

TERN Is a Flying Sailer

Nature foots the power bill when the boat you build carries 72 sq. ft.

By C. T. ALLEN

Craft Print Project No. 206

MANY a "stink pot" addict will take a second look at *Tern* because she planes in modest breezes, is easy to handle, and her streamlined prow and pod-shaped, "inland scow" type hull offer slight water resistance. Then too, there's a charm about the tiller of a sailer that's not matched by the wheel of a motor-powered boat. Part of it is the challenge of making the most of nature's free-wheeling breezes. Even with her 72 sq ft of sail, *Tern* is remarkably stable, and packs as many as four persons aboard.

I have hauled *Tern* into three states, so I know she's rugged and easy to launch. For thousands of inland lakes, *Tern* is the answer to sailing water sport. And she's remarkably easy to build. Common hand tools are all you really need, and I built mine while vacationing at a woods cabin. I will confess, though, that I used a portable electric drill to speed up drilling on the hundreds of screw holes necessary. A screw-driver bit for a brace also takes much of the work out of setting the screws. You'll need about 200 hours to build *Tern*.

Your best buy in materials is $\frac{3}{4}$ x 8-in. edge-grain fir boards ripped to size for frames, carlins, deck supports, boom and rub rails. Keel, bed logs and mast are made from $1\frac{1}{8}$ -in. edge-grain fir, better known as stair tread stock. If you can't buy $1\frac{1}{8}$ -in. fir in 20-ft lengths for the mast, buy 4 x 4-in. x 20-ft Douglas fir, straight grained and knot free, and have it ripped to size. Many lumber yards will do this free of charge. The ideal material for a mast is Sitka spruce, but it is hard to find and more expensive.

To start construction, lay out full-size patterns of frames #2 to #7 on heavy wrapping paper (Fig. 7). All dimensions are from the base line and the vertical center line to the outside edges of the frames. Lay out the transom and stem directly on the $\frac{3}{4}$ -in. material. To simplify cutting the frame pieces, make up a marking gage (Fig. 6). The gage used with the full-size frame layout eliminates any further measuring of angles and lengths.

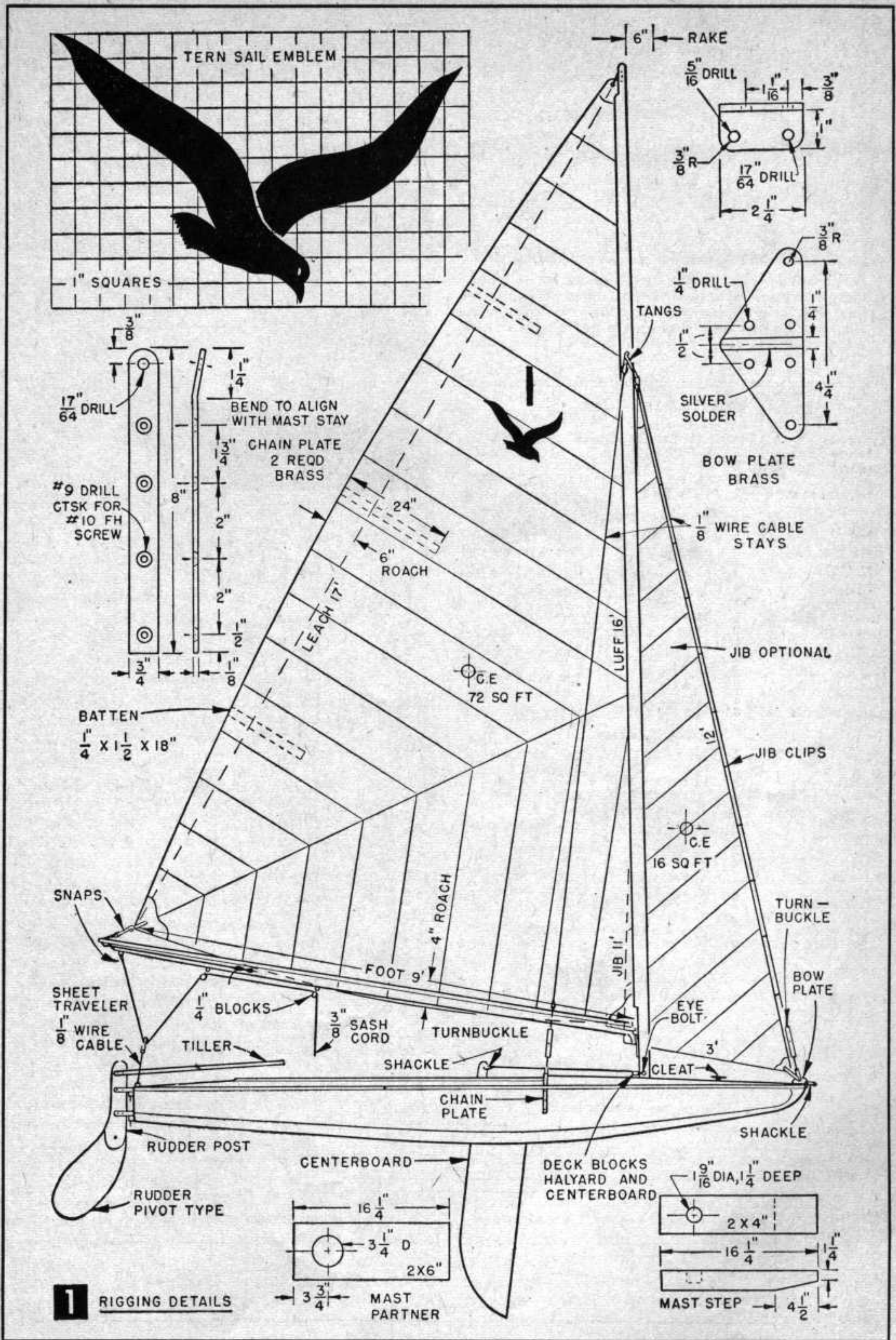
When all four pieces for each frame are cut, place them on the layout. Lay the marking



Tern makes any small inland lake a sailing course.

gage on the base line and mark a heavy line on each side piece, but *do not cut*. These lines will be used as a reference line later. Number each piece with its frame number.

Cut the 24 side and 12 center gussets from $\frac{1}{4}$ -in. plywood. The pattern was made to fit frame No. 5, so it will not fit all frames exactly. Either alter each gusset slightly to fit each frame or assemble them and plane to fit after the glue has dried. Gussets are glued (*Weldwood*) and screwed together with No. 8 x $\frac{3}{4}$ -in. *fh* galvanized or brass screws. If your boat is to be sailed



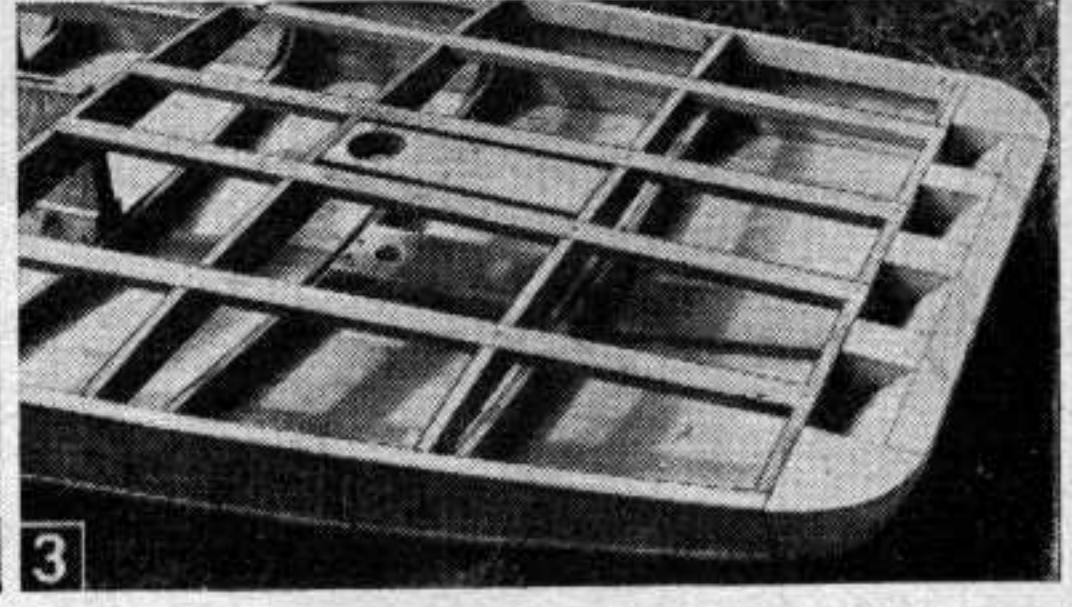
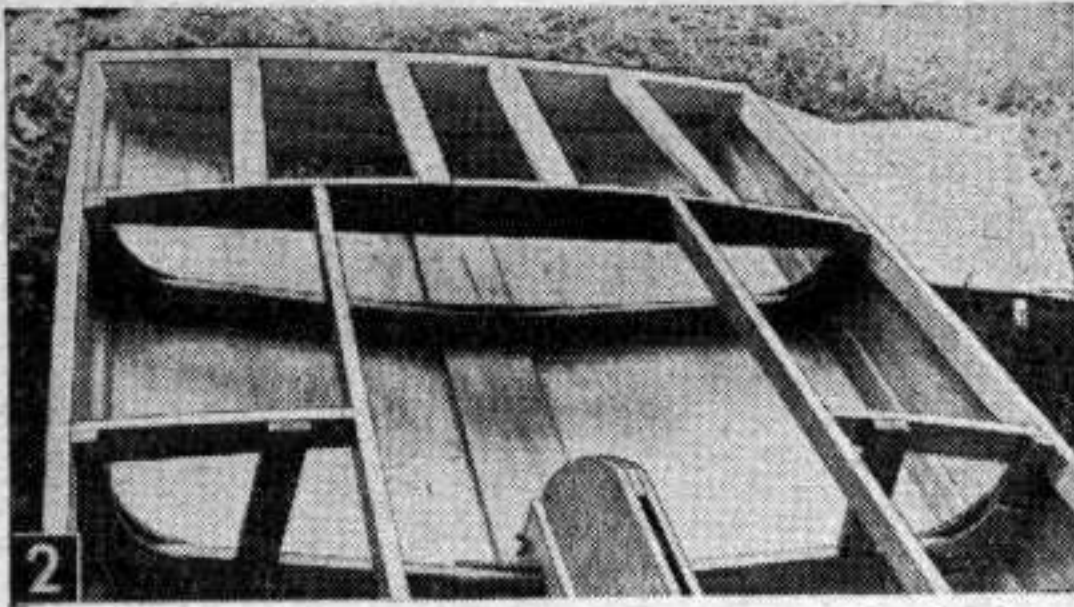
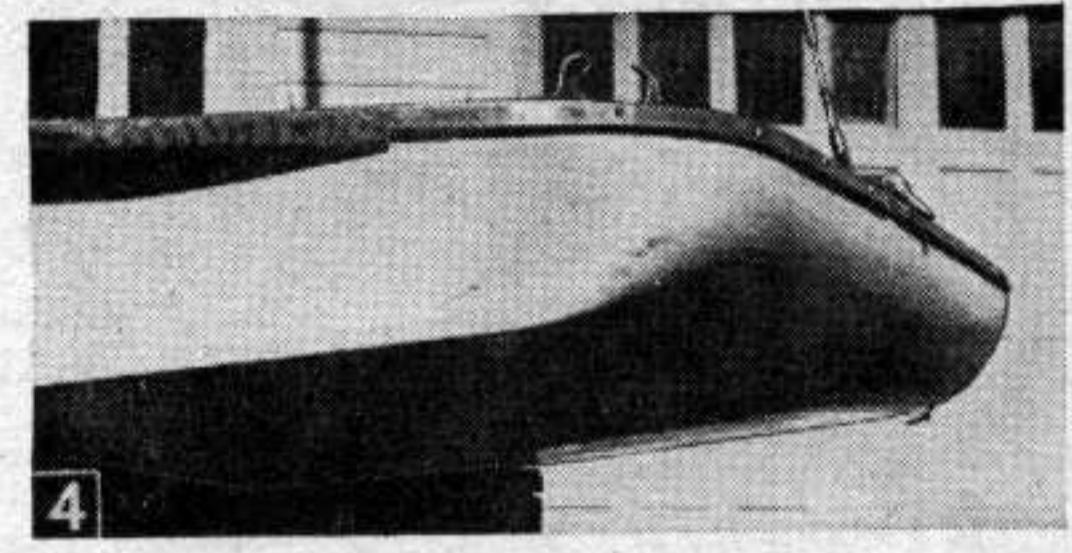
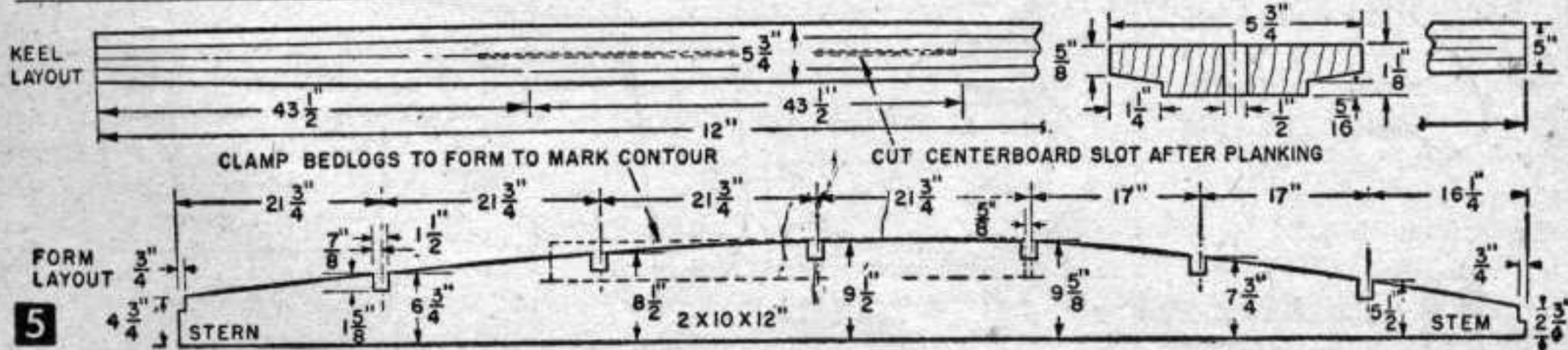


Fig. 2. Aft end and side deck framing just before planking. Note spacing of two center battens about centerline. Fig. 3. Prow framing before decking. Mast step, prow nose are in and ready for plywood decking. Fig. 4. Smooth lines of prow nose.



MATERIALS LIST—TERN

Part	No.	Size			
bottom	2	1/4" x 2 x 12'	Douglas Fir		
sides and gussets	2	1/4" x 2 x 12'	Fir		
deck	2	1/4" x 2 x 12'	Exterior Plywood		
centerboard well	2	1/2" x 1 x 4'			
Lumber: Edge Grained Fir					
keel	1	1 1/8 x 5 3/4" x 12'	stair tread material		
bed logs	2	1 1/8 x 4" x 4'	stair tread material		
chines	2	3/4 x 1 3/4" x 12'	1 pc 3/4 x 10" x 12'		
clamps	2	3/4 x 1 3/4" x 12'			
frames	8	3/4 x 1 3/4" x 8'	2 pc 3/4 x 8" x 8'		
transom	1	3/4 x 4 x 8"			
stem	1	3/4 x 4 x 8"	3/4 x 8" x 8'		
mast	2	1 1/8 x 4" x 20'		stair tread material	
boom	2	3/4 x 1 1/2" x 10'	1 pc 3/4 x 6" x 10'		
deck beams	2	3/4 x 4" x 10'			
rubbing rails	2	3/4 x 1 1/4" x 12'	1 pc 3/4 x 8" x 12'		
deck battens	2	3/4 x 1 1/4" x 12'			
carlins	2	3/4 x 1 3/4" x 6'			
deck supports	4	3/4 x 1 3/4" x 12"	scrap		
Lumber as Specified:					
prow	1	1 3/4 x 6" x 12'	clear white pine		
coaming	2	1/2 x 4" x 8'	mahogany, oak		
molding	2	1/4 x 1" x 8'	mahogany, oak		
centerboard knees	1	3/4 x 6 x 12"	mahogany, oak		
chine molding	2	3/8 x 1 1/2" x 12"	yellow pine		
mast partner	1	2 x 6 x 30"	1 pc 2 x 6" x 5' fir		
mast step	1	2 x 6 x 30"			
form	1	2 x 10" x 12'	new or used		
leg	4	2 x 4" x 3'	new or used		
braces	2	3/4 x 4" x 2'	new or used		
stringer	1	3/4 x 4" x 12'	new or used		
rudder post	1	1 1/8 x 6" x 2'	oak		
tiller	1	3/4 x 4 x 30"	oak		
floor boards	2	1/2 x 6" x 12'	clear pine		
floor board cleats	2	1/2 x 2" x 8'	clear pine		
Rigging:					
60 ft		1/8" wire rope			
3		1/4 x 4" turnbuckles—cleves and eye—S.S. Screw			
1		mast head sheave 1 1/2" dia			
1		boom goose neck fitting			
2		1/8 x 1 x 8" chain plates—brass			
5		1/4" blocks—brass or cadmium plated			
2		3/16" screw-eyes			
5		3/16 x 3" eye-bolts—brass or cadmium plated			
1		1/4 x 3" screw-eye—cadmium plated			
Hardware:					
3		1/8" thimbles			
1		1/4" thick centerboard as detailed			
1		3/16" thick rudder as detailed			
2		1/4 x 2" pipe nipples—brass			
2		1/4" pipe caps—brass			
1		5/16" dia x 2 3/4" long brass rod pivot pin			
2		1/4" cleves			
1		5/8 x 9" long sail track			
75 ft		3/8" sash cord			
3		snaps—brass or cadmium plated			
3		6" rope cleats			
2		handles—window lifts—brass			
2		cleats—jib			
2		1/4" blocks—jib			
1		3/4" boom sheave			
3		mast tangs			
12		jib snaps			
Hardware:					
8 gr		Screws: cadmium plated, zinc coated, or brass			
2 gr		#8 x 3/4" fh			
1 1/2 doz		#10 x 1 1/2" fh			
1 gr		#12 x 3" fh			
2 doz		#10 x 2" fh			
8		3/16 x 2" rh stove bolts			
2 doz		1/4 x 3" lag screws and washers			
1 doz		3/16" dia screw-eyes—brass or cadmium plated			
		1/4 x 3" carriage bolts and wing nuts			
Finishing Materials:					
1 qt		spar varnish			
1 qt		clear Firzite			
1 qt		white Firzite			
1 qt		marine paint—white (sides and bottom)			
1 qt		marine paint—green (deck)			
1 lb		Famowood filler			
1/4 lb		Weldwood glue			
1 1/2 qts		Kuhls bedlast			
10 yds		36" sail drill (mainsail)			
2 yds		36" sail drill (jib)			
6 sps		#40 cotton thread (white)			
16 ft		3/8" manila rope			
2 pcs		Bondex 7 x 11" blue denim (emblem and number)			



on salt water, use only brass or bronze screws. When the glue has dried, lay out and cut the notches for the keel, chines and clamp in each frame, stem and transom (Fig. 9).

The hull is constructed upside down on a form resembling an elongated saw horse (Fig. 8).

New or used lumber for the form must be straight. Frame notches are easier to cut after you have added legs to the form. Notches are cut wider than the frame thickness to permit wedging each frame tightly in position. It is also easier to remove the hull from the form after first removing the wedges. Since the form is the backbone of the hull during construction, keep it level and plumb.

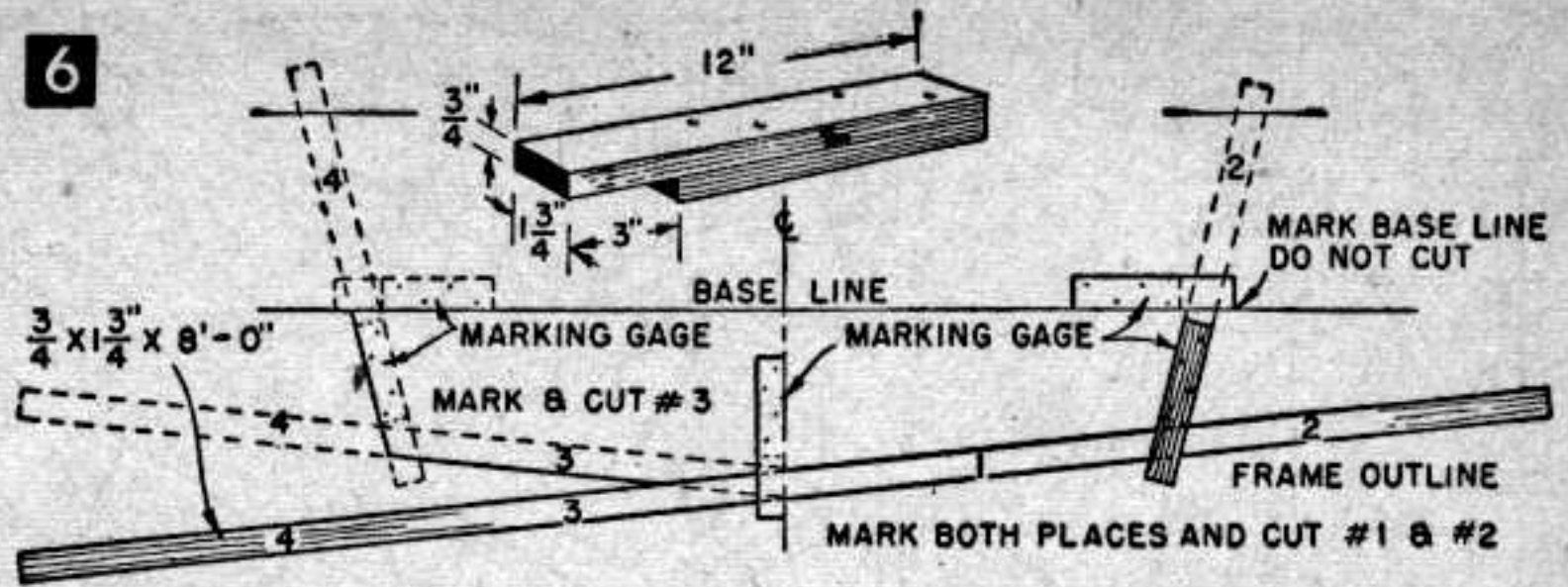
Scribe the contour of the bed logs for the centerboard well from the form to fit the keel perfectly. Clamp the two pieces to the form (Fig. 5), then mark and saw to within $\frac{1}{16}$ in. of the line. Reclamp in position and plane to fit the contour. Set the pieces aside.

Lay out and cut the keel to shape (Fig. 5), but do not cut the centerboard slot. This slot is cut after the hull is removed from the form.

Let's start putting the parts together. First, mark a center line on the form at each frame notch and at both ends.

Screwfasten stem and transom to the form with No. 10 x 2-in. *rh* screws. Make sure stem and transom are square with the form. Place the frames in their respective notches, and line up the center of each frame with the center line of the form. Wedge each frame in place, temporarily. Check frames for squareness with the form. Next, clamp fairing strips from stem to transom about 18 inches on each side of the center line. If a frame is high or low, cut the notch deeper or shim the frame up in its notch.

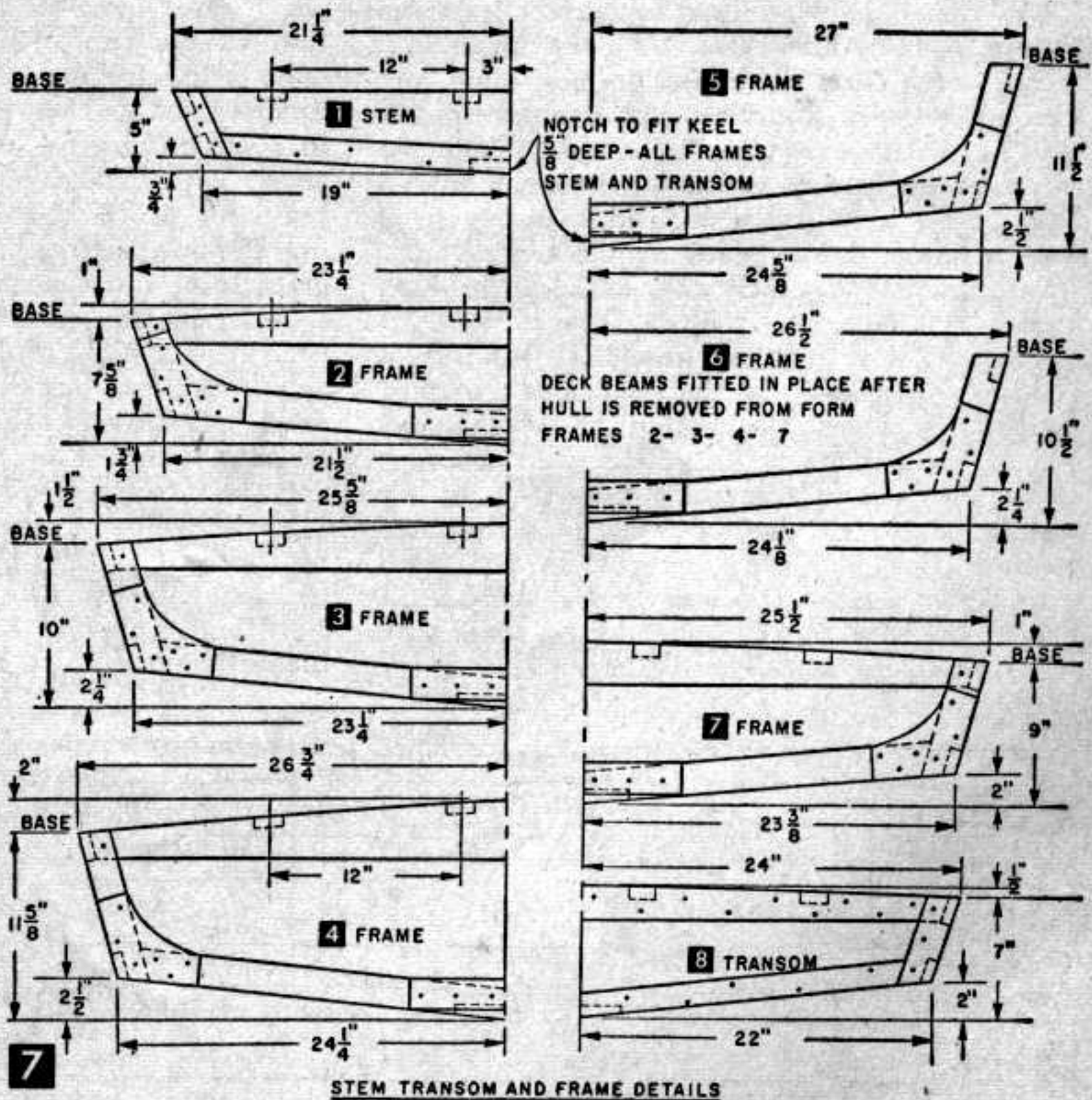
When frames are aligned, bevel keel notches in each frame to fit the contour of the form. Spring the keel in place and secure it to the form with a C-clamp at each end. The keel should extend beyond the stem and transom

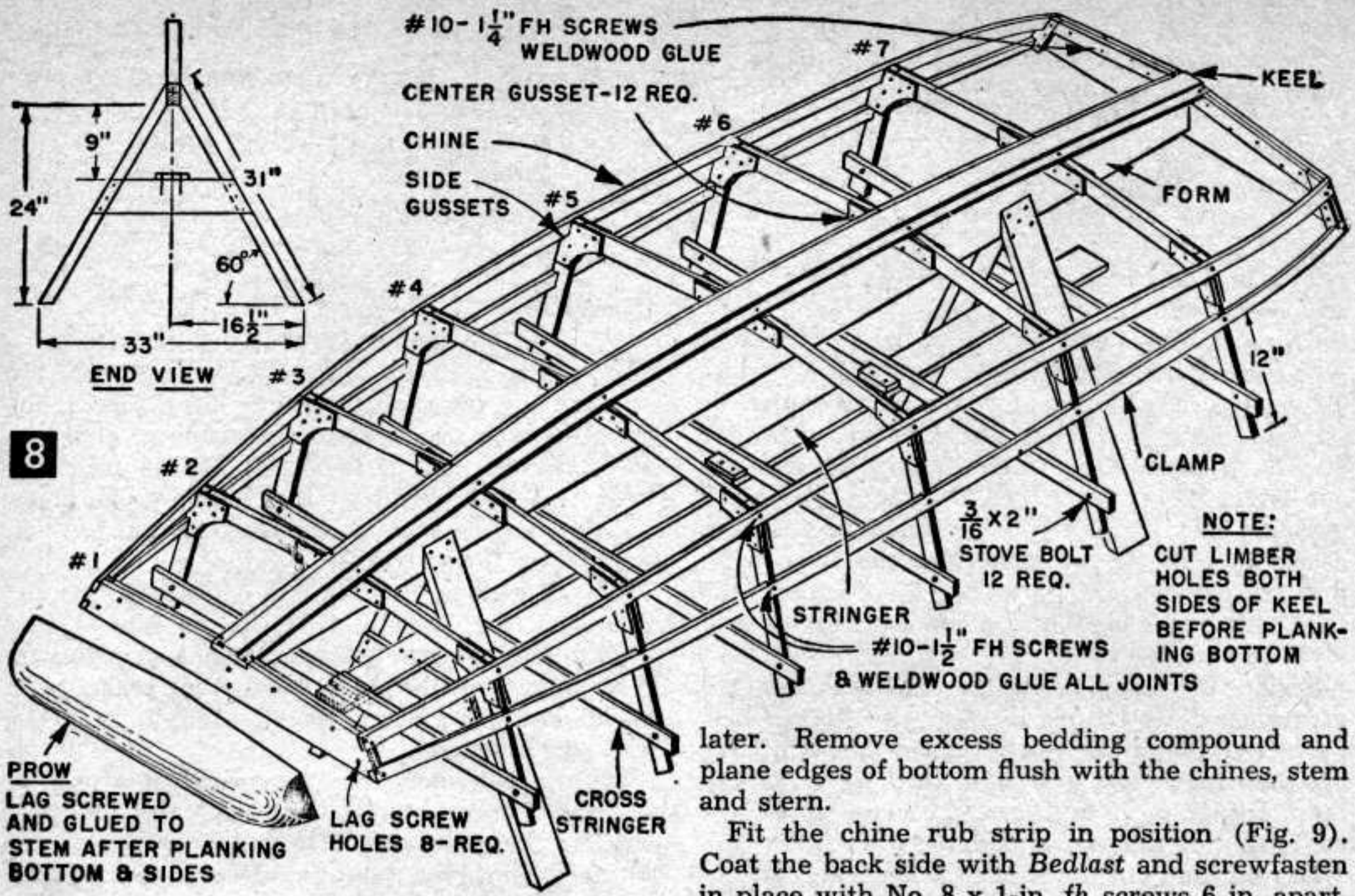


and will be trimmed to length later. Check the bevel in each frame, stem and transom and trim to fit the contour of the keel. Before fastening keel, secure the frame cross-stringers in place, with $\frac{3}{16}$ x 2-in. stove bolts (Fig. 8) and toe nail to cleat on form stringer.

Attach keel by drilling and countersinking the holes for the No. 10 x $1\frac{1}{2}$ -in. *fh* screws that secure keel to the frames, stem and transom. Now unclamp the keel, coat the joints with *Weldwood* glue, clamp the keel back in place, and screw-fasten.

Chines can now be temporarily sprung in place together around the frame, clamping the ends to the stem and transom. With the chines in place, mark the bevel required on each frame, stem and transom to fit the chines perfectly. Remove the chines, and cut the bevels as marked. Apply *Weldwood* glue and screwfasten the chines in place with No. 10 x $1\frac{3}{4}$ -in. *fh* screws. Use two





screws at stem and transom ends, and trim flush. Follow the same procedure for securing clamp strips in place. Use *Weldwood* glue and No. 10 x 1 3/4-in. *fh* screws to secure chines in place.

The frame is now ready to be faired. Bevel the bottom of the chines until they are flush with each frame. Next bevel the frames, stem and transom between the chine and clamp strips. A batten sprung over the frames will indicate where to plane each frame so bottom planking will contact each frame and lie smoothly from stem to stern. Before planking, cut limber holes (drainage hole on each side of keel) in each frame (Fig. 9).

The bottom is planked first. Lay a sheet of 1/4-in. plywood 24 in. x 12 ft in place and tack temporarily. Scribe the edge to the keel, remove and carefully plane to fit. Mark chine contour and saw to shape. Allow about 1/16 to 1/8 in. for planing to size. Fit the opposite side in the same manner. Coat the keel, chine, stem and stern with *Kuhls Bedlast* and screwfasten with No. 8 x 3/4-in. *fh* screws spaced 2 in. apart. Countersink screw heads 1/32 in. below the surface for filling

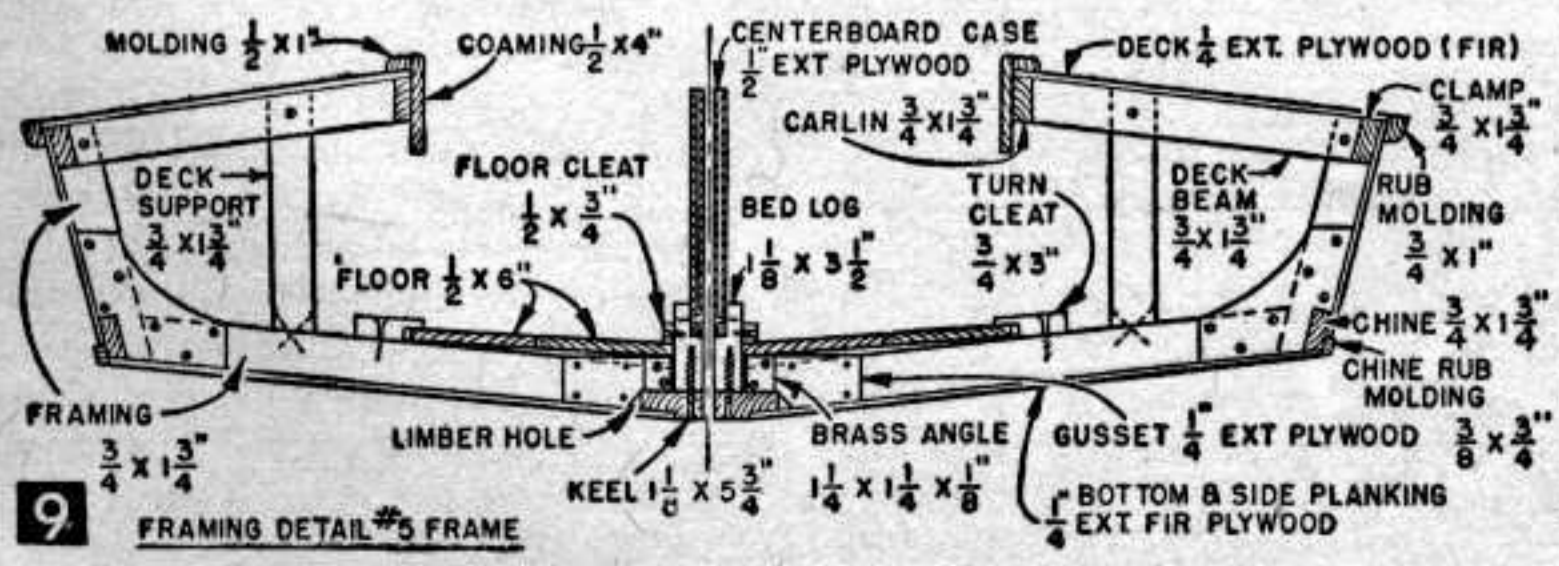
later. Remove excess bedding compound and plane edges of bottom flush with the chines, stem and stern.

Fit the chine rub strip in position (Fig. 9). Coat the back side with *Bedlast* and screwfasten in place with No. 8 x 1-in. *fh* screws 6 in. apart. Countersink screws 1/32 in. below surface. Remove excess compound and plane rub strip flush with bottom. Round edge with sandpaper.

To plank the sides, clamp a sheet of 1/4-in. plywood 24-in. x 12 ft in place and scribe to the contour of the rub strip. Saw and plane bottom edge to fit. Tack in place again, mark the clamp line, remove and cut to within 1/8-in. of the line to allow for final planing. Coat the chine and clamp with *Bedlast* and screwfasten side planking with No. 8 x 3/4-in. *fh* screws 2 in. apart. Countersink screwheads as before, and plane ends flush with stem and stern.

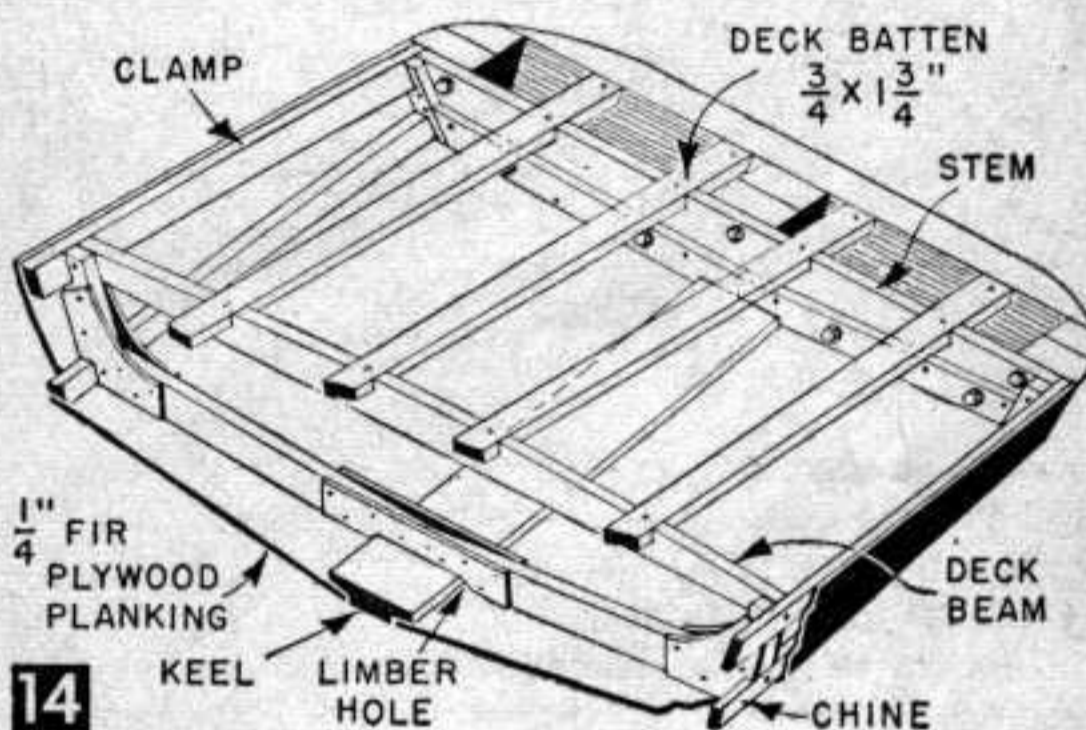
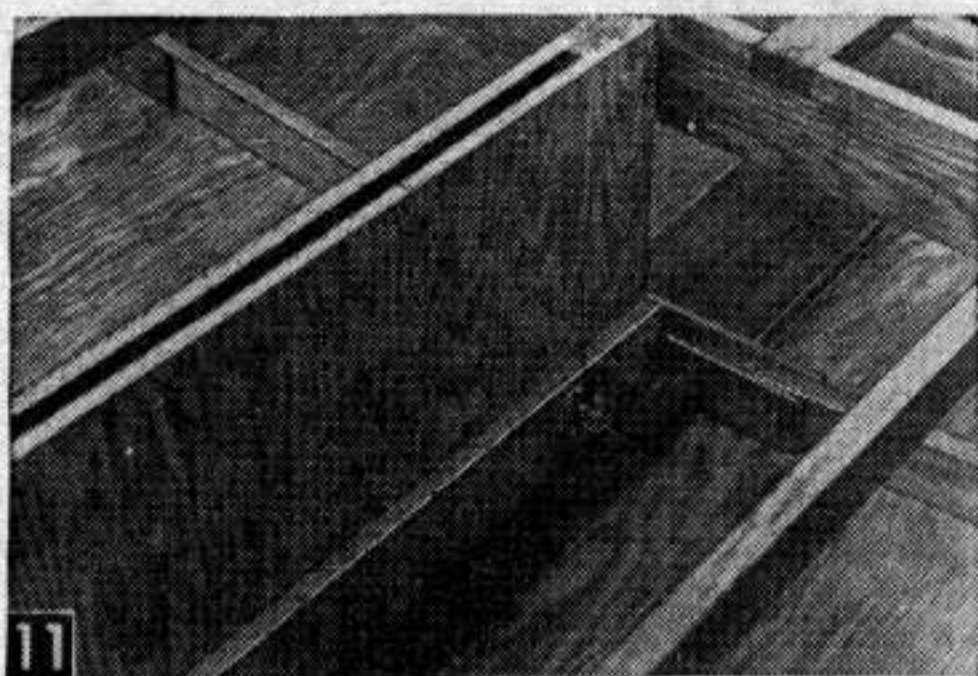
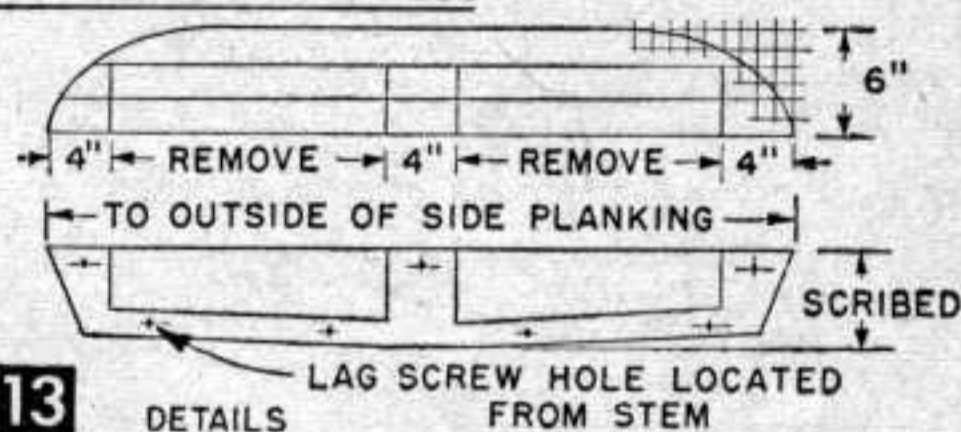
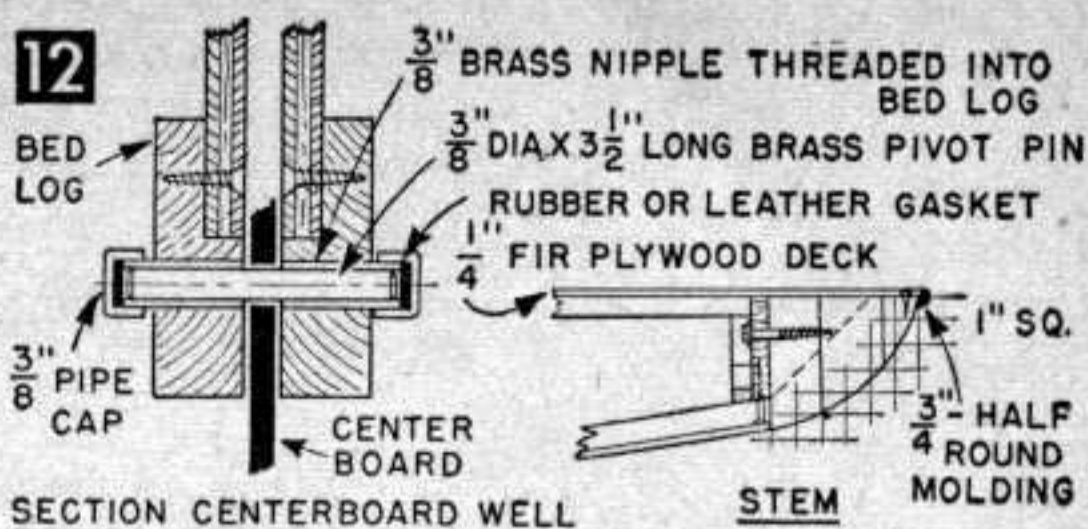
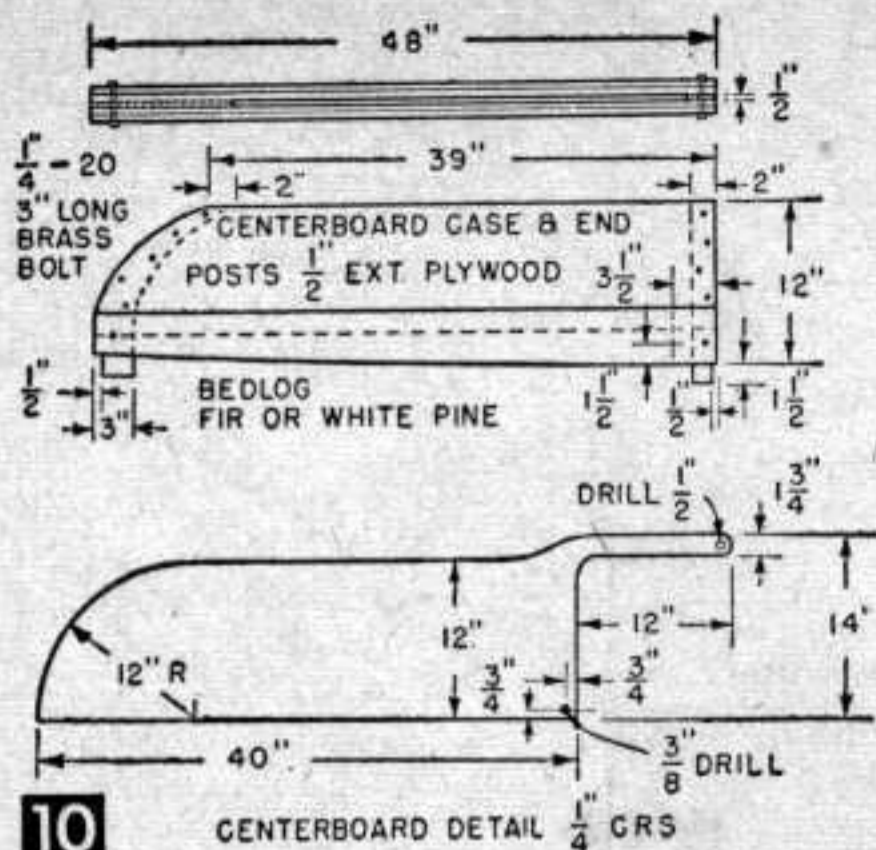
Clean out any excess *Bedlast* from each screw head hole and fill with *Famowood* filler (available at marine supply stores). When all the holes, bottom, and sides, are filled, sand the surfaces to a smooth finish for painting. Prime hull and sides with white *Firzite*.

You can now remove the hull from the form by simply knocking out the frame wedges and by removing the screws holding the stem and stern and the stove bolts in the cross ties. Set the hull right side up on saw horses. The hull is quite flexible at this stage and can easily be twisted out of shape. Fit wedges fore and aft and tack them to the saw horse to help keep the hull straight.



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Cut the sides of frames No. 2, No. 3, No. 4, No. 5, No. 6, and No. 7, flush with the clamp. Start with frame No. 4 to fit



Centerboard well screwed in and caulked at bed logs. Make sure sides and bed logs are square with keel.

the forward deck beams and work forward. Use the $\frac{3}{16}$ -in. stove bolts from the cross ties to secure the beams to the frame. Apply *Weldwood* glue before bolting the beams to the frame. Fair in deck beams No. 2 and No. 3 to align with frame No. 4 and the stem. Fit the beam at frame No. 7 and frame on top of transom. Notch the beams, stem and transom, and secure deck battens with glue and No. 10 x $1\frac{1}{2}$ -in. *fh* screws. Fit carlins between deck beams No. 4 and No. 7 and secure with No. 10 x $1\frac{1}{2}$ -in. *fh* screws. Fit cockpit beams at frames No. 5 and No. 6. Bolt and glue cockpit beams at frames and use No. 10 x 2-in. *fh* screws in carlins. Fit cockpit deck supports at frames No. 5 and No. 6, screwing and gluing them to deck beams with No. 10 x $1\frac{1}{2}$ -in. *fh* screws. Fit mast step and fasten between frames No. 2 and No. 3.

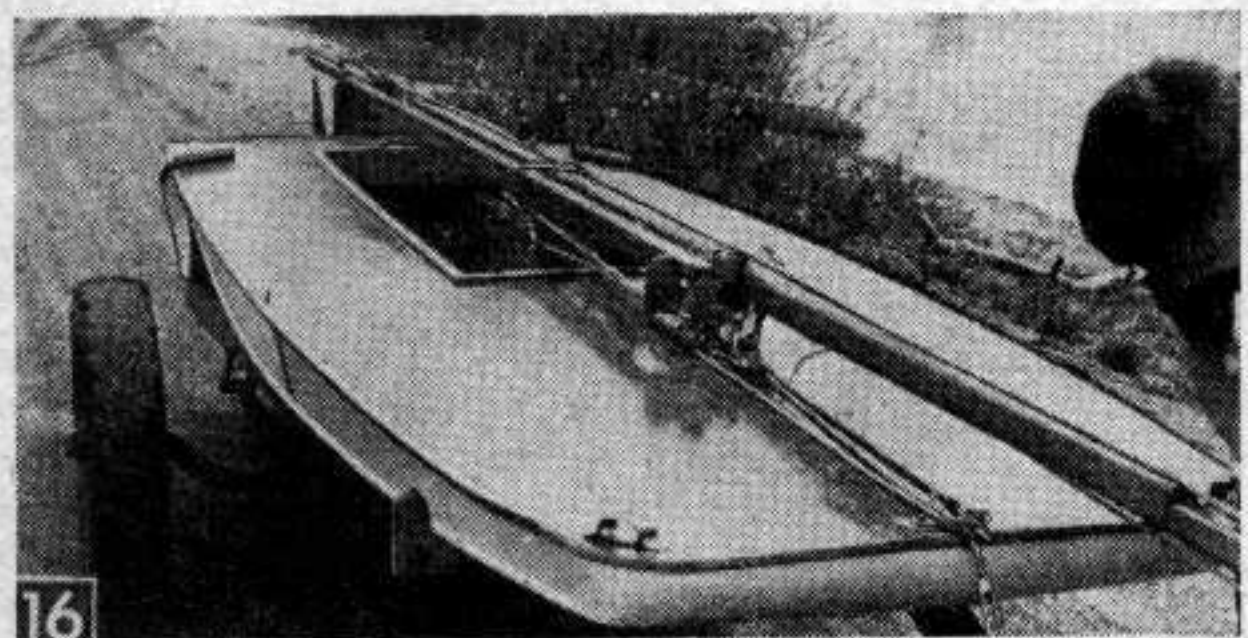
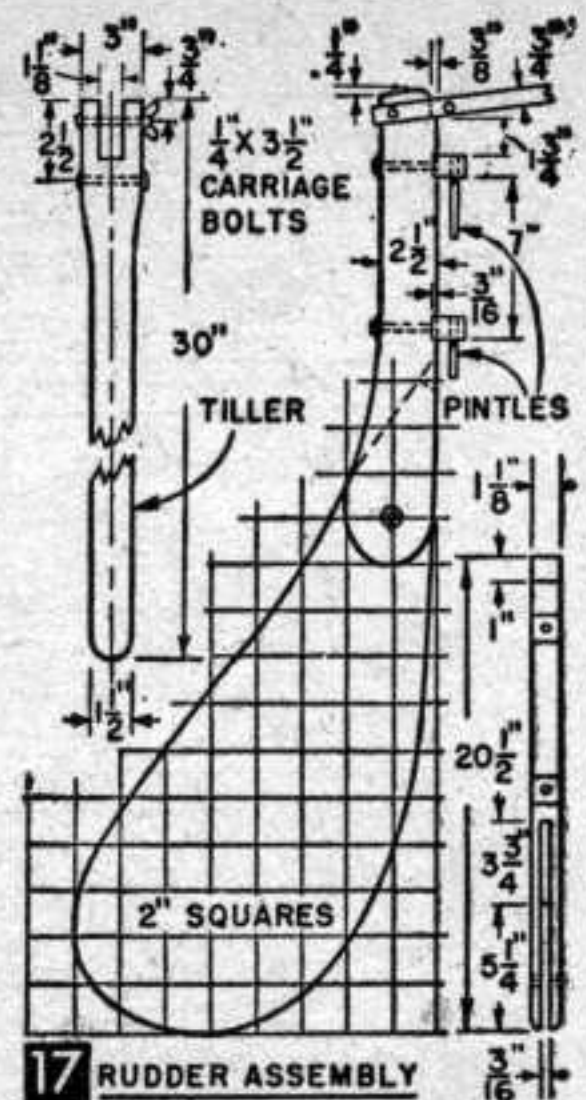
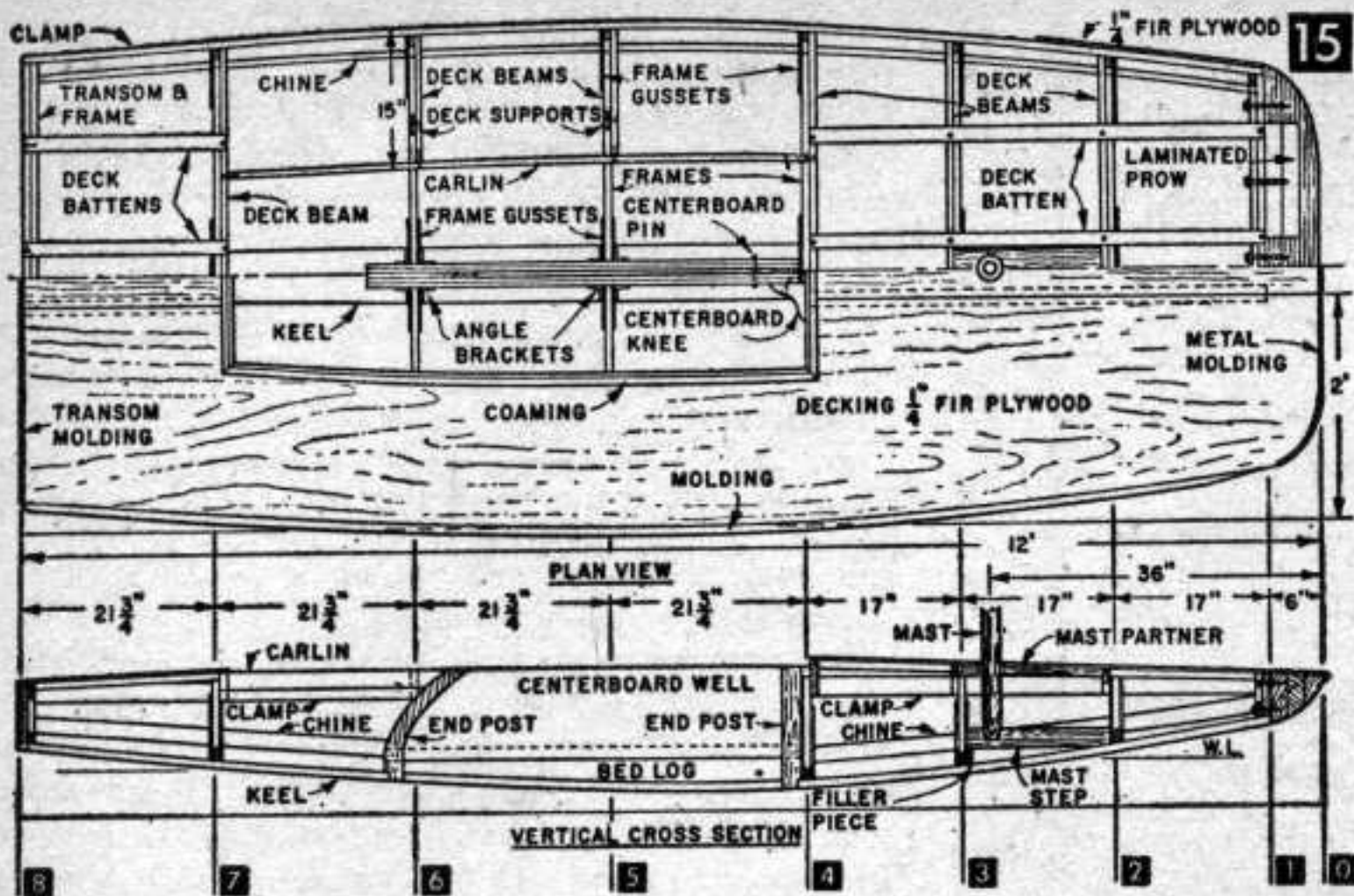
The centerboard well (Fig. 10) is made up as a unit and installed as one piece. Give the inside surfaces of the centerboard well three coats of spar varnish before final assembly. In assembling make sure the bottom edges of the bedlogs are square with each other or they will not fit snugly to the keel.

Lay out the centerboard (Fig. 10) on $\frac{1}{4}$ -in. steel boiler plate and band saw or flame cut it to shape. A metal working or welding shop will do

the job for you if you don't have the tools. Clean up the edges with a file, prime with zinc dust or zinc chromate primer followed by three coats of white marine enamel.

To install the centerboard well, measure the overall width of the centerboard well across the bedlogs. Lay out this distance on frames No. 5 and No. 6, half the distance on each side of the center line and saw out down to the keel. Measure the offset of the forward centerboard well end first, and drill a $\frac{1}{2}$ -in. hole aft of frame No. 4 in the center of the keel. The $\frac{1}{2}$ -in. hole should be tangent to the amount of offset. Measure the overall length to the rear end post offset and drill $\frac{1}{2}$ -in. hole center of keel.

Turn the hull bottom side up, draw lines tangent to the two holes and saw out the slot, starting with a key-hole saw and finishing with a rip saw. Square the ends of the slot with a chisel, or round the end post. Coat the bottom of the bedlogs with Kuhls' *Bedlast* and secure centerboard well to keel with 12 No. 12 x 3-in. *fh* screws, six screws evenly spaced on each side. Countersink the heads of the screws $\frac{1}{8}$ -in., fill with *Famowood* and sand flush with keel when dry. Turn the hull right side up and install the angle brackets at frames No. 5 and No. 6 with No. 8 x $\frac{3}{4}$ -in. *fh* screws.

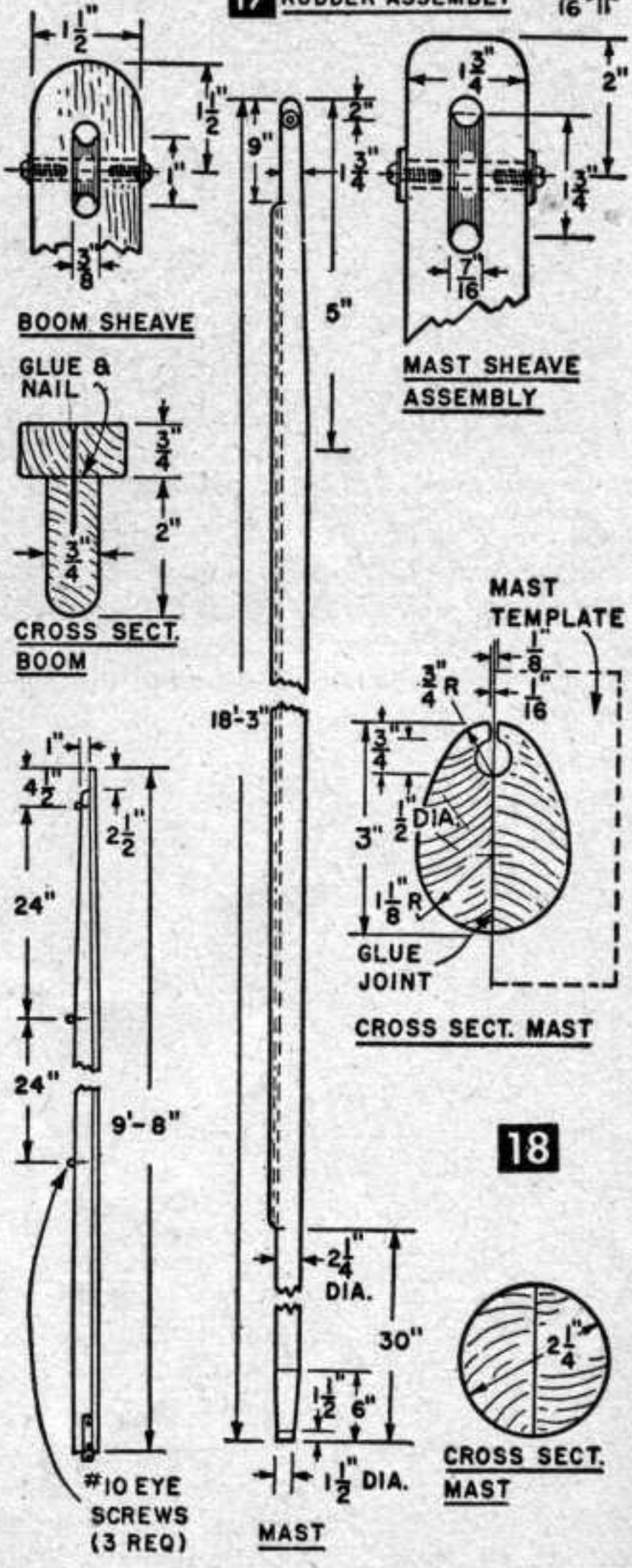


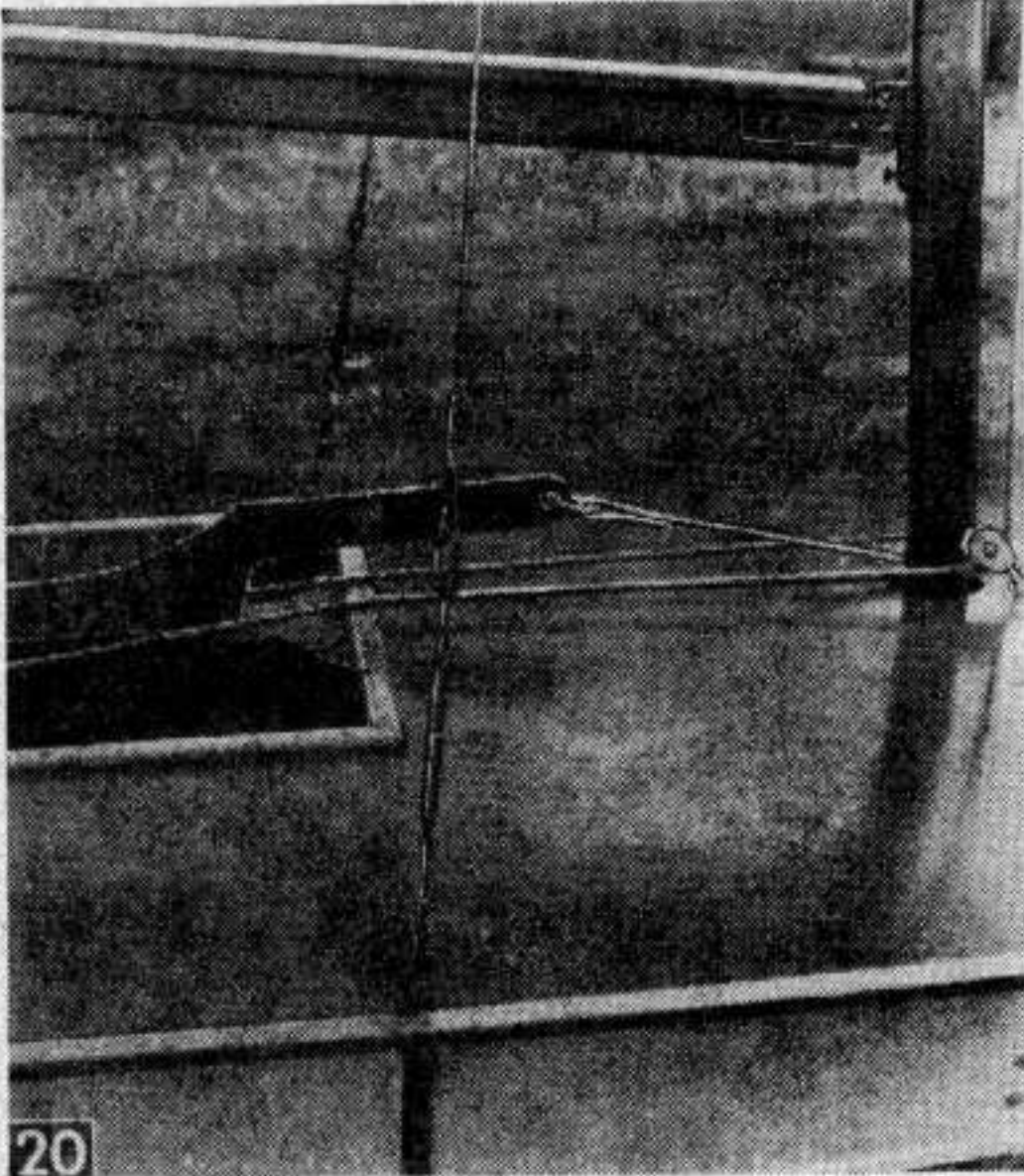
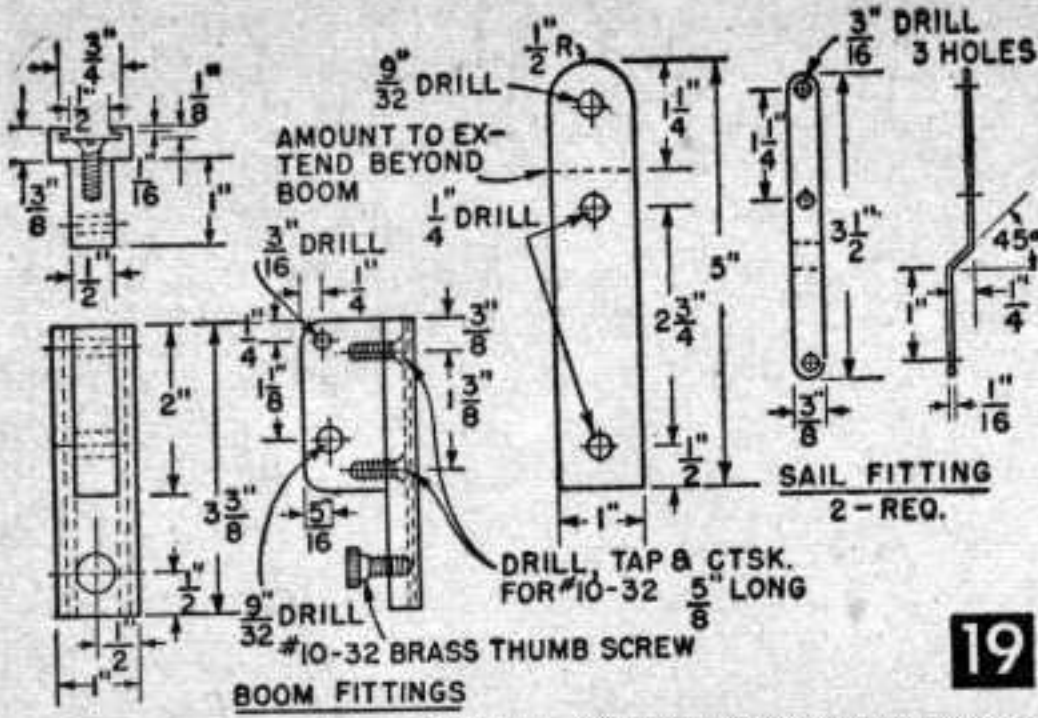
With mast lashed to top of deck fittings, Tern makes a neat package for convenient trailering to your favorite inland lake.

For the prow nose, glue up three pieces of 2-in. thick clear white pine. Clamp the nose piece to the stem with two or three C-clamps. Check on the fit between the prow nose and stem; plane the stem if necessary to make a good glue joint. Mark the shape of the nose to the outside of the side planking and bottom planking and to the top of the rounded corners. Also lay out and drill holes for the 1/4-in. lag screws while the nose is clamped in place. Remove and saw to within 1/16 in. of the line. Coat the nose with Weldwood glue and lagscrew in place (Fig. 15).

When the glue is dry, finish planing it flush with the top of the stem, side and bottom planking. The round front edge along the full width of the nose is easiest to shape after the prow nose has been glued to the stem. Use a draw knife to rough it out, then finish up with a jack plane and finally with coarse and fine sandpaper.

Planking the deck is next. Make sure the entire deck is faired so plywood lies evenly at all contact points. Lay a piece of 1/4-in. plywood 24-in. x 12 ft flush with the transom and extending 1/8-in. over the clamp. Inside edge should fall on the center of the inside deck batten fore and aft (Fig. 15). Clamp in place, mark round the outside and cockpit, remove and saw to within 1/8-in. of the line. Do the same for the opposite side. Tack pieces back in place, drill and countersink for No. 8 x 3/4-in. fh screws. Coat the top of the transom, clamp, nose and center deck battens with Bedlast and screwfasten with No. 8 x 3/4-in. fh screws. Countersink all screws 1/32 in. Fit the inserts





20 Rigging for centerboard with the board in Up position. Noteworthy are mast side stays and boom fittings.

in the fore and aft deck (Fig. 15), and cut the mast hole in the forward insert. Remove both inserts, caulk and secure in place with No. 8 x 3/4-in. *fh* screws. Remove any excess compound and plane the deck flush with the sides, transom, nose and carlins. Fill the screw head holes with *Famowood* and sand flush with deck when dry. Prime coat the deck with white *Firzite*, and follow with two coats of green deck paint.

Inside coaming pieces can now be fitted (Fig. 9), then the deck molding. Note that the inside pieces extend above the deck by the thickness of the molding. Miter all corners of coamings and deck molding and screwfasten with No. 8 x 1-in. *fh* screws. Cut the centerboard well knees to shape (Fig. 15), and secure them in place with No. 10 x 2-in. *fh* screws.

Cut the rub rail moldings from mahogany (Fig. 9), and notch out for the chain plate. Screwfasten them with No. 10 x 2-in. *fh* screws, 6 in. apart. Countersink the heads flush. Then remove the moldings and apply 2 or 3 coats of marine spar varnish. Rub down each coat of varnish with fine steel wool and wipe with a tack rag be-

fore applying the next coat. A tack rag has a slight amount of varnish in it that becomes sticky from the heat of your hand and picks up all dust. Available at many hardware stores. Use the tack rag method on all varnished surfaces for a super varnish job.

Next fit the aluminum or brass molding in the nose, and secure it in place with No. 6 screws. Countersink, for flat head screws, if you use brass and use round head screws if you use aluminum molding strip. Remove the molding while painting.

Building the Mast and Boom

Appearance and cost governed the design of the mast. Eliminating the sail track will save about \$9 or more. Each half of the mast is grooved for the sail rope before they are glued together. The groove may be cut by several methods: (1) *Stanley* No. 45 plane with a 1/4-in. radius blade, (2) 1/4-in. radius molding cutter on table saw, (3) shaper, (4) drill press with 1/4-in. radius router bit, (5) lastly, by running the pieces diagonally across the blade of a table saw.

Relieve the narrow edge 1/16 in. (Fig. 18). Sand the groove smooth. Glue the two halves together with *Weldwood*, spacing clamps 12 to 15 in. apart. Immediately remove any excess glue that might have squeezed out into the groove, with a nail driven at right angles into a piece of 1/2-in. dowel rod. Insert the dowel rod in the groove with the nail through the slot, and work the dowel back and forth over the entire length of the mast. Be sure the mast is lying in a straight line while the glue is drying, as a bowed mast is rather unsightly.

After the glue is completely dry, remove the clamps and mark the guide lines for shaping the mast. Plane or saw to the lines, and then keep planing off the corners until you get the final shape. The half-template (Fig. 18) will help you considerably. Give the whole mast a final sanding and cut the recess for the halyard sheave. Prime the mast with clear *Firzite* and follow with at least three coats of marine spar varnish, and rub each coat down with fine steel wool and tack rag before applying the next coat of varnish.

Make up the T-shaped boom as shown in Fig. 18. Fit the metal parts in place, but remove them when applying the finish. To finish, apply a coat of clear *Firzite* followed by three coats of marine spar varnish. Rub down each coat of varnish.

The rudder blade pivots up and down in a slot, (Fig. 17) so it will lift when it hits an obstacle. It also folds up as you are landing in shallow water. The tiller was designed to be folded back for compact storage in the boat. The blade looks best painted white and the wooden parts finished with three coats of spar varnish.

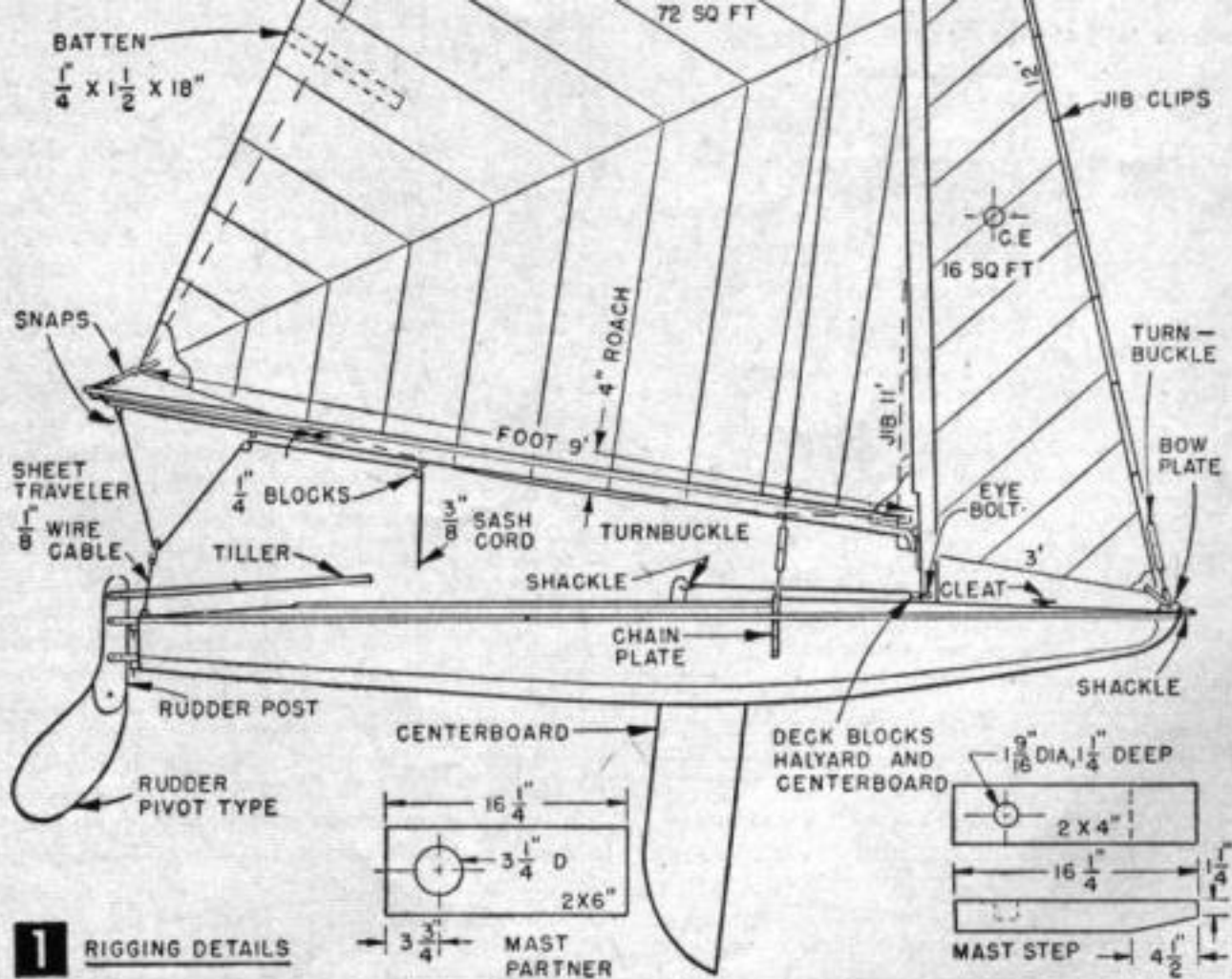
Floor boards extend 1 1/2 in. forward of frame No. 4 and 1 1/2 in. aft of frame No. 7. A 1/2 x 1 1/2 x 10-in. cleat at each end plus one cleat aft of frame No. 5 and No. 6 hold the floor boards together and keep them in place (Fig. 9). A 1/2 x 3/4 x 6-in. cleat screwed to the bedlogs hold the floor

boards down tight on the frames. A turn cleat holds the floor boards in place on the outside edge (Fig. 9). You will have to spring the floor boards under the bedlog cleat the first few times until they take a permanent set. (Screwed boards would require unscrewing for boat cleaning.) Apply three coats of spar varnish to floor boards.

Sail drill was used in making the sail for *Tern*, and is strong, lightweight, close woven and *Sanforized*. It comes 36 in. wide, and can be purchased in most dry goods stores. The blue line along the selvage forms an excellent guide for overlapping the seams. The hem on the luff, foot and leach are $\frac{1}{2}$ in. wide and triple stitched with No. 40 white cotton thread. The clew, tack and head should be reinforced with extra thicknesses of the material and $\frac{3}{4}$ -in. grommets set in each corner. The three pockets for the battens should be large enough for $\frac{1}{4} \times 1\frac{1}{4} \times 30$ -in. long strips. Use a waxed twine (electric wire lacing cord) to sew the $\frac{3}{8}$ -in. dia. manila rope to the luff of the sail.

Tern's sail emblem (Fig. 1) was cut from blue denim *Bondex* (available at variety stores) and pressed onto the sail with a hot iron. You will need two pieces of the large 3 x 11-in. size. Since the emblem is larger than the material, lay it out and piece it together. Make right and left hand emblems for both sides of the sail. If you want a numeral, make it the same way out of *Bondex*. You can also buy a professionally made sail from Alan-Clarke Company, 75 Chambers St., New York 7, New York.

● Craft Print No. 206 in enlarged size for building *Tern* is available at \$3. Order by print number. To avoid possible loss of coin or currency in the mail, we suggest you remit by check or money order (no CODs or stamps) to Craft Print Div., SCIENCE and MECHANICS, 505 Park Ave., New York 22, N. Y. Your order will be handled promptly and sent by first-class mail. 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, subtract 75¢, etc. Now available, our new, illustrated catalog of 238 do-it-yourself plans, 25¢ (refundable, first order).



1 RIGGING DETAILS