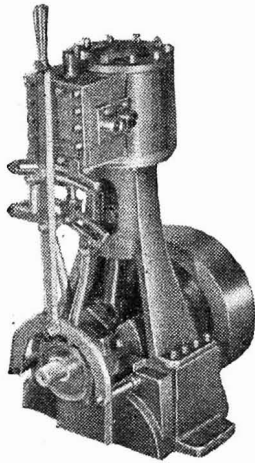


Machining Cylinder

By C. W. WOODSON

PART TWO



MUCH of the performance of a steam engine depends on the accuracy and smoothness of the cylinder bore. This is as true for the miniature reversing engine here described (see PSM, April '47, p. 190) as for full-size engines.

The casting for the cylinder is first mounted in the the three-jaw chuck and a roughing cut taken across the bottom so it can be reversed and held squarely for facing the top. If you have available an expanding mandrel, the cylinder is best bored after the rough facing and then mounted on the mandrel, where its ends can be faced smooth and squared accurately with the bore.

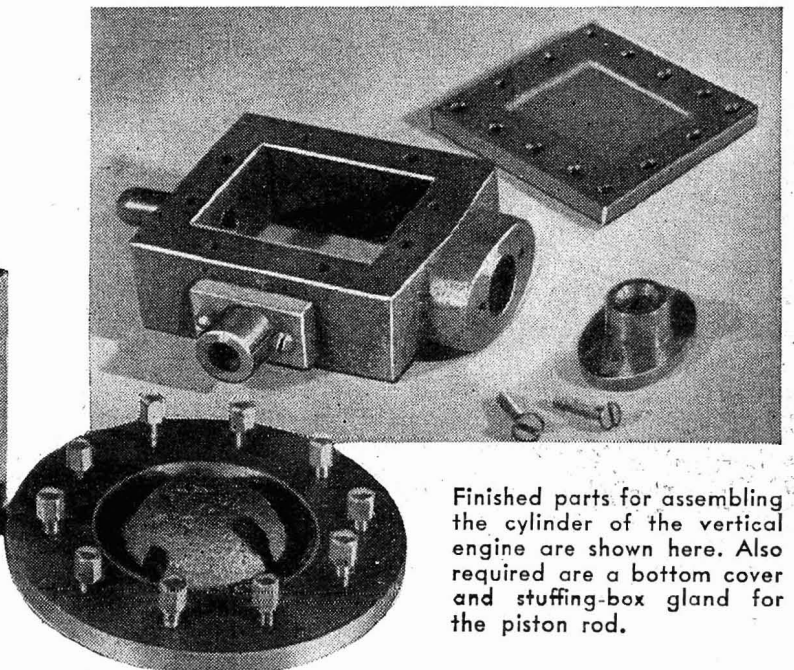
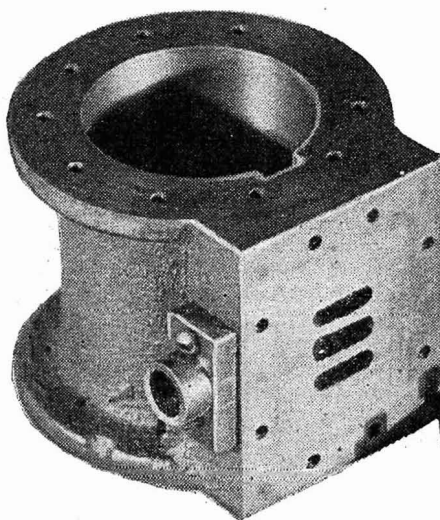
Lacking such a mandrel, face the top smooth first, and then reverse the piece and face the bottom smooth and square before attempting to bore. Although the cylinder may be held in the three- or four-jaw chuck for these operations, there is less likelihood of slipping if it is clamped to the lathe face-plate with lugs over its flange.

Bore the cylinder first with a heavy

roughing cut to get the bit under the hard surface scale and bring the hole nearly to size. Then, with a freshly ground bit inserted in the boring bar, take light finishing cuts while using a very fine power feed. If care is taken in sharpening the bit and setting it to eliminate chatter, an almost mirrorlike finish can be obtained.

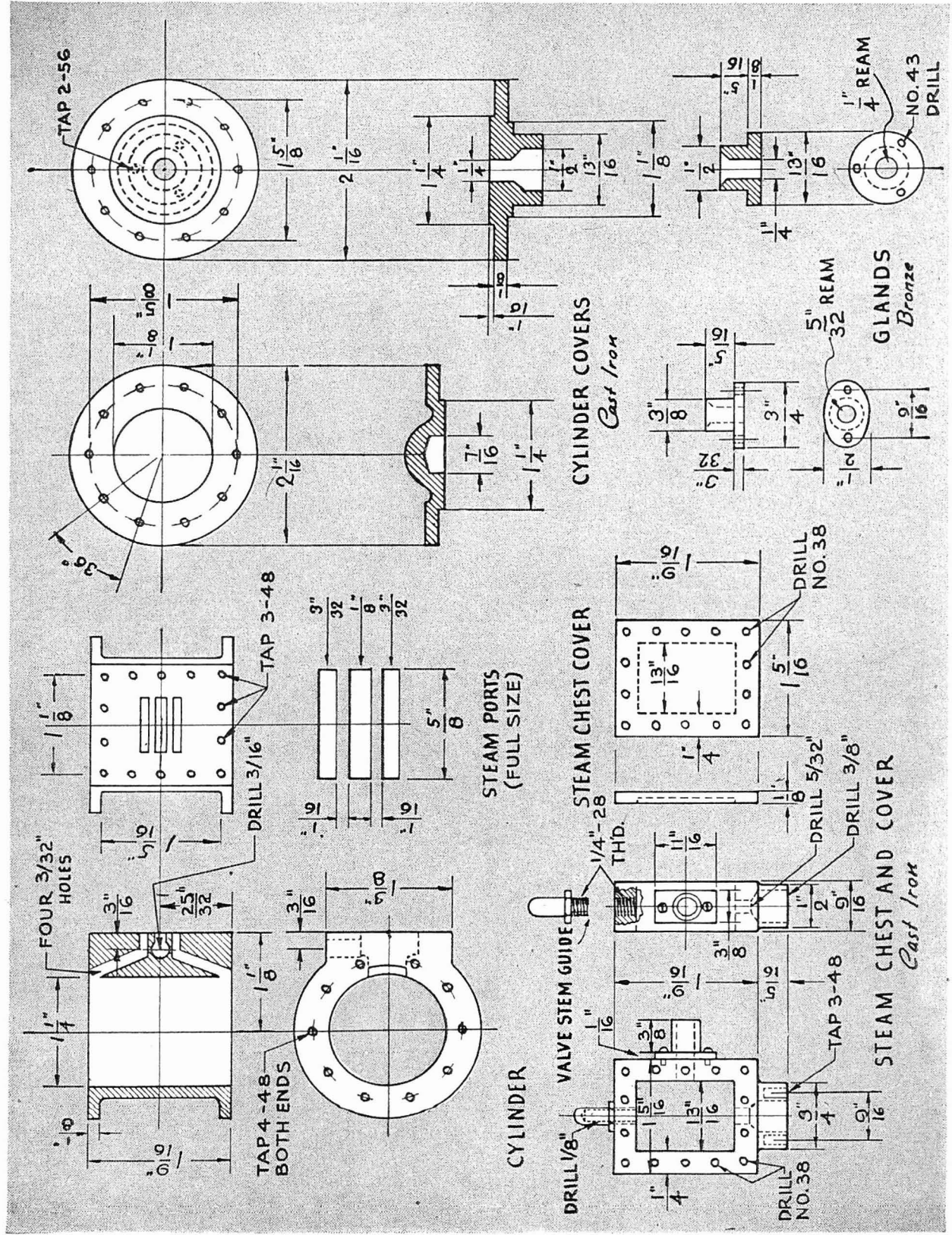
The steam-port face can be machined in the shaper or, as shown in one of the photographs, while mounted on an angle plate in the lathe. Again take a heavy roughing cut first to get under the scale, and then, with the bit freshly ground and honed to a keen edge, finish with light cuts and a fine feed.

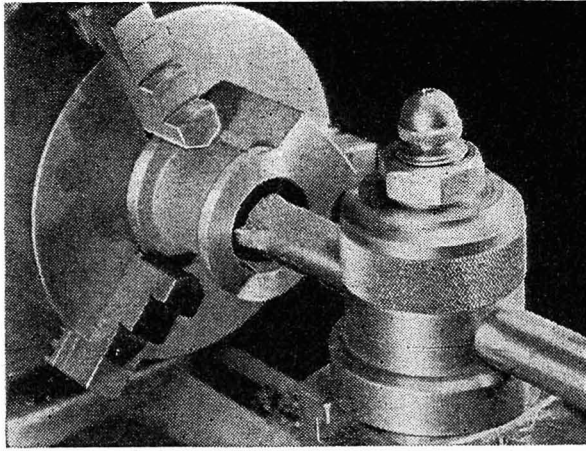
Remove the work to the drill press, clamp in the vise, lay out the steam and exhaust ports carefully, and drill a series of holes for each. Chip out the intervening metal and file the resulting slot to shape. Then mount the work in the angle vise and drill four holes for each of the two angle ports to meet those in the face. Chip and file out as before. A chisel made from 3/32" drill rod and hardened may be used for chipping. The cylinder is next remounted in the vise and



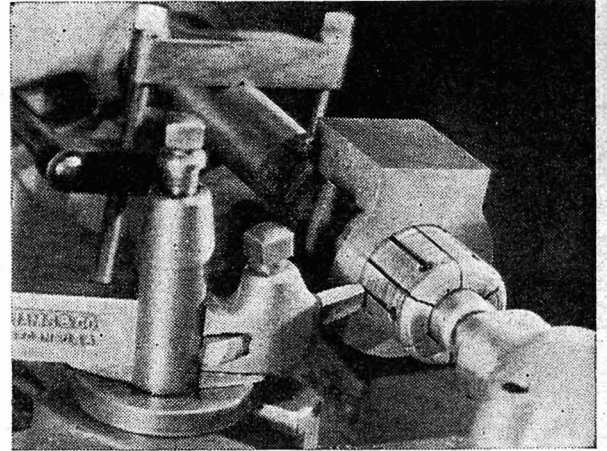
Finished parts for assembling the cylinder of the vertical engine are shown here. Also required are a bottom cover and stuffing-box gland for the piston rod.

Assembly for Steam Engine

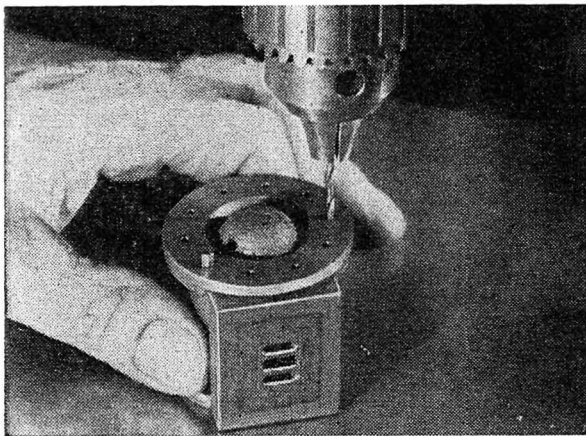




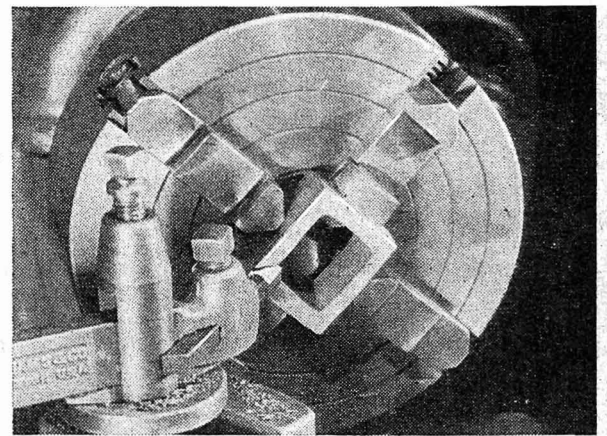
1 In boring the cylinder, take a heavy roughing cut to get under the surface scale. Finish the bore with light cuts and a freshly ground bit.



2 If an expanding mandrel is available, bore the cylinder before finish-facing the flanges; if not, machine the flanges first and then bore.



5 Drill and tap one hole in the flange, and then bolt the cylinder head on before spotting the others. Use a clamp at the opposite side.



6 Face the steam chest on both sides, taking a heavy roughing cut on each first and finishing with light cuts to assure a steamtight joint.

the exhaust port drilled in from the side to meet that in the face. Don't drill the 4-48 holes until the covers have been made.

Mount the cylinder-head casting in the three-jaw chuck and turn the chucking lug straight so the casting will run true when reversed. Machine the top and outer edge to shape, and then score a light $1\frac{1}{8}$ " circle on the face for locating the bolt holes. Again reverse the piece in the chuck, take off the chucking lug, face smooth, turn the step to a good snap fit in the cylinder bore, and drill a $7/16$ " hole $\frac{1}{4}$ " deep to clear the nut on top of the piston.

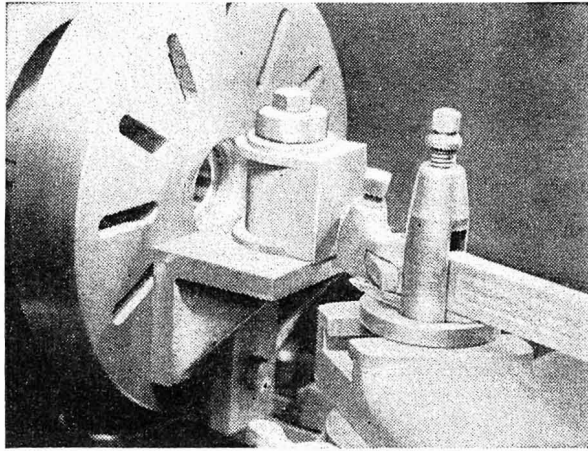
The bolt holes are then stepped off accurately with dividers, centerpunched, and drilled clearance size. Snap the head in place, spot one of the holes in the flange with a clearance-size drill, drill tapping size, and tap. Next, insert the bolt and spot the remaining holes. Make a file mark on meet-

ing edges so that the head can be replaced in the same position; then finish drilling and tapping the flange.

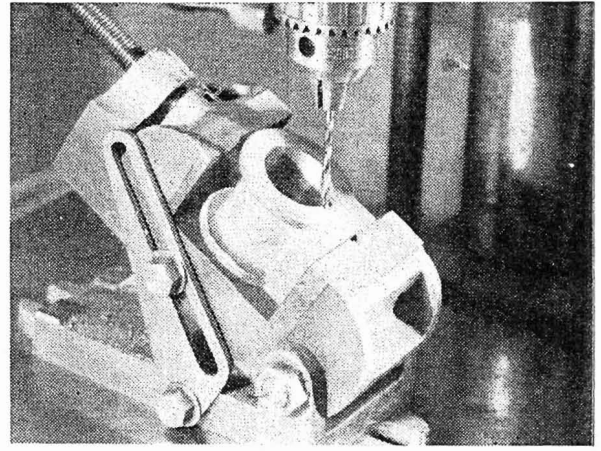
In machining the lower cover, it is important that the step fitting in the cylinder bore be concentric with the piston-rod hole so there will be no binding at that point. Equally important it is to turn the step on the outer face, or bottom, concentric for fitting the shouldered bore in the standard.

One way is to turn the gland stem and shoulder on the outer face first, bore and counterbore the $\frac{1}{4}$ " hole, and then mount the piece on a stub arbor or in a step chuck to face and step the inner side for a snap fit in the cylinder bore. In counterboring for the gland, be sure to start carefully in the piston-rod hole to assure concentricity.

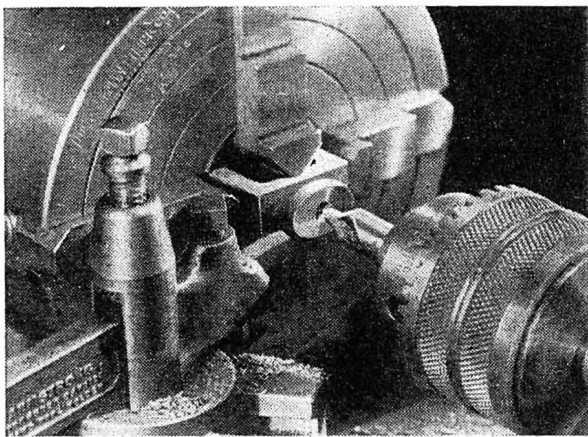
Snap the lower cover on the column, clamp, and spot the bolt holes through the column flange. Then snap the cover on the



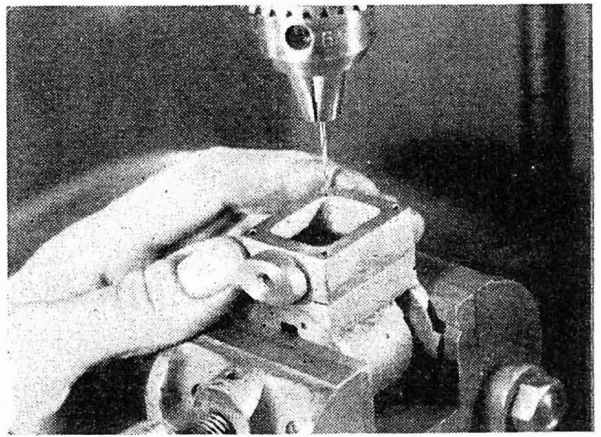
3 Machine the steam-port face with the cylinder mounted on an angle plate, finishing with very light cuts. A shaper will also do the job.



4 Ports are bored at an angle from both ends of the cylinder to connect with the steam ports in the face. Chip and file them to shape.



7 Chucked gland end out, the steam chest can be drilled and reamed for the valve stem and the hole then opened out to take the gland.



8 Corner holes are completed first in the steam chest and cylinder steam-port face; then the parts are bolted and the remaining holes drilled.

cylinder and repeat as for the head. Put witness marks on the column, cover, and cylinder flange, making certain that the valve face is at 90 deg. to the crankshaft centerline of the base.

Face the steam-chest casting on both sides, holding it in the four-jaw chuck, and bring it to proper thickness. A heavy roughing cut followed by several light finishing cuts will assure a steamtight joint.

Some difficulty may be encountered in drilling for the valve stem, since the inner surfaces of the steam-chest casting will have a slope. If you have a hand grinder, a small flat can be ground inside the stem-guide end for a drilling surface, after which the steam chest can be chucked and the hole drilled all the way through from the gland end. Otherwise it may be best to lay out the holes as accurately as possible on the outer surfaces, drill each from the outside with

an undersize drill, and then ream from the gland end. In this case, drill the gland end first, counterbore, and support it with the tailstock center when drilling from the stem-guide end. Finish by enlarging the upper hole with a No. 3 drill and tapping $\frac{1}{4}$ "-28.

Lay out the 14 bolt holes, drill the four in the corners clearance size, and spot, drill, and tap the corner holes in the cylinder steam-port face. Bolt through the four holes, and drill the remaining 10 tapping size through the steam chest into the cylinder. Separate the parts, tap the cylinder holes, and open up those in the steam chest.

Face the steam-chest cover in the lathe, mill the recess, clamp the steam chest to it in the drill press, and drill the bolt holes.

The valve-rod and piston-rod glands, valve-stem guide, and steam-pipe flange are turned from bronze bar stock to dimensions on page 193.

TO BE CONTINUED