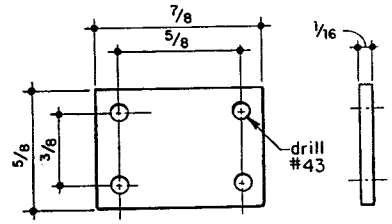
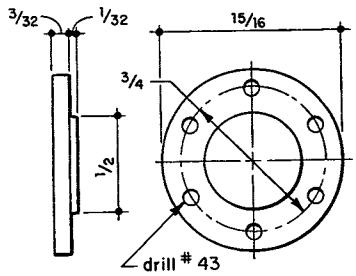
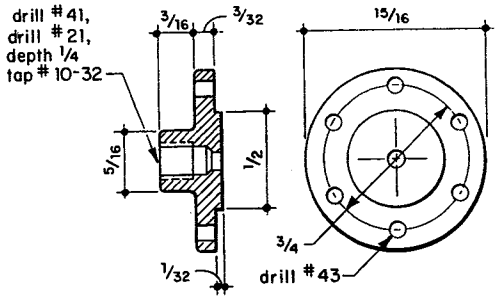


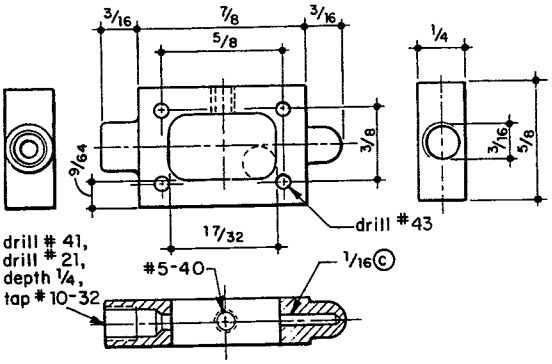
COVER



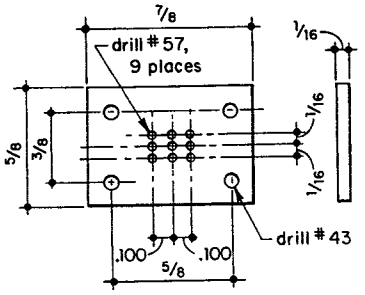
OUTBOARD HEAD



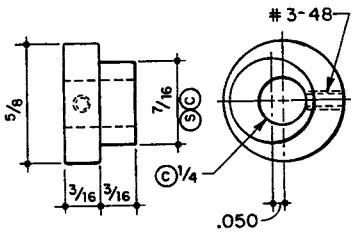
INBOARD HEAD



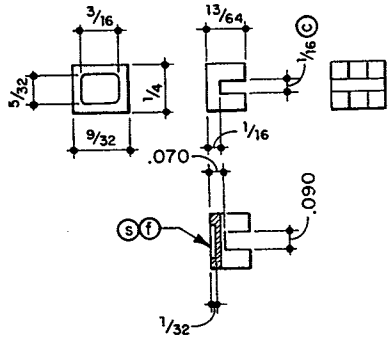
STEAM CHEST



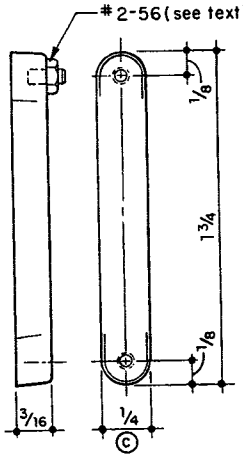
VALVE PLATE



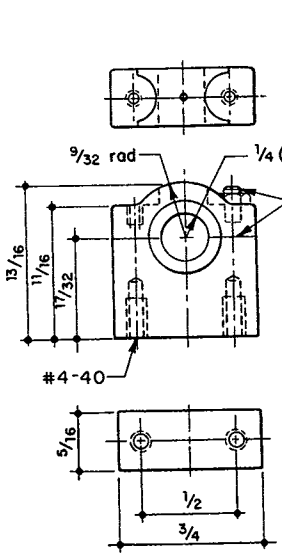
ECCENTRIC

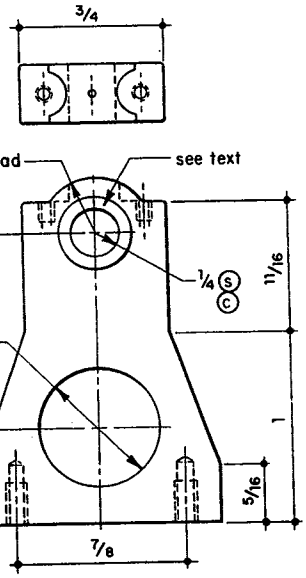


VALVE

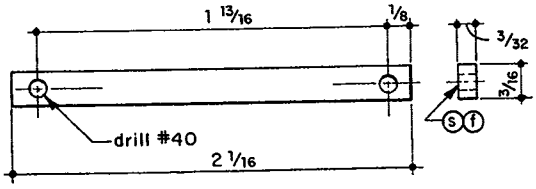


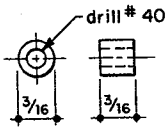
ANCHOR LUGS
2 Required



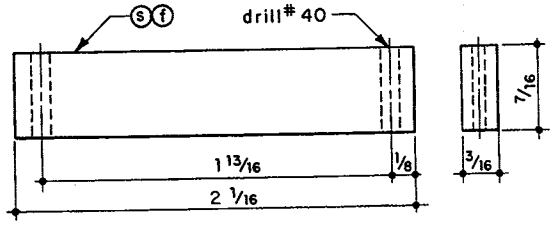


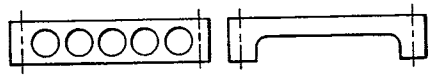
BEARINGS



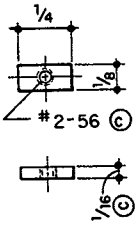


SPACER
4 Required

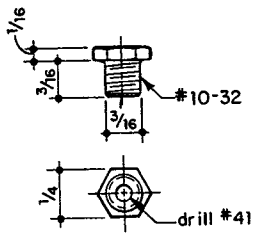




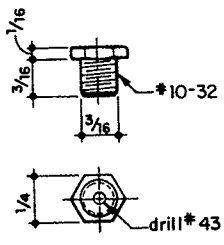
CROSSHEAD GUIDES



NUT



PACKNUT
(Piston)



PACKNUT
(Valve)

CHAPTER

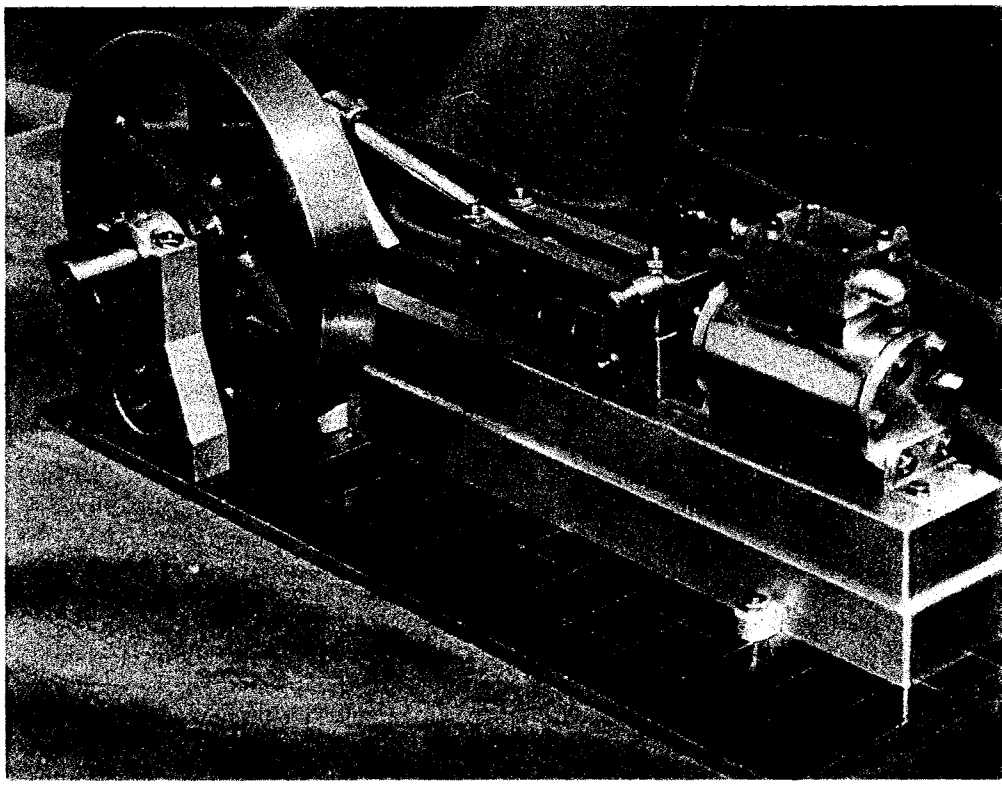
41 Factory Engine

This is a sister engine to the Mill Engine which, by now, you may already have completed. Many parts are common to both engines so, if you have finished the Mill Engine, you will have the benefit of past experience in this project. This Factory Engine has a 1/2" bore x 1" stroke with the Steam Chest on top actuated by a Rocker Shaft.

No castings are required and most of the material can come from your scrap box. On the model shown, most of the parts are made of a fairly hard jig-and-fixture grade of aluminum.

The **FLYWHEEL** shown in the photo is a 3" Stuart Turner from a 10H engine. Drawings and instructions are given in the Appendix for a Flywheel made from 1/2" flat stock.

For the **BEARINGS**, start out with accurate blocks, 5/16" x 3/4" x 13/16" and 5/16" x 1-1/4" x 1-13/16". Scribe the outlines on the faces of each Bearing. Lay out and tap the bearing mounting holes. Lay out the centerline for the shaft hole on the Tall Bearing and mill to outline. Assemble the Bearings to the Floor, Sub-Base and Base, all snug and well-aligned. On the model shown, the assembly was mounted in the cross-slide milling attachment. The shaft center was picked up with a wiggler and the bearing holes line-drilled in easy stages to avoid strain on the setup. The last few thousandths were taken out with a reamer, in this case 3/8", since "Oilite" bushings were to be used. If you do not choose to use bushings, work up to a 1/4" reamer. A 1" long, flat head bolt with a thick nut was used as a jack between the Tall Bearing and the Base to take some of the drill thrust. This operation might be done in a drill press, using an angle plate or a deep-jawed drill press vise. Mark each Bearing so it can be returned to its own position where it was machined. If you wish, you can actually make Split Bearings, but you must plan for this at the start. On this model, a deep scored line was scribed to represent a Split Bearing, and fake Studs were added in spot-faced holes. The 5/8" hole is optional.



For the **CYLINDER**, make an accurate 1" x 1" x 1-3/8" block. Lay out all the centers and lines on all six faces. Note that the bore is centered one way on the 1" square and 15/32" from the other face. In **STEP 1**, turn the **X** end, face and bore and ream it 1/2". For **STEP 2**, reverse, and turn the second end. Make a milling setup and complete **STEPS 3, 4, 5** and **6**. Rounding, as in **STEP 7** is optional, since Lagging will cover it. Next, complete all machining, drilling and tapping. Actually, you may prefer to do some of these while the block is still square. Watch the head bolt pattern location so the Cylinder will set squarely upright when the feet are attached.

Make the **FEET**, taking care in drilling for the head bolts so, when the Feet are attached, they rest down squarely on the Base. See, too, that the Steam Chest is parallel to the Base and that the shaft height matches the Crosshead drilling.

The **CONNECTING ROD** is made from 5/16" x 3/16" stock, drilled, reamed and turned. Add extra length for a center hole for tailstock support when turning.

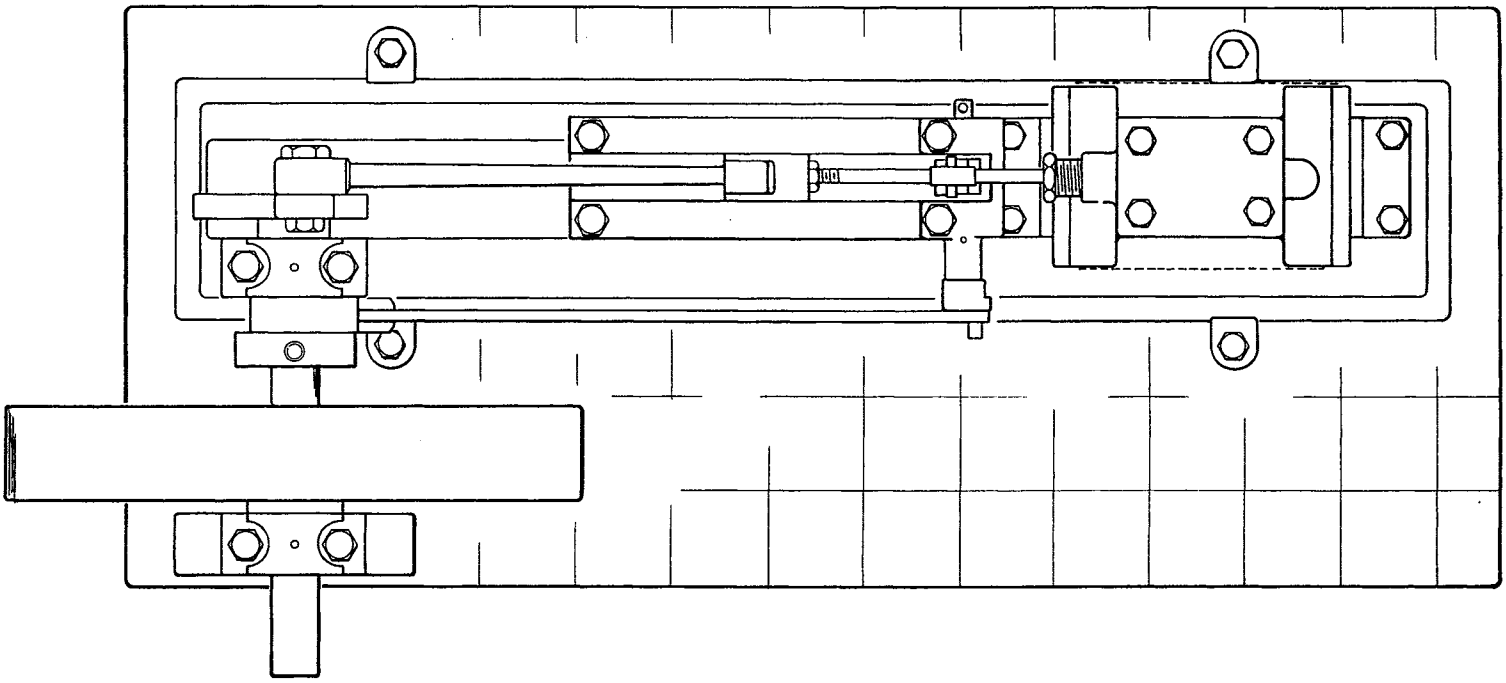
Try for good concentricity on the **PISTON** and **ROD** to avoid binding at the inboard head.

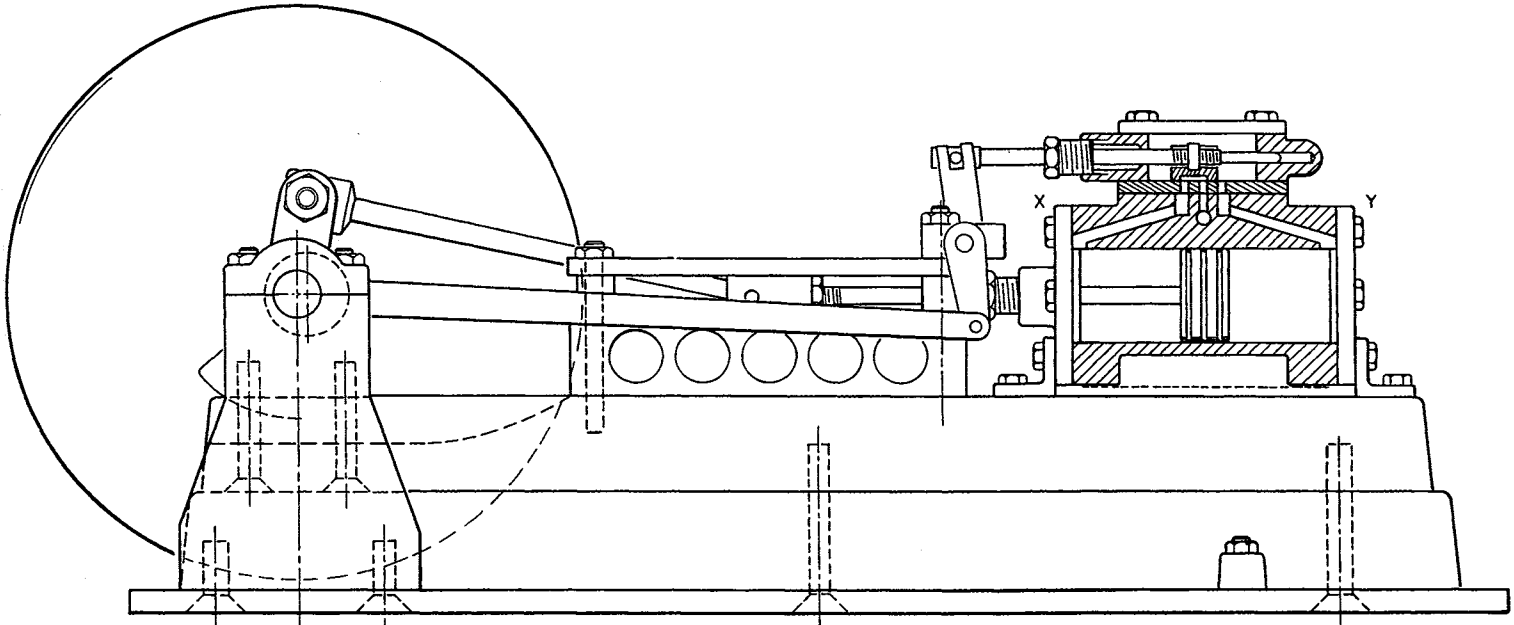
The **VALVE ROD** is 1/8" stock, turned with tailstock support. Mount in the cross-slide mill attachment and mill the flats. It is well that the Nut fit the 2-56 thread closely to reduce pounding at the Valve. Fit the 1/16" x 7/32" Cross Pin.

The **ECCENTRIC STRAP** is a machined bearing end, soldered to a flat bar.

The **FLOOR** on the model shown is salvaged blue-colored anodized aluminum and 1/2" squares were easily scribed to represent tile. The scribing is optional. The metal can be left bright or painted. Perhaps deep scribed lines can be filled with enamel and the surface wiped clean to leave some color in the lines. There are dyes on the market for coloring metal and they should make a background for the lines.

When making the **BASE** and **SUB-BASE**, make the beveling (which is





optional) the last operation. You will have more accurate edges and corners for layout and holding. Mount the Guides, Brackets and Cylinder on the Base before beveling so you can see which areas can be beveled and which corners can be rounded. The fake **LUGS** are set in the Base with Loctite. Short trimmings from #2-56 screws plus hex nuts complete the fake anchor bolts.

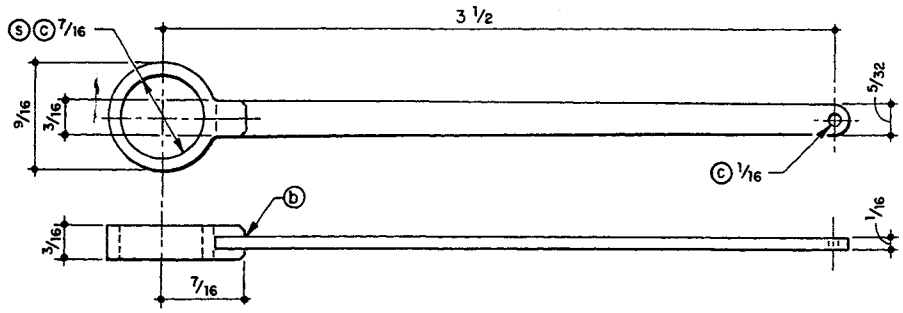
The lower **CROSSHEAD GUIDE** can be simple solid pieces or drilled out or arched as shown. The Piston Rod hole in the **CROSSHEAD** should match the Piston centerline height in the Cylinder. Use a 1/16" x 5/8" pin in the Crosshead.

For the **PACKING,** use 1/16" strands unraveled from braided asbestos graphite packing. do not snug up the packing nuts too tight; turn them in lightly with the fingers.

Make the **ROCKER SHAFT, ROCKER BEARING** and **FORK** of brass. A tiny bit of solder is the best way of assembling the Shaft, Arm and Pin. Use a short piece of soft copper wire in the #70 holes as retainers. Make the Fork a close, but free, fit on the Valve Rod Pin.

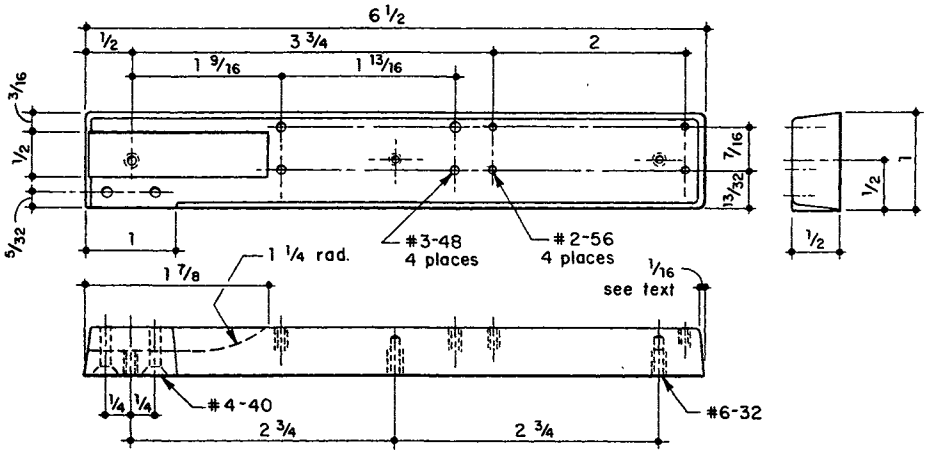
The **LAGGING** is tin can stock. Make a heavy paper pattern that fit the Cylinder, and transfer to the metal. The pattern is a cut-and-try job. Spot two #2-56 countersunk screw holes in the bottom of the Cylinder. Bind the Lagging to the Cylinder with soft wire and drive the Lagging metal into the countersink with a cone-shaped punch. This Lagging is optional since this Cylinder is fairly presentable without Lagging if the milling and filing are neat. If the screw heads strike the Base, make a couple of shallow drill dimples in the Base for clearance or file the heads extra thin. Pan head screws are used here.

At the final **ASSEMBLY**, turn the Crank to one dead center position and tighten the Eccentric with its axis 90 degrees from the centerline through the Crank. Temporarily hold the Steam Chest in place while adjusting the Valve to equally expose the Valve holes at each end of the stroke. You now have the companion to your Mill Engine and the two will make a very complimentary couple.

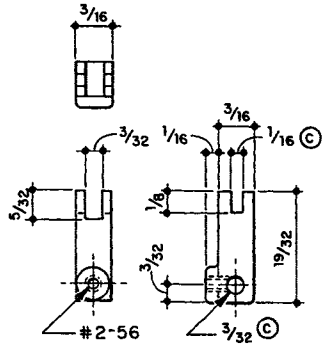


ECCENTRIC STRAP

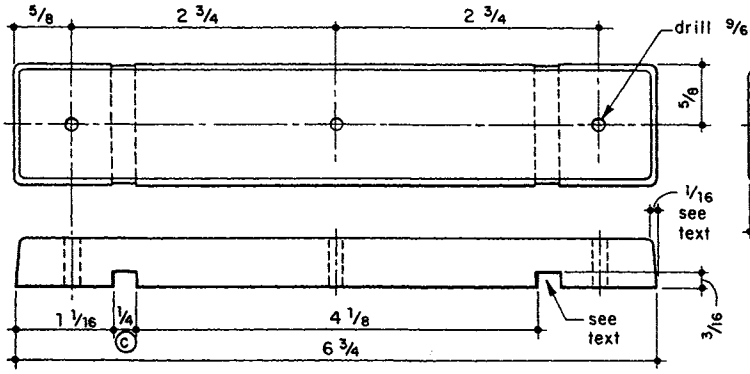
CYLINDER FOOT
2 Required



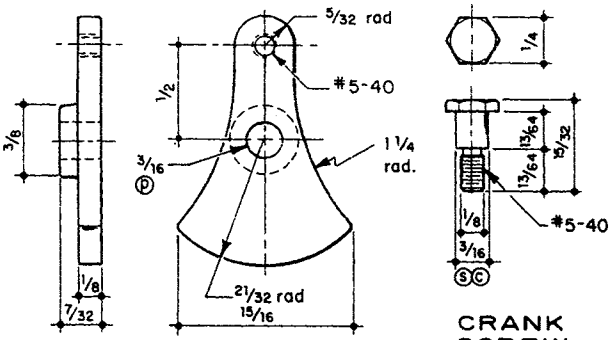
BASE



FORK

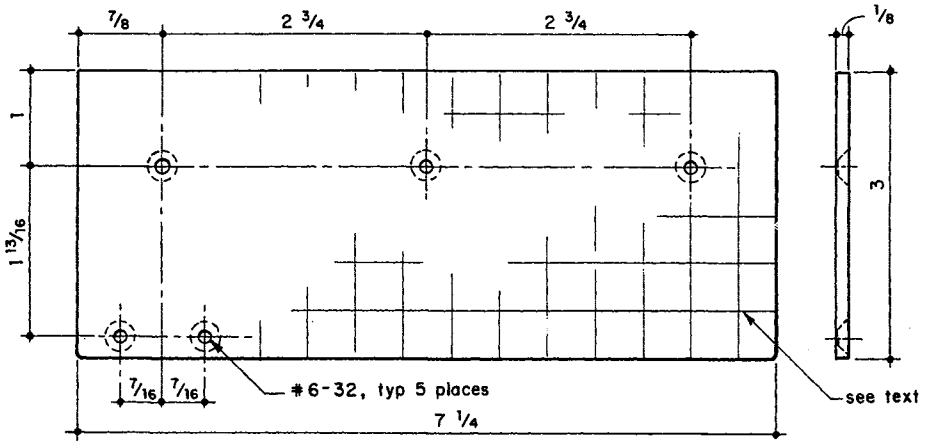


SUB-BASE

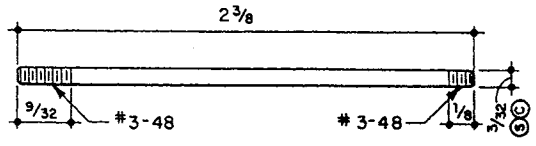


CRANK

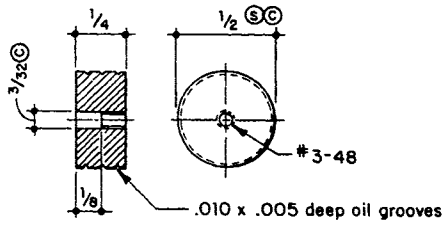
CRANK SCREW



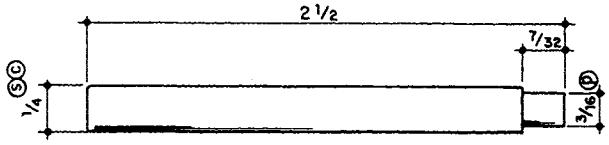
FLOOR



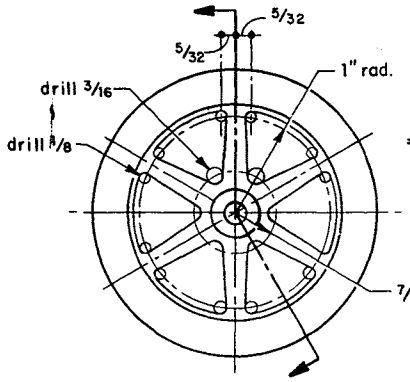
PISTON ROD

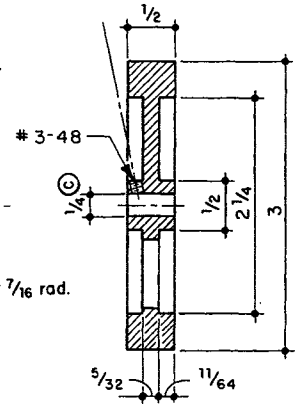


PISTON

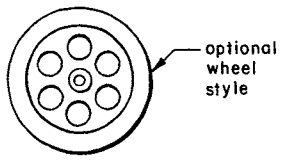


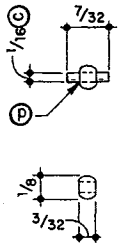
SHAFT

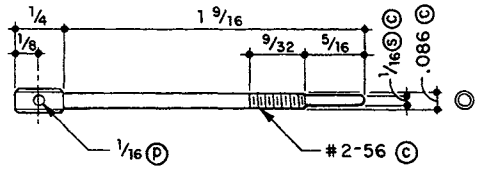




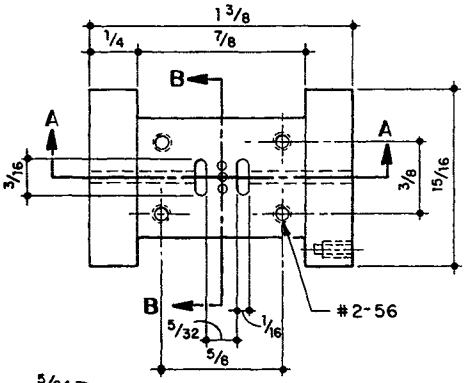
FLYWHEEL

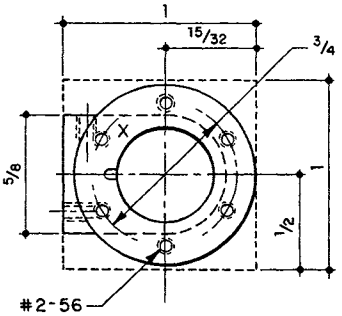


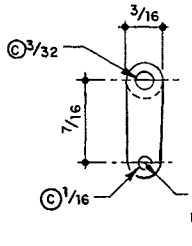


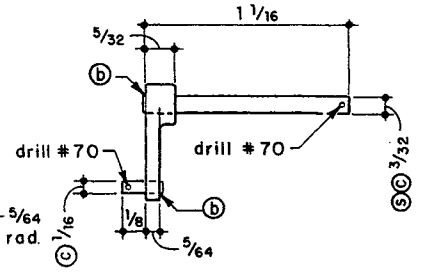


VALVE ROD

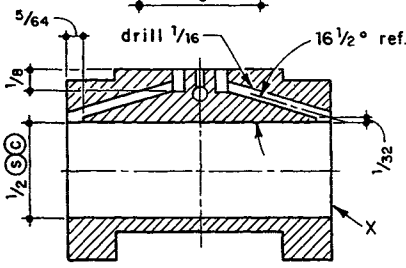








ROCKER SHAFT



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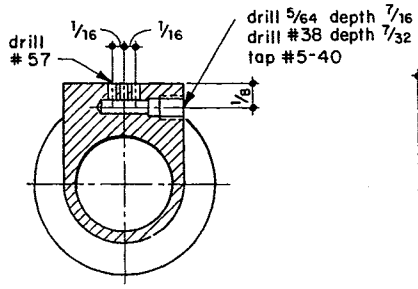
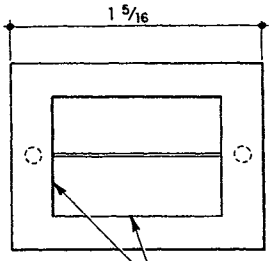
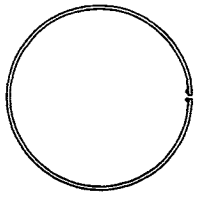
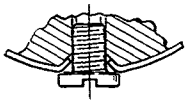
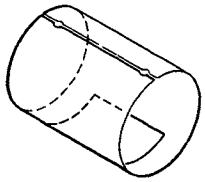


Section B-B



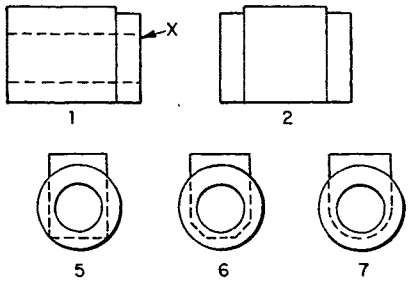






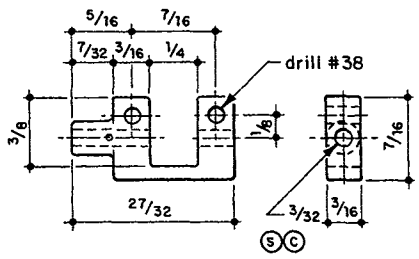
(see text)

LAGGING

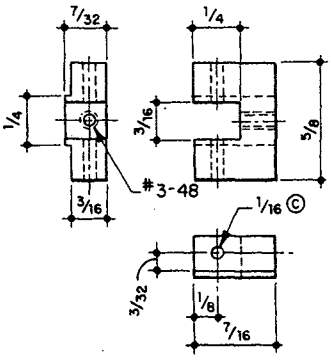


CYLINDER

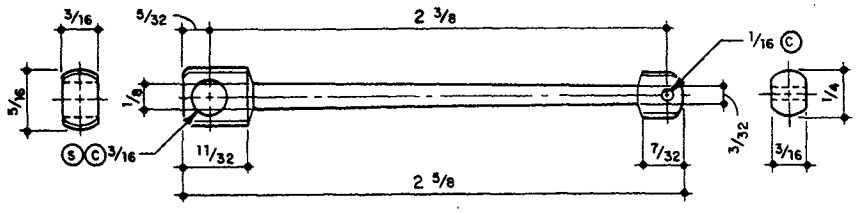
Ⓢ	smooth
Ⓕ	flat
Ⓒ	close fit
Ⓑ	solder or braze
Ⓟ	press fit or loctite



ROCKER BEARING



CROSSHEAD



CONNECTING ROD