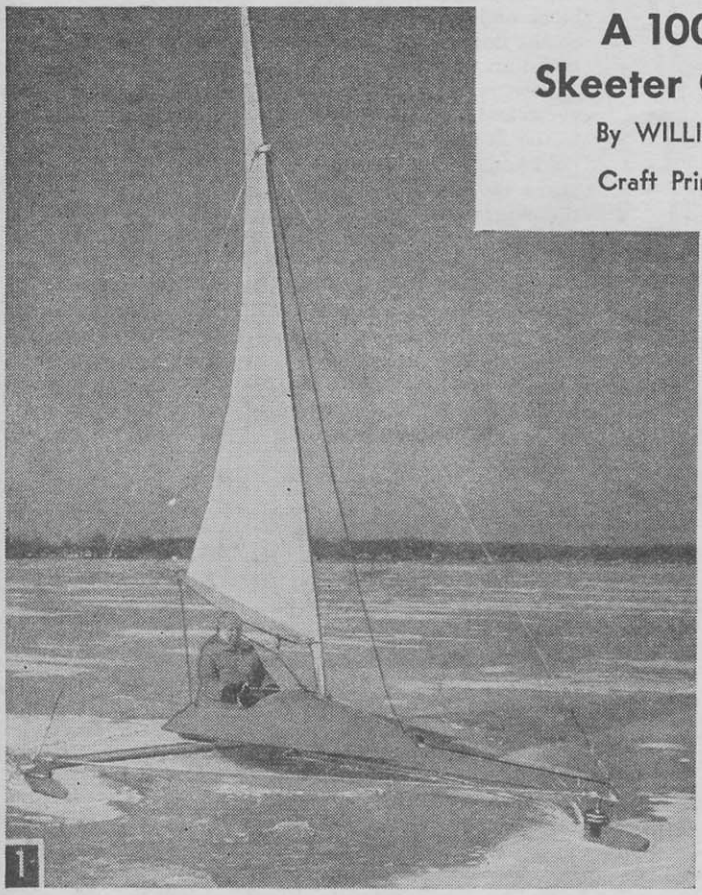
Cold Lightning—

A 100 *mph*-plus Skeeter Class Ice Boat

By WILLIAM D. JACKSON

Craft Print Project No. 302



Built to Skeeter-class specifications, Cold Lightning features a streamlined mast and boom with sail slot and halyards inside the mast to reduce wind resistance.

IF YOU live in the northern states, there's no reason to call it quits to boating at the end of the summer, because you can still use your favorite small lake for boating this winter—ice boating that is—and travel at speeds undreamed of in a boat on water.

Shown flashing across the ice at 2 to 3 times the speed of the wind and often exceeding 100 *mph*, Cold Lightning (Fig. 1), bears little resemblance to the old-time ice boats that weighed over one half ton and carried 400 ft. of sail.

Design refinements have brought her weight down to a mere 275 lbs. and only 71 sq. ft. of sail area and yet she is faster than her forebears costing hundreds of dollars to build.

Cold Lightning should not cost over $50 or $60 for materials to build the hull, mast and fittings. The sail, manufactured especially for this ice boat, costs about $75-$100 (see Materials List). No special boat lumber is required since ordinary house-framing lumber obtainable at any lumber yard can be used.

Construction. Choose a well-seasoned 16 ft. length of 2 x 6-in. plank (actually 1⅝ x 5⅝ in.) that is straight grained and clear of knots for the main longeron. Lay out a centerline and the tapering dot-dash lines to the 3 in. curved ends as in Fig. 5 first. Then, with a ¾ x 1 in. wooden batten bent against 2 in. nails partially driven into the longeron (Fig. 6), draw the curved lines. Use a portable circular saw or sharp hand rip saw and cut to the outside of the curved lines. Finish to size and shape with a jack plane.

For the longeron upright, choose a well-seasoned, clear and straight grained 16 ft. length of 2 x 4 in. stock. Lay out and cut the curved fore end with a batten as you did the longeron and make the cutout for the seat at the aft end as in Fig. 5. To fasten the upright to the longeron, first drill and counterbore the 14 holes along the longeron centerline spacing the holes 13½ in. apart as in Fig. 5. Then center the upright on the longeron as in the sectional view 5 and draw lines on the longeron at each side of the upright. Be sure the counterbore of the holes are on the underside of the longeron. Remove the upright, coat both contacting surfaces with waterproof glue and reassemble with three C-clamps. Then drive the 14 screws through the longeron into the upright.

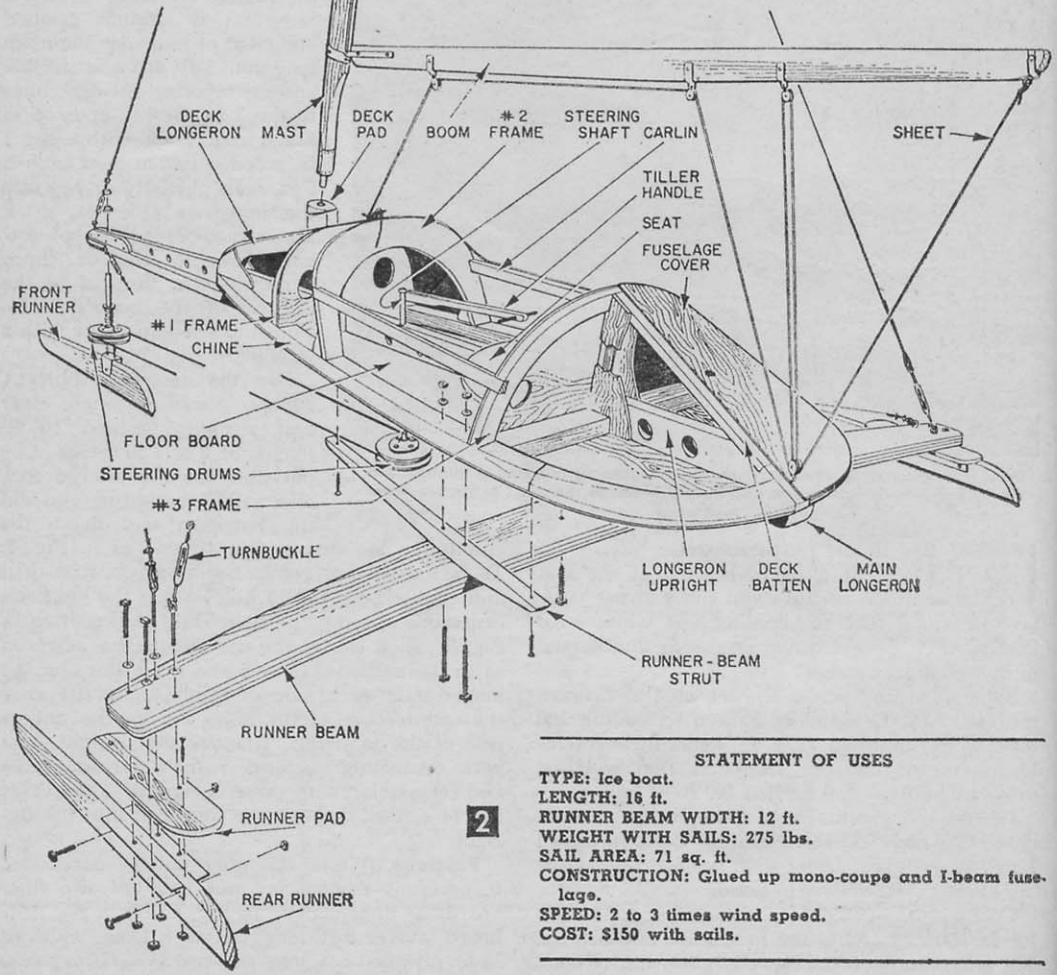
Fuselage. While the glue on the assembled longeron is drying, lay out and cut two floor boards as dimensioned in Fig. 5. Since the floor board is over 8 ft. long, cut off a 19-in. width of ¼ in. plywood 8 ft. long and two 14 x 21-in. pieces

as in Fig. 3 and temporarily nail them together with scrap pieces of wood. Use the batten to draw the forward curved edges and a tramnel for the 14¼ in. radius. Now, using one of the cut out floor boards as a pattern, lay out two chines on a 9 ft. length of 2 x 8-in. plank as in Fig. 5. Also lay out and cut two curved after chines from 2 by 6-in. stock as in Fig. 5. Then clamp one of the floor boards to the longeron so that the straight edge of the board butts against the longeron upright and with its fore end 6 ft. from the fore end of the longeron. Place the chine pieces on the floor board and mark, cut and fit the ends of the chines snugly against the upright and each other at joint "X" in Fig. 5. For the seam butt block (Fig. 5), bevel the long edge of a 13 in. length of 2 by 4 to a 15° angle and fit it on the floor board over the seam between the upright and chine, and in line with the aft end of the seat cut out on the upright. Temporarily clamp the fore and aft chines to the floor board when fitting the butt block and pencil mark the locations of all three pieces on the floor board. Also mark the location of the floorboard on the longeron.

Now, remove the floorboard assembly from the longeron and permanently fasten the chines and butt block to the floor with glue and #12 x 1¼-in. galv. Stronghold nails or #8 x 1¼-in. *fh* galv. screws. Stagger and space the nails or screws 3 in. apart. Fit and fasten the chines and butt block to the other floor board following the same procedure used in assembling the first one.

When the glue has dried, fasten the floorboard assemblies to each side of the upright on the longeron with glue and nails or screws. Drive a #14 x 2¾ *fh* screw through each end of the chine and butt block into the longeron as in Fig. 5.

Fuselage Frames. Starting with the #1 frame, first



2

STATEMENT OF USES

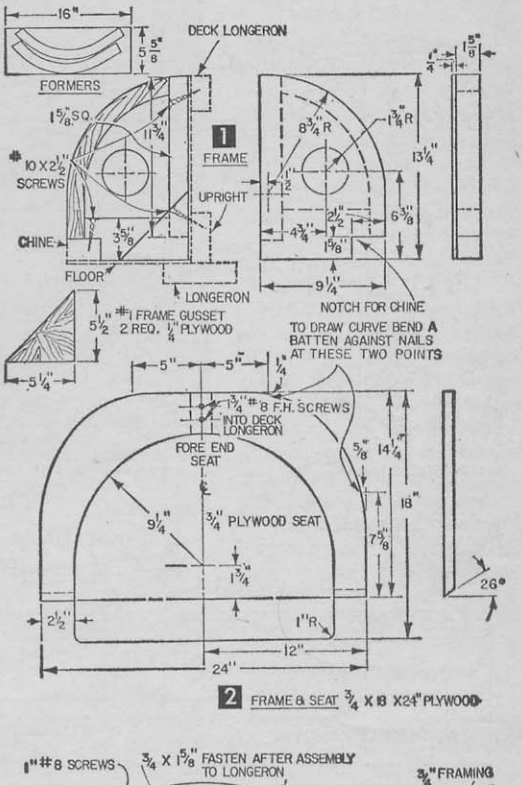
TYPE: Ice boat.
LENGTH: 16 ft.
RUNNER BEAM WIDTH: 12 ft.
WEIGHT WITH SAILS: 275 lbs.
SAIL AREA: 71 sq. ft.
CONSTRUCTION: Glued up mono-coupe and I-beam fuselage.
SPEED: 2 to 3 times wind speed.
COST: $150 with sails.

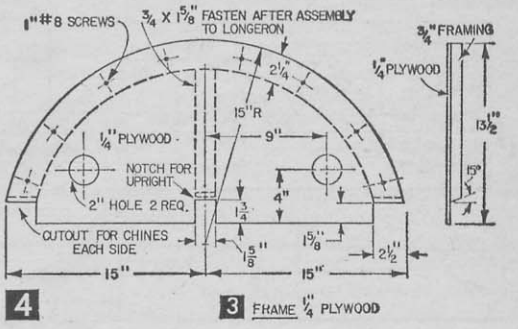
MATERIALS LIST—ICE BOAT

No. Req.	Size and Description	Use
	LUMBER	
1	2 x 4″ x 16′ fir or spruce	main longeron
1	2 x 6″ x 16′ fir or spruce	main longeron
1	2 x 8″ x 10′ spruce or fir	chines
1	2 x 6″ x 10′ spruce or fir	chines, fuselage frames
1	2 x 4″ x 16′ spruce or fir	chines, deck longeron, runner beam supports
1	1¼ x 5″ x 9′ oak, maple, ash	runners
3	¾ x 9⅝″ x 12′ spruce	runner beam
1	¾ x 1¼″ x 8′ spruce or fir	carlins
2	⅝ x 1⅝ x 24″ oak, ash, maple, fir	handle
1	¾ x 3⅝″ x 18′ spruce or fir	mast
1	¾ x 3⅝″ x 18′ spruce or fir	mast
1	¾ x 9⅝″ x 18′ spruce or fir	mast
2	¾ x 5⅝″ x 12′ spruce or fir	boom
1	1″ dia. x 8″ maple dowel	mast plug
1	⅜ x 2¼″ x 14′ spruce	sail battens
1	⅜ x 2¼″ x 10′ spruce	sail battens
1	⅛″ x 4 x 8′ exterior plywood mahogany or fir	fuselage covering
1	¼″ x 4 x 8′ exterior fir plywood	floor and gussets
1	¾ x 24 x 24″ exterior fir plywood	frame, seat
1	¾ x 6 x 32″ exterior fir plywood	pads

SCREWS AND BOLTS

No. Req.	Size and Description	No. Req.	Size and Description
2 gross	#7 x 1″ *fh* screws or 3 lbs of #12 x 1¼″ Stronghold nails	6	¼ x 1½″ machine bolts
		15	¼ x 2″ machine bolts
		6	¼ x 3½″ machine bolts
		1	¼ x 4″ machine bolts
6 doz	#8 x 1¼″ *fh* screws	2	⅜ x 2″ machine bolts
4 doz	#8 x 1¾″ *fh* screws	5	5⁄16 x 7″ machine bolts
15	#12 x 2¼″ *fh* screws	1	5⁄16 x 5″ lag screw
12	#10 x 2½″ *fh* screws	1	⅝ x 8″ machine bolt
6	#14 x 2¾″ *fh* screws	1	¼ x 1½″ eyebolt
4	3⁄16 x 2¼″ *rh* stove bolts	3	5⁄16 x 2¼″ eyebolts
		4	5⁄16 x 4″ eyebolts

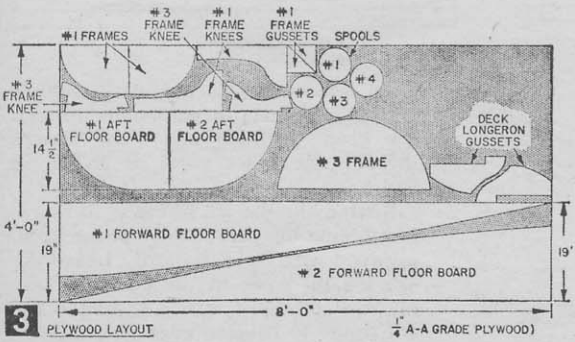


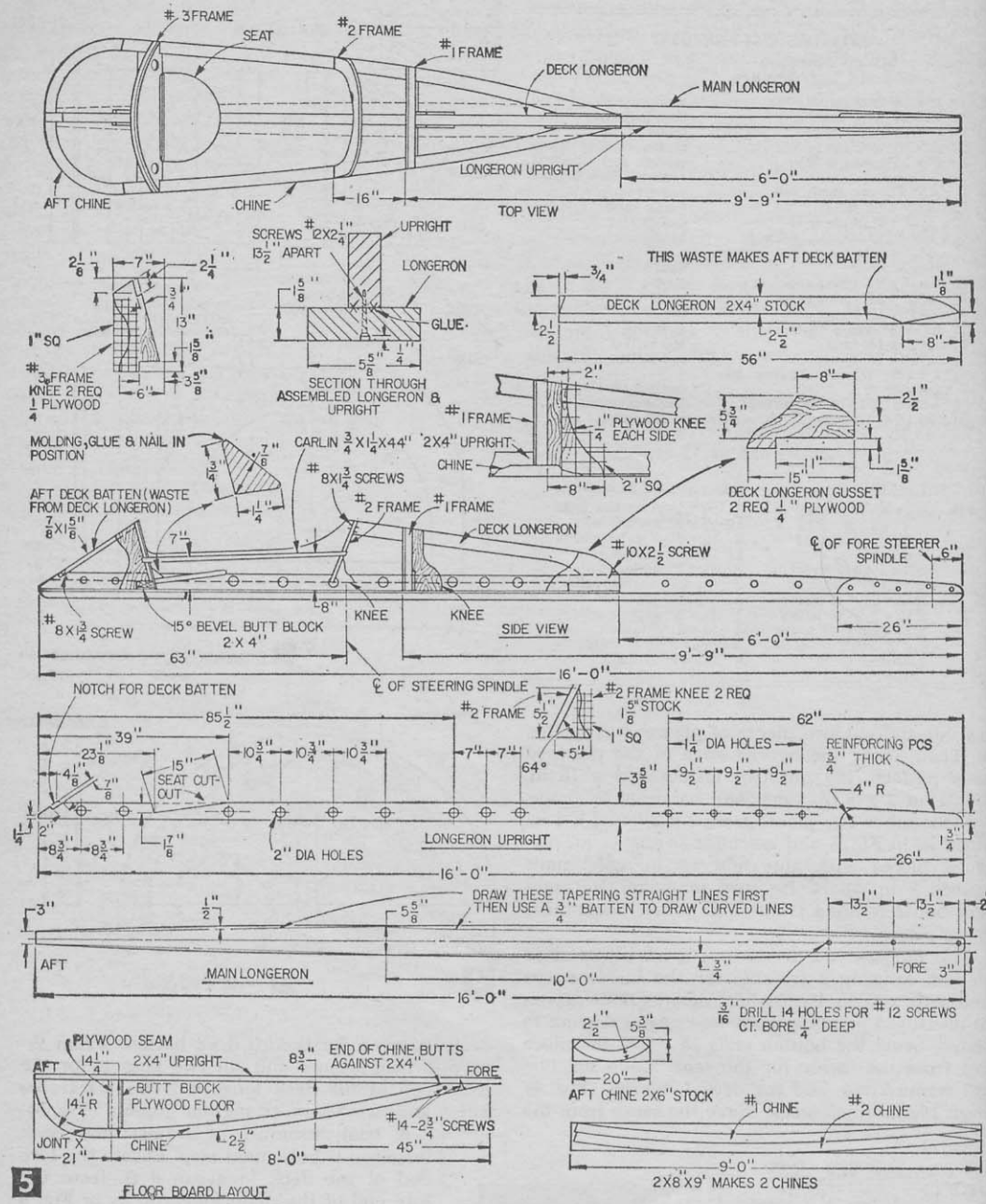


lay out and cut two pieces of plywood as in Fig. 4. Then, using the curved edge of the plywood as a pattern, lay out two formers on a 16 in. length of 2 x 6 in. stock and bandsaw to shape. Cut the other two pieces from 2 x 2 and 2 x 4 in. stock as in Fig. 4 and assemble to the ¼ in. plywood pieces with glue and 1¼-in. galv. nails spaced 2 in. apart. Be sure to make one right and one left hand frame side when assembling these pieces.

Lay out the #2 frame on ¾-in. plywood as in Fig. 4, using a tramnel for the inside curve and a 3⁄16 x ¼-in. batten bent against nails driven at measured points at each side. After sawing to shape, bevel the bottom ends 15°. Use the piece cut from the inside for the seat. Make the two #2 frame knees and the deck longeron (Fig. 4) from 1⅝-in. thick stock. Save the scrap from the deck longeron for the aft deck batten. From ¼-in. plywood, lay out and cut two gussets for the front end of the deck longeron, two #1 frame knees and two 5½-in. triangular gussets (Fig. 5).

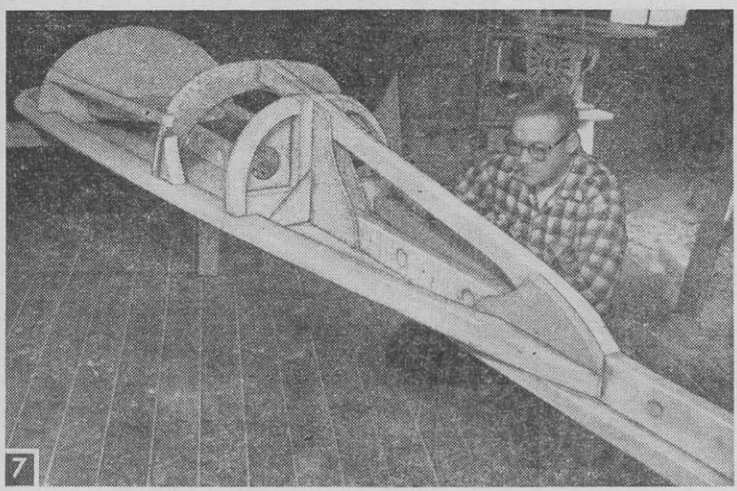
A trial assembly of frames and deck longeron is your next step. Locate the fore end of the deck longeron 6 ft. from the fore end of the main longeron as in Fig. 5 and clamp the deck longeron to the upright with the two gussets. Temporarily nail the #2 frame to the aft end of the deck longeron. Then clamp the #1 frames in place on each side of the deck longerons. You may have to resaw the chine notches at an angle to make them fit. Allow the curved edges of the frame to project beyond the chines and deck longeron for beveling later. Check to see that the #1 and 2 frame knees will fit properly too.





Then remove the parts and reassemble with glue and 1¼-in. galv. nails through the ¼-in. plywood and wood screws through the other parts as shown in Fig. 5.

Next, make the #3 frame as in Fig. 4, reinforcing the curved edge of the ¼-in. plywood with ¾-in. framing. Leave the ¾ x 1⅝ in. piece at the center of the plywood off until later. Assemble the #3 frame to beveled edge of the floor-



Heavy fuselage framework strengthens main longeron. Photo above taken at forward end looking aft.

seam butt block with glue and 1¼ in. nails. Then make two #3 frame knees as in Fig. 5 and assemble them together with the aft deck batten and ¾ x 1⅝ piece to the back of the #3 frame as in Fig. 2. The seat, cut from the #2 frame material, is now fastened to the notch cut in the longeron upright with three #8 x 1¾ in. *fh* screws. Cut a three-cornered strip 17 in. long as in Fig. 5 and fasten to the back edge of the seat and #3 frame with glue and 1¼-in. nails.

For cockpit carlins, cut two ¾ x 1¼ x 44-in. strips and notch them flush into the #2 and 3 frames as in Fig. 2. This completes the assembly of the fuselage framework. Before covering with ⅛ in. plywood, framing members must be faired and beveled so that the plywood covering will make contact with all surfaces. Since most of the fairing must be done upon curved surfaces, cut a ⅛ x 1 x 24 in. batten and bend it over the framing surfaces to determine the amount of fairing necessary. The fore end of the deck longeron and aft end of the chines will require the most beveling. Use a jack plane and a coarse wood rasp or Stanley *Surform*. A disc sander with coarse abrasive discs will also come in handy.

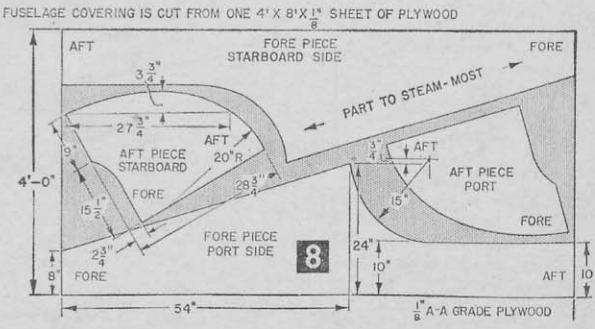
Planking. The next step is the application of the plywood covering on the framework. Lay out the fore and aft cover pieces on a 4 x 8 ft. sheet of ⅛-in. plywood as in Fig. 8 and saw the pieces to shape. Install the two aft pieces first. Plane the edges that will meet over the deck batten for a neat tight seam and apply glue to both contacting frame members and plywood. Fasten with #12 x 1¼-in. *Stronghold* nails or #7 x 1 in. *fh* screws spaced 3 in. apart along chines and 4 in. apart to fasten the frames.

Before installing the fore pieces, soften the fore ends of the plywood by sopping with water and ironing to drive steam into the wood. When the plywood is quite flexible, apply glue and install on each side of the fuselage framework. Fasten with nails or screws as you did the aft pieces. The aft end of the fore pieces lap over the aft pieces. Plane the edges of the plywood flush along the floor boards and sand the edges around the cockpit.

Make the deck pad that serves as the mast socket from two pieces glued together as in Fig. 9. Before drilling the 1⅛-in. hole, mount it on the fuselage directly over the #1 frame and deck longeron with glue and one #10 x 2½-in. *fh* screw forward and one #8 x 1¼-in. *fh* screw aft. Force a mixture of glue and sawdust under the pad at the sides where there is an opening due to curvature of the fuselage covering. Now drill the 1⅛-in. hole through the pad and into the deck longeron to a total depth of 2 in. for the mast-step plug.

Running Gear. The runner beam is made of three pieces of ¾-in. lumber with ends tapered as in Fig. 10. Make the center support (Fig. 10) from two 10-in. lengths of 2 x 4-in. stock and place it on the floor of your basement or garage. The runner beam is to be bowed over this center support and the ends of the beam held down against the floor with two 2 x 4's propped up against the ceiling rafters. Have this bending rig all set up before applying glue to the contacting surfaces of the running-beam boards so that you can work quickly before the glue sets up. Have someone help you spread the glue and handle one of the 2 x 4-in. props.

Allow the glue to dry at least three days while in the bent position so that the glue reaches full strength. Ice boats are notoriously rough riders and this beam is your main spring and takes considerable punishment. Finish the beam by planing the edges round and sand smoothly. Apply three coats of spar varnish. Next, make up



two runner struts from 2 x 4-in. stock as in Fig. 10. Fasten these to the underside of the fuselage with one #12 x 2½-in. *fh* screw at each end.

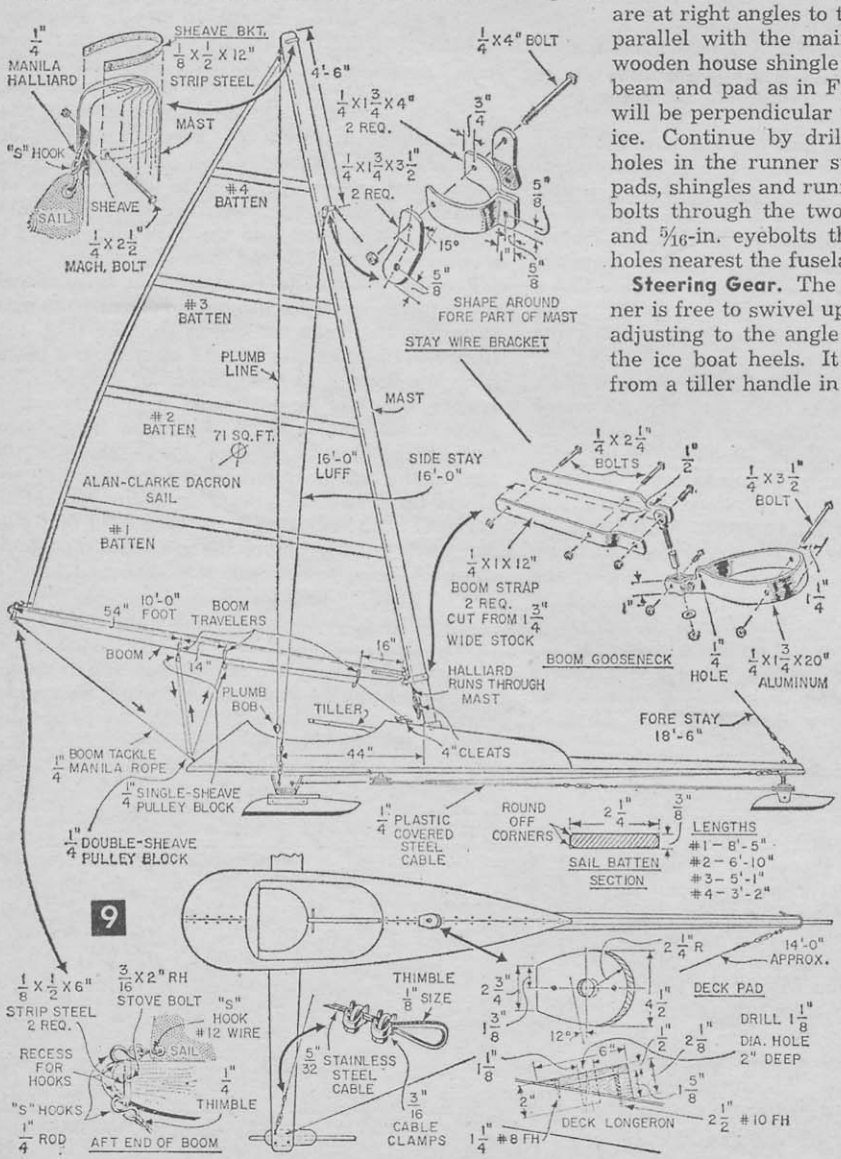
While the fuselage is turned bottom-side-up, place the runner beam across the runner struts and center it at the center of the main longeron. Fasten the runner beam at the center with a 5/16 x 5-in. lag screw driven into the main longeron. Then, after checking to see that the runner beam is at right angles to the center of the fuselage, drill 3/8 in. holes through runner beam, runner struts and chines for 5/16 x 7 in. bolts as in Fig. 10.

Three runners are used on this ice boat: two stationary runners on the ends of the runner beam and one steering runner at the forward end of the main longeron. Make all the runners (Figs. 11A and B) from 1¼-in. thick hardwood. Bevel the bottom edges to take 1 in. angle-iron blades. Have your local weld shop cut the fore ends of the angle-iron blades with a torch as in Fig. 11C and bend and weld the cut ends together to make rounded leading edges. Also grind the front and rear ends of the sharp angle iron corners round as in Fig. 11D. Fasten blades to runners with #7 x 1-in. *fh* screws.

To fasten the aft or stationary runners to the runner beam, make up two pads and two pairs of runner supports from 2-in. angle iron as in Fig. 11E. Fasten the pads to the top edges of the aft runners with two #8 x 1¾ *fh* screws and bolt the angle-iron supports under the pads on each side of the runners. Then, while the fuselage is still upside down, locate the assembled runners 2 in. from the ends of the runner beam and clamp in place. Check to make sure the edge of the blades are at right angles to the runner beam and parallel with the main longeron. Place a wooden house shingle between the runner beam and pad as in Fig. 11F so the blades will be perpendicular to the surface of the ice. Continue by drilling the four 5/16-in. holes in the runner supports through the pads, shingles and runner beam. Use ¼-in. bolts through the two sets of outer holes and 5/16-in. eyebolts through the inner or holes nearest the fuselage.

Steering Gear. The fore or steering runner is free to swivel up or down, to be self-adjusting to the angle of inclination when the ice boat heels. It is steered by cable from a tiller handle in the fuselage cockpit (Fig. 9). For the runner spindle (Fig. 11G), cut the head off a 5/8 x 8-in. bolt and thread the cut end with a 3/8 in. pipe die. Place a 3/8 to ½-in. reducing bushing and a ½-in. pipe floor flange on the pipe-threaded end of the bolt and braze or weld the parts together so they will not loosen. Make the steering-runner fork as in Fig. 11H and two of the steering drums (Fig. 11J).

When assembling the steering-runner parts, center the floor flange on the spindle on one of the steering drums and, using two opposite holes in the flange as a



guide, drill two 9/32-in. holes through the drum. Use this same hole spacing to drill the 9/32-in. holes in the fork. Then bolt the fork and drum to the flange on the spindle with 1/4 x 2-in. bolts as in Fig. 11K. Bolt the steering runner between the fork sides.

To mount the steering-runner on the fuselage, bore a 3/4-in. hole 6 in. from the fore end of the longeron as in Fig. 11K and counterbore the ends of the hole 7/8 in. so that you can screw two 1/2 x 3/4-in. pipe bushings into the hole. The outside threads on the bushings will cut into the wood and keep the bushings in place. Then slide a 5/8-in. washer and a valve spring from an International Harvester truck, or similar truck engine, on the runner spindle. Place another washer on top of the spring and slide the spindle through the hole in the longeron. Fasten with a 5/8-in. nut on the spindle.

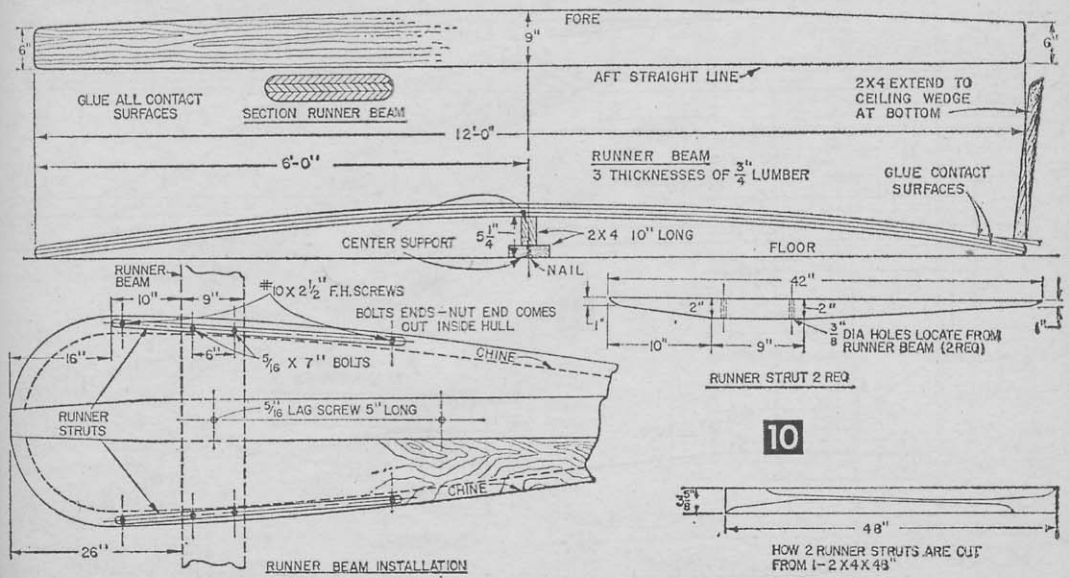
Now, drill another hole through the longeron 63 in. from the aft end as in Fig. 5 for the tiller-handle spindle. Accurately lay out the location of this hole on the top and bottom of the longeron pieces and drill the 1 1/4-in. counterbores as in Fig. 11L first. Then drill a through hole with a 7/8-in. drill bit from each side so that the counterbores will be concentric with the 7/8-in. hole. Screw 3/4 x 1-in. pipe bushings in the counterbores to act as bearings for the tiller-handle shaft.

The handle shaft is a 10 3/4-in. length of 1/2-in. pipe screwed into a 1/2-in. pipe floor flange and tack welded so it will not turn loose. Bolt the steering drum to the pipe flange and slide the assembly up through the hole in the longeron from the bottom of the fuselage. Place a few blocks on the floor under the drum to keep the steering shaft in place.

Make the tiller handle and tiller-handle bracket (Figs. 11M and N), and slide the bracket over the end of the tiller shaft projecting above the longeron. Using the two 9/32-in. holes in bracket as guides, drill two 9/32-in. holes through the tiller shaft and fasten bracket to shaft with two 1/4 x 1 1/2-in. bolts as in Fig. 11L. Bolt the tiller handle to the bracket with a 3/8 x 2-in. bolt.

MATERIALS LIST—ICE BOAT

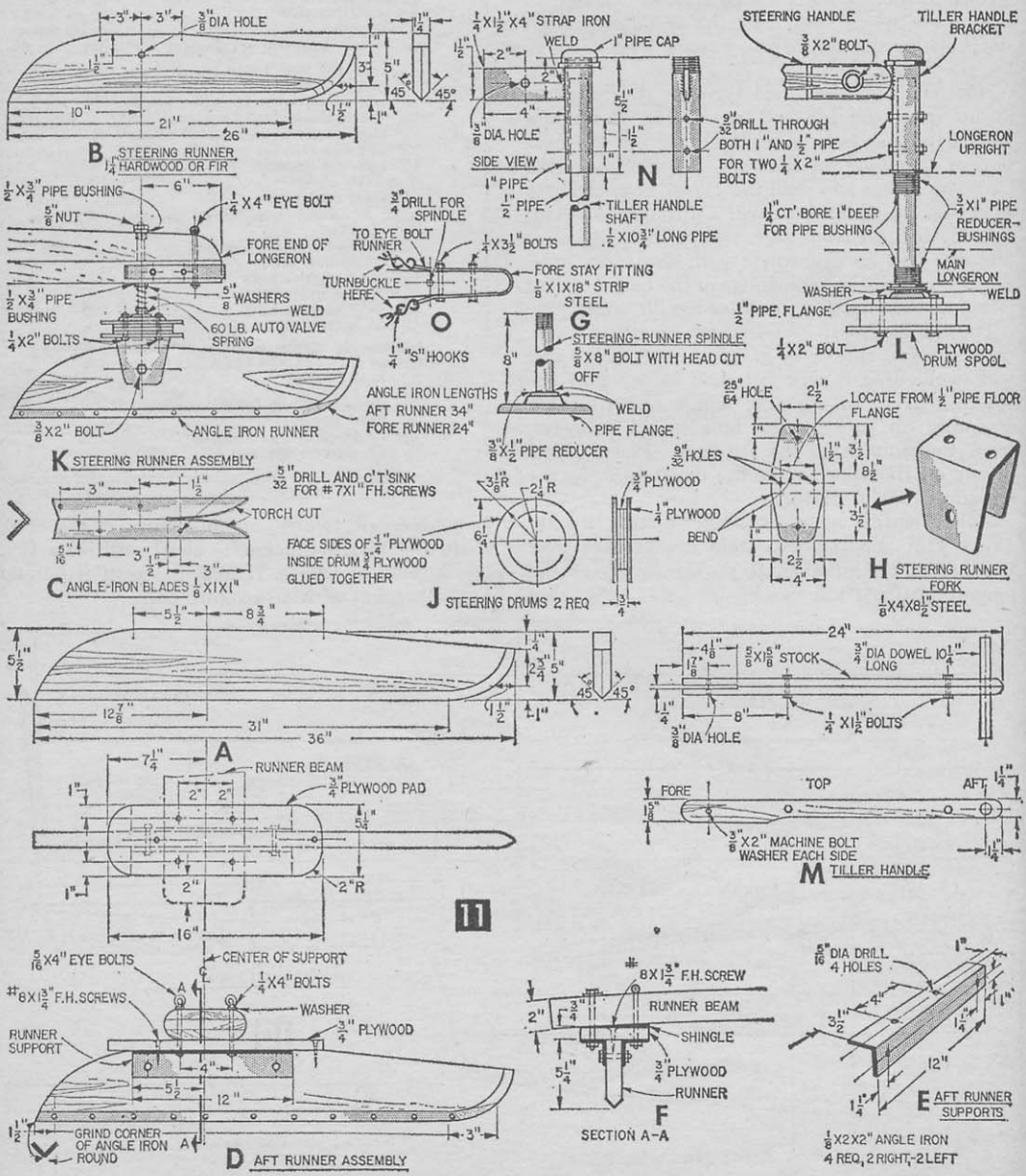
Amt. Req.	Size and Description	Use
	ALUMINUM AND IRON	
1	1/4 x 1 3/4 x 60" soft aluminum bar stock	rigging fittings
1	8 x 10" roof-flashing sheet aluminum	mast
1	1/8 x 4 x 8 1/2" steel plate	fork
1	1/8 x 1/2 x 30" hot-rolled strip steel	mast and boom
1	1/4 x 1 1/2 x 4" steel bar stock	steering handle
1	1/8 x 1 x 18" hot-rolled strip steel	fore stay fitting
1	1/8 x 1 x 1" x 9' angle iron	runners
1	1/8 x 2 x 2" x 4' angle iron	aft runners
1	60 lb. test valve spring from International Truck Engine	
	PIPE FITTINGS	
2	1/2-3/4" reducing bushings	steering gear
2	3/4-1" reducing bushings	steering gear
1	3/8-1/2" reducing bushings	steering gear
2	1/2" pipe floor flanges	steering gear
2	1/4 x 2 1/2" long pipe	steering gear
1	1/2 x 10 3/4" long pipe	steering gear
1	1 x 5 1/2" long pipe	steering gear
1	1" pipe cap	steering gear
	RIGGING HARDWARE	
90 ft	5/32" stainless steel 1 x 19 strand rigging wire	
80 ft	1/4" manila rope	
3	1/4" single-sheave, fast eye pulley blocks	
1	1/4" double-sheave, fast eye pulley block	
24 ft	1/4" plastic covered, flexible steel outboard steering cable	
8	1/8" wire-rope thimbles	
4	1/4" wire-rope thimbles	
24	3/16" cable clamps	
1	4" awning mast-cleat	
5 ft	#12 cold drawn, steel wire or 3/16 gas-welding rods	
1 ft	1/4" steel rod	
6	1/4" turnbuckles (hook and eye type)	
3	1/4 x 1" machine bolts	
2	1/4 x 2 1/4" machine bolts	
1	1/4 x 2 1/2" machine bolt	
2	1/4 x 3 1/2" machine bolts	
1	1/4 x 4" machine bolt	
	(Following items available from Alan Clarke Co., 235-239 Main St., Northport, L.I., N.Y. 11768)	
1	Sail, made especially for this ice boat	
3	#1 Boom travelers	
1	1 3/4 x 7/16" mast head sheave	
1	1/4 x 2" shoulder eye bolt	

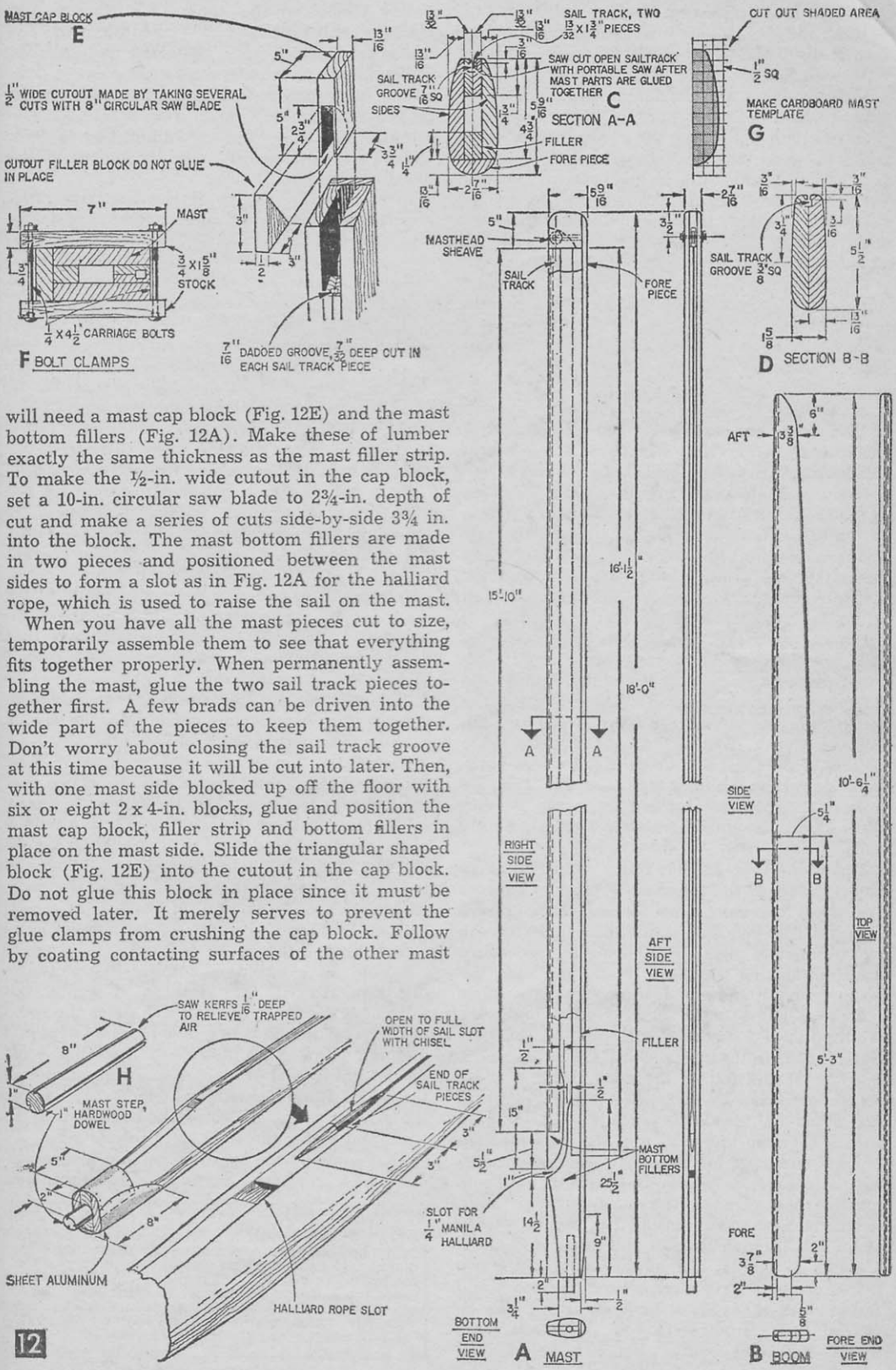


The drum on the tiller shaft is connected to the drum on the steering runner with a cable. Use 24 ft. of ¼-in. dia., plastic-covered, flexible cable —the same type used for steering outboard motors. Wrap the cable one complete turn around the drums and connect the two ends of the cable midway between the drums with a turnbuckle.

Mast and Boom. Starting with the mast, first rip the 18-ft. length of ¾ x 9⅝-in. board lengthwise to make two 4¾-in. wide pieces for the mast sides (Fig. 12C). Rip a 1¼-in. strip from one of the 18-ft. lengths of ¾ x 3⅝-in. boards for the filler piece. The 2¼-in. strip left is for the fore piece. Rip the remaining 18-ft. length of ¾ x 3⅝-in. lumber into two equal width strips of 1¾ in. each. Then, turning these strips on edge, again rip them to obtain a 13/32-in. thick strip from each one for the sail track pieces. Check the thickness of the ¾-in. filler strip before ripping these strips. Often so-called 1-in. stock measures 13/16 in. in thickness, and the two sail track pieces must equal the thickness of the filler when glued together. Before gluing, however, cut a 7/16 x 7/32-in. deep groove in each sail track piece 3/16 in. from the edge as in Fig. 12C. Note in Fig. 12A that the sail track pieces are 15 ft. 10 in. long, the filler 16 ft. 1½ in. long, while the dimensions for the mast sides and fore pieces are actually 18 ft. long.

In addition to the long strips for the mast, you





12

will need a mast cap block (Fig. 12E) and the mast bottom fillers (Fig. 12A). Make these of lumber exactly the same thickness as the mast filler strip. To make the ½-in. wide cutout in the cap block, set a 10-in. circular saw blade to 2¾-in. depth of cut and make a series of cuts side-by-side 3¾ in. into the block. The mast bottom fillers are made in two pieces and positioned between the mast sides to form a slot as in Fig. 12A for the halliard rope, which is used to raise the sail on the mast.

When you have all the mast pieces cut to size, temporarily assemble them to see that everything fits together properly. When permanently assembling the mast, glue the two sail track pieces together first. A few brads can be driven into the wide part of the pieces to keep them together. Don't worry about closing the sail track groove at this time because it will be cut into later. Then, with one mast side blocked up off the floor with six or eight 2 x 4-in. blocks, glue and position the mast cap block, filler strip and bottom fillers in place on the mast side. Slide the triangular shaped block (Fig. 12E) into the cutout in the cap block. Do not glue this block in place since it must be removed later. It merely serves to prevent the glue clamps from crushing the cap block. Follow by coating contacting surfaces of the other mast

side with glue and clamp the assembly together with all the clamps you have available. Glue the fore piece to the edges of the mast side and secure with bar clamps.

Unless you are a professional boat builder, you probably will not have enough C-clamps to apply pressure uniformly along the entire length of the mast. A good substitute for clamps is several long strips of inner tube tightly wrapped around the mast 4 or 5 turns. Space these inner-tube "clamps" about 6 in. apart. The bolt clamps shown in Fig. 12F are another inexpensive way of clamping the mast until the glue dries.

Allow the mast to dry 3 or 4 days in a heated garage or basement before removing the clamps. Then place the mast on saw horses and mark center-lines lengthwise on the fore piece end sail track piece. Lay out and cut a cardboard template as in Fig. 12G and start planing the mast to shape. Use the template to check the amount of stock removed. Shape the top and bottom of the mast as in Fig. 12A. Final smoothing is best done with a portable electric belt sander.

Use a portable electric saw with the blade set at 5/16-in. depth of cut to make the saw cut into the sail-track groove (Fig. 12C). Sand the saw cut corners round by inserting coarse sand paper folded several times into the cut. To feed the sail into the slot, chisel open the groove to full width for a distance of 6 in. at the bottom of the mast as in Fig. 12A. Apply three coats of spar varnish on the mast, sanding lightly between the first two coats. When thoroughly dry, force paste wax in the sail track groove with a putty knife and polish with a rag folded and run into the groove. Drill a 1" hole 6 in. deep in the bottom of the mast and drive in a 1 x 8-in. hardwood dowel for the mast step as in Fig. 12H. To protect the bottom of the mast, wrap it with sheet aluminum and fasten with 3/4-in. aluminum nails.

The boom (Fig. 12B) is fairly simple to make as compared to the mast, since only two pieces are glued together. Cut the sail-track groove (Fig. 12C) as you did for the mast and glue the two boom sides together following the procedure used for making the mast. Plane and sand the boom to shape, and give it three coats of varnish.

Rigging. Since most of the rigging hardware required is of a special shape and size, commercially made sailboat hardware cannot be used. Starting at the top of the mast, bend a 12-in. length of 1/8 x 1/2-in. strip steel around it as in Fig. 9 for the sheave bracket. Fasten in place with a C-clamp and drill a 9/32-in. hole through bracket and mast for the sheave. Before installing the sheave, draw a 36-ft. length of the 1/4-in. manila rope through the mast with an 18-ft. length of wire. Then install the sheave with a 1/4-in. bolt through bracket and mast.

Going to the aft end of the boom, bend two pieces of 1/8-in. strip steel around the boom and fasten with a 3/16-in. stove bolt. Bend two S-shaped hooks from 1/4-in. rod and insert them under the steel bands. Boom travelers, and pulley blocks on the boom (Fig. 9) are purchased parts. Bolt the travelers to the boom and make up S-hooks from #12 wire to fasten the pulley blocks to the travelers.

The boom goose neck and stay wire bracket on the mast are hand made from 1/4 x 1 3/4-in. aluminum bar stock. The soft aluminum is quite ductile and bends easily, and can be cut with a wood cutting band.

Bend an 18-in. length of 1/8 x 1-in. strip steel around the fore end of the longeron and fasten with two bolts as in Fig. 11O. Drill 9/32-in. holes in the two tang ends for the hook end of the turnbuckles, then run 5/32-in. stainless steel cables from the turnbuckles to the eyebolts on the ends of the runner beams. The mast is held upright with the three stay wires as in Fig. 9. Use 20 1/2 ft. of 5/32-in. stainless stranded cable for the fore stay and fasten it to the stay-wire bracket on the mast with a 1/8-in. thimble and two 3/16-in. cable clamps. Similarly fasten two 18-ft. long cables to the bracket for the side stays. (These lengths of cable include 2 extra feet for fastening).

Now, with a plumb bob hanging from the top of the mast as in Fig. 9, have a helper hold the mast upright in the fuselage. Tilt the mast until the distance from plumb bob to bottom of mast is 44 in. and quickly fasten the stays to their turnbuckles. A more accurate adjustment of the mast can be made later by adjusting the turnbuckles. Sails made especially for this ice boat design are available from Alan-Clarke Co.—see Materials List for address.

Make up the four sail battens to size and length give in Fig. 9 and slide them into the batten pockets sewn on the sails.

Fasten the top of the sail with an S-hook through the grommet to the halliard. Then feed the luff edge of the sail into the sail-track groove in the mast through the opening near the bottom of the mast and haul it up with the halliard. Feed the foot of the sail into the sail-track groove in the boom and fasten it at the aft end of the boom with an S-hook as in Fig. 10. Starting at the aft end of the boom, rig the 1/4-in. manila boom tackle through the pulley blocks.

Sailing an ice boat is nothing like sailing a sail boat. It's true that "tacking" is similar, but to achieve speeds of two to three times the speed of the wind, an ice boat's sails must be kept stiff and not allowed to billow—so haul the boom down tight to keep it inboard and run quartering the wind. Running with the wind will give you the slowest speed. To come about, head into the wind and throw the tiller over to one side.

That sums up the construction and instruction. Good luck and happy, speedy ice boating to you.

• Craft Print No. 302, in enlarged size for building Cold Lightening, is available at $3. 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 C.O.D.'s or stamps) to Craft Print Dept., SCIENCE AND MECHANICS, 229 Park Avenue South, New York, N.Y. 10003. See handy order form on page 112.

