearest the pattern centerline. This last mark determines the angle and length of the bottom framepiece. The stock may now be cut at the marks. Turn the remaining piece over and repeat the procedure for the opposite side of the frame.

Place the four frame pieces on the full-size drawing to mark the locations of the tops of the clamp notches (sheer line) and the end of the 12-in. extensions.

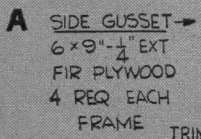
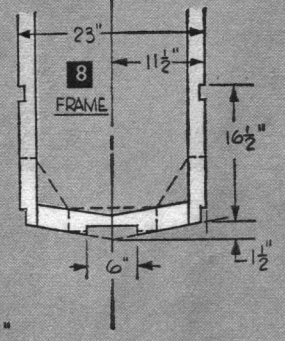
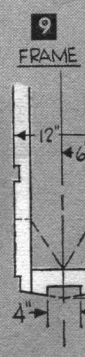
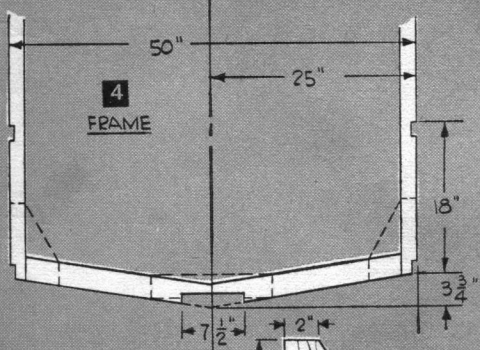
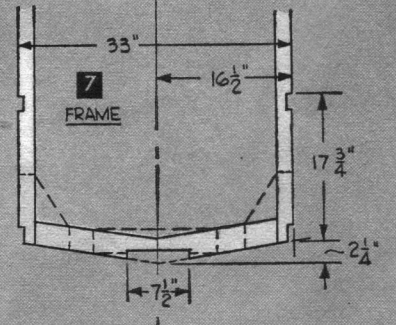
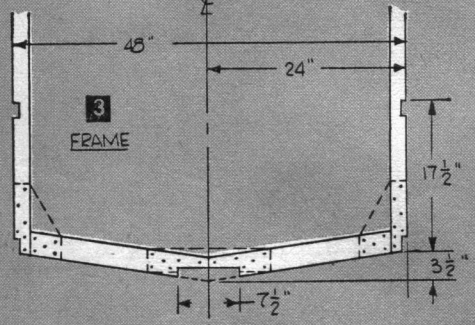
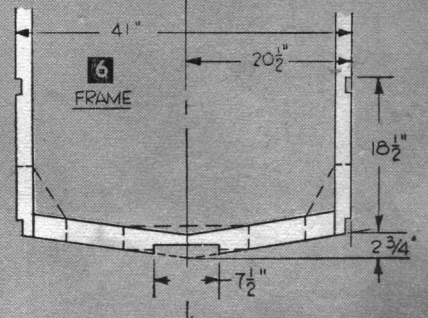
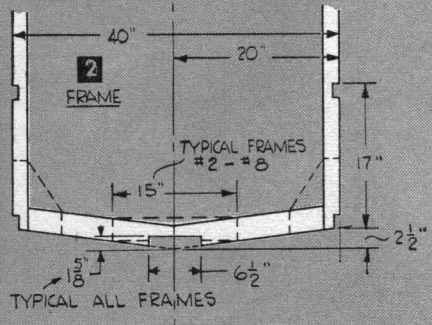
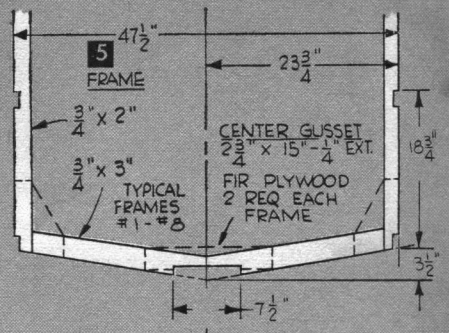
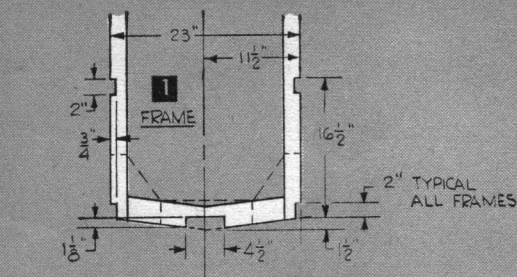
Next lay out a cardboard template of the gussets (Fig. 4) and trace this on 1/4-in. plywood to make four of these for each frame or 36 gussets in all. Assemble the frame members with the gussets, using the full-size drawings as an alignment guide. Use *Weldwood* or *Elmer's* waterproof glue and seven #8 x 3/4-in. (galvanized) fh screws or the same number of #0 x 1-in. *Stronghold* nails spaced as indicated in Fig. 4 so they do not interfere with cutting the chine or clamp notches.

Also mark the centerlines on the gussets of each frame to aid in setting up the framework on the building form. If you intend to use this boat in salt water, use bronze screws or *Anchorfast* monel nails.

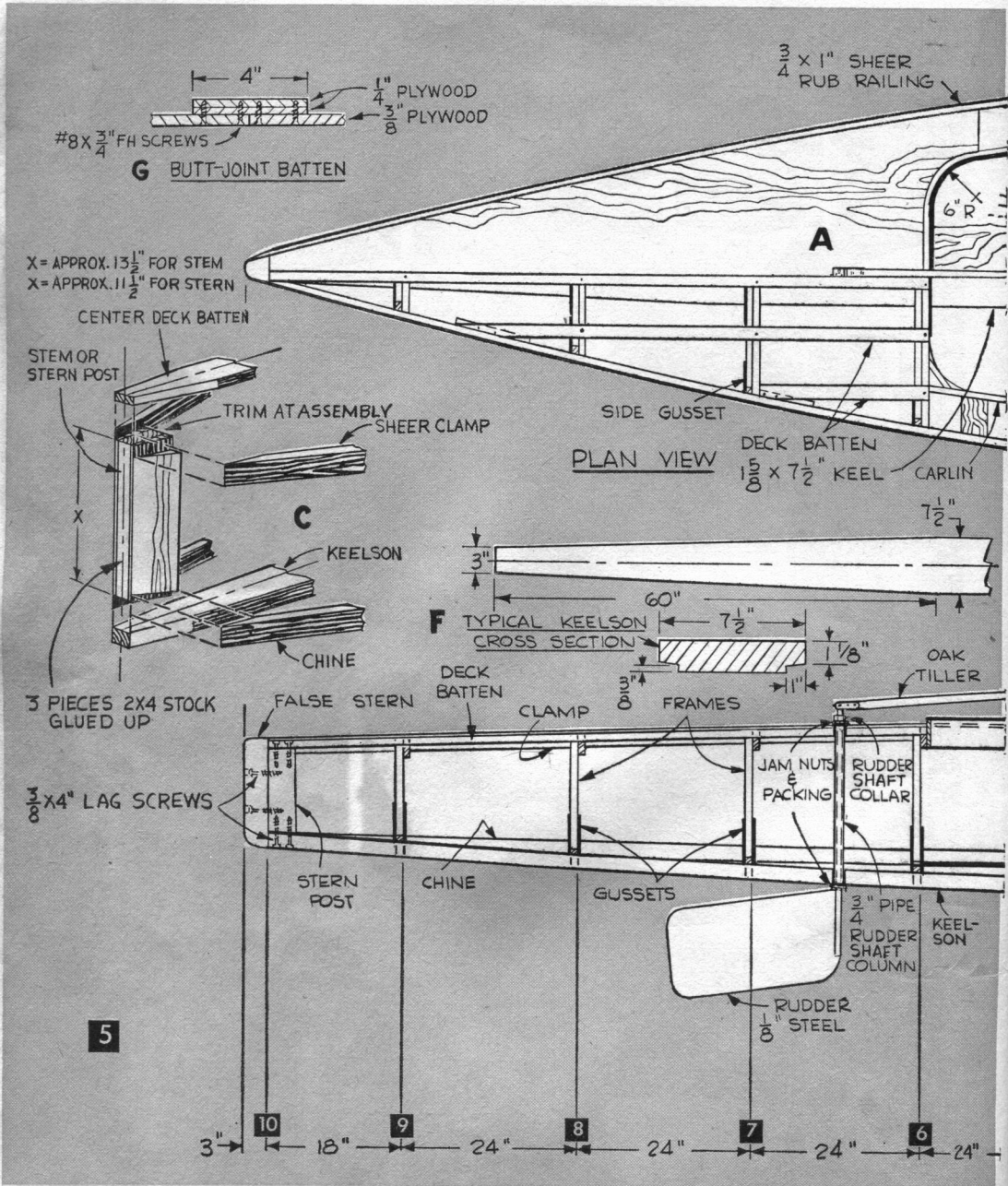
Assemble all nine frames, following this procedure. When the glue has dried, lay out and cut the clamp, chine, and keelson notches, using a 5- or 6-in. piece of stock to



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FRAME DETAILS - 1 TO 9

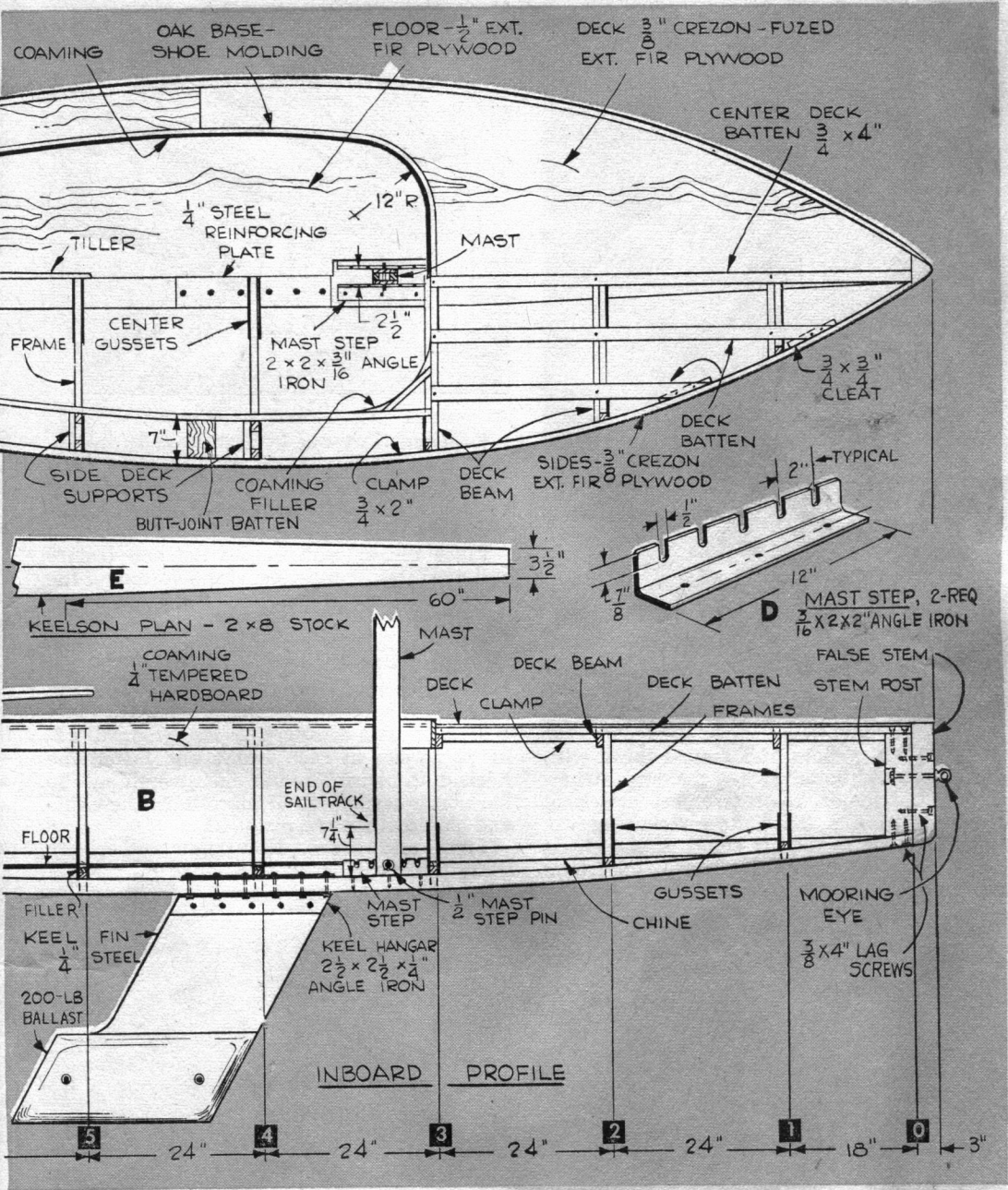


check each notch and be sure the part will fit flush in the notch.

Building Form. To keep the frame parts in alignment during construction, the hull is built upside down on a form of 2 x 10 stock that has been shaped and notched as in Fig. 2A. New or used lumber can be used for the form just as long as it is not warped. Note that the notches in the form are cut wider than the actual frame thicknesses to allow for

wedging the frames securely in the form. Wooden shingles make excellent wedges here and, when the hull is completed, these wedges can be knocked out and the hull lifted from the form.

After shaping the form, cut and attach the 2 x 4 legs as in Fig. 2, anchoring the legs to the floor with lag screws driven through 2 x 2 stock bolted at the lower ends. If the boat is being built out of doors, anchor the legs of the

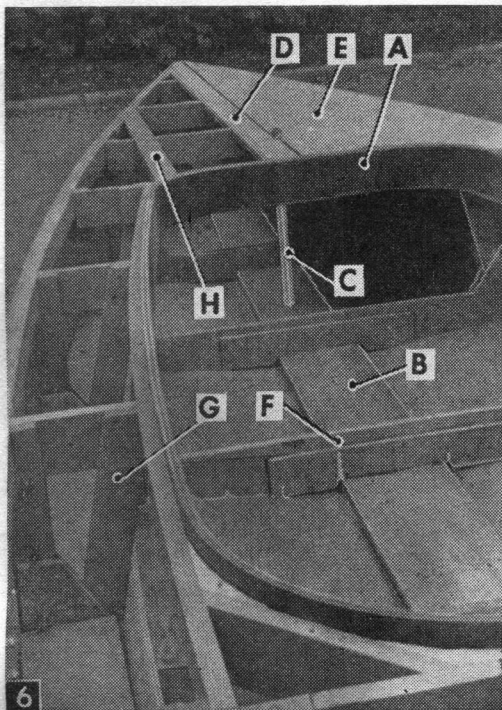


form to stakes driven into the ground. In either case, be sure the form is level and plumb.

Framework Assembly. You are now ready to assemble the framework. Mark the centerline on each frame and at each notch on the building form (Fig. 7). Then set the frames in place and drive shingle wedges from each side forward of the bottom framepieces, forcing them tightly against the aft edges of the

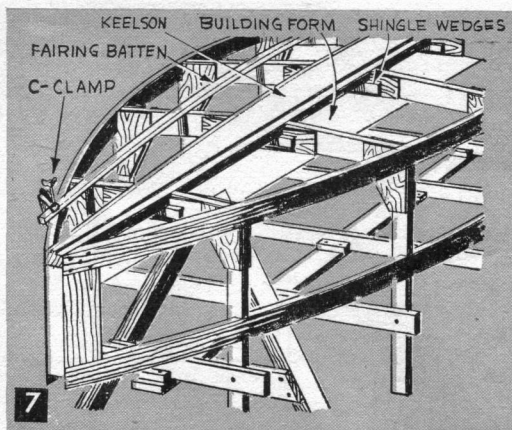
notches. Clamp the $\frac{3}{4}$ x 3-in. cross stringers (Fig. 2B) to the longitudinal stringer and then clamp the side members of each frame to the cross stringers.

The vertical distances from the chine notches to the cross stringer should be the same on both sides. If not, loosen the clamps and tap the high side down to make both sides equal. While the clamps are still in place, drill $\frac{7}{32}$ -in. holes through the stringers and



A) coaming; B) keelson; C) rudder column; D) center deck batten; E) deck; F) tapered floor beams; G) deck supports; and H) side deck battens.

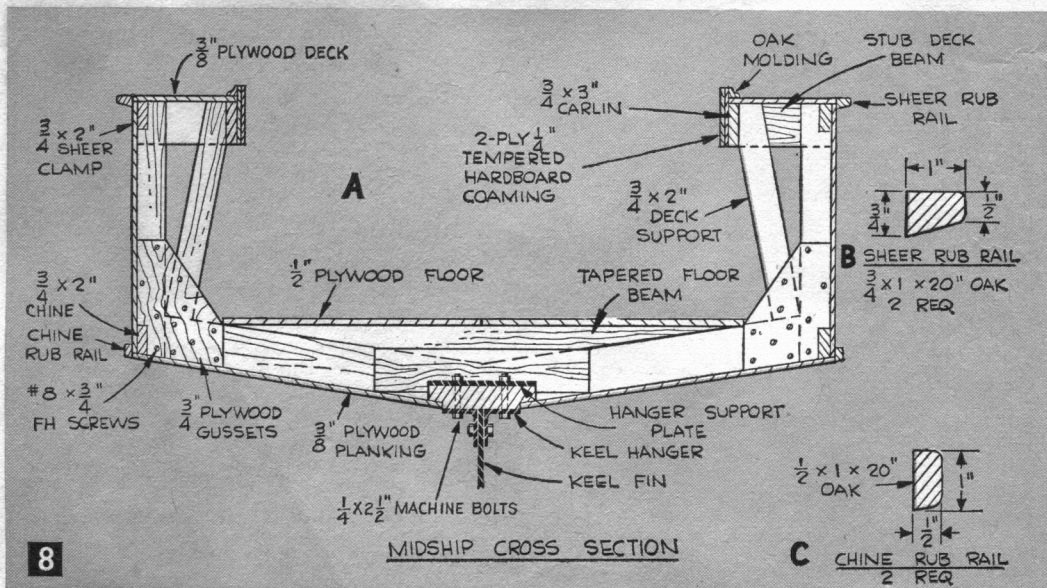
frame side members and secure these with $\frac{1}{4}$ x 2-in. stove bolts. Fasten the cross stringers to the longitudinal stringer, attaching cleats as in Fig. 2A before removing the clamps. Be sure the aft edges of the cleats are directly below the aft edges of the frame notches.



Keelson. Lay out keelson next as in Fig. 5E. Saw to within $\frac{1}{16}$ in. of the layout lines and rabbet as in Fig. 5. The beveling can best be done after the keelson has been assembled to the frames.

Place the keelson in the notched frames and mark for final fitting so the bottom of the keelson notches can be beveled to follow to the curve of the building form. Refit the notches with a wood rasp. When finished, coat the keelson notches in the frames with glue and spring the keel in place on the form, securing it with bar clamps at frames #1 and #9. Drill and countersink for two #10 x 2-in. *fh* screws at each frame and fasten the keelson in place. The bar clamps holding the keelson must remain in place until the chine and clamp strips are installed.

Stem and Stern. Now glue and clamp three 3-ft. lengths of 2 x 4 stock and, when dry, cut them to provide stock for the stem



and stern posts (Figs. 1 and 5C). Rough out the posts, beveling the sides 30° on a bandsaw. To determine the angle of the post where it joins the keelson, use a bevel gauge or make a cardboard pattern of the angle between the top of the keelson and the end of the building form (Fig. 2).

Do not attempt to trim the upper end of the stem or stern until you are ready to install the center deck batten. Attach the keelson to the stem and stern posts with glue and two countersunk 3/8 x 4-in. lag screws. This joint will be further reinforced when the chines are installed (Fig. 5C).

Chines. Proceed by clamping a chine strip (Fig. 1) to frame #4 and then spring it and clamp it to each frame fore and aft and to the stem and stern. These strips can be fitted one at a time because the form is rigid enough to resist springing out of alignment. Check the amount each notch in the stem, stern, and frames must be beveled to hold the chine snugly.

You can draw lines on the frames parallel to the chines as a guide for sawing or, as some boat builders prefer, you can make a number of saw cuts between the chine and the frame

notches until the two pieces fit.

Next, cut a bevel on the end of each chine to fit the stem. Keep the saw blade parallel to the stem while making this cut. If the joint is not tight, run your saw between the stem and chine until it is. Secure the chine with glue and one #10 x 2-in. *fh* screw at each frame and to the stem, stern, and keelson with #12 x 2 1/4-in. screws. Install the chine on the opposite side in the same manner and then install the clamp strips (Fig. 5) in the same way as you did the chines. The frame is now ready to be faired.

Fairing. Use a block plane and a wood rasp for fairing the frame members. First spring a batten over the entire length of framework and then clamp the ends as in Fig. 7. This batten will show you which frames are high and the amount each member should be beveled to allow the plywood covering to lie flat. Also fair the stem and stern posts to blend with the chines and clamps, and plane the bottoms of the chines and the keelson to match the frames at each station. Continue fairing and testing with the batten until the plywood planking will make full contact with each frame member.

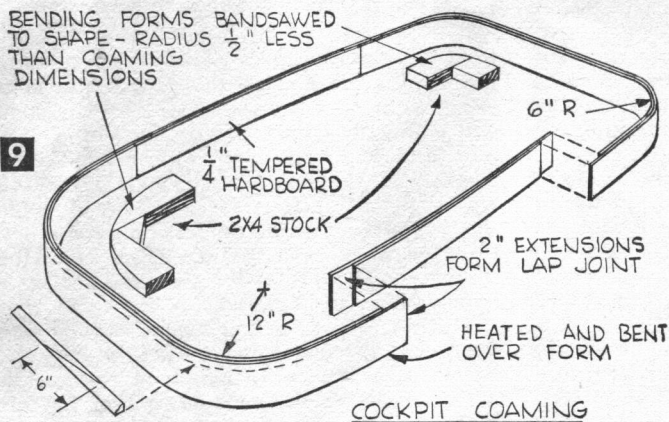
MATERIALS LIST—MISSILE

Amt. Req.	Size and Description	Use	Amt. Req.	Size and Description	Use
EXTERIOR FIR PLYWOOD (CREZON)					
2	3/8" x 4' x 20'	sides, bottom	5	1/4 x 4" x 8' tempered hardboard	coaming
2	3/8" x 4' x 8'	decks	2	1/8 x 6 x 8" brass	fore chain plate
2	1/2" x 2' x 6'	floors		1 x 1 x 12 x 1/8" brass angle	aft chain plate
1	1/4" x 4' x 8'	gussets, battens	16 gr.	#8 x 3/4" <i>fh</i> screws (galvanized)	
FIR STAIR-TREAD STOCK					
2	3/4 x 2" x 12'	frames	2 gr.	#10 x 1 1/2" <i>fh</i> screws	
3	3/4 x 3" x 10'	frames	1/2 lb.	Weldwood glue powder	
3	3/4 x 3" x 10'	deckbeams	2 gal.	Firzite plywood sealer	
2	3/4 x 3 1/2" x 20'	mast sides	1 gal.	marine enamel	
2	7/8 x 7/8" x 20'	mast edges			
1	1/8 x 4" x 10'	boom			
CLEAR FIR LUMBER					
2	3/4 x 2" x 20'	clamps	Amt. Req.	Size and Description	Cat. Fig. No.
2	3/4 x 2" x 20'	chines	1	#0 open shell block w/becket	9520
2	3/4 x 3" x 6'	carlins	2	#2 single pad eye	901
4	3/4 x 2" x 8'	deck battens	1 pr.	4 1/2" bow chocks skene	4121
4	3/4 x 2" x 30"	deck supports	1	6 1/2" hollow deck cleat	4020
1	1 1/8 x 7 1/2" x 20'	keelson	2	10 1/2" chain plates finishing	6301
3	1 1/8 x 3 5/8" x 36"	stem and stern	2	adjustable jib sheet leaders	9860
2	3/4 x 4" x 8'	center deck battens	4	5" jam cleats	4055
2	3/4 x 3 5/8" x 18'	false stem and stern	2	#0 eye straps	275
1	1 1/8 x 9 5/8" x 20'	building form	1	sheet snubbing winch	886
1	3/4 x 3 5/8" x 18'	stringer	1	#2 bow eye	6145
4	1 1/8 x 3 5/8" x 40"	form legs	6	1/4" rigging turnbuckles	3164
2	3/4 x 5 5/8" x 24"	cross stringers	12	#0 solid rigging thimbles	3210
CLEAR OAK LUMBER					
2	1/2 x 3/4" x 10'	base-shoe molding	2	haliard shackles	2870
2	3/4 x 1" x 20'	sheer rub rail	1	bullet blockon shackle	968
2	3/4 x 1" x 20'	shine rub rail	1	3/8" capacity mast head sheave	849
2	3/4 x 3" x 34"	spray rail	3	5/8" x 10' mast track	120
1	1 1/8 x 3 5/8" x 40"	tiller	6	#0 mast tangs	9896
FASTENERS AND MISCELLANEOUS					
12	shingles	frame wedges	1	adjustable sail track stop	8241
1	3/4" dia. x 30" steel shaft	rudder shaft	1	#0 jib haliard block	954
1	3/4" I.D. x 24" water pipe	rudder column	1	Fits-All gooseneck	6483
1	3/4" I.D. set collar	rudder collar	1	#0 clew outhaul	980
1	1/8 x 12 x 24" steel	rudder	3	#1 outhaul cheek block	5800
1	1/4 x 28 x 40" steel	keel fin	3	#0 boom travelers	6390
2	2 x 6 x 28" steel (see text)	ballast	2	#0 open shell block	952
2	1/4 x 3 x 36" steel	fin reinforcements	1	#1 bow plate	9893
2	2 1/2 x 2 1/2 x 24 x 1/4" angle iron	keel hanger	1	whisker pole fitting (optional)	654
1	1/8 x 6 x 24" steel	hanger plate	120'	1 x 19, 1/8" wire rope	standing rigging
2	2 x 2 x 12 x 1/8" angle iron	mast step	100'	3/8" nylon or manila line	running rigging

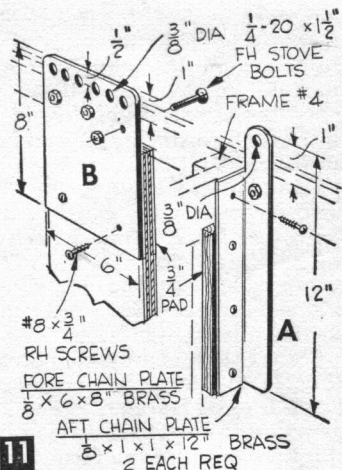
Rigging parts available from Wilcox-Crittenden, Middletown, Conn. Order by figure number and name of part. Sails are available ready-made from Alan-Clarke Co., 75 Chambers St., New York 7, N. Y.

BENDING FORMS BANDSAWED TO SHAPE - RADIUS $\frac{1}{2}$ " LESS THAN COAMING DIMENSIONS

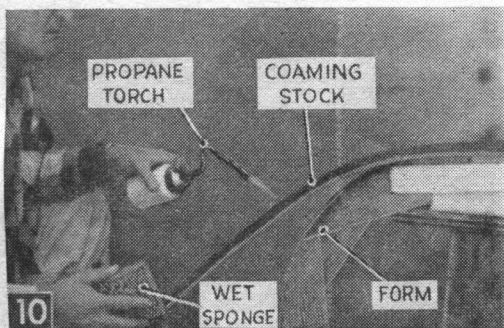
9



A MOLDING SCARF JOINT



11



Tempered hardboard stock for coamings bends accurately over form when heated by propane torch. Charring is prevented by wetting surface with sponge.

Cut the limber holes at the same time. These are triangular notches at each side of the keelson which allow all water taken aboard to flow to the lowest part of the hull and be bailed away. The entire framework, except for the surfaces to be glued, should now be coated with a wood preservative such as *Firzite* to prevent dry rot and water absorption. Flow this on liberally with a brush and allow to dry thoroughly.

Side Planks. Plank the sides of the framework before planking the bottom. Each 4 x 20-ft. sheet of $\frac{3}{8}$ -in. plywood will make one side and one bottom plank (Fig. 5). Proceed by clamping a sheet of the plywood to one side of the framework and tracing along the chines, clamps, stem, and stern. Remove the plywood sheet and saw it to within $\frac{1}{8}$ in. of the traced line.

When both side planks are cut, clamp them in place to check their fit, and drive several #8 x $\frac{3}{4}$ -in. fh screws in each plank to help relocate it. Then remove one side plank at a time and apply a $\frac{1}{32}$ -in. layer of Kuhl's *Bed-last* bedding compound along the chine, clamp, stem, and stern. Replace the plank in

its original position and fasten it in place with the locating screws.

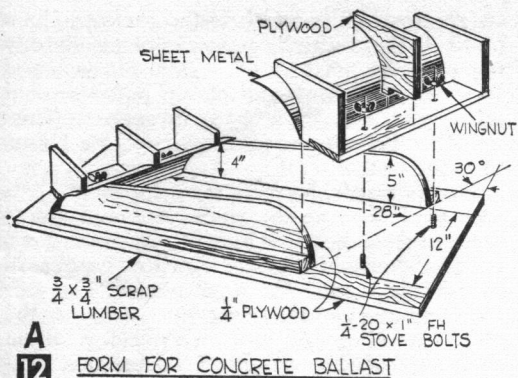
Use a pair of dividers to mark the locations for additional #8 x $\frac{3}{4}$ -in. fh screws at 2-in. intervals along the chines and at 3-in. intervals along the clamp strip and frames.

A combination drill and countersink should be used for starting each screw, countersinking the screw heads $\frac{1}{32}$ in. below the surface to allow filling with *Famowood* plastic putty. When finished, drive a staggered double row of #10 x $1\frac{3}{4}$ -in. fh screws spaced 2 in. apart at the stem and stern. The excess bedding compound can now be removed with a putty knife and, if kept clean, be reused.

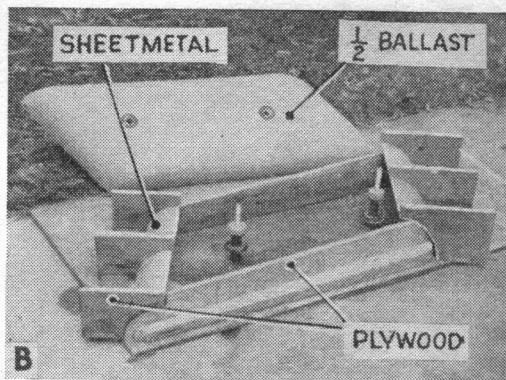
After fastening both side planks, plane the edges flush with the chines, taking care to maintain the particular bevel at each frame. If lengths of plywood paneling less than 20-ft. are used, install the first panel and then attach a batten (Fig. 5G), made up from a double thickness of $\frac{1}{4}$ -in. plywood, to the exposed edge of it. Butt the next panel against the first when fitting and join it to the batten with bedding compound and #8 x $\frac{3}{4}$ -in. fh screws as assembly.

Bottom Planks. Now take the piece of plywood from which one side has been cut and butt the remaining straight edge against the keelson. Clamp or tack this in position. If the joint at the keelson does not fit smoothly, scribe the contour of the keelson on the plywood with dividers, and saw or plane to the line. When you have a good fit at the keelson, trace the plywood along the chine and saw it to within $\frac{1}{4}$ -in. of the line.

Next make a pencil mark on the keelson and the side planks at the centerline of each frame member. These marks will aid you later in locating the screws to attach the bottom planks to the frames. Replace the bottom plank and temporarily secure it with several screws. Step off the spacing for additional screws at 2-in. intervals along the keel and chine. Drill and countersink for #8 screws,



A 12 FORM FOR CONCRETE BALLAST



Concrete keel weights are cast in sheet metal and plywood form. Pipe inserts and hardware cloth reinforcement are integrally cast by inserting in mold before pouring concrete.

but do not drive the screws at this time. The spacing of the screws at the stem and stern, however, should be $1\frac{1}{2}$ in. for six to eight holes.

Remove the bottom planking and apply a bead of Kuhl's *Bedlast* to the contacting surfaces. Then refasten the bottom to the chines with #8 \times $\frac{3}{4}$ -in. fh screws, and #10 \times $1\frac{3}{4}$ -in. screws at the stem and stern. Remove the excess bedding compound and carefully plane the edge of the bottom planking flush with the sides.

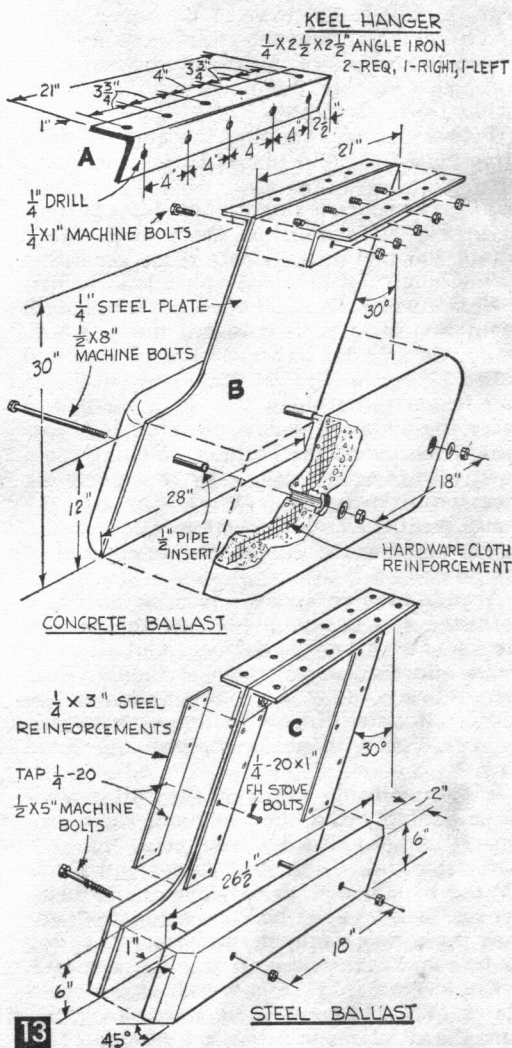
To fasten the bottom planking to the frame members, first locate where the screws should be placed by drawing a line between the two marks you previously made on the keelson and sides at each frame. This line will indicate the exact center of the bottom frame members. Drill and countersink for #8 \times $\frac{3}{4}$ -in. fh screws, spaced about 4 in. apart and secure the plank to the frames.

Prior to sanding the planking with 3/0 sandpaper, fill the screw-head holes and all dents with plastic putty. Remove the sanding dust with a vacuum cleaner and then give the hull a coat of *Firzite* sealer.

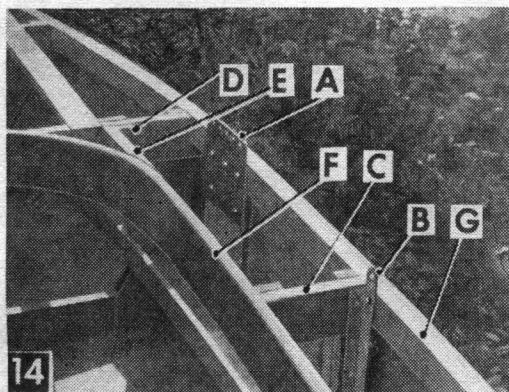
To remove the hull from the building frame, first knock out the shingle wedges that hold the frames in place and also remove the bolts from the cross stringers. With the aid of a few friends, lift the hull from the form and place it right side up on a pair of saw horses.

Deck Beams. Use the material from the cross stringers as stock for the deck beams (Fig. 5A). Note that the beams are installed on the fore side of frames #3, #6, #7, #8, and #9 and on the aft side of #1 and #2. Attach the beams with glue and two #10 \times $1\frac{1}{2}$ -in. fh screws to each joint and then saw the frame extensions flush with the sheer clamps and beams.

Next cut and install the 7-in. stub deck beams (Fig. 8) for frames #4 and #5, and also attach the back-up blocks (Fig. 5A) to deck beams #3 and #6 with C-clamps. Then



13 STEEL BALLAST



A) fore chain plates; B) aft chain plates; C) stub beam; D) back-up block; E) carlin; F) coaming; and G) shear clamp.

clamp the carlins in place, bowing them outward to follow the curve of the sheer. Mark and bevel the ends of the stub beams and the blocks to fit snugly against the carlins. When finished, assemble the parts with glue and #10 x 1½-in. *fh* screws.

Follow this by clamping the angular deck supports (Fig. 8) in place, fitting them, and attaching them in the same way. If the decking is to be spliced, glue up butt-joint battens as in Fig. 5G and install them in the deck framing at this time. Locate these according to the lengths of plywood you intend to use.

Next cut the stem and stern posts to length as in Fig. 5B and then install the ¾ x 4-in. center deck battens (Fig. 5A) with glue and #10 x 1½-in. *fh* screws. Cut ¾-in.-sq. cleats and fasten these along the sheer clamps to carry the outboard ends of the side deck battens. Then install the battens, notching them flush into the deck beams by first clamping them onto the framing. When they are correctly positioned, mark their location on the beams and remove the battens, to cut and fit the notches.

Also, to provide a curved backing on which to fasten the coaming, lay out the curved blocks (Fig. 6) on 2 x 4 stock. Cut these to shape and then fasten them to the ¾ x 2-in. corner braces (Fig. 5A). When this is finished, fair off all the deck framing, trimming as necessary with a block plane and wood rasp.

While the inside bottom of the hull is readily accessible, install the keel hanger and support (Fig. 13A) and the mast step (Fig. 5D). Lay out and drill the steel angles and plates for the hanger and then bolt them in place over a thick layer of bedding compound. Attach the mast step in the same way, butting its fore end against the aft side of frame #3.

Chain Plates. Make two each of the chain plates (Fig. 11) from ½-in. brass stock. Secure the aft plates to frame #4 with ¼ x 1¼-

in. *rh* stove bolts and bolt the forward chain plates to ¾-in.-thick reinforcing pads directly opposite the mast on each side. Fit each pad between the chine and clamp and secure it with glue and #8 x ¾-in. *fh* screws. Then bolt the plates to the pads with six ¼ x 1½-in. *fh* stove bolts.

Floor Boards. Next, using a cardboard pattern to determine the shape, cut and attach tapered floor beams (Fig. 8), for frames #3 to #6. Then cut another piece of cardboard as a template for the floor boards. Cut this template away at the centerline to expose the mast step (Fig. 5A) and then check its fit on each side of the cockpit. Transfer this template to two pieces of ½-in. exterior plywood and saw them out. Coat both sides of the boards with *Firzite* and two coats of spar varnish. When dry, secure the floor boards to the tapered beams with #10 x 1½-in. oval-head screws and finishing washers.

The interior of the hull should now be given a coat of primer paint and two finish coats of a light-colored porch-and-deck enamel.

For increased safety with only a slight increase in weight, a plastic foam flotation such as *Plasti-Foam*, available from PolyStructures, Inc., 41 Montvale Ave., Stoneham, Mass., can be mixed and poured into the end compartments of the hull at this time. Sheets of cardboard or aluminum must be cut and installed to cover the openings in frames #2 and #8 as temporary bulkheads to hold the foam in place until it sets.

Decks. After temporarily removing the chain plates, you are now ready to make and attach the ⅜-in. plywood deck. Make up the deck panels (Fig. 1) by clamping them in place on the framing with a straight edge along the centerline of the hull. Trace the sheer lines on these and, when all the panels are cut to within ½ in. of the traced lines, replace the chain plates to locate and cut openings for these in the deck. Make the chain plate openings slightly undersize and force the decking over them by tapping with a hammer and wooden block.

Coat the underside of the deck panels with *Firzite* and allow to dry before attaching them to the deck framing and butt-joint battens with bedding compound and countersunk #8 x ¾-in. *fh* screws. When finished plane the edges of the deck flush along the sheer lines. To avoid exposing the edges of the plywood planking and deck, cover these edges with 3-in.-wide fiber glass tape.

Coaming. The coaming (Fig. 9) is made up of a double-thickness of ¼ x 4-in. tempered hardboard, heated and bent to shape on a form as in Fig. 10. Note that the outer member of each curved section and the inner member of each straight section extend 2 in. on each end to form a half-lapped joint when assembled. The outside radius of the form

is $\frac{1}{2}$ in. less than the matching radius of the cockpit to provide a tight fit after the hardboard has dried.

Clamp each piece to the form separately so the smooth sides of hardboard will show and the dull sides will be joined. After softening by alternately applying water from a sponge and heating with a torch, clamp the coaming parts to the form and allow to dry 30 minutes. Then coat the dull sides of the pieces with glue and clamp together on the form until dry. When the pairs of curved sections are completed, fasten them to the cockpit framing so they project $\frac{7}{8}$ in. above the deck, using glue and #10 x $1\frac{1}{2}$ -in. fh screws. Cut the straight sections to fit and attach these in the same way.

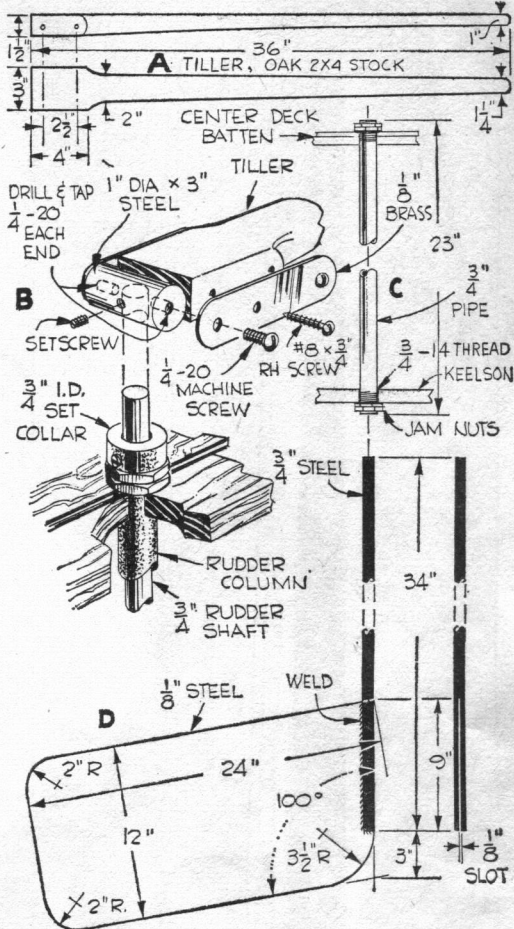
Finish the outside of the coaming with oak base-shoe molding (Fig. 9). Bend the molding in the same way as you did the hardboard, using the coaming itself as a form. Use clamps spaced about 4 in. apart when forming the bends and use scarf joints (Fig. 9A) to join the straight sections to the curved sections.

If the molding should twist slightly during forming, plane the inside corner to make a tight fit at the coaming. Fasten the molding with $1\frac{1}{4}$ -in. fh screws, covering the countersunk screwheads with plastic putty. Plane the coaming flush with the molding and round off the inside edge.

Trim. Now fasten the false stem and stern (Fig. 5) in place with glue and two $\frac{3}{8}$ x 4-in. countersunk lag screws in each piece. Drill a hole in the aft face of the stem post to countersink the nut for the bow eye (Fig. 5B). When the glue has dried, finish shaping these parts with a wood rasp so they are flush with the posts and follow the curvature of the hull.

Cut the spray rails (Fig. 16F) and the rub rails (Fig. 8B) and temporarily attach these so you can check their fit and shape them as necessary with a wood rasp. Then remove these parts for sanding and varnish and lay them aside until the hull is painted. Also locate as many as possible of the metal fittings that attach to the deck (Fig. 16E) and install these temporarily. Remove these before giving the hull two coats of primer followed by two coats of marine enamel. When finished, reinstall the spray and rub rails and give these one more coat of varnish.

Rudder and Tiller. Use a straight section of $\frac{3}{4}$ -in. galvanized water pipe for the rudder shaft column (Fig. 15C), drilling through the keelson and aft center deck batten and cutting the pipe to fit. Thread each end of the pipe to take a pair of thin-wall conduit nuts. Check the fit of the $\frac{3}{4}$ -in. rudder shaft (Fig. 15D) in the pipe. If there is noticeable side play, flatten the midsection of the pipe slightly in a vise. Then install the column, using a felt washer and a liberal coating of bedding compound at each end before installing the nut.



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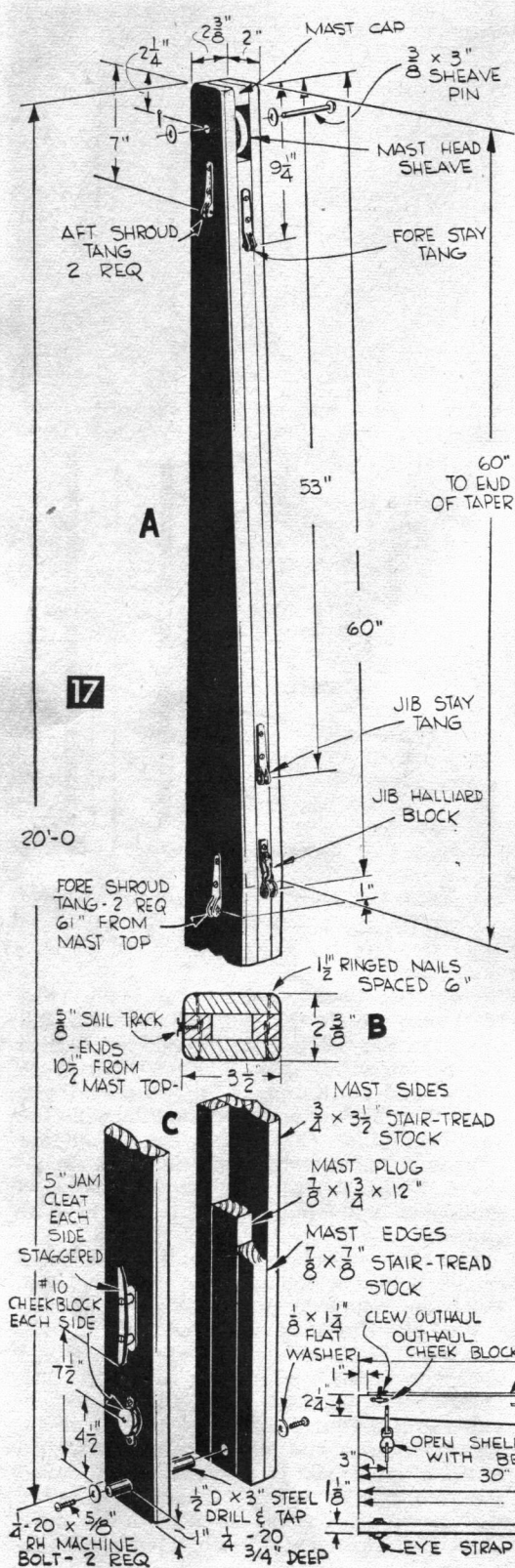
RUDDER

Weld the $\frac{1}{8}$ -in. steel rudder blade (Fig. 15D) into the slotted $\frac{3}{4}$ -in. shaft and install this as in Fig. 5B. Secure the rudder shaft in the column with a $\frac{3}{4}$ -in. I.D. set collar.

Drill and tap the parts for the tiller hinge as in Fig. 15B and assemble this with the hardwood tiller (Fig. 15A). Rough out the tiller on a bandsaw and shape it with a spokeshave. Finish the tiller by sanding with 3/0 sandpaper and applying two coats of spar varnish.

The tiller travels on the rail of the boom crutch holder which is made up along with the boom crutch as in Fig. 16A.

Keel Fin. Cut or have the keel fin (Fig. 13) cut from $\frac{1}{4}$ -in. cold-rolled steel plate and drill it to fit the keel hanger (Fig. 13A). Alternate methods of ballasting the fin are provided to suit your preferences and resources. Two hundred pounds of ballast were attached to the original boat in the form of reinforced concrete, cast as in Fig. 13B and attached to the fin with countersunk $\frac{1}{2}$ x 8-in. machine bolts. Ballast may also be obtained by attach-



ing $\frac{1}{4}$ x 3-in. steel reinforcement along the leading and trailing edges of the fin and then bolting 1 x 6-in. steel weights to each side with $\frac{1}{2}$ -in. machine bolts. In either case, attach the ballast after checking the fit of the fin in its hanger. Leave the fin unattached until you have your boat at the water, ready for launching.

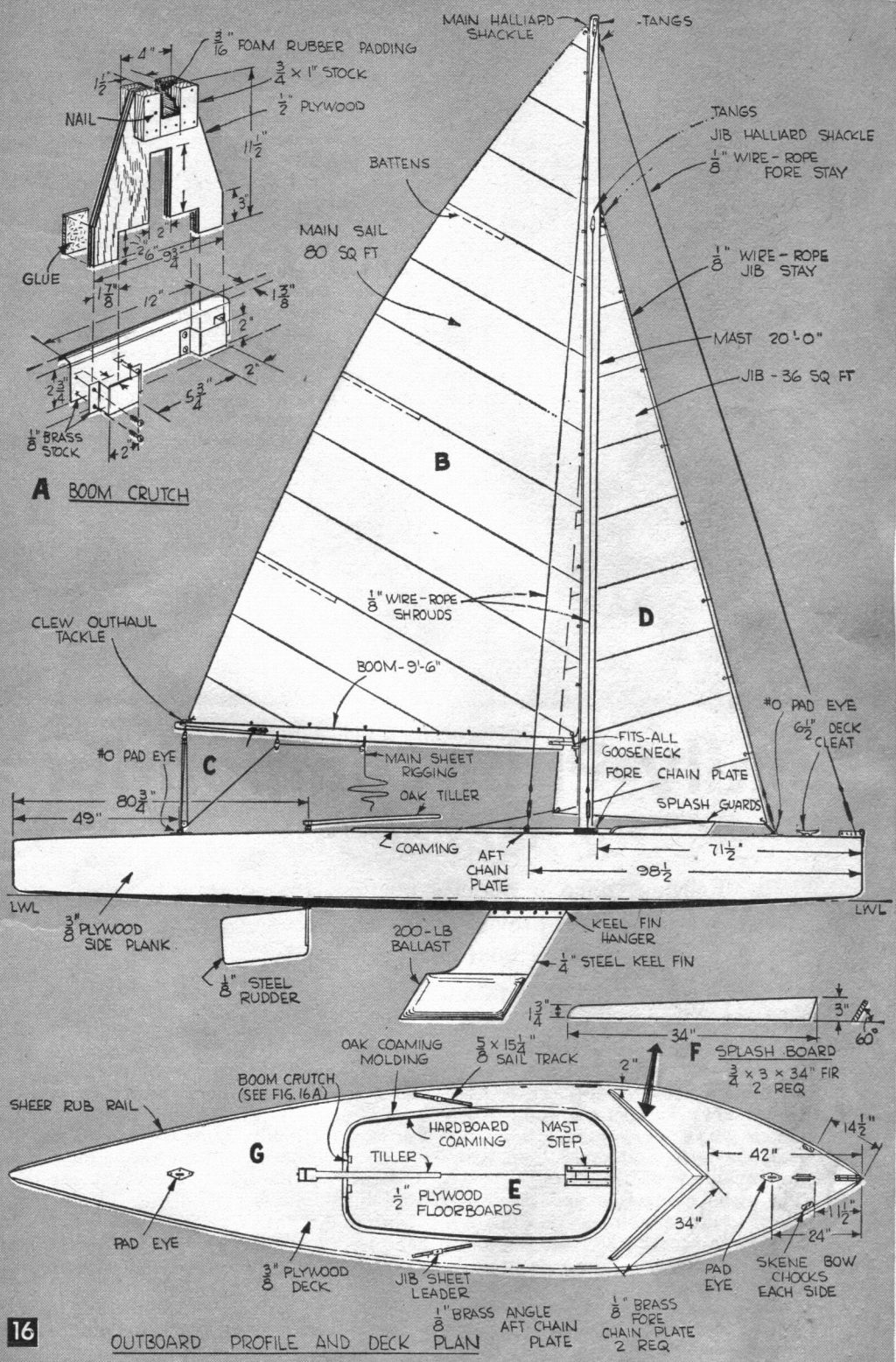
Spars and Rigging. Cut and taper the sides and edges of the mast and join these with *Weldwood* contact cement and $1\frac{1}{4}$ -in. ringed nails spaced at 6-in. intervals. Use $\frac{3}{4}$ -in.-thick fir stair-tread stock for the mast sides and $1\frac{3}{4}$ -in. stock for the edges. Cement the edges to one side first and secure this with nails before attaching the second side. Round the corners of the mast and sand it smooth. Before varnishing, locate, temporarily install, and then remove the sail track, tangs, cleats, mast-head sheave, and jib-halyard cheek block so they can be permanently installed later without damaging the finish on the mast. Also drill the foot of the mast $\frac{7}{16}$ in. and drive a $\frac{1}{2}$ -in. bolt into this hole as a step pin to fit in the notched mast step.

Cut the boom from $1\frac{1}{8}$ -in. stair-tread stock and finish this in the same way as you did the mast, permanently attaching the mainsheet rigging, gooseneck, sail track, and clew out-haul after varnishing.

You're now ready to launch *Missile*. With the keel fin in place, put the boat in the water and check it thoroughly for leaks. Then rig the main and jib halyards and the stays on the mast and, with the help of a friend, step the mast while someone attaches the stays to the chain and bow plates. Tighten the stays equally so there is no rake to the mast. Then set up the boom crutch and install the boom and mainsheet rigging.

All that's left to do is bend on the sails, get well acquainted with *Missile* underway on all points of wind, and then find somebody to race against.—DON R. SCHMIDT.

● Craft Print No. 330, in enlarged size for building *Missile* is available at \$2.50. SPECIAL QUANTITY DISCOUNT! If you order two or more craft prints (this or any other print), you may deduct 25¢ from the regular price of each print. Hence, for two prints, deduct 50¢; three prints, deduct 75¢, etc. Order by print number. To avoid possible loss of coin or currency in the mails, we suggest you remit by check or money order (no CODs or stamps) to Craft Print Dept. 2196, SCIENCE AND MECHANICS, 505 Park Ave., New York 22, N. Y. Now available, our new illustrated catalog of "194 Do-It-Yourself Plans," 25¢ (refundable, first order). Please allow three to four weeks for delivery.



A BOOM CRUTCH

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OUTBOARD PROFILE AND DECK PLAN

