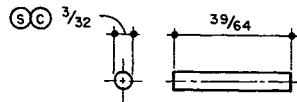
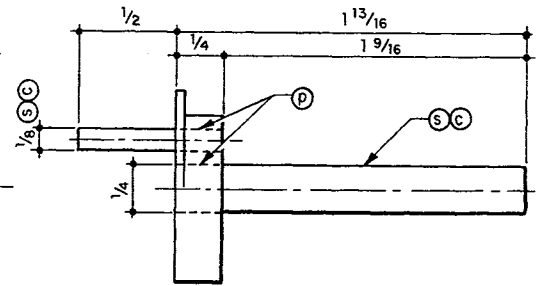
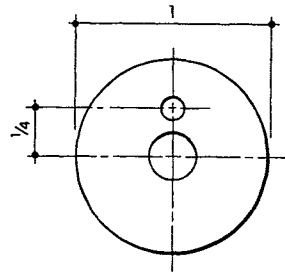
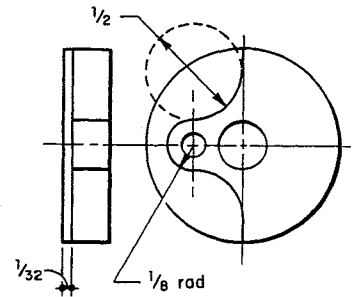


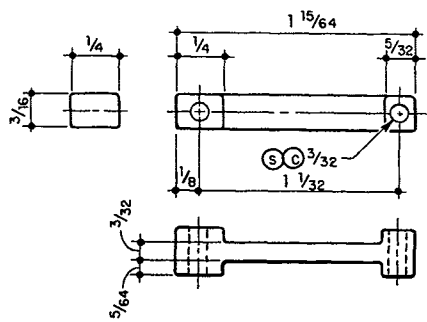
**PISTON**  
3 Required



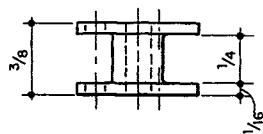
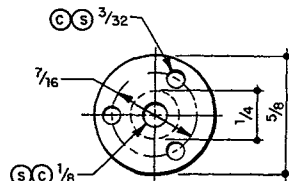
**WRIST PIN**  
3 Required



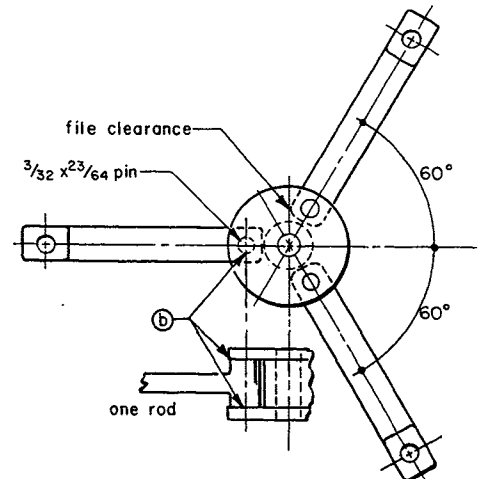
**CRANKSHAFT**



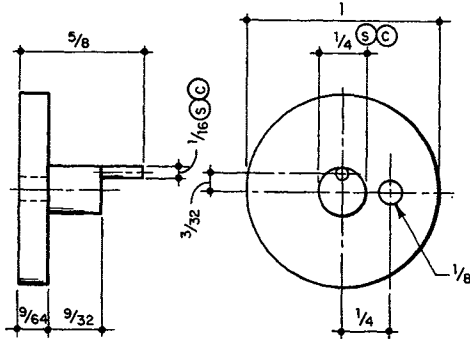
**CONNECTING ROD**  
3 Required



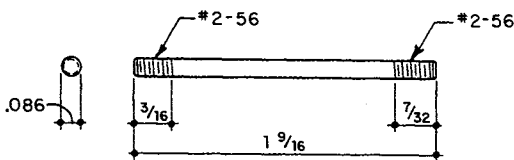
**CONNECTING ROD HUB**



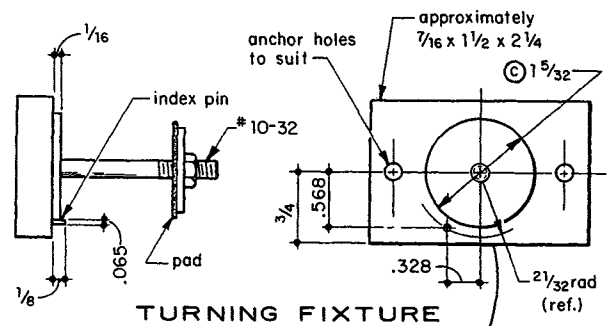
**CONNECTING ROD ASSEMBLY**



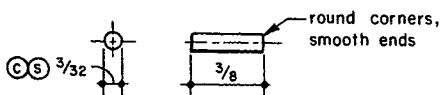
**VALVE CRANK**



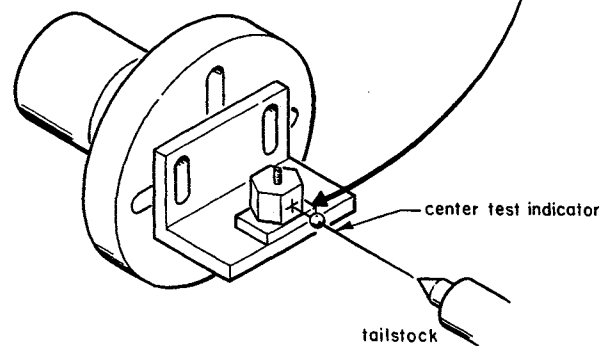
**STUDS**  
12 Required



**TURNING FIXTURE**



**HUB PIN**  
2 Required



tailstock

## 11

## Radial Engine

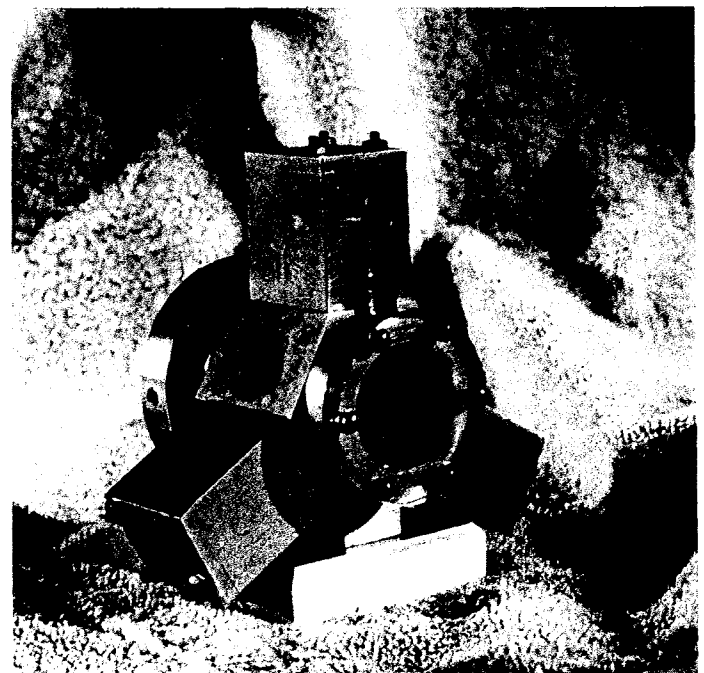
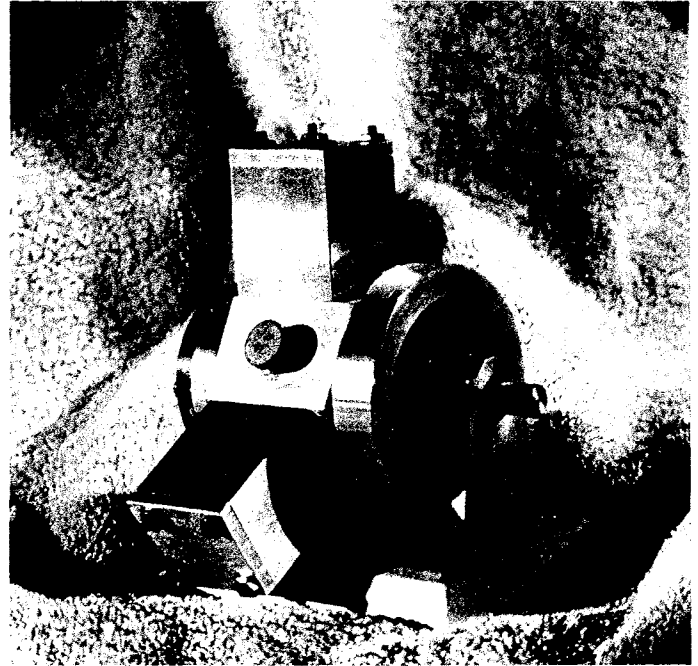
This is a simplified radial engine using a disk valve driven by an offset pin in the hub of the crank mechanism. It is interesting to build and run; and with three impulses per revolution, it has quite a bit of power. The optional Bearing Bushing is "Oilite." Use any material you may have in your odds-and-ends department as the kind of material is not critical.

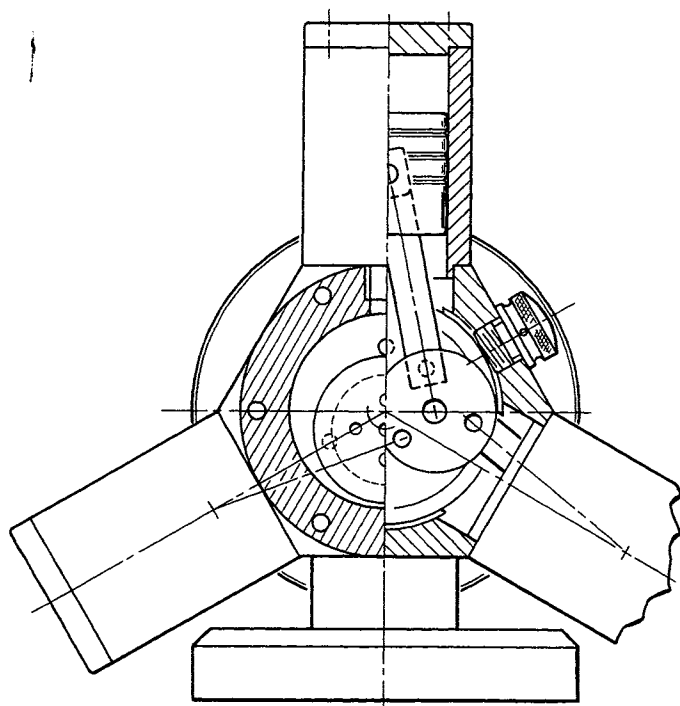
The Base is detailed to show four anchor holes, a decision made after the engine was assembled. Since most of the parts involve common machining practice, only the parts that need an extra word will be mentioned.

Make the **CRANKCASE COVER** with 6 accurately located #50 (.070") drilled holes on a 1-5/16" bolt circle and 1-5/32" dowel. NOTE: These are tap drill size for use on a jig on the crankcase. Enlarge later as needed.

Make the **VALVE HOUSING**, again drilling #50 for use as a jig. Take care to make the face and inside backwall parallel and smooth. This has to be just barely a free fit on the valve to make it as steam-tight as possible. Drill #23 (.154") through the backwall for later tapping the 3/16-40 MTP exhaust connection.

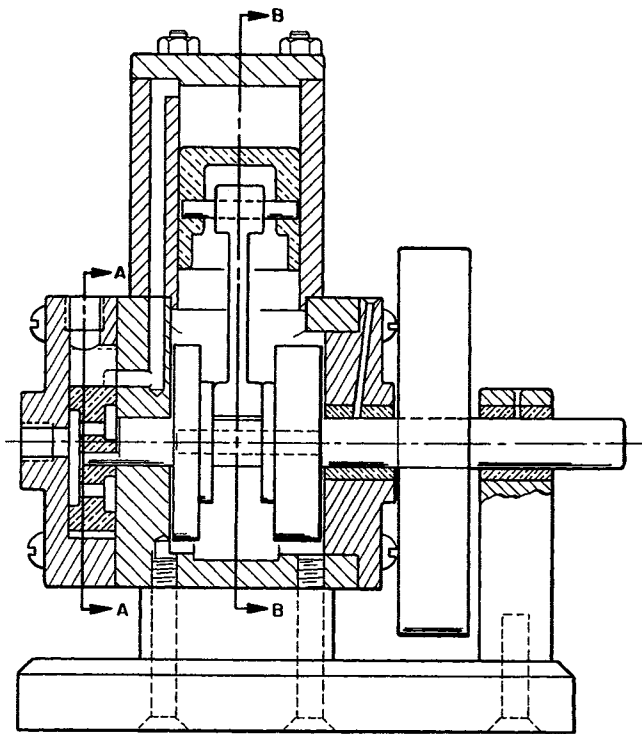
The **CRANKCASE** starts out as 1-3/4" round stock. First, chuck a 1-5/16" length in the three-jaw. Face the end and bore 1-5/32", 31/32" deep to a close fit on the Crankcase Cover. Bore and ream the 1/4" hole in the backwall. Since this is a very compact engine, a 1/32" x 7/16" undercut in the bore helps to provide clearance for the Connecting Rod Assembly. Use the Crankcase Cover as a jig and drill six #50 holes. Reverse in the lathe and turn the back face. At final assembly, this face must be smooth and flat. Make a turning fixture for mounting on an angle-plate mounted on the lathe faceplate. The location of the .065" pin and the diameter of the 1-5/16" pilot are important since this is the indexing means for turning the faces of the hexagon and making the three holes for the Cylinders. Center the jig squarely on the angle plate and spot the Crankcase on the lathe centerline. Index and machine the six faces. Prick punch the center for one Cylinder Mounting Hole; and using a center test indicator tunk the angle plate around until centered. Bore the three Cylinder Holes. Use the Cylinders as jigs to make the four Stud Holes for each Cylinder and the three 5/64" Steam Passages. Also, use the Cylinder to drill the three Cylinder Heads. Mark all these parts so they can be assembled in the spot where they were drilled. Use layout dye and transfer the center lines of the 5/64" Steam Holes around onto the back of the Crankcase. Using a "morphy" caliper, mark the



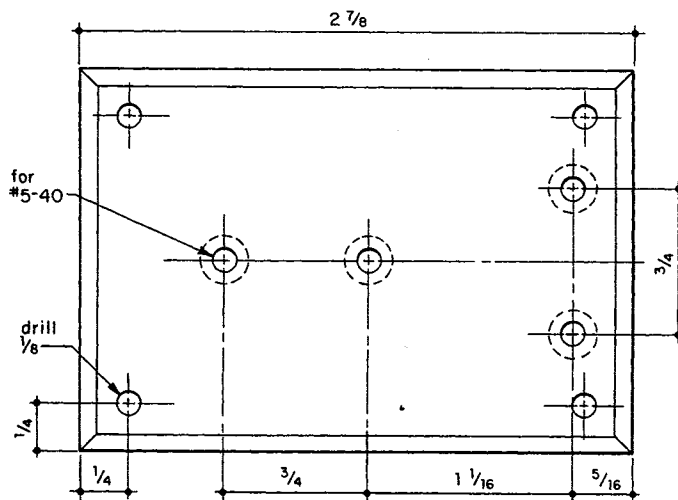


Section A-A

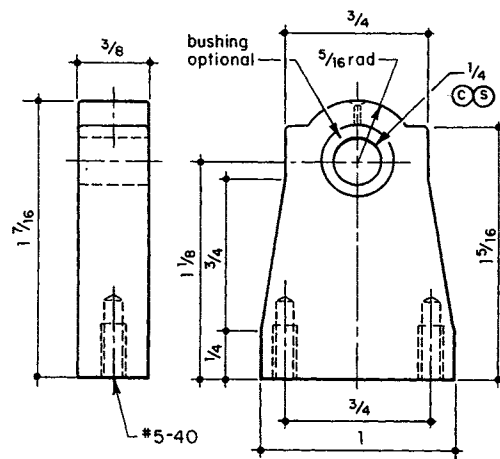
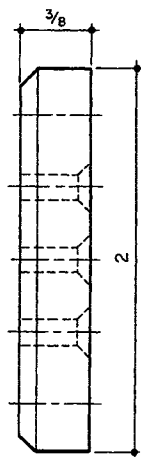
Section B-B



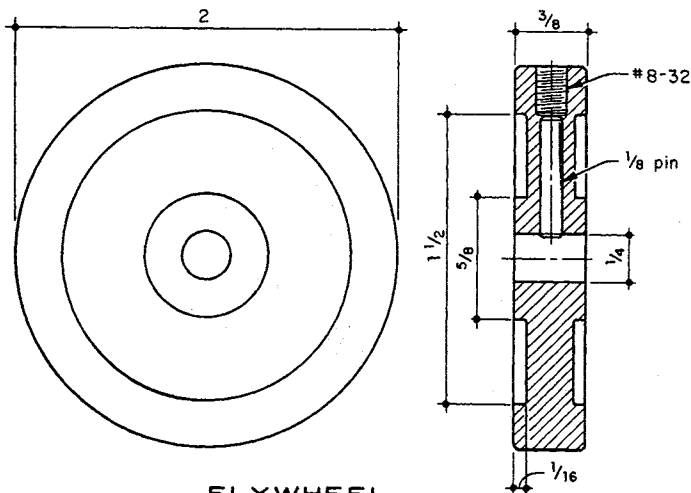
**RADIAL ENGINE**



**BASE**

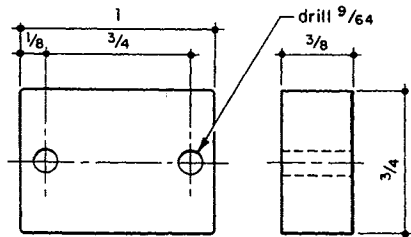


**BEARING**

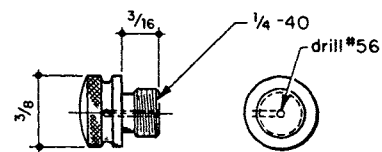


**FLYWHEEL**

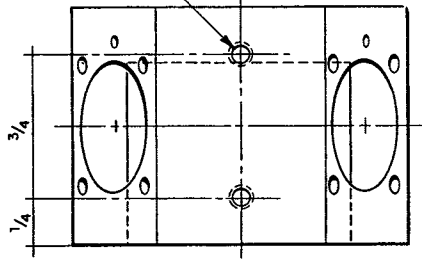
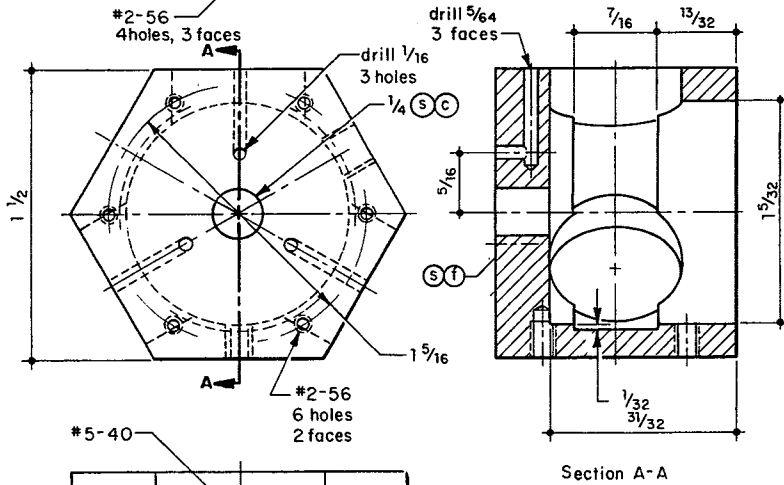
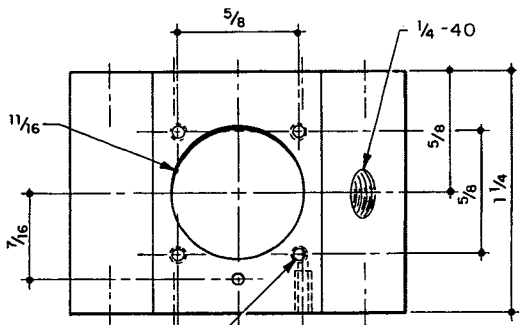
- |   |                        |
|---|------------------------|
| Ⓢ | smooth                 |
| Ⓒ | close fit              |
| Ⓕ | flat                   |
| Ⓑ | braze or solder        |
| Ⓓ | press fit or "loctite" |
| Ⓘ | parallel               |



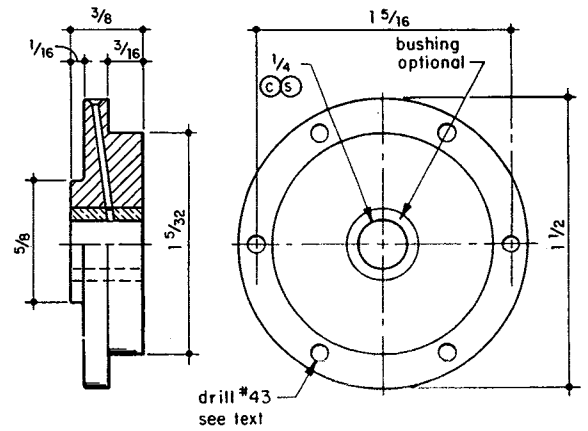
**ENGINE FOOT**



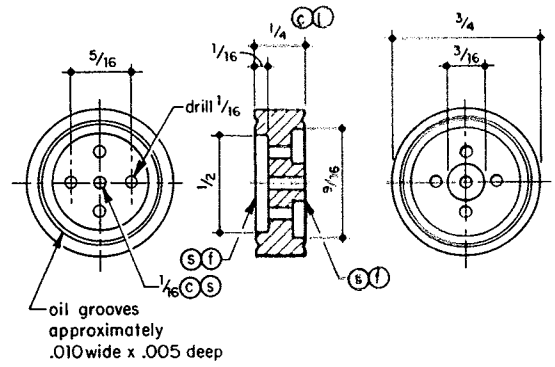
**VENT PLUG**



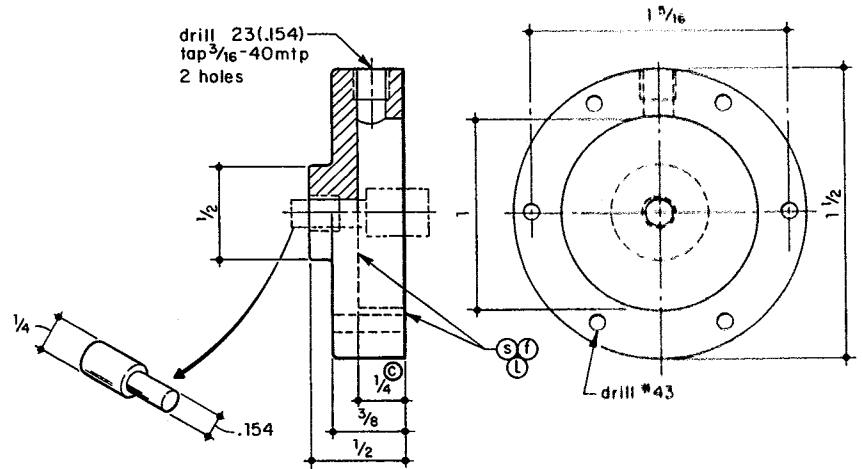
CRANKCASE



CRANKCASE COVER

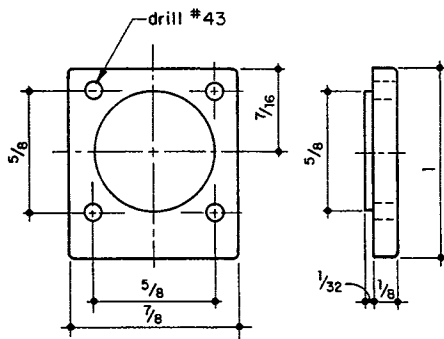


VALVE

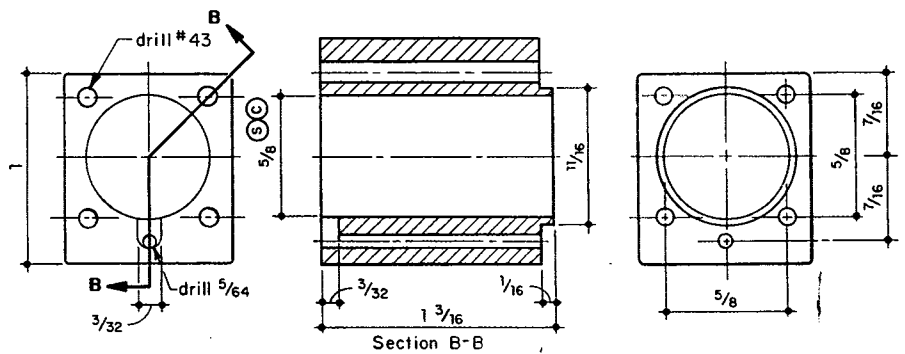


LOCATING PIN

VALVE HOUSING



CYLINDER HEAD



CYLINDER  
3 Required

centers of the 1/16" holes, 3/16" from the 1/4" hole, thus 5/16" from the center. Now carefully drill the 1/16" holes into the 5/64" holes. Make a Stepped Pin .154" and 1/4" diameter to locate the Valve Housing on the Crankcase. Spot so as to locate the holes on the centerlines through the hexagonal points. Tap-drill #50 for 2-56 thread.

The **VALVE CRANK** is a turning job. Turn the 1/4" diameter 31/64" long, then make a parting cut 5/32" from the face (to later clean up to 9/64") down to a diameter of 1/4". Offset 3/32" and turn the 1/16" diameter projection. Chuck on the 1/4" diameter, using a bit of thin copper to avoid chuck marks, and bring the **DSteamed Ham Directory**

23 Feb 1989isk to 9/64" thickness.

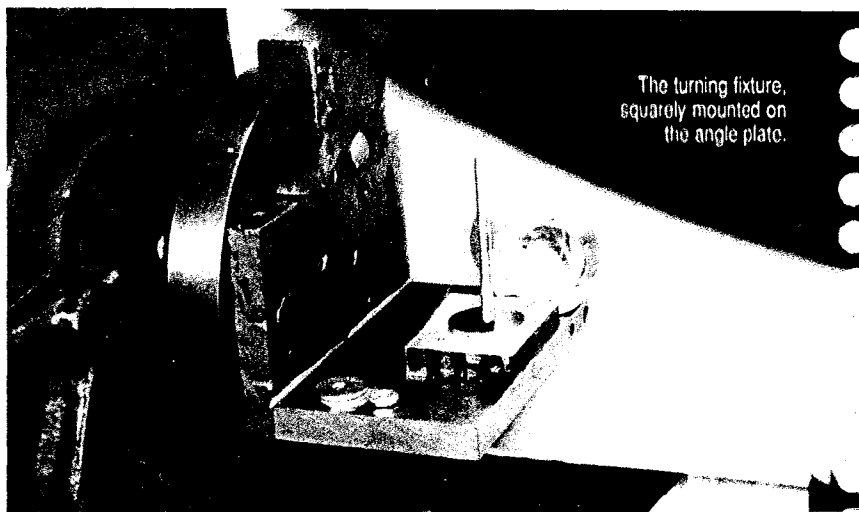
The **VALVE** is also a simple turning job, but flatness and parallelism are important. Turn the outside, face, and recess 9/16" x 3/16" x 1/16", adding the oil groove. Make an accurate 1/16" center hole. Make a rough parting cut at 17/64" down to about 3/16" diameter. With a keen parting tool, make a fine cleanup cut to bring the thickness to 1/4". This is to guarantee the two faces are parallel. Part off without touching this surface. Re-chuck and cut away the 1/2" x 1/16" metal without touching the finished 1/4" rim. Add the oil groove. At assembly, using a very fine emery on a flat surface, lap this Disk or the Disk Housing or both until the Disk is just barely free in the Housing when assembled. Another important point on this Valve is to accurately hold the O.D. and the 9/16" diameters. This rim slides across the 1/16" ports, exposing them to steam and exhaust at the right amount and moment in each revolution. This Valve can be assembled with a thin coat of Moly Lube to fill the surface pores and prolong its sealing life.

The **CRANKSHAFT** is more or less simple, except the entire 1" diameter face is required to retain the two loose pins in the Connecting Rod Hub. It is hard to balance this engine so all the counterbalance possible is used. The milling cut shown is one way. Another way is to drill blind holes to remove metal. Even then, it will not be entirely free of vibration. So, mount the engine solidly. (If you care to try it, the Crankcase Cover can be made perhaps 1/8" shorter and the Crank Disk 1/8" thicker. There is also a possibility to remove some weight from the Pistons and Connecting Rods.)

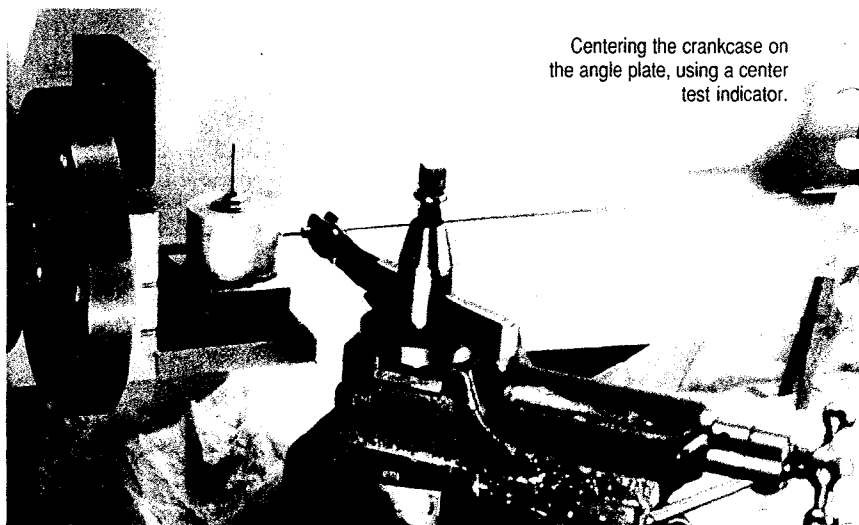
The **CONNECTING RODS** are all alike except one is soldered into the hub permanently. Try to make the Rod centerline pass through the hub centerline. A brass Pin is used in this Rod for easy soldering. The other two pins are bits of drill rod with polished ends to reduce scoring in between the Crank Disks.

The **WRIST PINS** are drill rod, a bit shorter than the Piston diameter. A tiny bit of **PISTON** metal is flowed over the ends of the Pins to keep them centered to avoid scoring the Cylinder Walls. A prick punch mark at the rim of the hole will form a tiny burr over the end of the Pin.

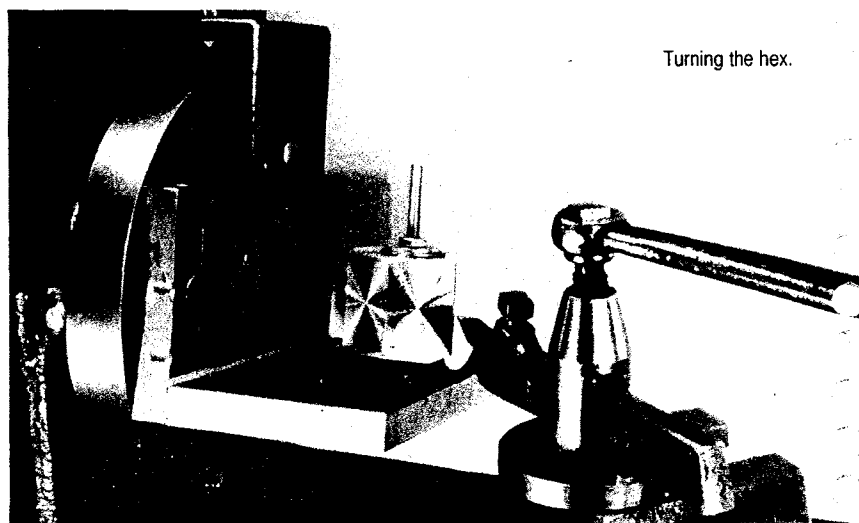
This Radial Engine should provide you with many hours of enjoyment in both the building and operation.



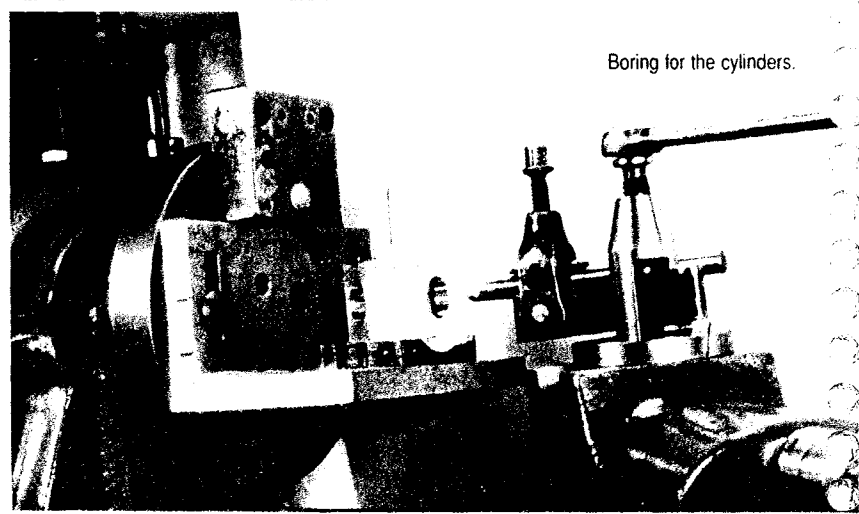
The turning fixture, squarely mounted on the angle plate.



Centering the crankcase on the angle plate, using a center test indicator.



Turning the hex.



Boring for the cylinders.