SECTION IV—Sailboats and Special Purpose Boats

Manu...

With sails trimmed in hard and flat and one crew member out on a hiking board to keep her level, Manu planes with winds of 10-12 mph. With a 25 mph. wind, planing speeds of 28-30 mph. are possible.

STATEMENT OF USES

USES: Speedy planing-type sailboat for use on protected bodies of water such as bays, rivers, lakes, for speeds in excess of 18 M.P.H. with two or three aboard. With load of more than five passengers, boat reacts like any conventional displacement-type sailboat.

TYPE: Shallow-scow type with convex bottom, ¼" plywood planking and covered with fiber-glass.

LENGTH: 20-ft. over all. Length waterline—19-ft. 4-in.

BEAM: 6-ft. 1-in.

SEATING CAPACITY—Planing 4 maximum, 6-non planing, maximum.

POWER: Main sail and jib sail.

WEIGHT: 305 lb.

SAIL AREA: 238 sq. ft.

RATIO OF SAIL AREA TO WEIGHT—1 square foot of sail area to 1.25-lb. of boat. This ratio twice as efficient as a catamaran of equal size.

SPEED: 18 M.P.H. and more depending upon technique and trim of sails.

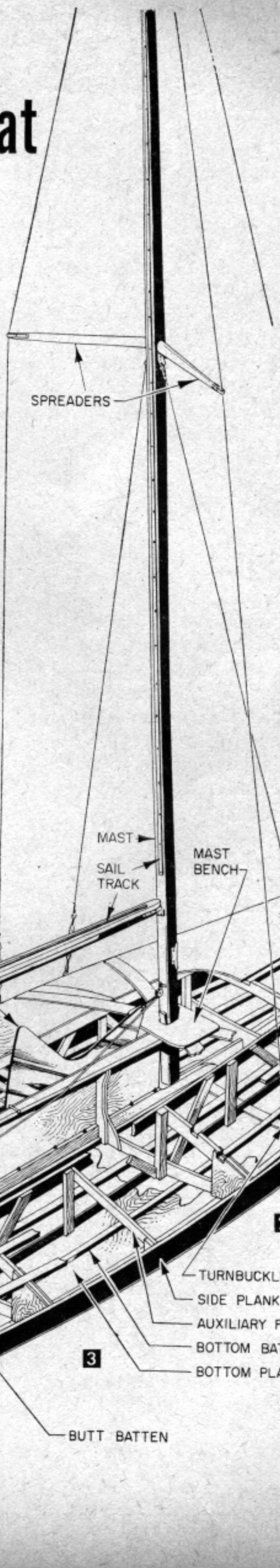
Twice as efficient as an INTERNATIONAL 14-ft. DINGHY. In winds below 10 MPH it is not quite as efficient as a displacement-type boat. But with winds over 10 MPH it is five times faster than a conventional displacement-type sailing craft of equal waterline length.

a 30 mph Planing Sailboat

By WILLIAM D. JACKSON
Naval Architect

HAVE you ever sailed in a planing-type sailboat? If you haven't you have a real thrill awaiting you. The difference between sailing a *planing*-type sailboat and the conventional *displacement*-type sailboat is about the same as chugging along in an outboard powered, displacement-type row boat as compared to breezing along in an outboard planing-type runabout.

It's a remarkable experience to actually feel the hull of a planing sailboat rise and go skimming across the surface of the water at 18 to 30 mph! That's faster than the American Cup Defenders will do, which, of course, are long sleek displacement-type sailboats. Manu's tremendous speed is due to (1) a new concept in design and construction of hull and sails and (2) a vastly different theory and technique of sailing than that used for sailing displacement sailboats. But, more about that later, right now let's get into the construction of this speedy little sailer.



Craft Print Project No. 292

Douglas Fir plywood and #2 western spruce for framework and mast was used in building the original Manu. Ask your local lumber dealer to allow you to select the pieces of #2 western spruce noted in the Materials List that have the fewest number of knots. While waiting for delivery of your lumber, make full-size drawings of the frames (Fig. 2) on red rosin building paper. To draw a true-arc curve for the top and bottom frame numbers, mark the height of curve on the frame vertical centerline with a pencil. Then,

with the paper over a sheet of plywood, partially drive finishing nails at marked ends of the curve to be drawn. Place two ½ x 1¼ in. wooden strips, each about 6 in. longer than the entire length of the curve, on the paper so that they touch the finishing nails and overlap at the center (Fig. 2A). Temporarily fasten the overlapping ends together with nails. Now, holding a pencil against the strips at the center, move strips from one finishing nail to the other and pencil will scribe a perfect arc of a circle.

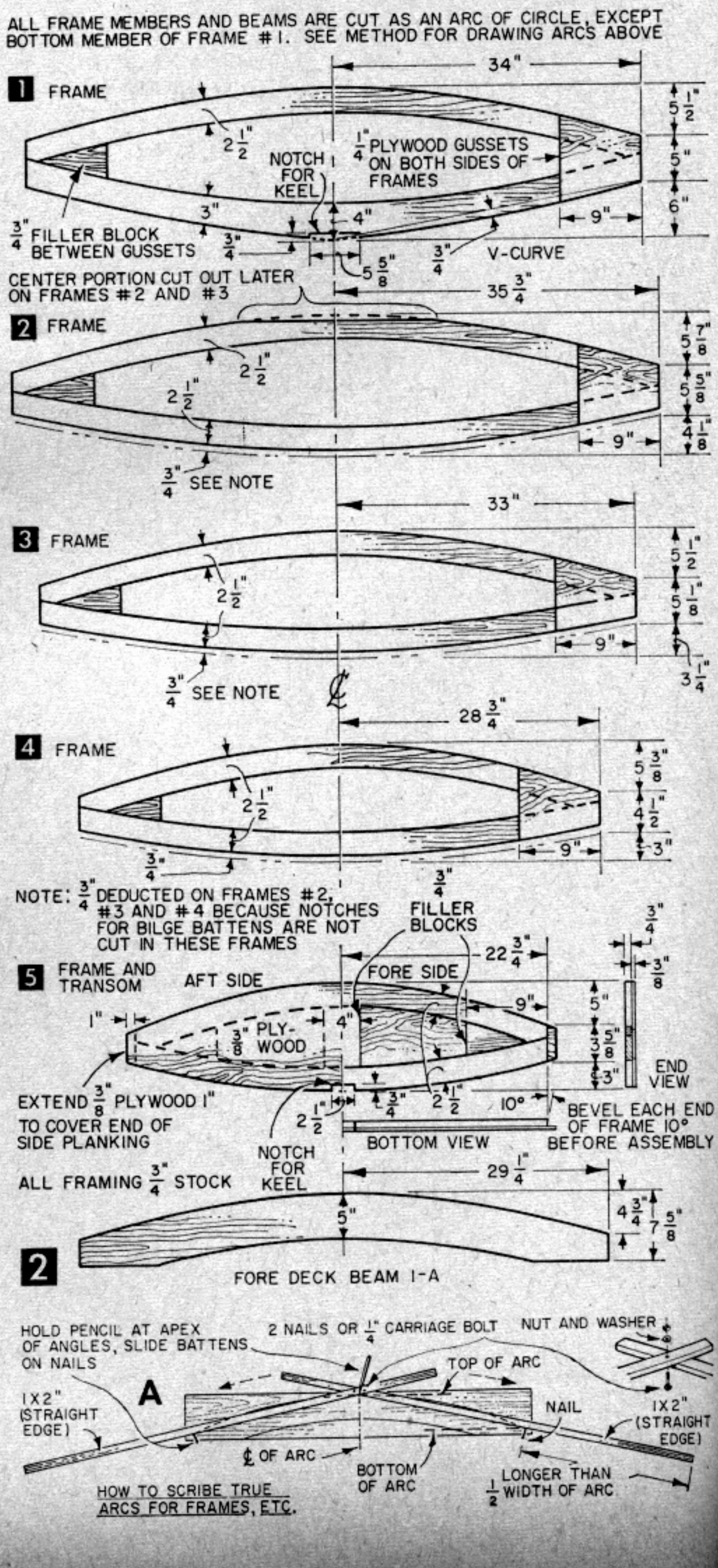
Note that the bottom curve of #1 frame is drawn with two arcs from center to ends instead of one curved line from end to end. Note also that the bottom curved line of #2, 3 and 4 frames are drawn ¾ in. above true bottom of frames. This is done to eliminate notching these lower frame numbers for the bottom battens.

After completing the frame drawings, transfer the outlines of the various frame pieces to the frame stock and plywood for the gussets by using carbon paper, a pointed transfer wheel (similar to a dressmaker's wheel), or with a sharp awl by marking a series of holes through the paper on to the wood. Saw the pieces to shape on a bandsaw and place them in their respective places on the paper patterns to assure perfect alignment during assembly. Fasten gussets to frame members and filler blocks with glue and #6 x 1 in. *fh* screws. Note that ⅜ in. plywood extends 1 in. beyond ends to cover end grain of hull side pieces.

For the side planks add a 24 in. length of ¾ x 5⅝ in. to the 16 ft. lengths as in Fig. 3 reinforcing the butted joint with a 48 in. length of ¾ x 5⅝ in. stock. Use the straightest edge of the 16-ft. board for the sheer line and layout the measured points for the chine line from this edge. To draw the curved chine line, bend a long ¾ x ¾ in. batten against finishing nails driven partially into the side planks at measured points. Saw boards to shape on a bandsaw or with a portable jigsaw. Lay out keel with its tapered ends (Fig. 3) and saw to shape.

The keel stem and bow sheer plate (Figs 6 and 7) come next. Make full-size paper patterns and transfer outline of pieces to lumber stock. Assemble with ¼ in. plywood gussets fastened with glue and #6 x 1 in. *fh* screws. Temporarily nail a 2 x 2 across the ends of the bow sheer plate to hold it in alignment.

When the glue is dry on all of the parts you have made thus far, you are ready to start assembling the framework. No building form is used, however, a long flat floor, like a concrete garage floor is needed. First mark the frame locations on the inside surface of the side planks. Since the frames are located on center, also make a mark ⅝ in. on each side of the center mark



8'-0"

8'-0"

BUTT BATTENS

AUX. FRAME CENTER BETWEEN FRAMES #2 AND #3

¼" PLYWOOD DECKING

DECK BATTENS

16" R

TRANSOM

KEEL

½"

29"

¼" PLYWOOD BOTTOM PLANKING

BOTTOM BATTENS ¾" X 1¼" X 16'

BUTT BATTEN

DECK BEAM 1-A

GLUE BLOCK ¾" X 1" X 6"

SHEER PLATE

SIDE PLANK

30"

JOINT

BUTT BATTEN

4"

¼" PLYWOOD

PLANKING JOINT

DECK OR BOTTOM PLANKING BUTT JOINT BATTEN

BEVEL SIDE PLANK ONLY

REINFORCING PIECE

¼"

SEC. C-C

SIDE PLANK

¾"

INSTALLING DECK BEAM 1-A

FRAME

2 X 2" BLOCK

SIDE PLANK

1¾"

1"

ALUMINUM BRACKET

¼" X 2" RH MACHINE SCREW

¼"

2½"

5½"

2½"

KEEL

66"

16'-0"

21"

5

4

3

2

1

0

A

B

C

1⅝" X 1⅝" UPRIGHTS

BOTTOM BATTEN

COAMING

¾" X 1¾" STRUT BRACES

45°

SIDE DECKING

CENTER DECK BATTEN

BEVELING FRAME ENDS

SHEER PLATE

FILLER BLOCK

STEM

4¼"

BOTTOM PLANKING

¼" PLYWOOD STRIP

KEEL SECTION A-A

¾" X 3" X 3" METAL BKT. – 68"

34"

34"

54"

48"

16'-0"

47½"

TOP VIEW STRAIGHT SIDE PLANK

JOINT STRAIGHT

9"

CURVED

⅛"

CURVE

5/16"

¾"

SIDE VIEW

5⅛"

5⅝"

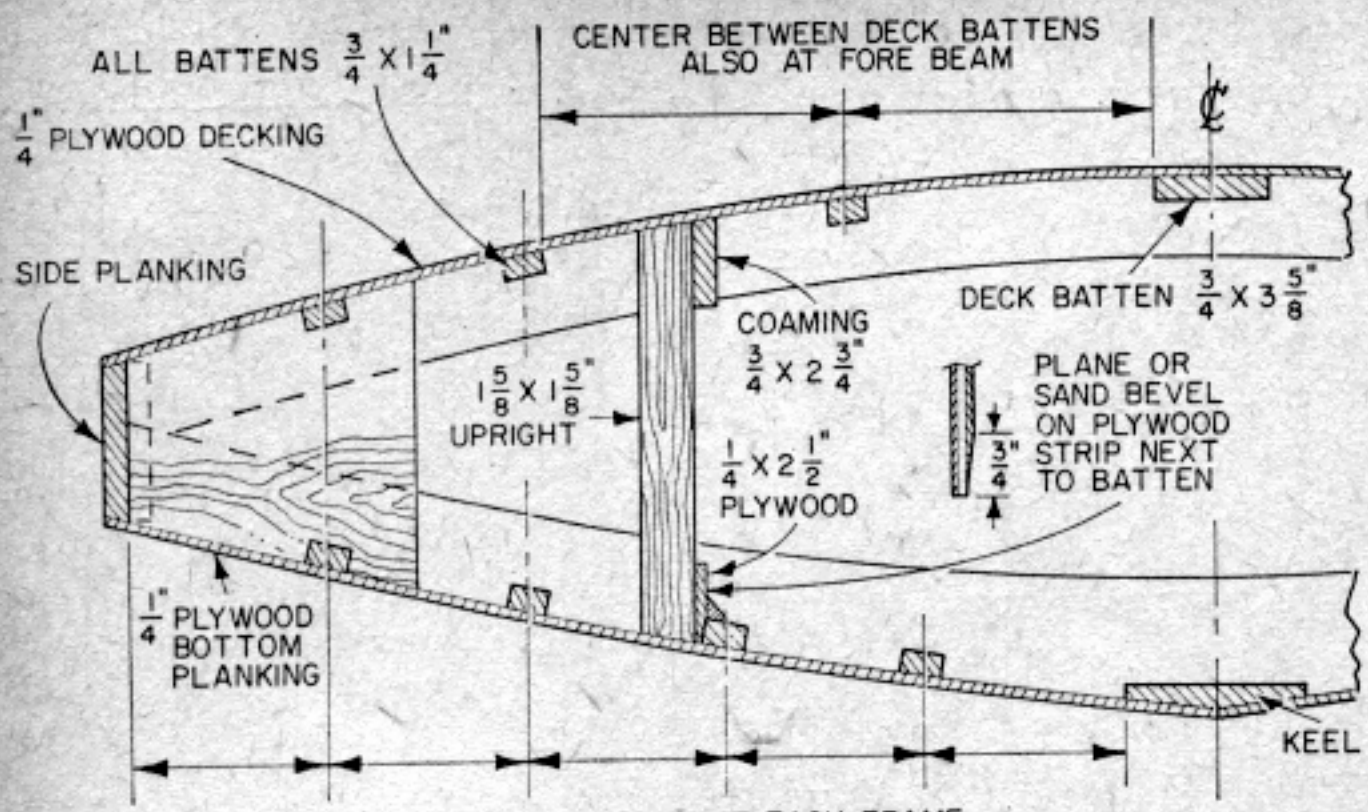
5"

3⅝"

4½"

3½"

26½"



5

SECTION B-B #1 FRAME

MATERIALS LIST—MANU

No. Req.	Size and description	Use
10	1/4" x 4' x 8' AB or AC exterior fir plywood	checking and planking
1	1/4" x 4' x 8' AC exterior fir plywood	mast saddle
1	3/8" x 4' x 7' 5 ply African mahogany plywood	centerboard well sides, rudder casing and transom
2	3/4" x 5 5/8" x 16' western spruce	side planks
1	3/4" x 5 5/8" x 8' western spruce	side planks
3	3/4" x 5 5/8" x 16' western spruce	battens
1	3/4" x 3 5/8" x 8' western spruce	deck center battens
1	3/4" x 5 5/8" x 12' western spruce	coamings
12	3/4" x 7 5/8" x 8' western spruce	beams and frames
2	3/4" x 9 5/8" x 8' western spruce	beams and frames
1	3/4" x 5 5/8" x 16' western spruce	keelson
1	3/4" x 7 5/8" x 10' western spruce	sheer plate
1	1 5/8" x 5 5/8" x 24" western spruce	stem
1	1 5/8" x 3 5/8" x 60" western spruce	stem
1	1 5/8" x 3 5/8" x 12' western spruce	bed log
1	3/4" x 3 5/8" x 10' western spruce	centerboard well sides
2	3/4" x 5 5/8" x 16' western spruce	mast
2	3/4" x 5 5/8" x 12' western spruce	mast
1	1 5/8" x 3 5/8 x 60" western spruce	mast spreaders
1	1 5/8" x 5 5/8" x 6' western spruce	tiller boom

FASTENINGS

1 gross	#6 x 3/4" galv. fh. screws
8 gross	#6 x 1" galv. fh. screws
4 doz	#8 x 1 1/2" galv. fh. screws
1 1/2 gross	#8 x 1 3/4" galv. fh. screws
1 doz	#8 x 2 1/2" galv. fh. screws
10 lbs	Weldwood glue

PAINT etc.

1 gal	Kuhls Three Way Preservative
6 qts	Dolfinite's row boat paint—gray
1 qt	Condon's BoatLife—clear
1 pt	Stay-tite neoprene caulking compound—gray

FIBER GLASS

27 yds	38" wide chrome—glas. cloth
40 yds	4" wide chrome—glas. tape
3 gals	Resinote
6 oz	ground glass fibers
	(the above may be purchased at Herter's, Inc., Waseca, Minnesota)

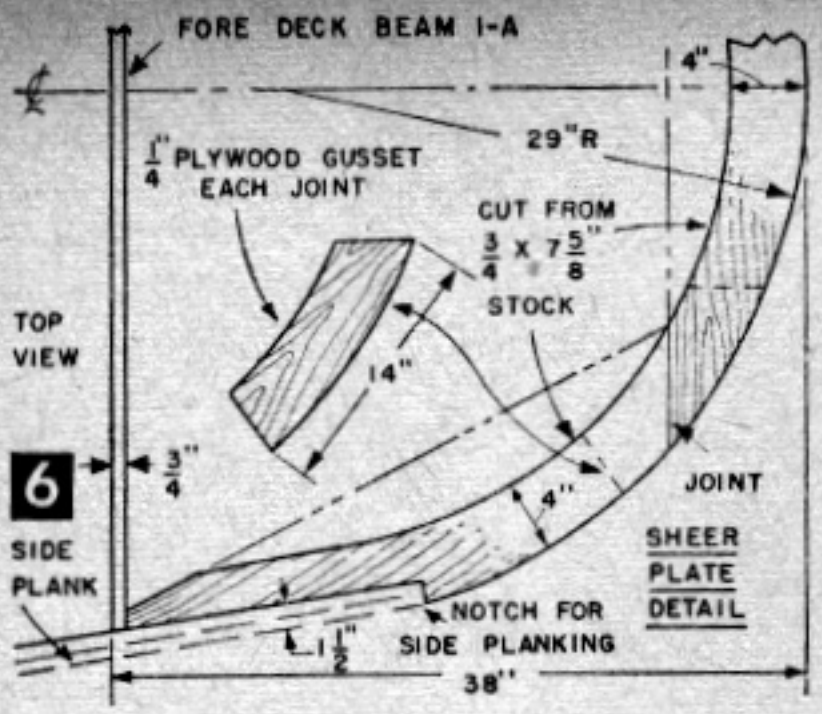
RIGGING, SAILS etc.

1	3/16" x 36" x 48" aluminum plate (specs. 6061-T6) for rudder, chain plates and centerboard
	(available from Aluminum Distributors Inc., Forest Park, Illinois)
125 ft	3/32" preformed 1 x 9 stainless steel strand
	(available from Hackensack Cable Corp., Hackensack, N. J.)
35 ft	5/8" sail track
5	6" aluminum cleats
	(above two items available from Aluminum Marine, Auburn, New York)
150 ft	5/16" manila rope or 1/4" Nylon cordage
1	5/16" x 4" bow eye bolt—manganese bronze
5	5/16" x 7" jaw-and-jaw, forged rigging turnbuckles
2	7/8" rudder pintles and gudgeons
1	[illegible]-stay plate—manganese bronze
6	3/16" screw-pin anchor shackles—manganese bronze
6	3/8" rope-size tiller rope blocks
12	1/4" wire rope thimbles
1	Snipe-style #0 mast-boom gooseneck
12	3/16" cable clamps
1	3/8" x 6" x 18" sheet traveler
1 suit	sails (available from Alan Clarke Co., 75 Chambers Street, New York, N. Y.)

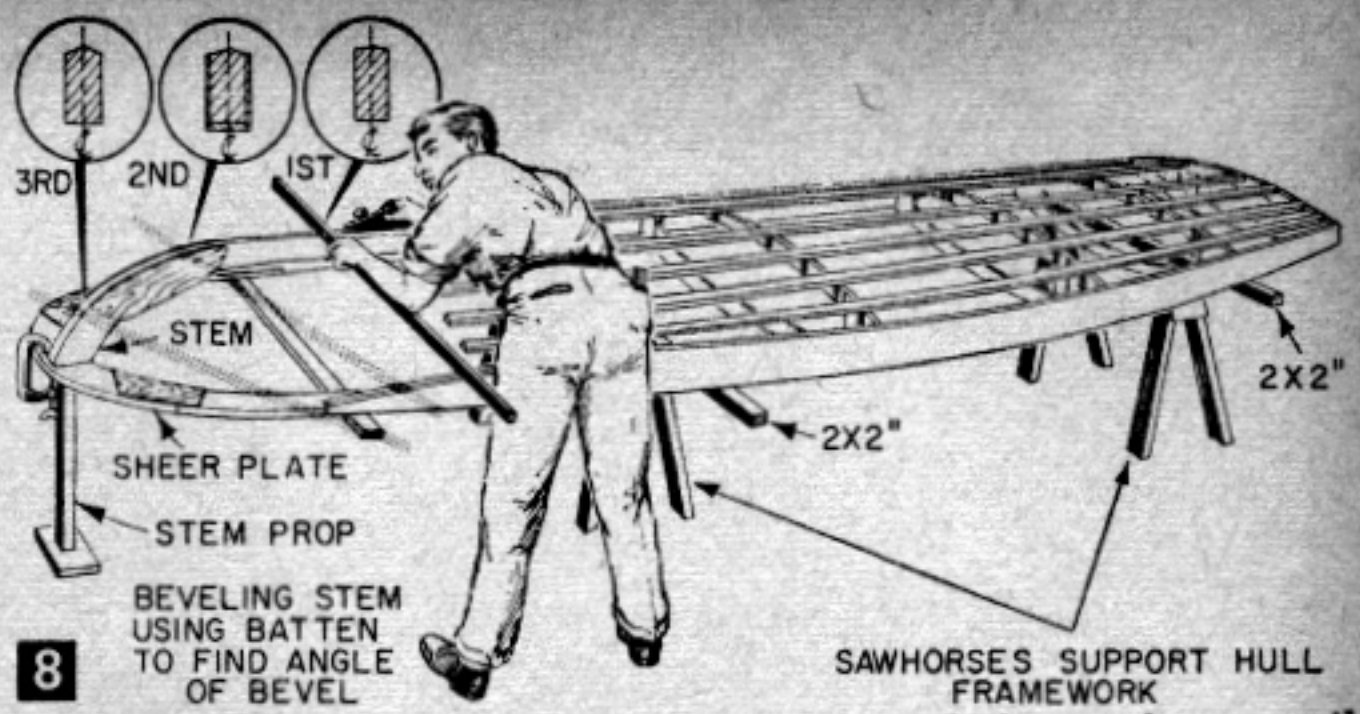
indicating the frame thickness at each end. Then, with the transom and two sides held upright and in their normal position on the floor, clamp the sides to the transom ends with two 8 in. C-clamps or a long bar clamp. Now, working toward the forward ends of the sides, setup the #4, 3, 2 and 1 frames between the sides clamping them as in Fig. 3A. Tie the forward ends of the sides together with a rope. The ends of all of the frames except #2 must be beveled slightly to fit tightly against the sides. Do this by running a hand saw down between the sides and frame ends as in Fig. 3A. Hold saw flat against side and take a cut off frame ends.

Before placing any fastening screws, check the framework alignment by measuring diagonally across from the port side at the transom to the starboard side at #1 frame, then across from starboard end of transom to port side of #1 frame. These measurements should be the same. If not, it indicates that one side plank is not bending as readily as the other. To correct, clamp a 2 by 4 along the weaker side plank to stiffen it. Draw up on the clamps slowly until diagonal measurements are the same, then clamp or temporarily nail two of the 3/4 x 1 1/4 x 16 ft. battens diagonally across the framework to keep it in alignment. Spring the sides away from a frame end one at a time just enough to apply some glue and permanently fasten sides to frame ends with three #8 x 1 3/4 in. *fh* screws at each joint.

With the sides fastened, turn the framework over and place it on sawhorses as in Fig. 8. Then assemble the keel with glue and three #8 x 1 3/4 in. *fh* screws to each frame. Keel is notched into transom and #1 frame only. Clamp the sheer plate assembly to the tapered ends of the side planks and prop up the fore end of the sheer plate with a 2 x 2 extending to the floor so that the chine edge of the sides and the sheer plate make a straight line as in Fig. 3. Fasten sheer plates to doubled ends of side planks with glue and three #8 x 2 1/2 in. *fh* screws on each side. Next, trim the forward end of the stem assembly at an angle as in Fig. 7 to fit against bow of sheer plate. Fasten with three #8 x 1 3/4 in *fh* screws to the keel and two #8 x 1 3/4 in. *fh*

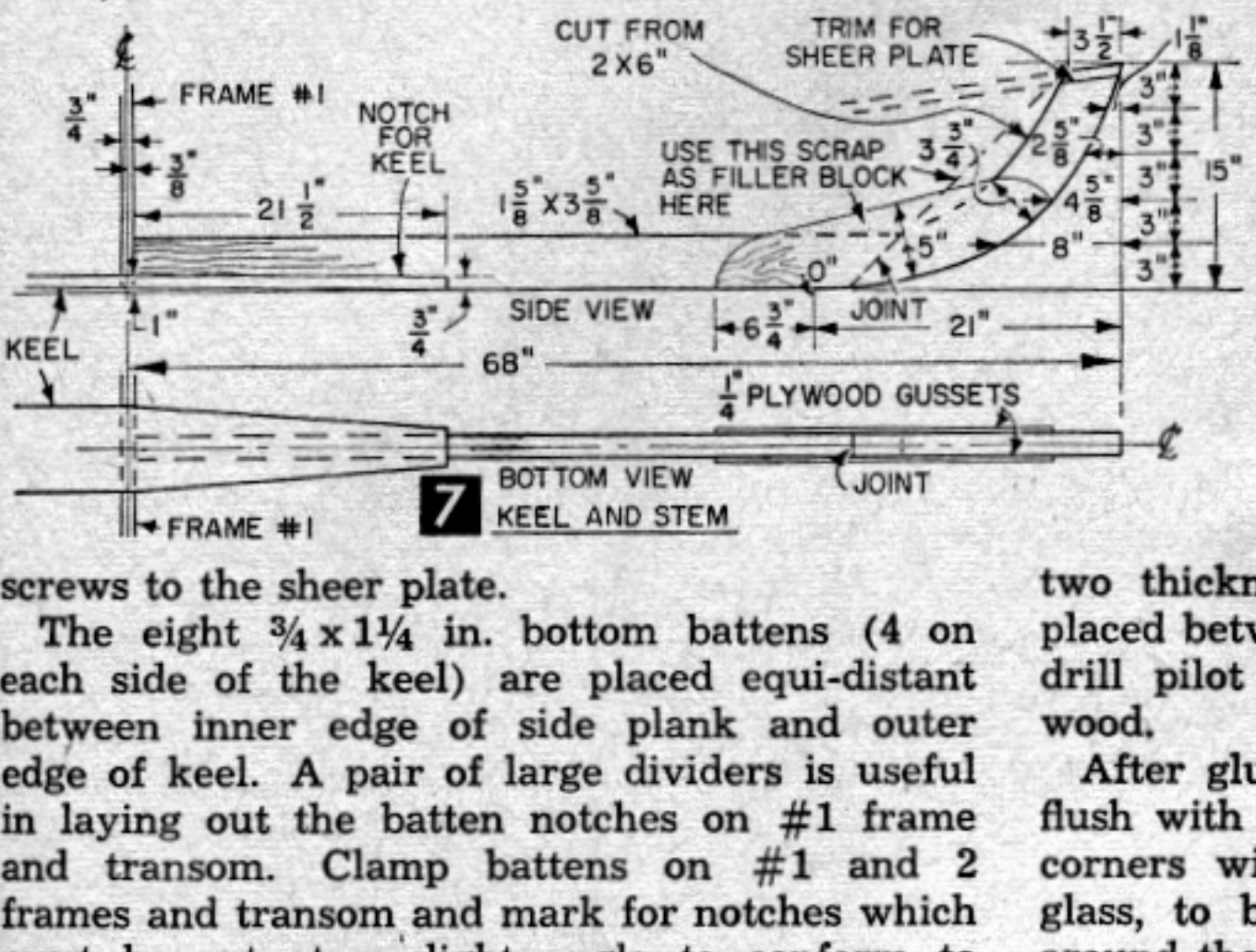


6



BEVELING STEM USING BATTEN TO FIND ANGLE OF BEVEL

8



7

screws to the sheer plate.

The eight ¾ x 1¼ in. bottom battens (4 on each side of the keel) are placed equi-distant between inner edge of side plank and outer edge of keel. A pair of large dividers is useful in laying out the batten notches on #1 frame and transom. Clamp battens on #1 and 2 frames and transom and mark for notches which must be cut at a slight angle to conform to bend of battens. Do not notch #2, 3 and 4 frames for battens, merely fasten with glue and one #8 x 1¾ in. *fh* screw at each joint.

Your next step is to bevel the stem, sheer plate and chine edge of side planks, and fair the bottom framework members so that the plywood planking will make contact with all frame members. Use a jack plane for beveling and a Stanley *Surform* rasp for fairing. Test the frame surfaces frequently by bending a batten across them to locate high and low spots.

After fairing is completed, start installation of the ¼ in. plywood planking at the bow and work toward the transom. Bottom planking will require four full 4 x 8 ft. sheets plus two 4 x 8 ft. sheets cut off at the transom. Sheets are joined along centerline of keel and stem. Because of the abrupt bend at the stem, the fore ends of the two forward sheets of ¼ in. plywood must be saturated with hot water to make them pliable enough to bend. Pour the hot water on the plywood and then go over the wetted surface with a hot electric iron to force steam into the wood fibers.

First clamp the two forward sheets in position on the framework and mark them along the bow and chine line for cutting. Also mark the underside along each side of every frame member so that the glue may be applied to surface contacting frame members. Then remove the plywood and saw to shape. Drilling ⅛ in. holes about 12 in. apart between the marked glue lines, and connecting these holes with a pencil line on the outside of the plywood will aid you in locating fastening screw placement.

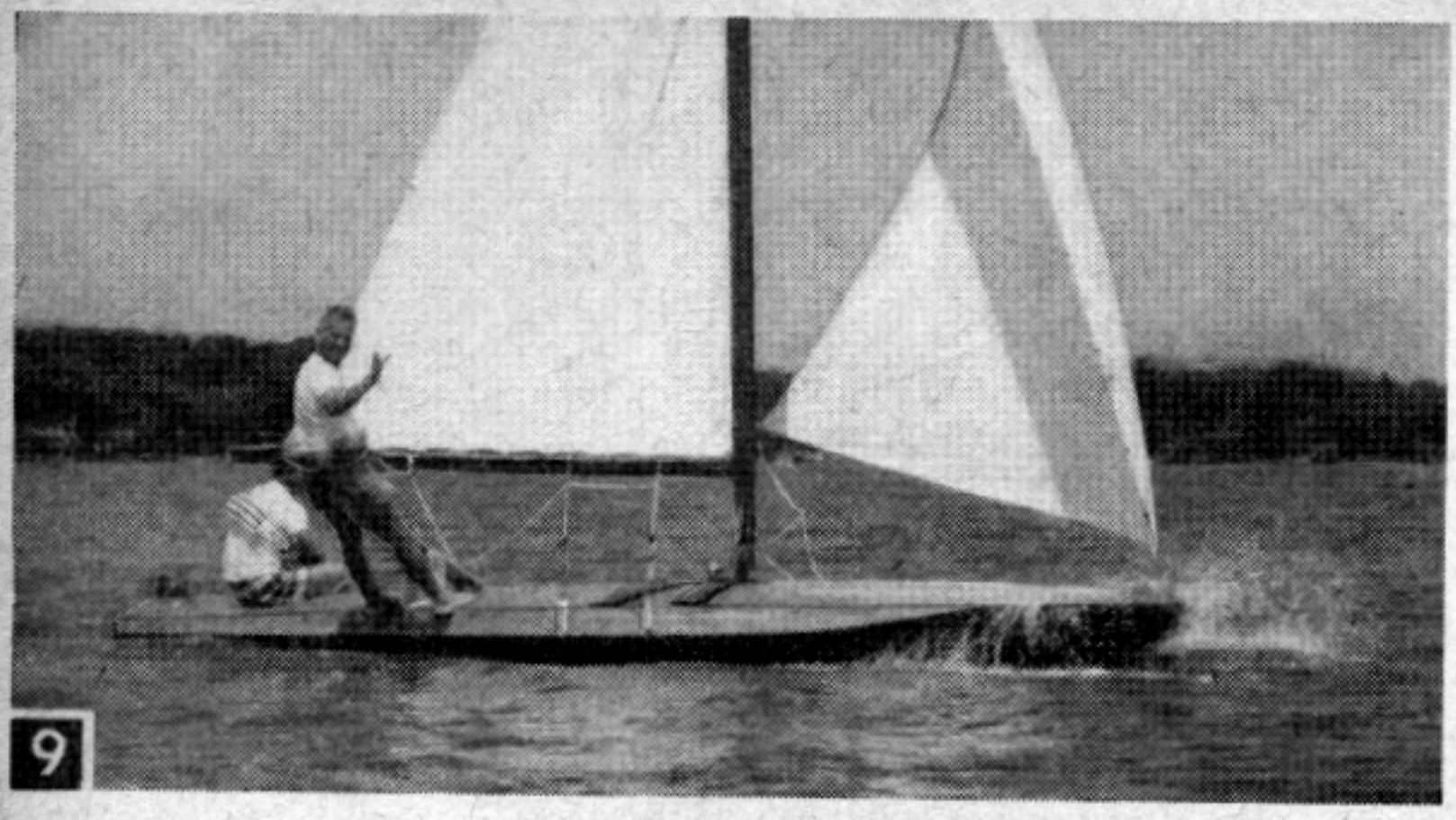
When installing the planking, coat contacting surfaces of both framework and planking with glue, clamp in position, and fasten with #6x¾ in. *fh* screws spaced 2 in. apart. Leave clamps on until glue has dried. Reinforcing planking butt joints with butt battens made up of two thicknesses of ¼ in. plywood 4 in. wide placed between battens as in Fig. 3B. Be sure to drill pilot holes for screws to avoid splitting wood.

After glue has dried, plane edges of plywood flush with sides and transom and round off the corners with a disc sander so that the fiber glass, to be applied later, will adhere tightly around the corners.

Now turn the hull right side up and block it so it rests evenly on the sawhorses. To provide a fastening strip for the uprights, cut 2½ in. wide strips of ¼ in. plywood to fit against the outside of the second batten from the keel and between frames #1 and 2, 2 and 3, and 3 and 4 as in Fig. 3. Fit these strips snugly against the bottom planking and fasten with glue and 1 in. nails. Then rip six 1 x 1 in. triangular pieces the same length as the plywood strips and fasten with glue and nails in the corner where the plywood joins the bottom batten.

For the uprights (Fig. 5) cut eight 12 in. lengths of 1⅛ x 1⅝ in. pieces from 2 x 4 in. stock and fasten to the aft side of #1, 2 and 3 frames and the fore side of #4 frame, as in Fig. 3, with glue and one #8 x 1¾ in. *fh* screw at each joint. Be sure to position these upright pieces perpendicular athwartships. Then saw out the upper frame members flush with and between these uprights on #2 and 3 frames only to make the cockpit opening.

For the coamings (Fig. 1 and 3), rip a 12 ft. length of ¾ x 5⅝ in. stock lengthwise and fit the pieces to the uprights on each side of the cockpit with glue and two #8 x 1¾ in. *fh* screws at each joint. Cut the ¾ x 1¾ in. strut braces (Fig. 3) from scrap frame stock and fasten them to the ¼ in. plywood strip with glue and #8 x 1½ in. *fh* screws. Now, continuing forward place the #1A deck beam 30 in. forward of the #1 frame and fasten with #8 x 1¾ in. *fh* screws



With a 25-30 *mph* wind here's a sailboat!

and one 2½ in. angle at each end.

The deck battens (Fig. 3) must be installed next. Cut notches in all deck beams so the battens will be flush with the top edges of the deck beams and bevel the fore ends of the battens to fit the sheer plate. Assemble the ¾ x 3⅝ in. fore and aft center battens first and fasten with glue and two #8 x 1¾ in. *fh* screws. Then install the remaining battens on each side of the center battens and fasten with glue and one #8 x 1¾ in. *fh* screw at each joint. To stiffen the deck between frames #2 and 3 make up two short deck beams as in Fig. 3.

After the glue dries, plane the top edges of the side planks to conform to the curvature of the deck beams and fair the battens and deck beams flush with one another as you did before planking the bottom. Then turn the hull upside down to clean out the shavings and sawdust and prepare to paint the inside of the hull. *Do not* paint the outside of the hull because fiber glass will not adhere to a painted surface. Be sure too, not to paint the top surfaces of the sides, deck beams and battens because the decking will be glued to these surfaces. Mix one quart of Kuhls *Three Way Preservative* to one gal. of paint. Give the interior three coats of paint.

The entire top of the hull with the exception of the cockpit opening is decked over with ¼ in. plywood. Starting at the bow, first clamp the 4 x 8 ft. sheets in place joining them along the center deck batten. Mark the underside along the sheer and cockpit opening. Remove the sheets, draw in the radius at the fore end of the cockpit as in Fig. 3 and saw the sheets to shape. Do the same for aft decking, again using full 4 x 8 ft. plywood sheets. Now, before fastening these sheets in place, give the undersides two coats of Three Way Preservative. Glue will bond to a surface treated with this preservative when used alone, so do not mix it with paint. When dry, follow the same procedure you did for fastening the bottom planking. Then fit and cut the two small pieces of decking needed to cover the area midships between the fore and aft decking. Use butt battens on underside of decking at seams as you did on bottoms. Plane edges of decking flush and sand corners round for fiber glass.

After completing the hull, make up the centerboard-well assembly as a separate unit and then install it in the hull. For the two well bedlogs (Fig. 10), rip a stock size 2 x 6 (actually 1⅝ x 5⅝ in.) lengthwise. Layout and bandsaw the curved ends to shape and cut the ⅜ x 1-in. rabbets on a circular saw, trimming the rabbet ends square with a hand chisel. Be sure to cut the rabbets on opposite sides on each bedlog so you come up with a right and left hand bedlog. Then drill the 9/32-in. holes for the ¼-in. carriage bolts. Cut the two well sides from ⅜-in. plywood, and fasten to the bedlog rabbets with Kuhls *Sealtite* and #6 x 1-in. *fh* screws.

Now, make the two well topping boards as in Fig. 10, and fasten to the top of the sides with glue and #6 x 1-in. *fh* screws,

Next, make the two ¾ x 2-in. posts that go between the fore and aft ends of the well sides and the ¾-in. thick spacer pieces that go between the fore and aft ends of the bedlogs.

When you have completed these, temporarily assemble and clamp the well together, and layout the location of the mast socket Fig. 10. Note that this socket must be cut partially into each bedlog and the fore spacer piece. Then disassemble the well, and chisel out the socket to a depth of 1½-in.

Now, before permanently assembling the centerboard well, make and fasten the reinforcing pieces (Fig. 10A) to the well sides and apply one layer of fiber-glass cloth to the inside of the well sides.

Mark off the area that is going to be covered by the two posts first, and cut the cloth to fit between the posts. Allow the cloth to extend about 3-in. beyond the bottom of the bedlogs to wrap around the keel and bottom planking later. Do not apply resin to this portion of the fiber glass. Assemble the well with glue and ¼ x 2-in. bolts through the sides and posts, and ¼ x 4½-in. bolts through fore and aft ends of bedlogs. Then saturate with resin, two 3-in. strips of fiber glass 18 in. long and apply to the inside fore and aft ends of the centerboard well. Locate and drill the ⅜-in. hole for the centerboard pivot bolt.

Now, getting back to the hull, a 4-in. wide piece must be cut from the lower #2 frame member to clear the centerboard bedlogs. Measure and mark the lower #2 frame member 2 in. on each side of the keel centerline and saw out the 4-in. piece. Then layout the ¾-in. slot that

must be cut through the keel and bottom planking between frames #1 and 3 for the centerboard as in Fig. 16. Make the layout inside the hull on the keel first. Then drill two ⅛-in. holes through keel and bottom planking at each end of slot to transfer its location to outside of hull. Turn hull over, connect ⅛-in. holes with pencil lines and saw out slot with a portable circular saw.

To permanently fasten the centerboard well in the hull, again turn the hull over to its upright position and set it up off the floor on sawhorses. Place the well inside the hull on the keel and line it up with the slot you just cut. Transfer the locations of the bolt holes in the bedlogs to the keel by placing bolts in the holes and rapping them with a hammer to make an impression on the keel. Then set the centerboard well to one side in the hull and drill the holes through the keel and bottom planking. Coat the bottoms of the bedlogs liberally with Kuhls *Sealtite* and again place it on the keel, pulling the edges of the fiber glass through the keel slot. Insert the bedlog carriage bolts through the holes from the outside bottom of the hull up through the bedlogs and draw down uniformly and tightly with a washer under each nut. Scrape off the caulking compound that squeezed out, especially in the slot, and fasten the fiber glass around the slot edges with resin.

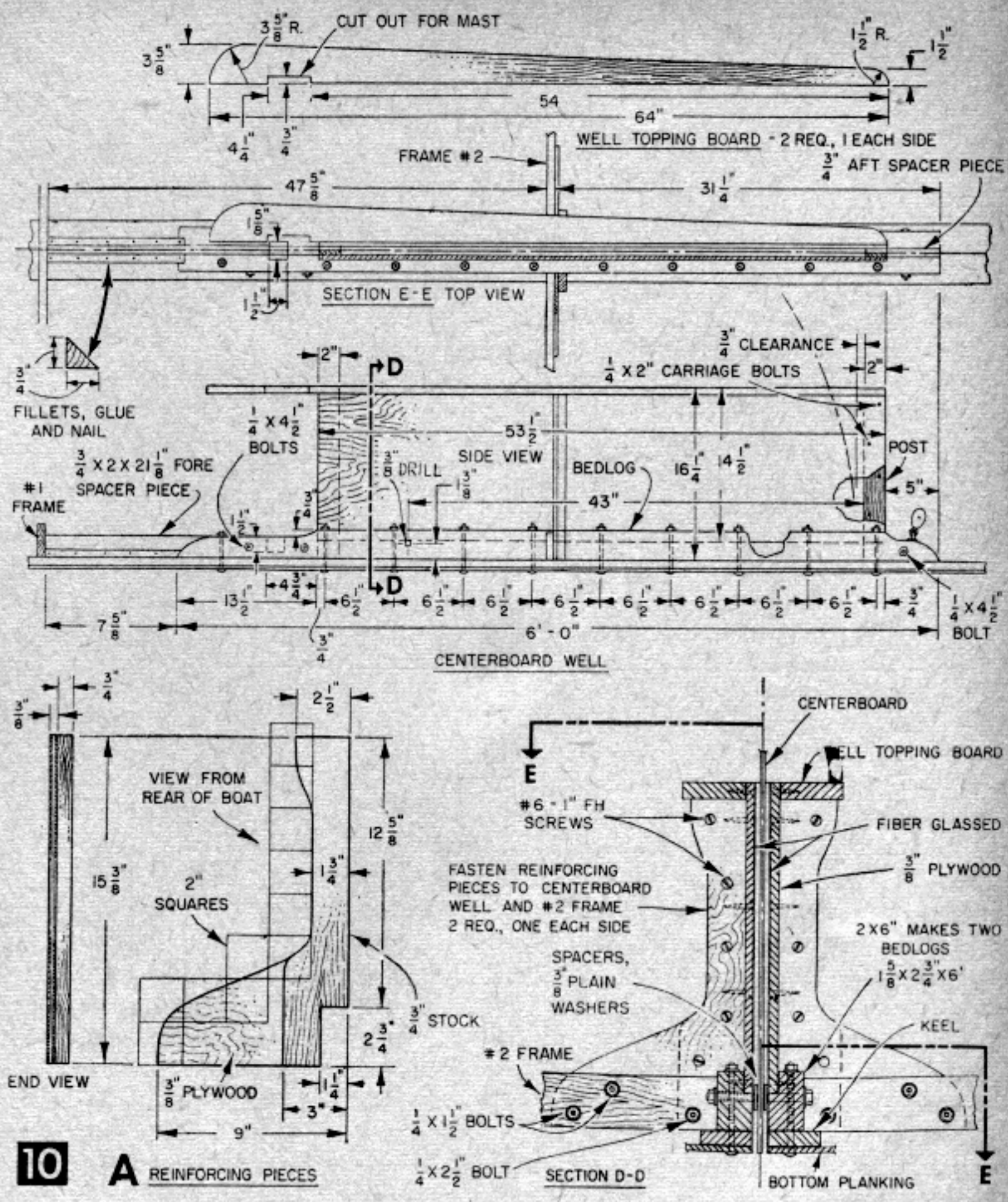
Right now, before any of the fittings or moldings are fastened to the hull is the time to apply the fiber-glass covering. Cover the corners with 4-in. fiber-glass tape (see Materials List) first, lapping half of the tape over the top or bottom and half over the sides. Then cover the entire hull including the decks with the 38-in. wide fiber-glass cloth, lapping the center seams 2 or 3 in. Complete instructions for application of fiber glass are included when material is ordered from Herter's, Waseca, Minnesota. After fiber glass hardens, feather the rough edges with a medium grit disc sander and paint the hull any color desired.

The centerboard and rudder are cut from a 3/16-in. sheet of aluminum alloy. Do not use soft aluminum for these parts because it bends too easily. Layout the shape of the centerboard and rudder (Fig. 15) on the aluminum with a scratch-awl and make all straight cuts first, with a flexible abrasive cutoff wheel on a circular saw. Then make radii cuts on a jigsaw, using a metal cutting blade. Lubricate blade with beeswax or tallow.

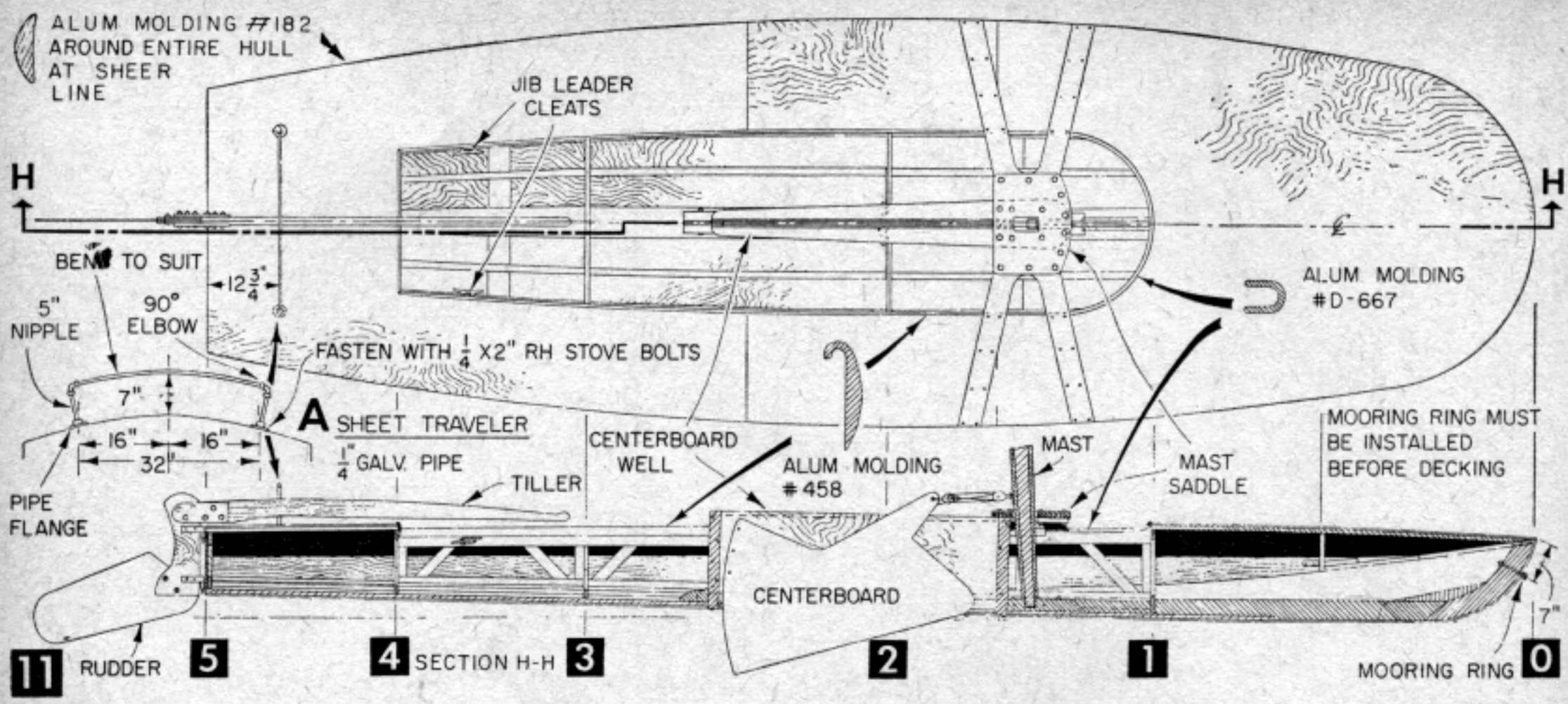
Make the tiller and other wooden rudder parts as in Fig. 15, and assemble, and fasten to the hull transom with ⅞-in. pintles and gudgeons.

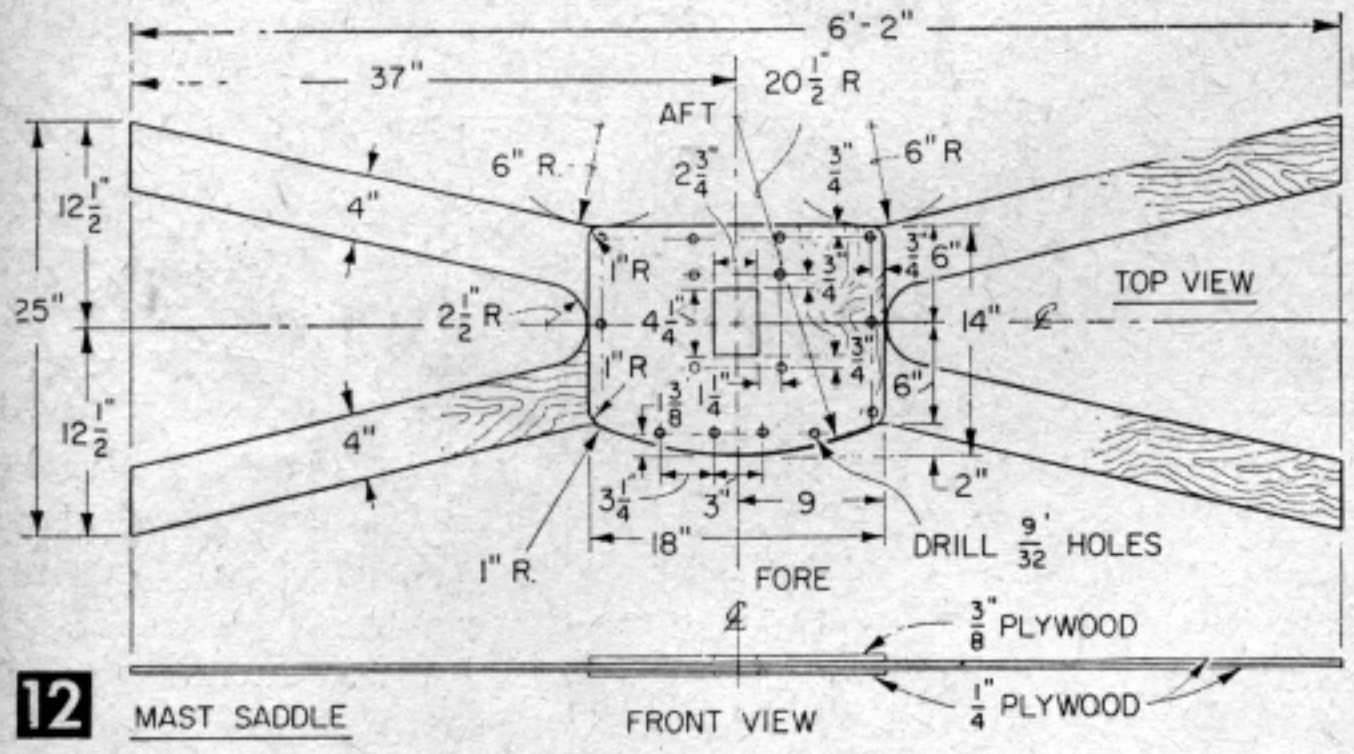
Aluminum instead of wooden moldings (Fig. 11) were used on the original Manu because the aluminum molding is easily bent around the bow and fore end of cockpit. Use four 12-ft. lengths of #182 flat oval molding around the bow, sheer and transom. This and other aluminum molding needed may be purchased from Youngstown Mfg. Co., 66-76 S. Prospect Street, Youngstown, Ohio.

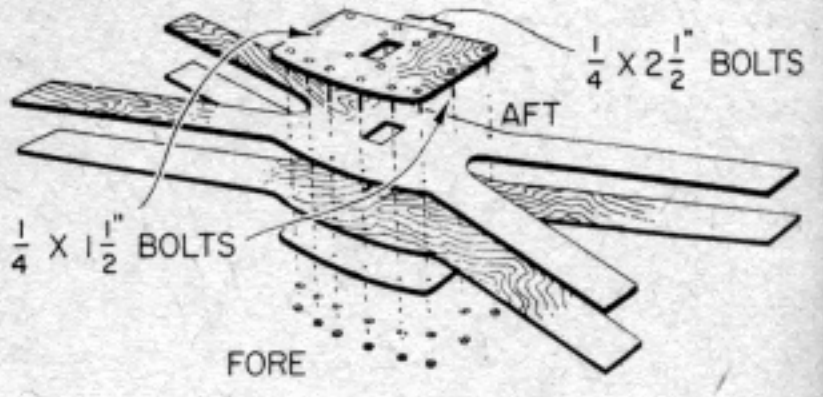
Fasten the jib-stay plate at the center of the bow and the chain plates first as in Fig. 17. Then working from the bow toward the transom, install and fasten the molding along the sheer with #5 x ¾-in. stainless steel, oval-headed screws in predrilled holes in molding. Use two 12-ft. lengths of #458 gunwhale molding along coaming sides and back of cockpit and an 8-ft. length of D-667 windshield molding around the curved



10 A REINFORCING PIECES





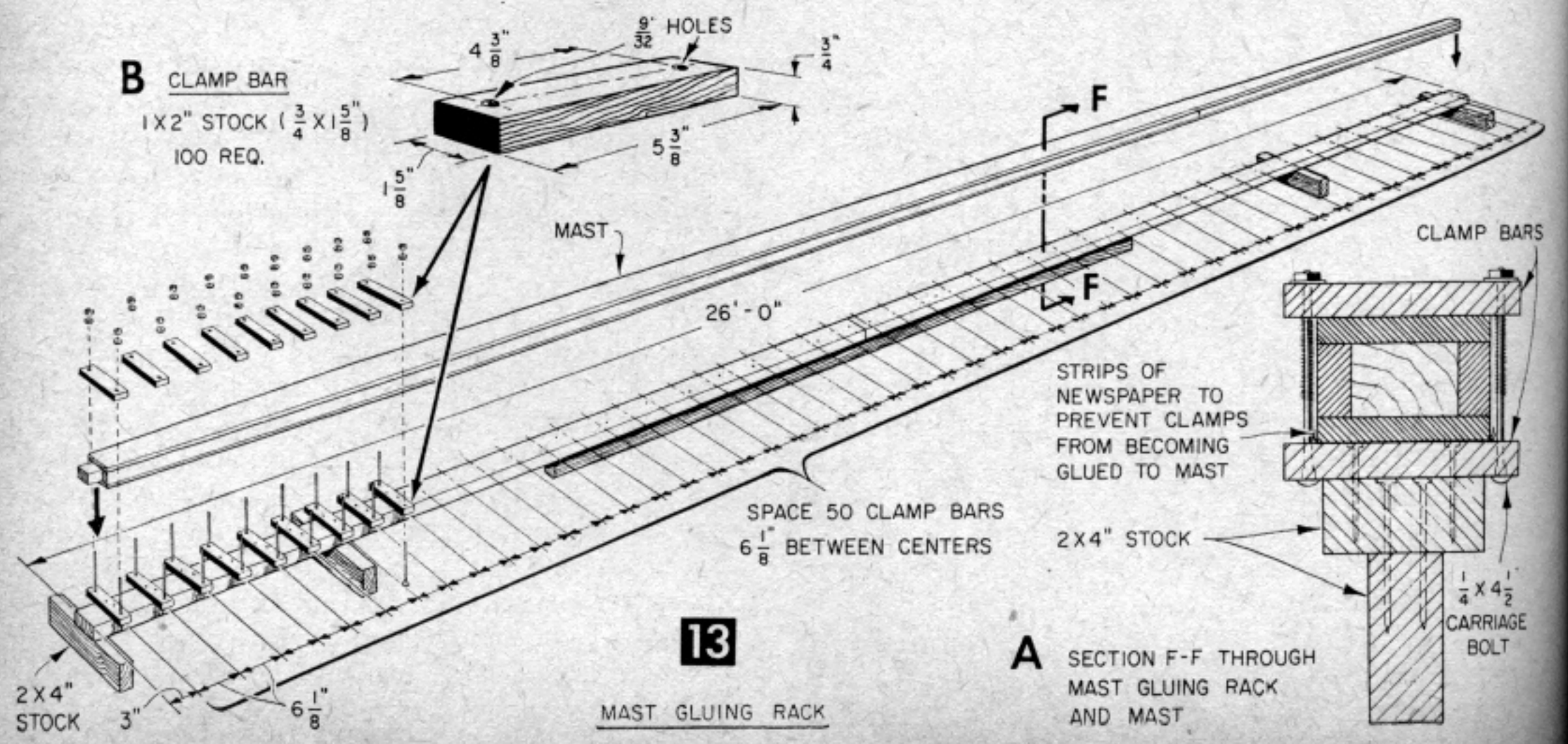


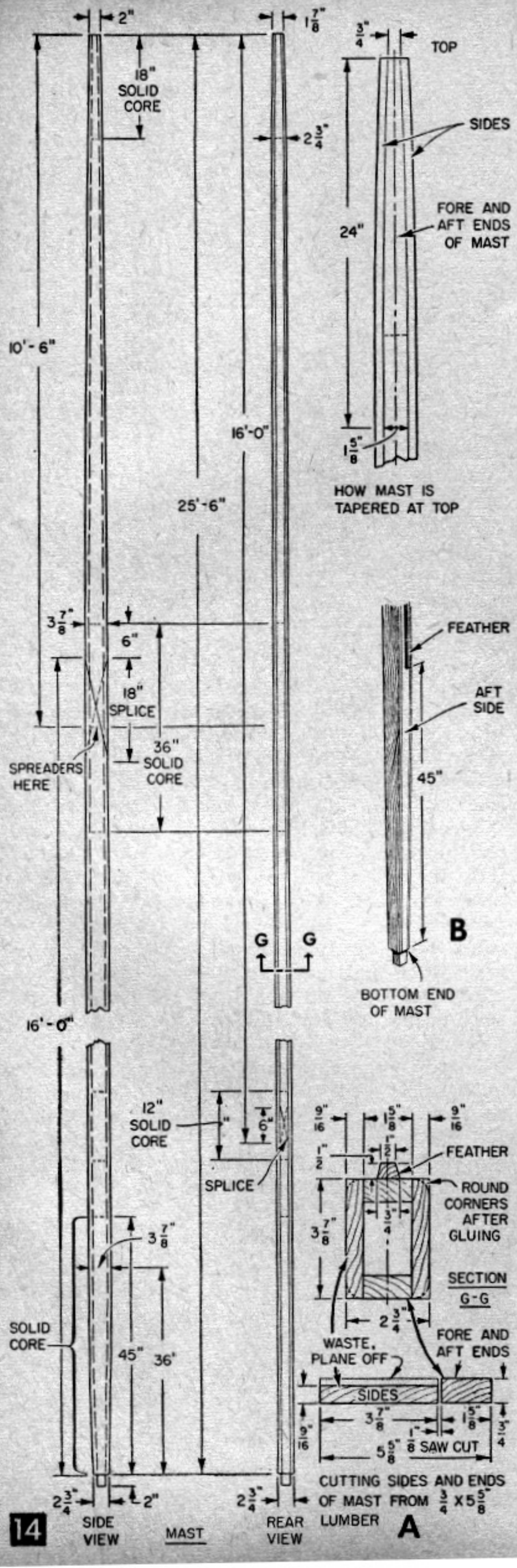
fore end of the cockpit.

Manu's mast is of the hollow, boxed-type construction which is much stronger than a solid mast of the same weight. Use select stock size 1 x 6-in. lumber (actually 13/16 x 5 5/8 in.) free of knots and straight grained. Rip 1 5/8-in. wide strips from each of the four lengths as in Fig. 14A and have the 3 7/8-in. pieces planed down to 9/16 in. thick at your local lumber yard or mill. Then taper one end of each piece and splice to make up four 25½-ft. lengths as in Fig. 14.

For a straight and flat surface on which to align the spliced pieces and later assemble the mast for gluing, fasten two 13-ft. lengths of 2 x 4-in. stock end for end as in Fig. 13. Use a chalk line to align the two 2 x 4's so they will be absolutely straight and block up the underside so the 2 x 4's will rest solidly on the floor.

Now, taper the 9/16-in. side pieces as in Fig. 14. The taper at the bottom is 3 ft. long, the one at the top 10 ft. long. The shortest or 10½-ft.





HOW MAST IS TAPERED AT TOP

MATERIALS LIST—MANU

No. Req.	Size and Description	Use
2	Halliard shackles	sail hoist lines
16	1/4 x 1 1/2" galv. carriage bolts	mast saddle, rudder
10	1/4 x 2 1/2" galv. carriage bolts	mast top
1	1/8 x 1 1/2 x 24" half-hard aluminum bar	boom fittings
1	1/16 x 1/2 x 36" half-hard aluminum bar	mast clamps
8	1/4 x 1 1/4" galv. machine bolt	mast saddle
2	1/4 x 1 3/4" galv. machine bolt	spreader bars
4	1/4 x 1 1/2" galv. machine bolt	mast top fitting
2	1/4 x 3 1/2" galv. machine bolt	centerboard
1	1/4 x 2 1/2" galv. machine bolt	chain plates
1	3/8 x 4 1/2" machine bolt	spreader bar
100	1/4 x 4 1/2" galv. carriage bolts	mast top
14	1/4 x 2" galv. carriage bolts	centerboard well, rudder
5	3/4 x 1 5/8" x 10' hemlock or fir	mast clamps
22	1/4 x 4 1/2" galv. carriage bolts	centerboard well
4	1/4 x 3 1/2" galv. carriage bolts	centerboard well
3	1 5/8 x 3 5/8" x 14' (2 x 4's) hemlock	mast gluing rack
1	1/8 x 3 1/4 x 9" Plexiglas	inclinometer
1	3/8" dia. ball-bearing ball	inclinometer
4	#6 x 5/8" rh screws	inclinometer
1	8 x 10" heavy drawing paper	inclinometer
2	1/4" galv. pipe floor flanges	sheet traveler
2	1/4" galv. pipe nipples	sheet traveler
2	90° x 1/4" galv. pipe ells	sheet traveler
1	1/4" x 32" galv. pipe	sheet traveler
2	5/16" rope-size rope blocks	

lengths of the mast sides go to the top. The 1⅝-in. mast fore and aft end pieces are also tapered, but at the top only. Be sure to taper the 15-ft. length of the mast ends and place them at the top when assembling the mast so that the spliced joints of ends and sides will be about 5 ft. apart.

Next, make up the four solid core pieces that will go inside the mast. Taper them to correspond with the taper of the mast sides and allow the bottom one to project 2 in. beyond the end of the mast. Note that the core piece at the top of the mast will have to be tapered on all four sides.

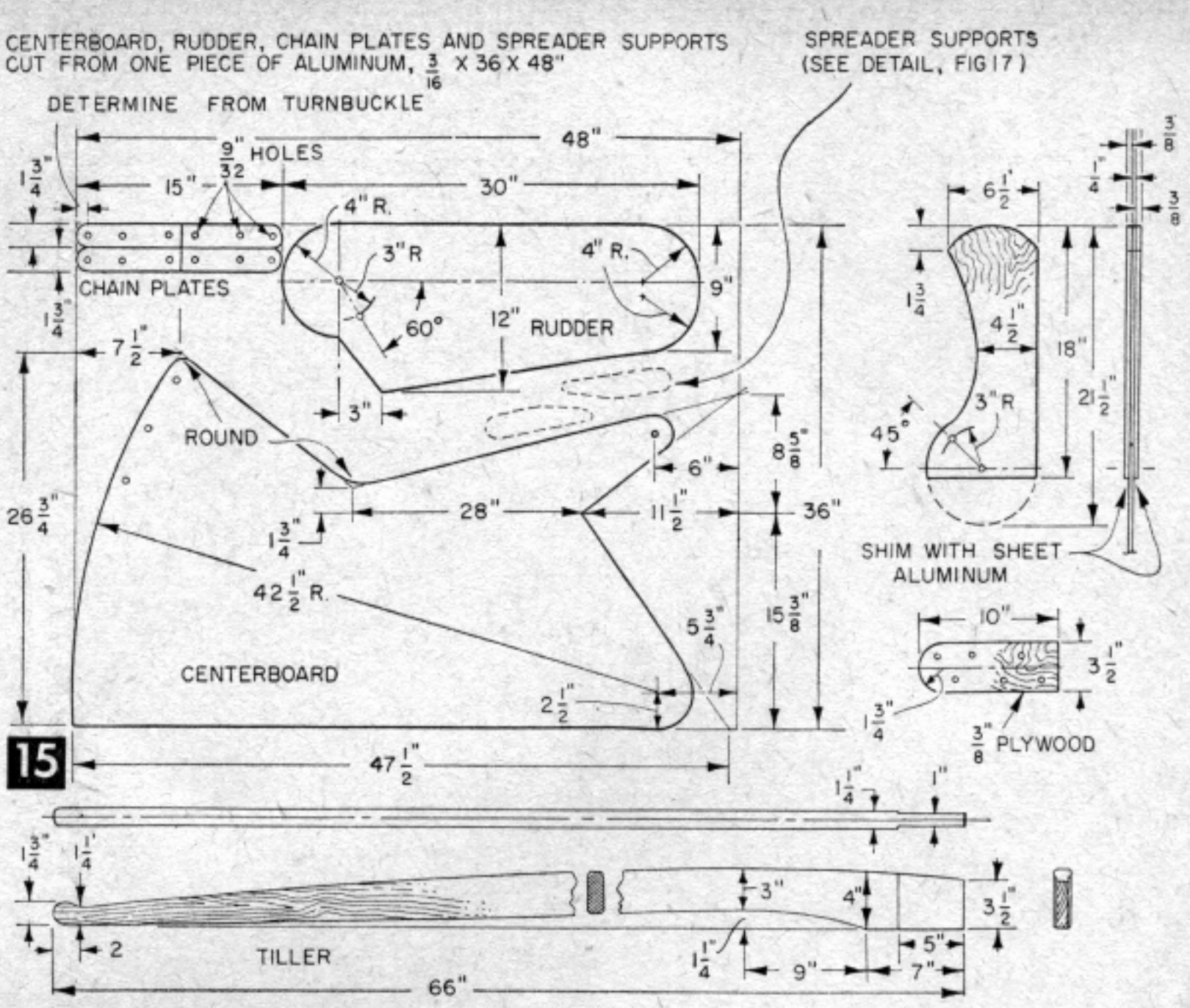
Make a trial assembly of all the mast parts first to make sure they will fit together properly. Since about 50 c-clamps would have been needed to clamp the mast until the glue dried, we used clamp bars and ¼-in. bolts as in Fig. 13A. If you are going to use the same method make up 100 of the clamp bars (Fig. 13B), and purchase one hundred ¼ x 4½-in. carriage bolts with washers. The bolts will cost about $3.00.

For a gluing rack, nail 50 of the clamp bars across the 2 x 4's on the floor spacing them about 6⅛ in. apart center to center. Then glue the core pieces and fore and aft mast end pieces to one of the mast sides. Drive a few nails into the cores and mast end pieces to hold them in position. Place this assembly on the gluing rack, mast side piece down, and proceed to glue and nail the other side piece in position. To avoid having squeezed-out glue running down and gluing the mast to the clamp bars, place a piece of paper under the mast and on top of the clamp bars. Then bolt the top clamp bars down, drawing up the nuts uniformly. Drive two wedges above and below the tapered top of the mast to clamp that end. Clamp the mast end pieces to the core blocks with c-clamps. Allow the mast to dry 24 hours. Then remove and fasten the beveled feather for the mast track (Fig. 14B) to the aft side of the mast with glue and #6 x 1-in. *fh*

screws spaced 10 in. apart. Make the aluminum stay-line tongs (Fig. 17A) and bolt to the top of the mast.

The boom is made of two pieces of ¾-in.-thick spruce glued and screwed together to form a Tee shape as in Fig. 17B. Reinforce with ¾ x ¾-in. fillets glued and nailed in place. After glue hardens, round off all corners with a plane and sand smooth. Then finish the mast, spreaders and boom with four coats of marine spar varnish.

Make the block hangers for the boom from ⅛ x 1½-in. aluminum as in Fig. 17B and fasten to underside of boom as in Fig. 17. All other fittings including sail tracks can also be fastened to the mast and boom at this time.



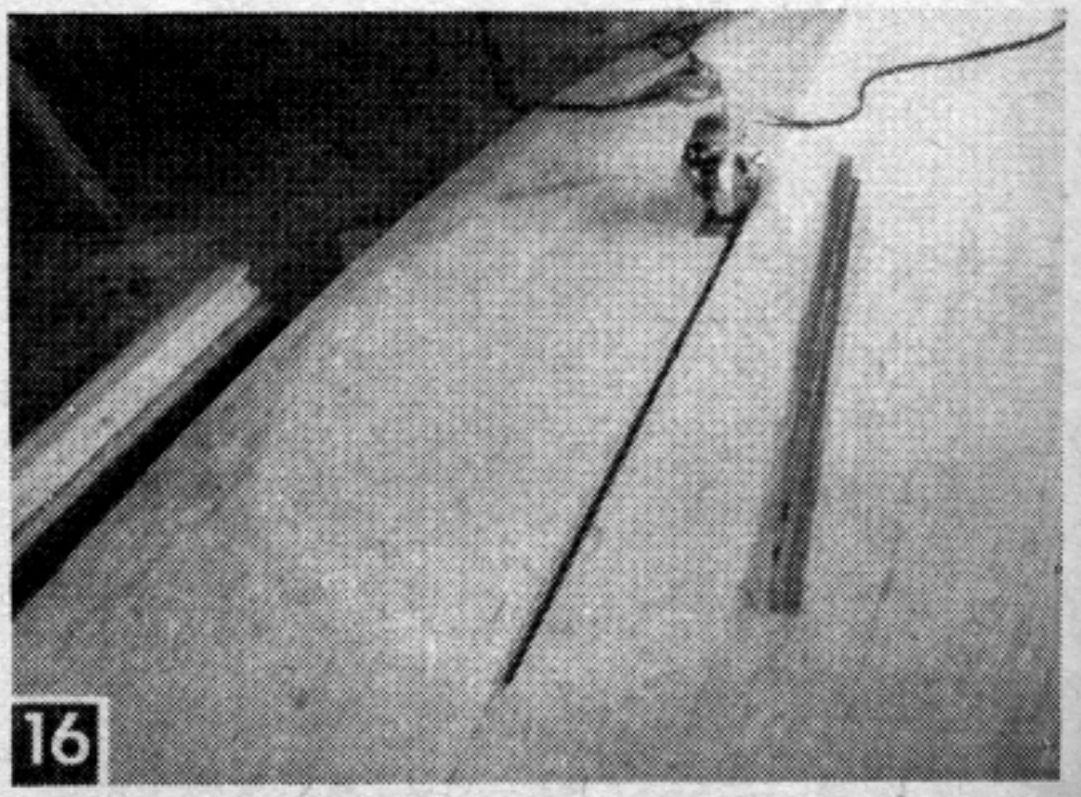
Make the mast saddle (Fig. 12) next. Cut the top 14 x 18-in. piece of ⅜-in. plywood from the material used for the transom and centerboard well. Do not cut the 2¾ x 4⅜-in. hole for the mast in any of the pieces until after assembly. The large X-shaped pieces and lower 14 x 18-in. piece can be cut from one 4 x 8-ft. sheet of ¼-in. plywood. Now, temporarily assemble all four pieces with c-clamps and drill the 9/32-in. holes for the ¼-in. bolts. Layout and cut the mast hole through all four pieces. Then disassemble, coat all contacting surfaces with glue and reassemble, this time with the ¼ x 1½-in. bolts. Do this quickly so that you can place the saddle in position on the hull aligning the mast hole with the one in the centerboard well, and clamp down the four ends of the X-shaped pieces at the hull sheer and coaming before the glue dries. The laminated saddle will then take the same curvature as the deck.

After the glue has dried, remove the saddle and sand smooth, rounding off all edges. Then give it one coat of mahogany stain and three coats of spar varnish and permanently fasten the saddle to the hull with #8 x 1¾-in. *fh* screws driven into the battens and sides, and ¼ x 2½-in. bolts to fasten the saddle to the centerboard top.

Erecting the mast to determine the length of the five mast stays is your next step. Rather than attempting to level the hull with the waterline on land to set up the mast with an 18-in. rake aft as in Fig. 17, launch the boat in shallow water. Tie five lengths of cord to the mast fittings to represent the stainless-steel stays. Note that two of the stays go through the fittings at the ends of the spreader bars. Also tie or tape a plumb bob cord to the top of the mast so it will hang down the aft side of the mast with the bob point at about deck level.

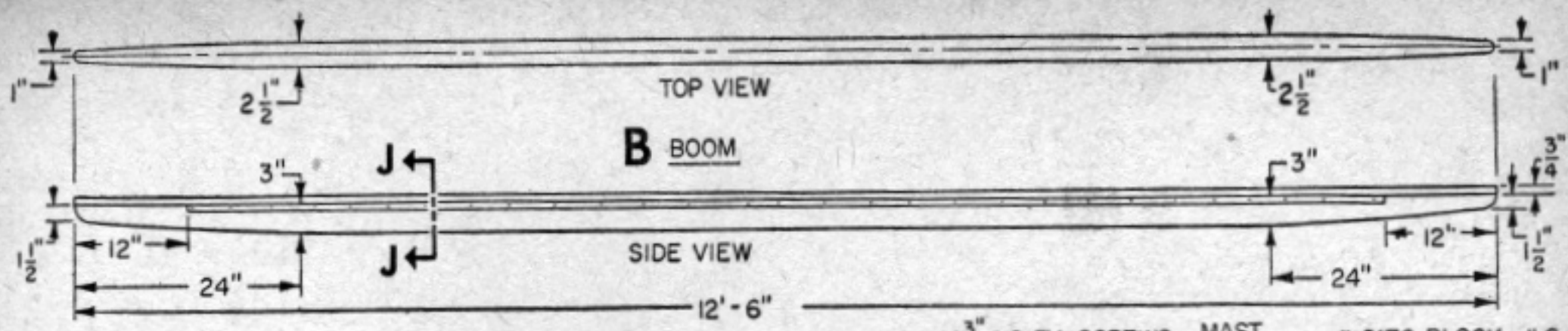
Now, set up the mast and place wedges at the fore and aft sides of the mast and partially through mast hole in the saddle. With the boat riding level, adjust the wedges until the distance from the plumb bob to the aft side of the mast measures 18 in. The plumb bob will also indicate when the mast is perpendicular athwartships. Place the turnbuckles on the chain plates and jib stay and open them about ⅔ out. Then string the cords through ⅛-in. thimbles on the turnbuckles and cut off 4 in. from the thimbles for splicing.

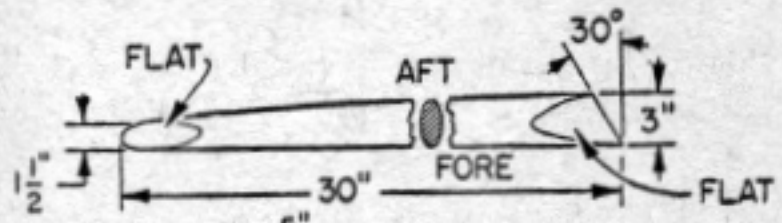
The mast can now be taken down and the 3/32-in. stainless steel stays permanently fastened to the mast fittings. Use a cable clamp close to the



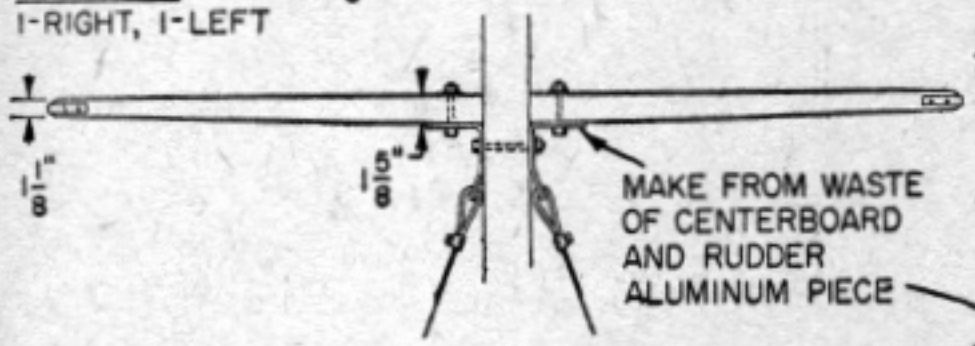
16

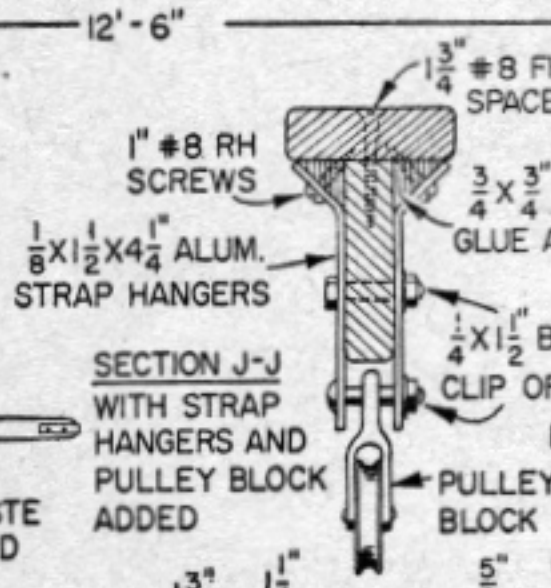
Freehand guide the portable electric saw when cutting slot for centerboard.

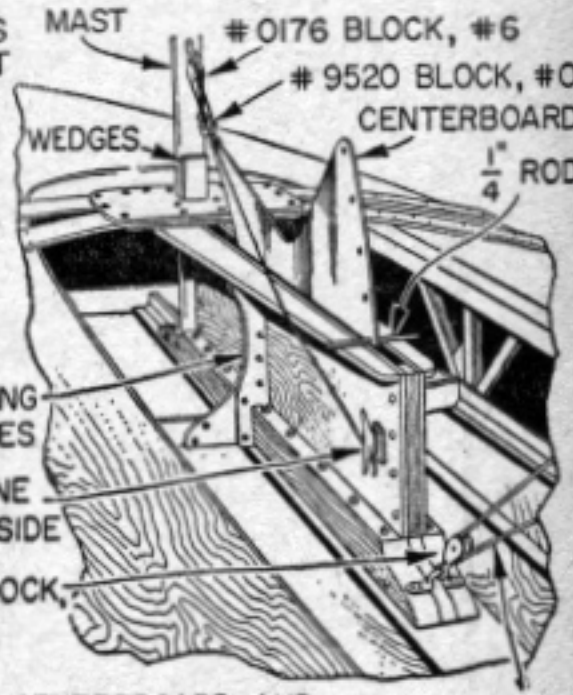


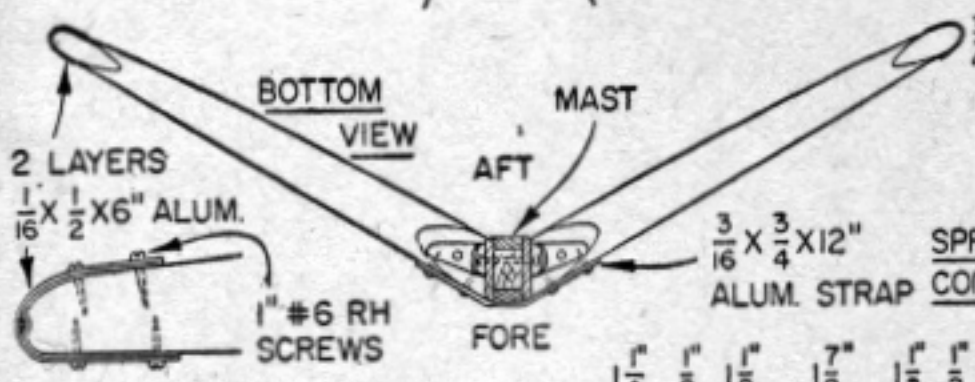


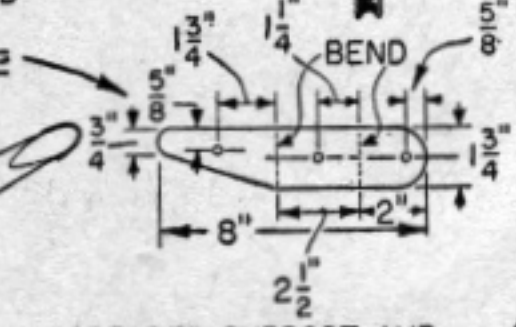
SPREADER, 2 REQ. - $1\frac{5}{8}$" STOCK (BOTTOM VIEW)
1-RIGHT, 1-LEFT

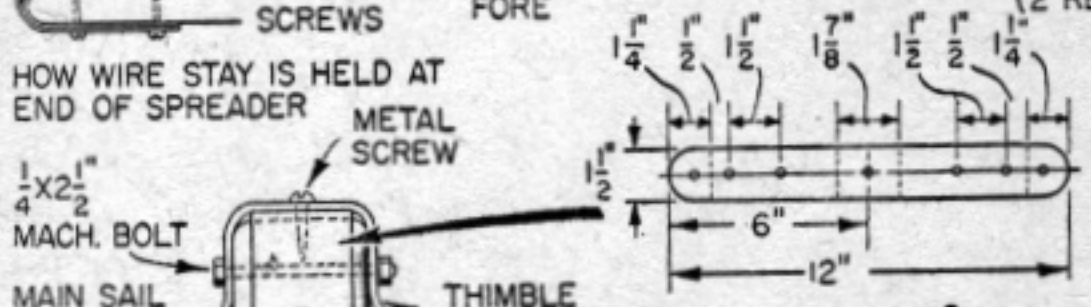












A

C

OPTIONAL SAIL INSIGNIA
"MANU" IS THE POLYNESIAN WORD FOR BIRD

PINTLES AND GUDGEONS #462 AND #460
$\frac{7}{8}$" SIZE

17

FITTING NUMBERS FROM WILCOX-CRITTENDEN CATALOG

ALL TURNBUCKLES - 3162-C
ALL CLEATS - #401, 6"


18

One crew member out on the hiking board can exert as much weight to balance sail pressure as two crew members leaning out over the hull sides without hiking boards. Board can be quickly moved from side to side.

thimble as in Fig. 17C and *silver solder* the overlaid cable after wrapping the end with copper wire. Ordinary lead-tin solder will not hold. You can purchase enough silver solder and Xcel-Flux to solder all cable joints on Manu for $1.50 from American Products Corp., Chicago, Illinois. Apply flux to cable joint and heat with a propane torch until flux glazes over. Then immediately apply silver solder. A torch rather than a soldering iron must be used to heat the cables to the melting point of the solder.

Fasten the jib and main sail hoist blocks to the top of the mast as in Fig. 17 and rig with 5/16-in. rope with halliard shackles on one end to hoist sails. Then again erect the mast, set the rake angle as before and tighten the stay turnbuckles. Make the sheet traveler (Fig. 11A) and fasten to the aft deck. Rig the boom as in Fig. 17 with 5/16-in. rope.

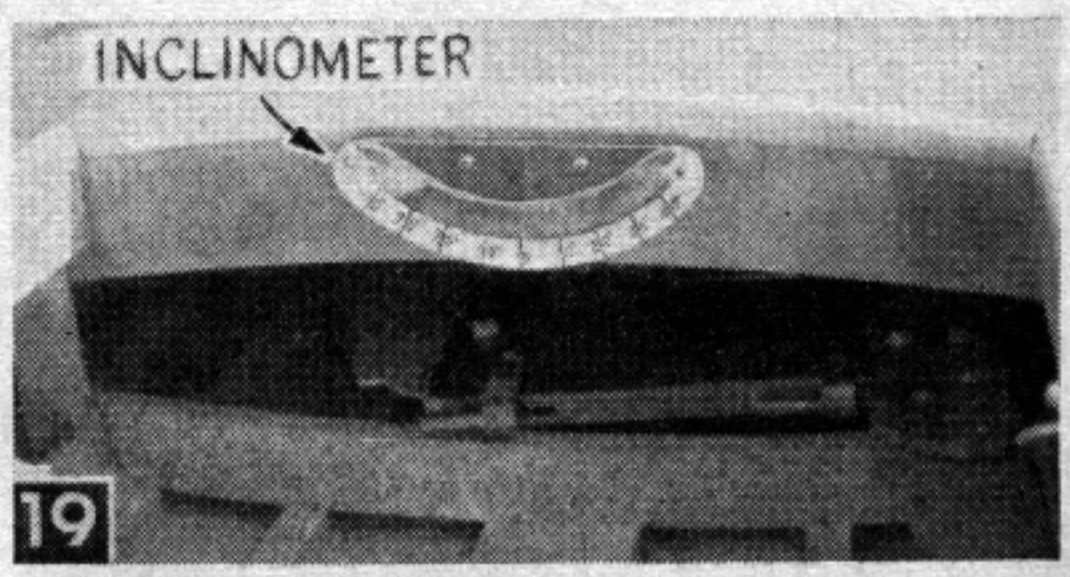
Because of its 30 *mph* speed, there's quite a knack to sailing this boat. For instance, after making several trial runs with Manu, we found that an inclinometer (Fig. 19) and a hiking board (Fig. 18) proved very useful, particularly when learning the plane-sailing technique.

Detailed in Fig. 20 is an easily built inclinometer that will serve the purpose. Lay out the indicator card on a piece of heavy drawing paper that will take ink well. Then, using the cut-out card as a pattern, lay out and cut the 1/8-in. *Plexiglas* cover, the 3/8-in. plywood spacer and the 1/4-in. plywood backing. Glue and nail the 3/8-in. plywood spacer to the plywood backing and varnish the assembly. When dry, glue the card to the spacer, place the ball bearing in the groove and fasten the Plexiglas with four #6 x 5/8-in. *rh* screws. Fasten the inclinometer to the aft cockpit beam as in Fig. 19 so that the ball bearing rests at 0° when the boat is riding level. Make the hiking board as detailed in Fig. 21.

When you are ready for a trial run with your version of Manu, install the centerboard using a 3/8-in. steel bolt for the pivot. Place a 1/4-in. bolt or rod through one of the 1/4-in. holes in the centerboard to hold it up until you are ready to lower it. The bolt or rod rests against the well top and may be quickly removed by a crew member. Then drop the rudder in place on the gudgeons, run up the sails and you're all set for a real thrill in high-speed sailing.

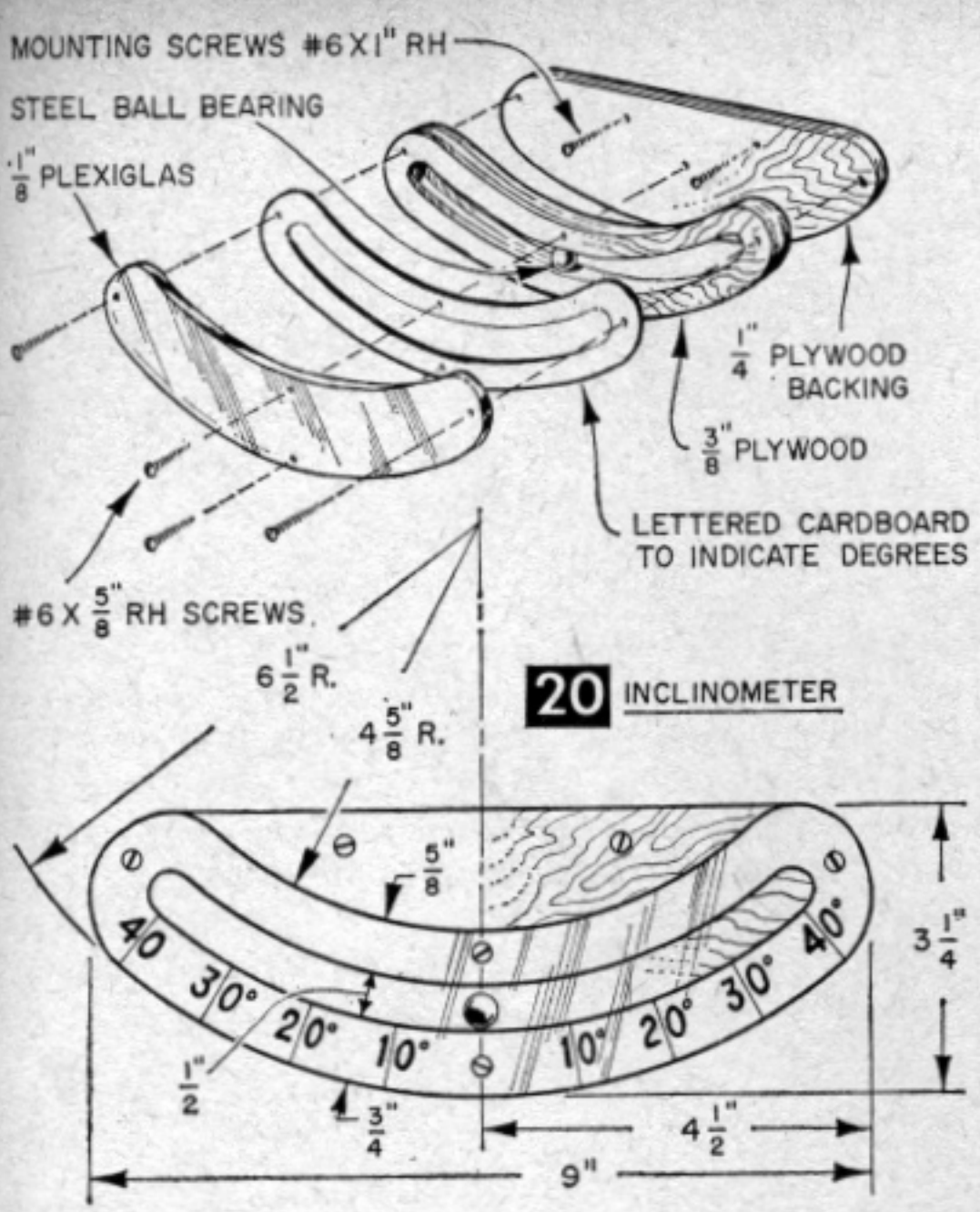
How to Sail Manu. The art of sailing conventional displacement-type sailboats cannot be applied to a planing-type sailboat. It is true, of course, that the method for tacking a planer is similar, and in light winds of 5 to 6 *mph* the planing sailboat will act very much like a displacement-type sailboat. In fact, in very light winds when planing isn't possible, displacement sailboats of the same water-line length may even be faster. But, here the similarity ends.

In planing-type sailing: (1) Maintain the boat in an almost upright position, if heeling exceeds 15°, planing is not possible; (2) Trim sails hard and flat as in Fig. 22A. If the sails are allowed

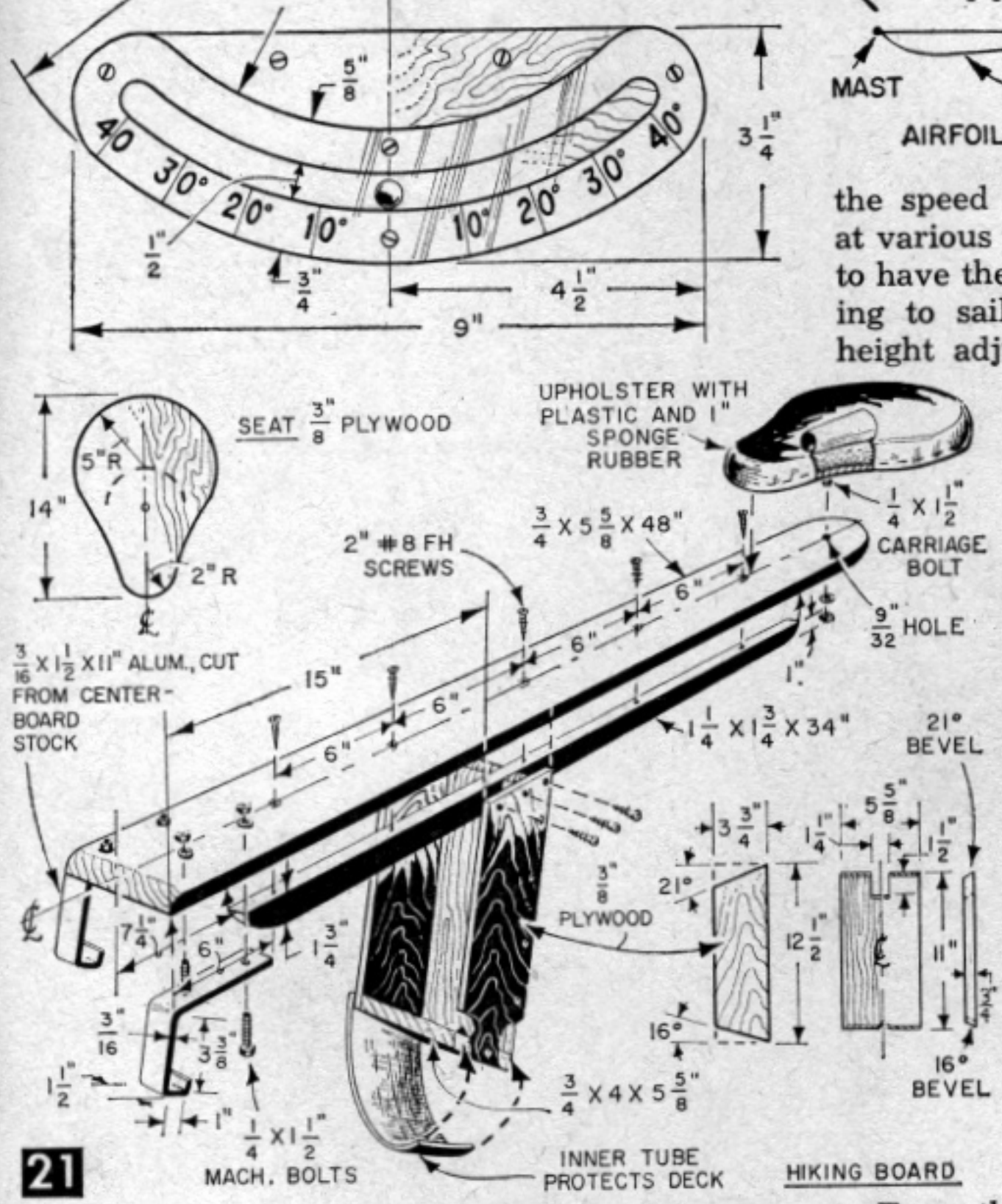


19

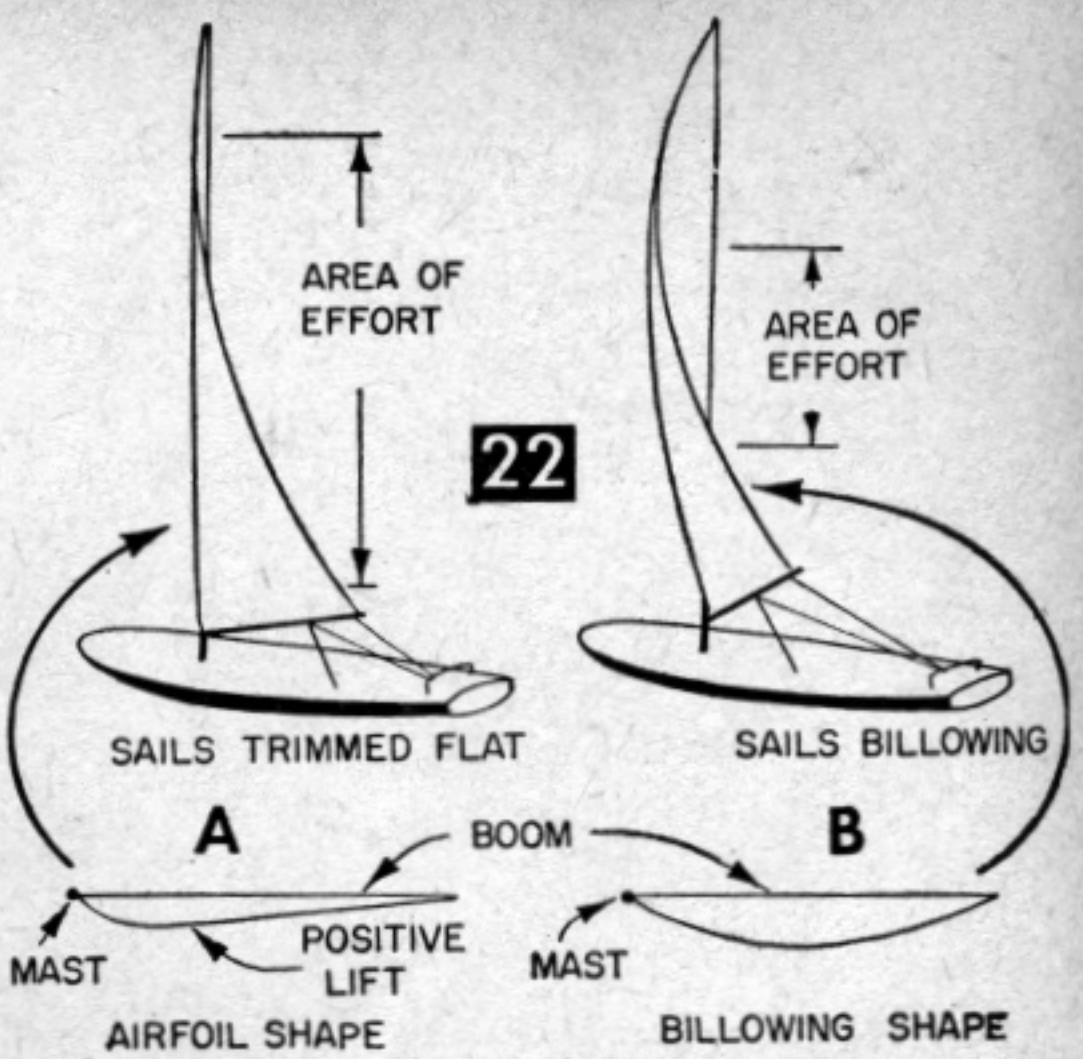
A steel ball in the inclinometer indicates the angle at which the boat is heeling over.



20 INCLINOMETER



21 HIKING BOARD



the speed increases so try adjusting the board at various positions for utmost speed. It is better to have the wind quartering rather than attempting to sail too close into the wind. The best height adjustment for the jib was found to be around 4 to 6 in. above the deck.

The first attempts at sailing Manu were with the jib fore foot at 18 in. above the deck, resulting in a planing speed of only 16 *mph* with three persons aboard. With four persons aboard, planing action ceased. When the jib was lowered to 6 in. above the deck and in a wind with gusts over 20 *mph* Manu easily planed with four persons aboard. On one reach of two miles, a speed of 22 *mph* was clocked by an outboard running alongside and later verified by Air Guide Speedometer. A speed of 30 *mph* was reached with two persons aboard on a very windy day having gusts of probably more than 30 *mph*. The curious phenomenon with the lowered jib sail is that strain on the rigging seems to be less even though the speed is greater.

From the experience we have had during the two months we test-sailed Manu we feel the sailing potentialities of this type of boat have barely been scratched. Undoubtedly you will develop other sailing techniques that will better our results.

to billow as in Fig. 22B the airfoil shape of the sails is destroyed and their efficiency drops off.

To maintain a near upright position of the boat, the hiking board is needed to place the weight of a crew member out far enough (Fig. 18) to balance the sail pressure. The pilot must also sit on the same side so his weight can be added to that of the crew member. Since it is difficult to tell the correct angle of heeling for best performance, particularly when learning to handle the boat, the inclinometer fastened to the center of the aft cockpit beam (Fig. 19) should be watched closely.

Other things that affect planing are the height and angle of the wind approaching the sails. Only a small portion of the centerboard is needed as