This engine is about the right size for a 2- to 3-foot boat. It isn’t too easy to make an engine reversible but the type of reversing valve here is a common type. The Column is complicated by a bit of drilling and plugging, though not difficult if you make accurate layout lines. It has a 5/8” bore and 3/4” stroke with simple drilled holes for ports. It is double acting.

All the simpler parts that are straight machine shop practice will not get any mention here.

The CYLINDER starts as an accurate 1” x 1-1/4” x 1-3/8” block. Lay out all the centerlines and surface lines on all five faces. You may choose to use the heads as jigs for spotting for the eight bolt holes. The port holes are located with the drill jig. Chuck the block in the 4-jaw, centering on and machining the Pivot Shaft Hole. If necessary, make a very light skin cut on the face to square it up with the pivot hole. Turn the flange to 1/16 thick down to the 1-3/32” diameter. Use a protective pad on this face and chuck, centering on the 5/8” bore. The faces will not quite clean up so go back and rotate the chuck by hand and feed the bit in with a “shaper” motion the way Kozo Hiraoaka makes a halfround in the lathe. Cut away the four small corner points and bore a smooth 5/8”.

When the Inboard Head, Piston and Rod, Crosshead and Guide, Drill Jig and Pivot Shaft are complete, assemble, and drop the Jig over the Pivot Shaft. Run a 3/16” pin through the Jig and Crosshead. Drill the two 5/64” port holes. The Pin and Shaft must be close fitting in the Jig for accuracy of port location.

The COLUMN shown is a hard fixture-grade aluminum, anodized. Steel would be good for this part. The flatness and finish were OK on both surfaces. Here again, make a complete layout of all centers. Center in the Lathe with face running true for the Pivot Bearing Hole and for the Crank Bearing Hole. The 3/4” hole is optional and can also be done neatly in the lathe.

Make the Pivot and Crank Bearings. If you intend to use live steam, it might be best to try for a good press-fit for the Pivot Bearing since the heat may affect the Loctite. Insert close-fitting 3/16” and 1/4” pins in the bearings and place the Jig over the 3/16” pin and against the 1/4” pin. Hold the Jig tight against the 1/4” pin while drilling two of the port holes. Turn the Jig over and do the same for the other two port holes. Drill these about 1/4” deep. Drill the deep vertical 5/64” holes. Pick up the centers of these port holes and transfer around onto the edge of the Column; then, drill and tap 3-48 the horizontal holes to the port holes. Drill the 5/64” horizontal steam connection holes 11/16” deep and tap 3/16-40. Drill the four 5/64” valve holes. When all the machining is done and there is little danger of chips getting into the passages, plug the six places with short pieces of 3-48 threaded rod using a bit of gasket cement. Cut off and dress smooth and flush. If you thread a .099” diameter rod with 3/32” of thread and jam the metal home, the plugs will barely show after dressing. Complete the remaining holes and clean up the Column and polish. Check for flatness and smoothness where the Cylinder and Valve rub. This is a metal-to-metal seal and may require lapping. Enamel the surface inside the 3/4” ornamental hole with
some bright color of your choice.

The CROSS HEAD GUIDE can be two pieces hard soldered together or cut from the solid, though it makes a lot of valuable metal into chips. The axis of the Cylinder Bore should be exactly on the axis of the Cross Head Guide, so squareness and concentricity are important on the Piston, Rod, Crosshead, Inboard Head and this Guide.

The SPRINGS are from the scrap box and the dimensions shown are the proportions finally used. You can do a bit of cut-and-try from your collection.

The curved tracks in the REVERSING VALVE were first drilled 1/16" deep at each end at the 5/16 dimensions shown and then milled with a 1/16" end mill. The photo shows a set-up that may be interesting to you. A heavy 1" x 2" x 7-1/4" steel bar was slotted and fitted with a stud and clamp to anchor to the bed ways. A socket was added at one end to take the milling column of the Unimat SL lathe. The lathe head was mounted with the 1/16" end mill in the drill chuck. An indexing block, using the Unimat chuck and lathe change gear, was mounted in the cross slide milling attachment. The gear was used as a handwheel to rotate the work. About four passes were made to get a 1/16" + depth. It was not difficult to turn by hand.

Milling the steam passages in the Reverse Valve

This same indexing feature was used to make the eight notches in the PACKNUT.

A short tiny shoulder pin was used in the 5/64" Valve hole in the Column and a 1/16" diameter end made to enter the grooved passage in the Valve. (Don't make it too short and lose it in a blind hole in the column.) Turning the Valve to the two extremes will help you spot the location of the two stop pins. Spot them well up in the corner so as not to break into a steam passage.

The PACKING is 1/16" strands of unravelled braided graphited asbestos packing. Do not set up too tight. Add a drop of oil.

This turned out to be a fairly powerful and compact engine. It will idle along on as little as 5 psi air. Like all single cylinder engines, it has to be nudged to start if it has stopped on dead center.

SAFETY FIRST

KEEP EVERYTHING IN ORDER