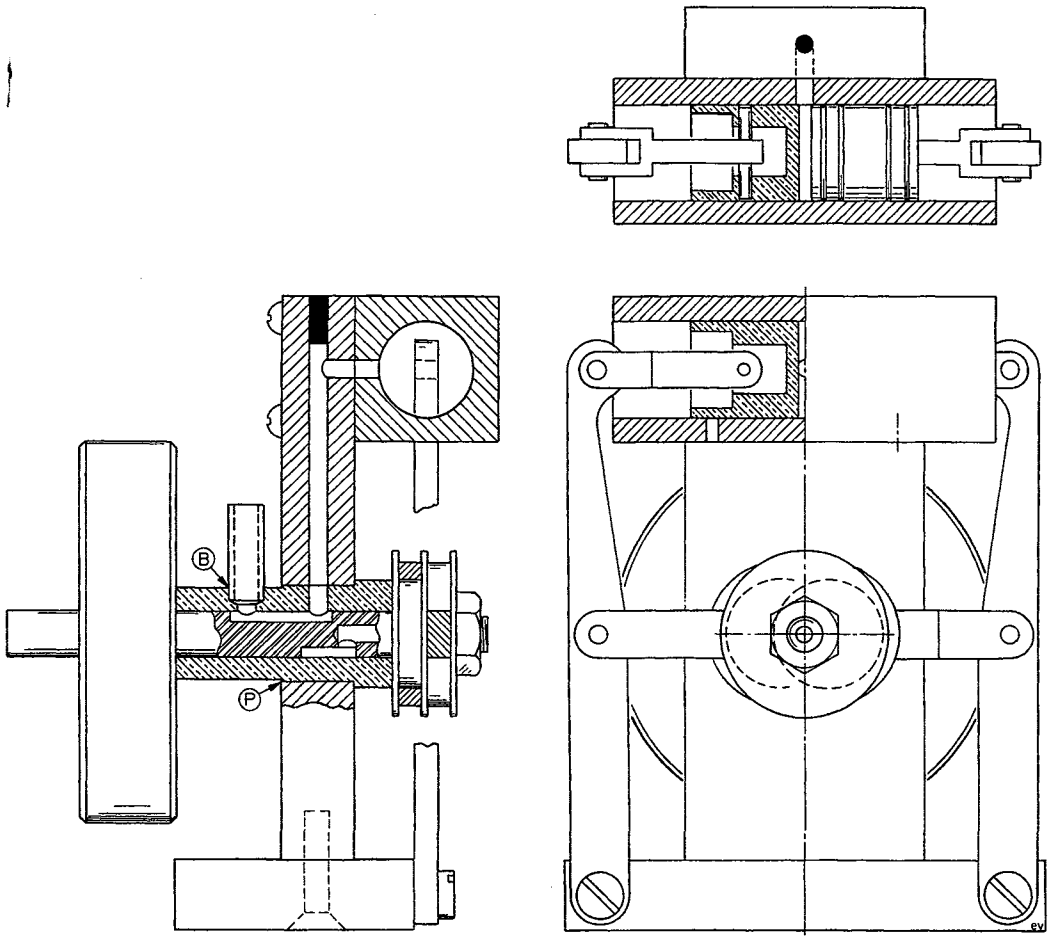
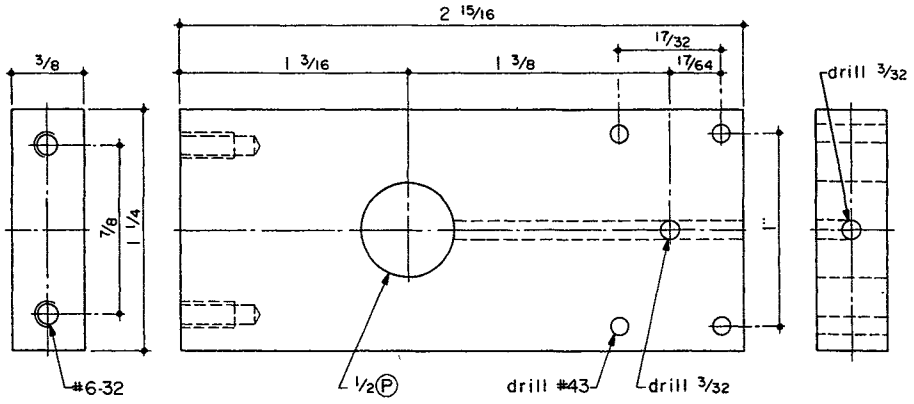
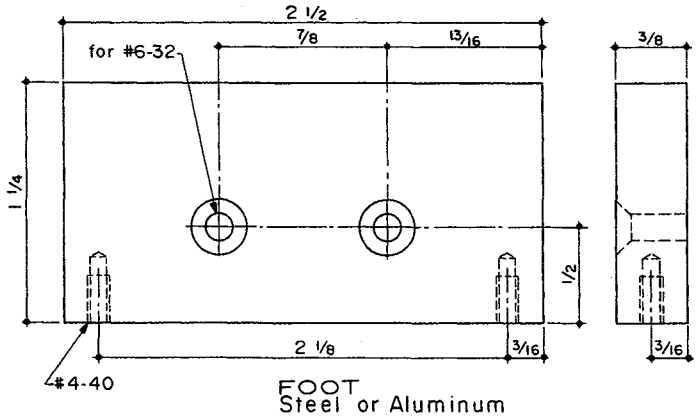


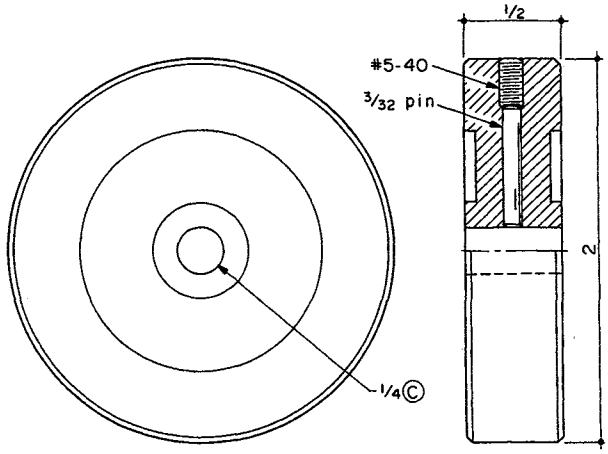
OPPOSED-PISTON ENGINE



COLUMN
Steel or Aluminum



FOOT
Steel or Aluminum



FLYWHEEL
Any Metal

CHAPTER

30 Opposed Piston Steam Engine

In the December, 1977, issue of *Popular Science*, a radical new diesel engine design caught my eye. It was an opposed piston, swing-beam engine being developed by the English firm of Armstrong Whitworth & Company, Ltd., of Slough, near London. The model presented here is an adaptation of this principle to a steam-powered engine which is simple to build and provides an answer to the Amateur Machinist asking for designs of small stationary engines which do not require castings.

I am unable to go into the fine points of determining stress and horsepower but feel that, for a simple engine, it does have several interesting features. It appears to be a balanced engine, but the weight of the Arms and Pistons and the speed do cause some vibration. The short throw at the Cranks requires a high speed. The Pistons travel twice as far as the Connecting Rods do at the Cranks.

Also, there is room for some experimenting. The engine was first made with the exhaust only through the Shaft, but it did not seem to run quite right. Two exhaust holes were then added to make a una-flow type exhaust. These, plus the other exhaust passage, lets it run like mad! If either of the two exhaust systems is closed off, the engine slows down, so both are needed.

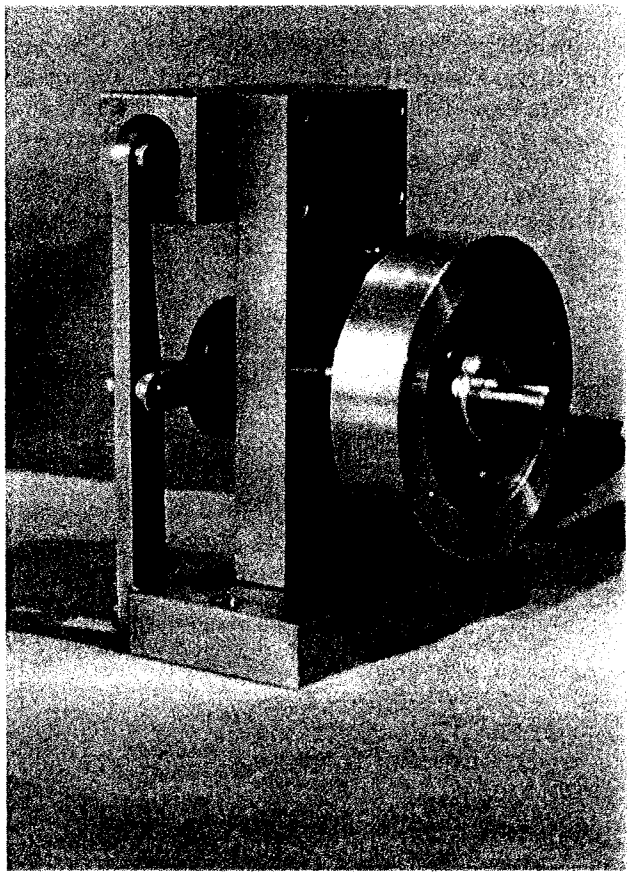
Another question involves the direction of rotation. There is a similarity in porting and it appears that the engine should rotate either way, but it will run only one way. The problem must lie in setting the Eccentrics in the right relationship to the flat Valve surface on the Shaft. It is hard to do this right down to a fine point.

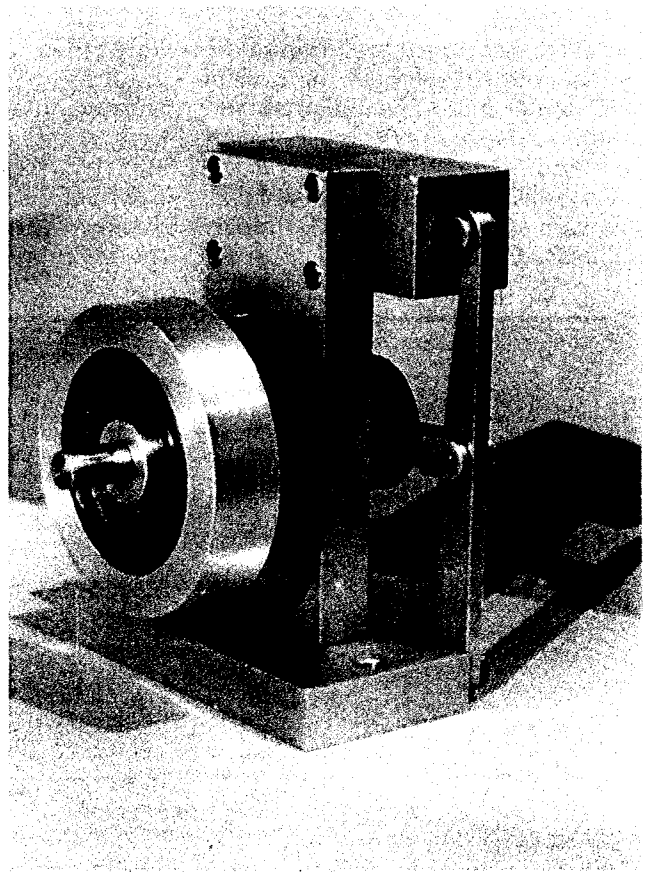
Something else to experiment with is the width and location of the flats on the Shaft, to change the timing and cutoff.

The material for this engine can be most any of the common metals. Since this was to be a display and conversation piece and not run very much, it was made of a fairly hard aluminum that was on hand. The Pistons, Bearings, Eccentrics and screws are brass, the flat washers at the Eccentrics are steel and the Piston pin is drill rod.

The **FOOT**, **COLUMN** and **CYLINDER** are simple, straight pieces requiring squareness and accurate layout. Insert a short, 3/32" pin in the steam passages in Column and Cylinder as a guide, then square up and clamp together for spotting the four 2-56 tapped holes.

Make the **ROCKER ARMS**, shoulder **SCREWS**, **SHAFT** and **BEARING**. Assemble the Bearing into the Column with the 3/16" hole on the vertical centerline, then drill through 3/32" for the steam passage. Solder a short length of 3/16" tubing in the





Bearing for a steam hose connection, as shown. I often run the engine on compressed air at 15 psi, so plastic tubing clings tight enough. For a more durable and steamtight joint, the tube can be longer and threaded.

When making the **PISTONS**, spot four oil grooves as shown, about .010" wide and .005" deep. After Piston, Connnecting Rod and Pin are assembled, very lightly prick-punch the pin hole rim over the ends of the Pin to retain it. One very light punch per end is enough.

The **ECCENTRICS** can be made in a four-jaw chuck. First, turn to an accurate 9/16" diameter, about 1/2" wide, then loosen the jaws slightly and, using the cross-slide for measuring, move the workpiece 1/8" off center. Ream 3/16" for the Shaft. Return the workpiece to center (or near center) and make parting cuts for two .130" thick Eccentrics. Mount the two Eccentrics on a close-fitting 3/16" Pin. Rest this Pin on two more 3/16" Pins on a flat surface, as shown. With the two Eccentrics also touching the surface, clamp together with a small machinists clamp and drill the 1/16" pin hole. Mark with a stamp the two faces that touch, so the Eccentrics can be reassembled in the same relationship in which they were drilled.

Make three **DISKS**. Use one of the Eccentrics to spot the pinhole in the center Disk only. This 1/16" pin, about 9/32" long, is retained by the two outer Disks as shown. The O.D. of the Disks can be finished by chucking the Shaft to run true, then mounting the three Disks and two Eccentrics in place and hold them with a 10-32 nut.

There are several ways to make the four **CONNECTING RODS**. These range from plain hacksaw-and-file work to gang-milling the way Kozo Hiraoka does it. For accuracy and finish, the 9/16" bore is a lathe job, using a center test indicator and fine cuts.

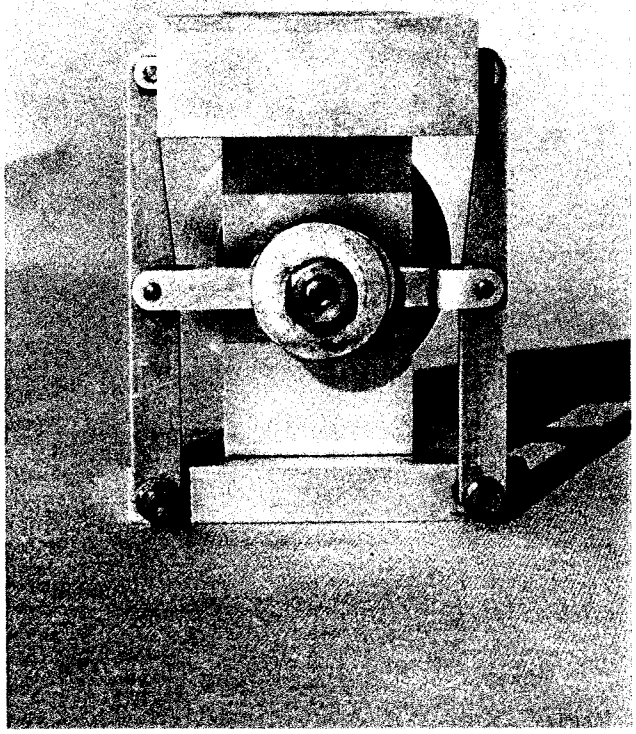
The four 3/32" pins in the Rocker Arms may be made in several ways. Here again, it isn't very good engineering, but a small prick punch near the rim of the pin will keep them in place. Tiny nuts and bolts can be made or make the pins long enough to take tiny cotter pins.

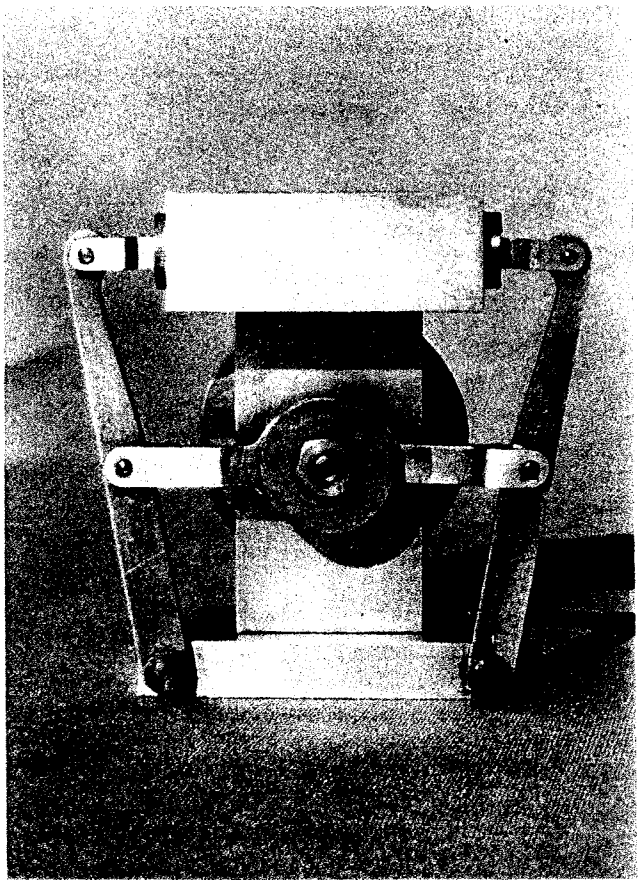
The **FLYWHEEL** should be about 2" in diameter and 1/2" wide, with a setscrew, to fit the 1/4" Shaft.

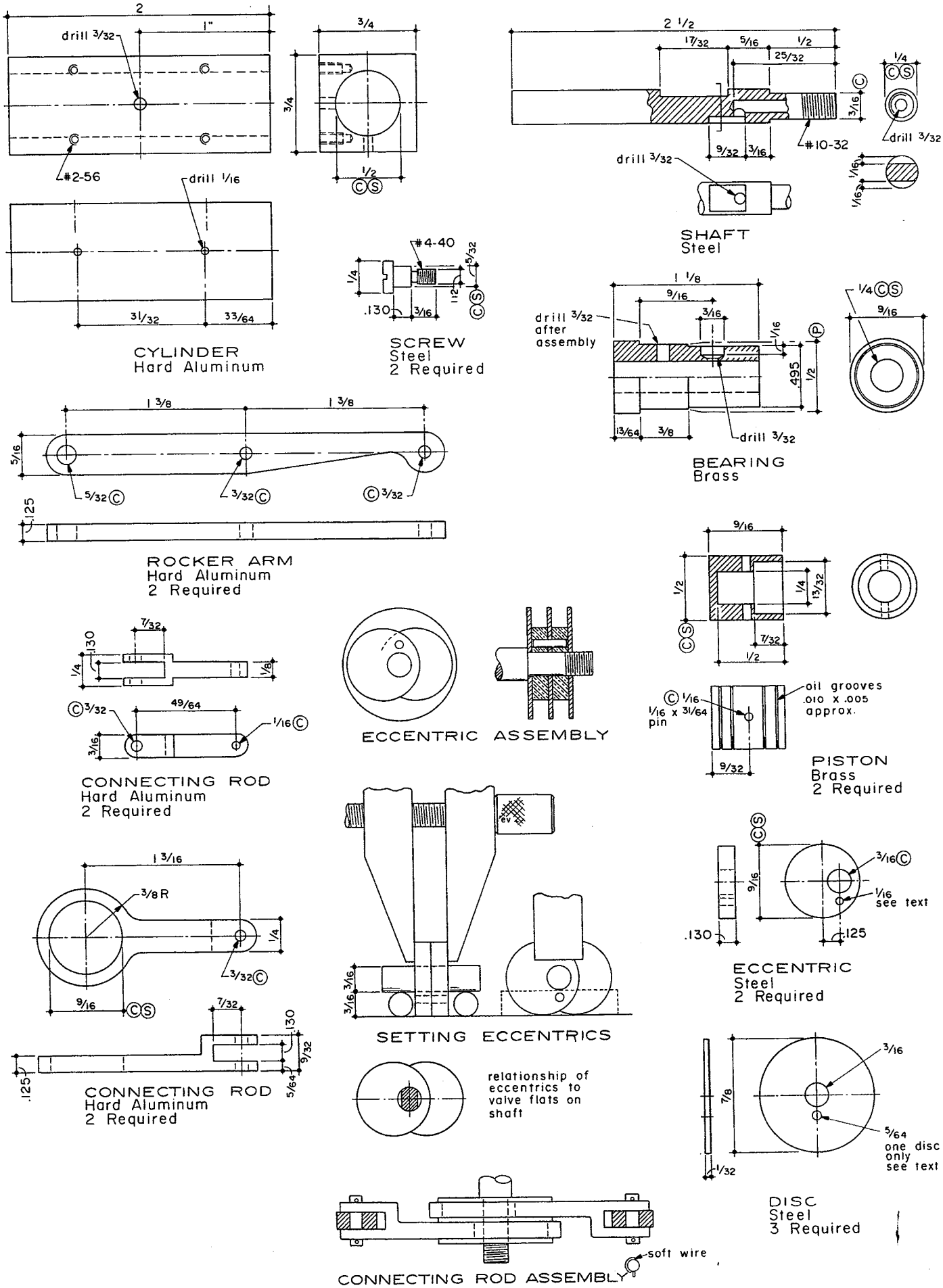
At final assembly, be certain that the relationship of the Eccentrics to the Valve surfaces on the Shaft are correct. They are shown in the Eccentric Mounting Detail drawing.

This simple and unusual engine should provide you with several hours worth of enjoyment in building and operation.

It will be a most interesting addition to your collection of fine steam engines.






drill 3/32
#2-56
drill 1/16
3 1/32
33/64
CYLINDER
Hard Aluminum
#4-40
.130
SCREW
Steel
2 Required
drill 3/32
#10-32
SHAFT
Steel
drill 3/32
after
assembly
drill 3/32
BEARING
Brass
5/32 C
3/32 C
3/32 C
.125
ROCKER ARM
Hard Aluminum
2 Required
.130
3/32 C
1/16 C
CONNECTING ROD
Hard Aluminum
2 Required
ECCENTRIC ASSEMBLY
oil grooves
.010 x .005
approx.
1/16 C
1/16 x 31/64
pin
PISTON
Brass
2 Required
3/8 R
9/16 CS
CONNECTING ROD
Hard Aluminum
2 Required
SETTING ECCENTRICS
relationship of
eccentrics to
valve flats on
shaft
3/16 C
1/16
see text
.130
.125
ECCENTRIC
Steel
2 Required
5/64
one disc
only
see text
1/32
DISC
Steel
3 Required
soft wire
CONNECTING ROD ASSEMBLY