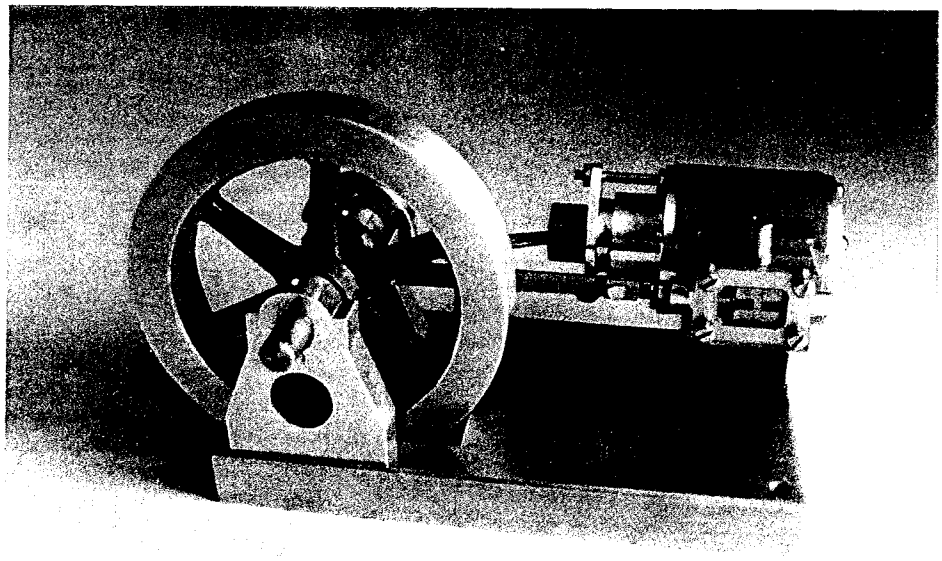
CHAPTER

45 Single Cylinder Compound



Richard Castagnola of Santa Barbara, California, sent in the suggestion for this engine. It is a compound using only one cylinder. The valve design feeds the exhaust from the high pressure side to the low pressure side. While steam is fed into the high pressure side, the low pressure side exhausts. The ratio of the areas of the low pressure to the high pressure is approximately 1.8 to 1. It seems a compound design on a small model is no advantage over a common double-acting engine but this shows an interesting principle and is a bit of an educational project. It is fun to build and it ran nicely on about 10 psi air. Care must be taken at the Piston, Head and Stuffing Box for good concentricity and a close, free fit.

Start the **CYLINDER** with an accurate 1-3/8" x 1-3/8" x 1-1/8" block. The one shown is a tough bronze. Compare the Cylinder drawing with the Assembly drawing and note how the 1/16" port pattern of holes is offset from the Cylinder center. Also, rather than run deep1/16" end milling, drilled holes are used at sections **CC** and **DD**. Lay out all of the outlines and hole centers (**Step 1**) and, while it is still a square block, make all bolt holes and port holes. In **Step 2**, the block is centered on the bore centerline in the 4-jaw using a center test indicator and bored 3/4". While on the same chucking, finish the 1-1/4" flange. For **Step 3**, reverse it in the chuck and turn the other flange. Make a milling setup and do **Steps 4, 5, 6** and **7**. Rounding, as in **Step 8**, is optional. After boring, mill the 3/32" openings at the bore end of the slanting steam passages.

Now that the Cylinder is finished, we can take a moment and mention the related **LAGGING**. A heavy paper pattern is made, mostly by cut and try. The outline is then transferred to the metal and the piece cut and filed to shape. Roll it over some round stock to a diameter smaller than the Head diameter and spring into place.

The **INBOARD HEAD** requires a bit of extra care. Chuck the stock and turn the 3/4" O.D. as well as the 1/2" and 5/8" bores, then part off at about 19/32" long. Chuck, centering on the 3/4" diameter; turn to length and form the dowel. Scribe a 1-1/6" bolt circle and pace off six centers for a #43 drill.

The **PISTON** can be completed, except for the Wrist Pin hole, in one chucking. As mentioned, work for a fine finish and close, free fit in the Cylinder and Head. At assembly, use a prick punch to flow a bit of Piston metal over the ends of the Wrist Pin to retain it. Remove any burrs with an oil stone.

The **GLAND** is made close-fitting to help support the Piston. The long neck on the Piston acts as a crosshead, guided by the deep Head and this Gland.

The **STEAM CHEST** starts as an accurate 1/4" x 5/8" x 1-1/4" block. All centers and outlines are laid out and the #43 holes made. Drill 4 holes and mill out the center 11/32" x 17/32" opening. Chuck in the 4-jaw, picking up the Stuffing Box center with a center test indicator. Drill #41 through, just making a starting dimple for the 1/16" hole. Drill #21 and tap 3/16-40. Make the 1/16" hole; turn the 1/4" diameter. Reverse and make the blind hub.

The **VALVE PLATE** calls for very careful layout. Note how the pattern of holes is offset like the Cylinder. Remove all burrs and grind flat with fine emery on a surface plate.

The **VALVE ROD** requires tailstock support while turning to the small diameters. When the turning is completed, the end can be cut off and the 2-56 thread added using a tailstock die holder. Use the cross slide mill to make the 1/16" slot and cut to 5/32" thickness.

The thread in the **NUT** should be a close fit on the Valve Rod. Avoid sloppiness at the Valve and Nut. The Valve should just float on its seat. The spacing of the ports and the Valve travel can tolerate only a very small amount of backlash at the Valve.

The **VALVE** is straight machining on a tiny part and will require patience. Make sure the rubbing face is flat and smooth.

The **BEARINGS** can be bushed with Oilite if desired. They can be mounted on the Base and line-reamed for a nice, free-running Shaft. Mark them so they can be

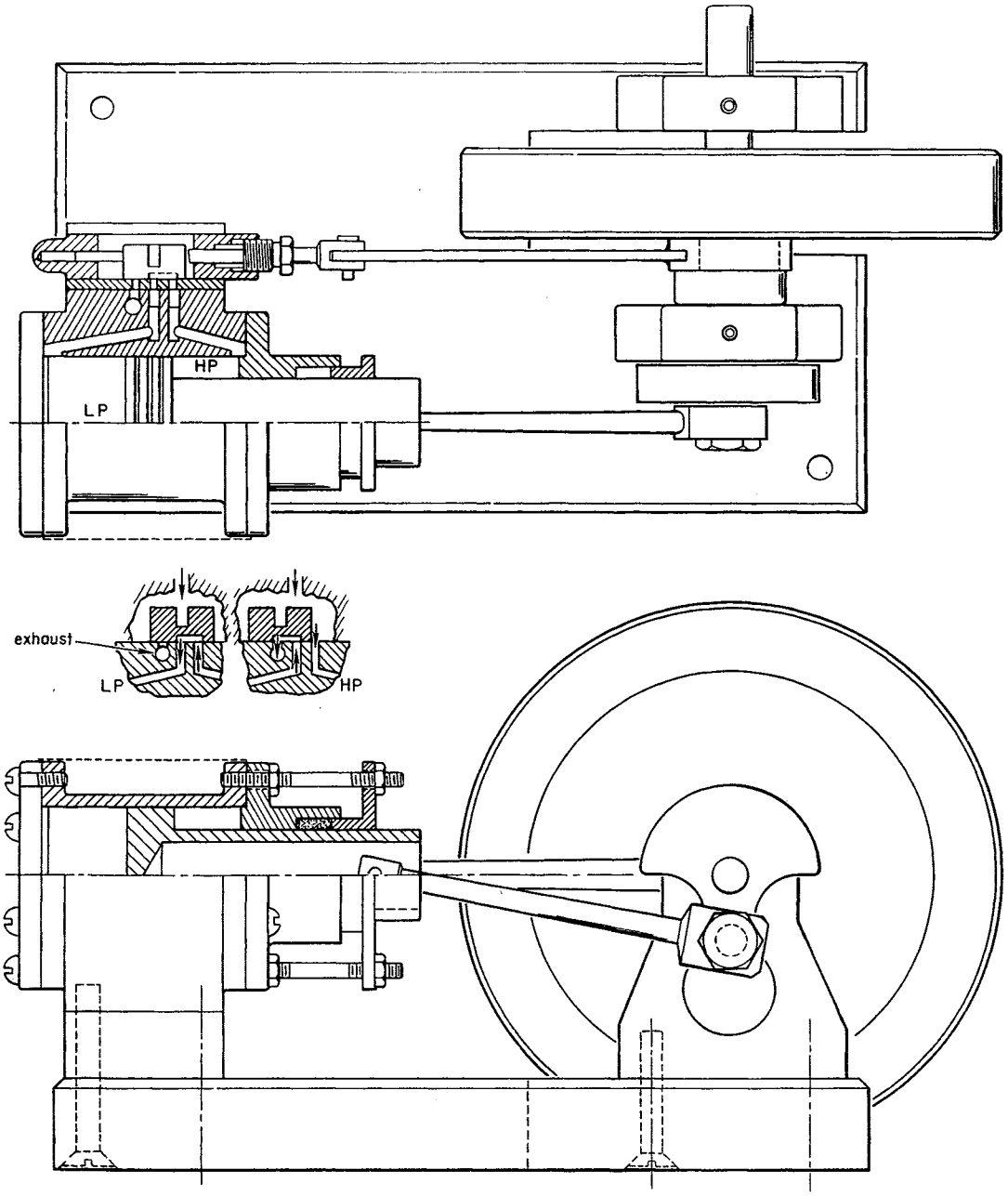
returned to where they were mounted when machined.

The **CONNECTING ROD** is made from 3/16" x 3/8" stock that is chucked and turned, using the tailstock support. First lay out and make the 1/16" and 3/16" holes while the stock is square. The 11/64" diameter tapered to 7/64" is not serious. It is roughly what you get at 1° setting. Make it so it looks good to you.

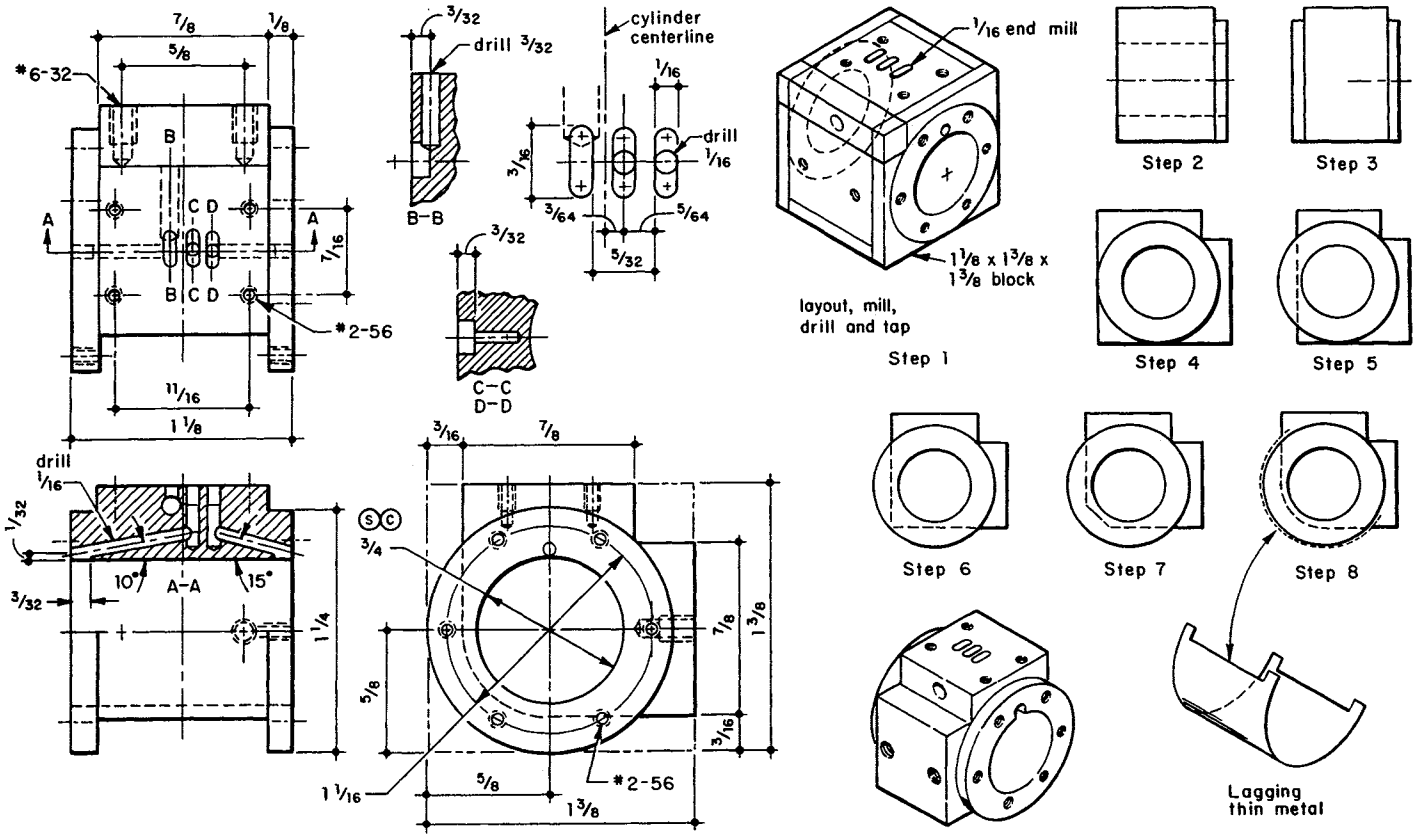
For the **ECCENTRIC**, center a short piece of 5/8" stock in the 4-jaw and take a fine cut to brighten up the O.D.; bore 1/4". Offset .050" and turn the 7/16" diameter. One way to make the offset is to turn the chuck so two jaws are horizontal. Mount a square-ended bar in the tool post and bring it up against the 5/8" diameter. Set the collar at zero, loosen the vertical jaws slightly and back up the rear jaw about 1/16". Force the work piece back using the front jaw. Feed the cross slide in .050" and bring the stock back against the bar using the rear jaw. Now snug up all the jaws. Ease the bar against the high spot and then rotate the chuck 180°. A .100" diameter rod should just pass between them.

The **ECCENTRIC STRAP** is a turned end, filed to shape and soldered to the 1/16" blade.

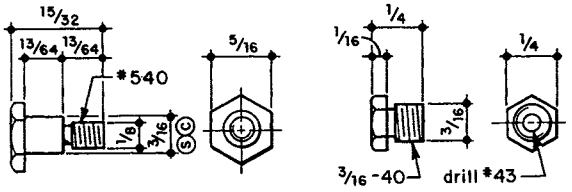
Set the centerline through the Eccentric offset and the Shaft at 90° to the centerline through the Crankpin and the Shaft. Adjust the Valve Rod so the high pressure port is just fully exposed at one end of the Valve travel. Apply compressed air and note the action. Try turning the Valve Rod 1/2 turn and note how the engine runs. You can easily find the spot where the engine runs best.



SINGLE CYLINDER COMPOUND ENGINE



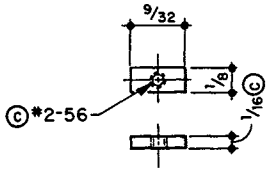
CYLINDER
Hard Aluminum, Brass or Cast Iron



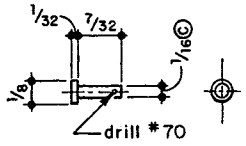
CRANK SCREW
Steel

PACKNUT
Brass or Aluminum

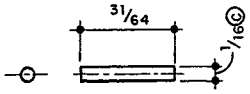
(c) close	(b) solder
(s) smooth	(p) press fit or loctite
(f) flat	



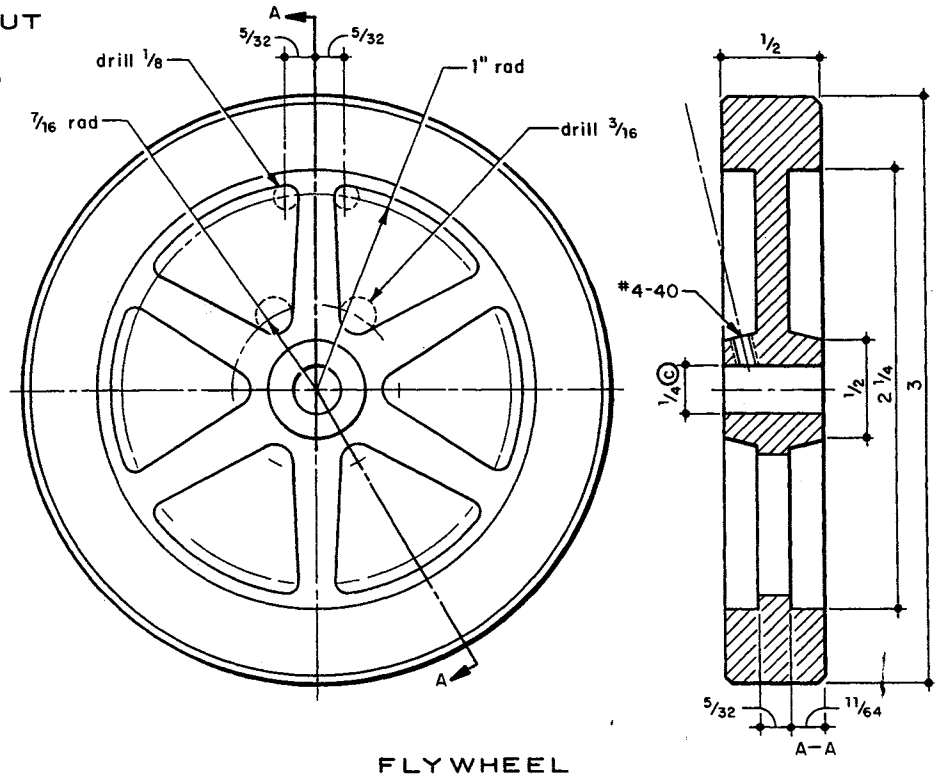
NUT
Brass



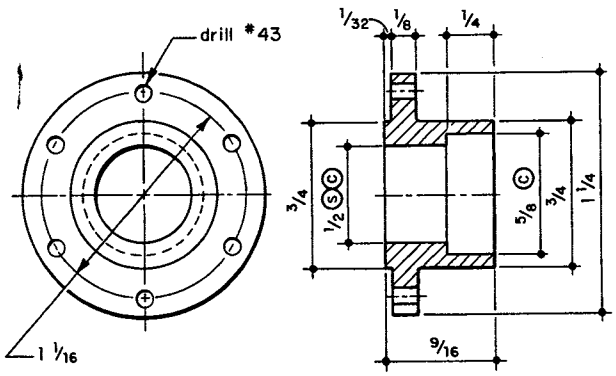
PIN
Brass



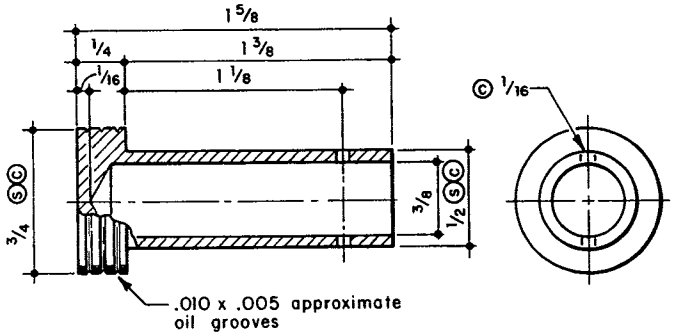
WRIST PIN
Steel



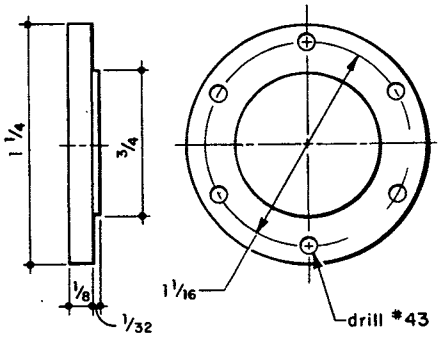
FLYWHEEL
Any Metal



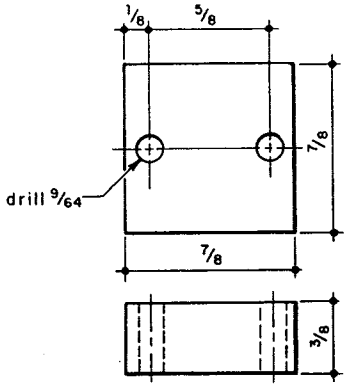
INBOARD HEAD
Aluminum or Brass



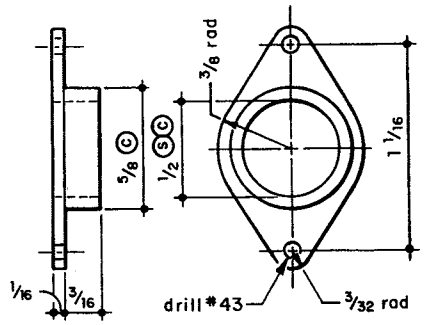
PISTON
Brass



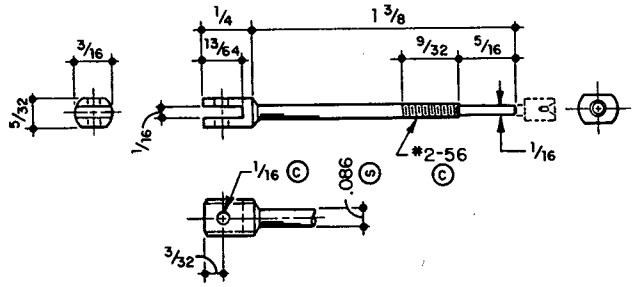
OUTBOARD HEAD
Aluminum or Brass



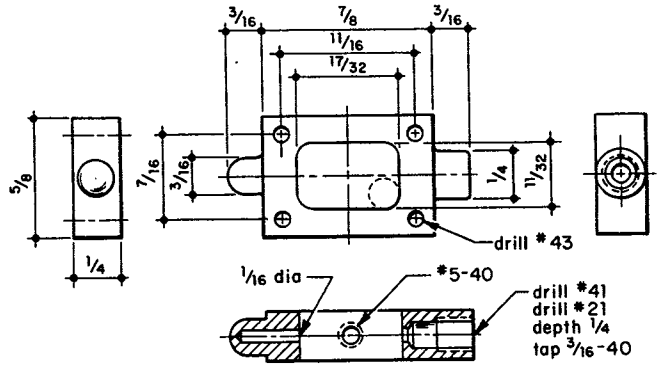
FOOT
Any Metal



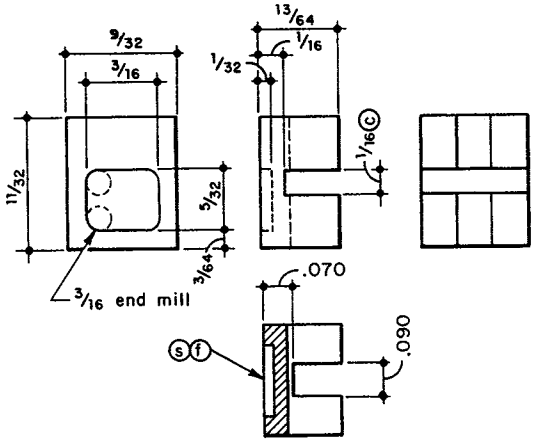
GLAND
Aluminum or
Brass



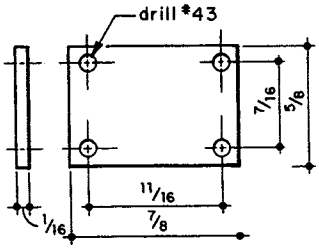
VALVE ROD
Brass



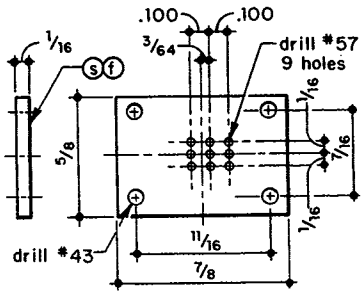
STEAM CHEST
Aluminum or Brass



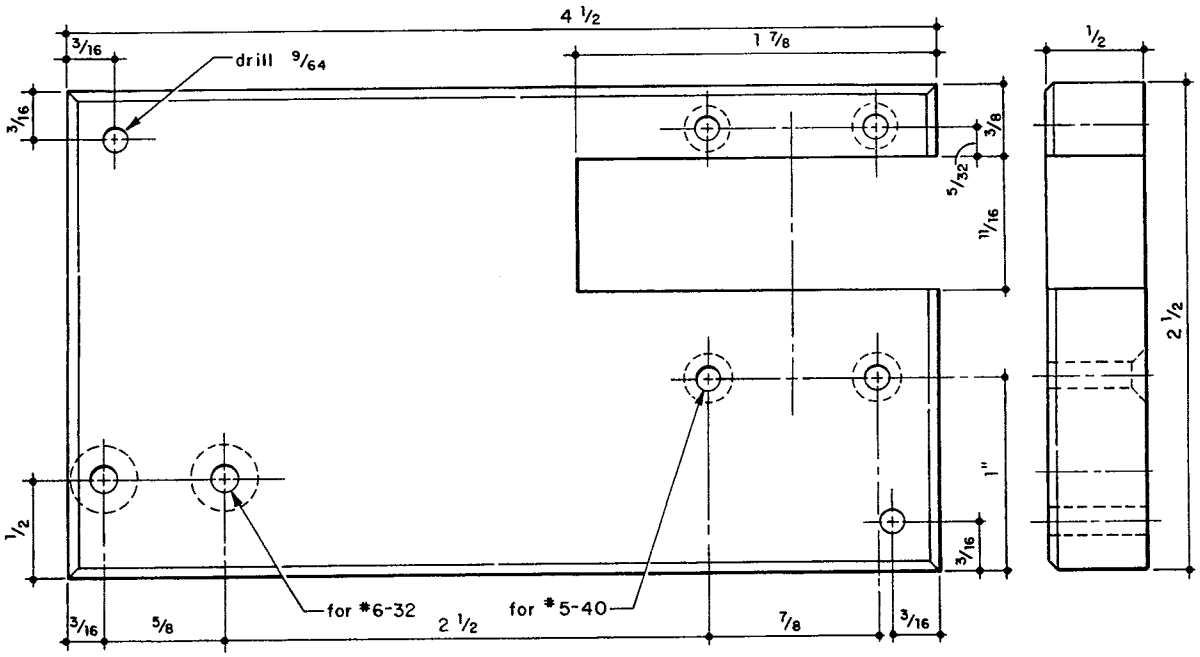
VALVE
Brass



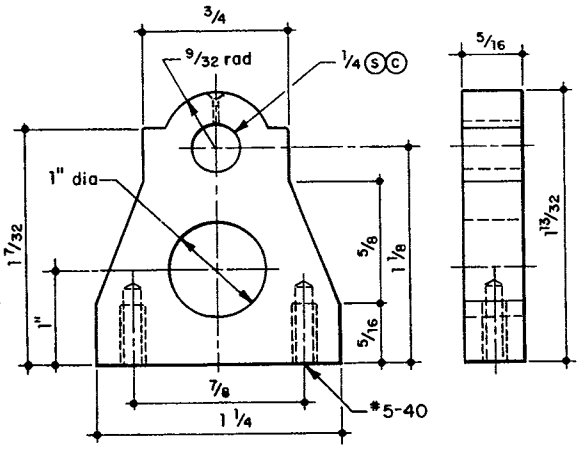
COVER
Aluminum or
Brass



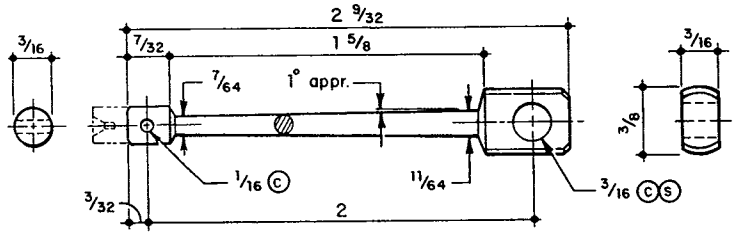
VALVE PLATE
Brass



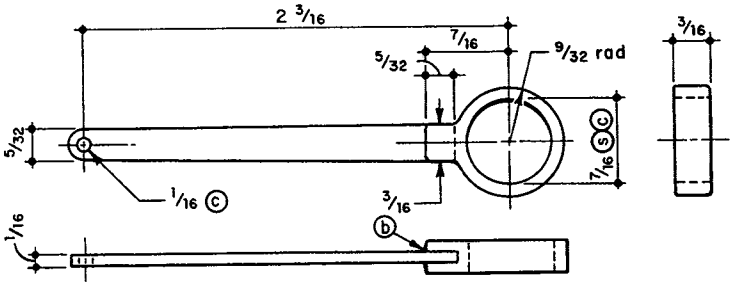
BASE
Any Metal



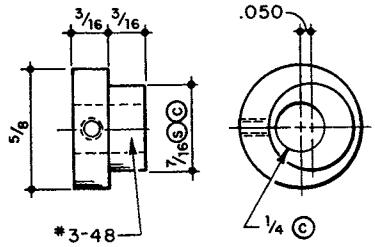
BEARING
Hard Aluminum or
Brass — 2 required



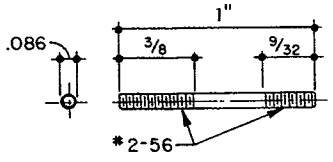
CONNECTING ROD
Hard Aluminum or Brass



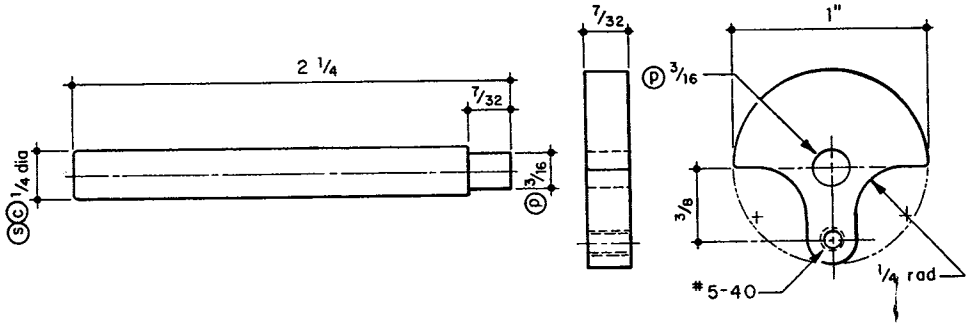
ECCENTRIC ROD
Brass



ECCENTRIC
Steel



STUD
Brass — 2 required



CRANKSHAFT
Steel