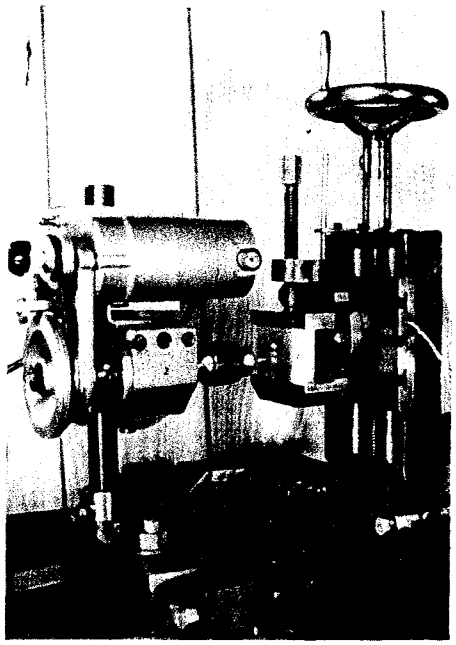
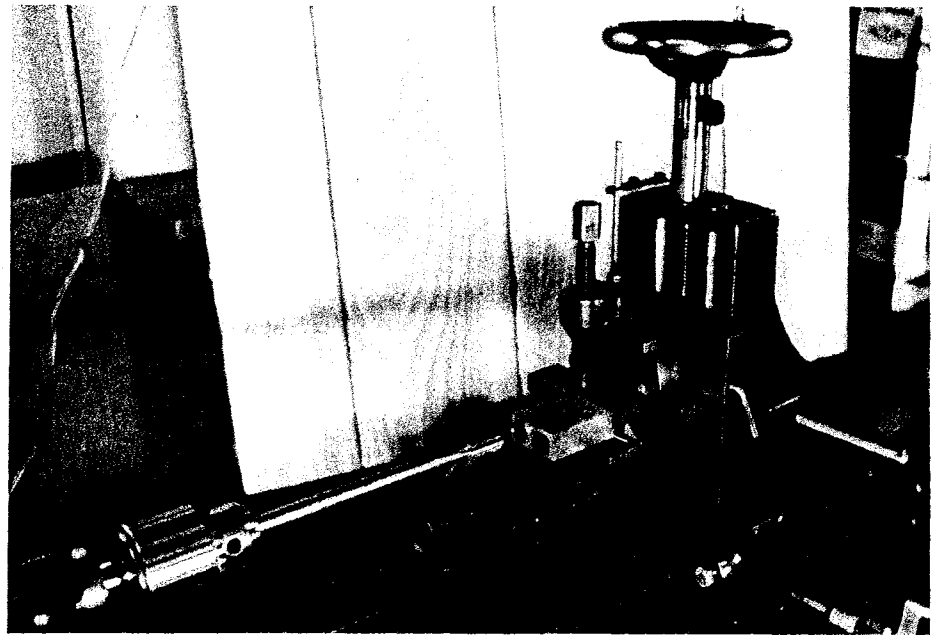
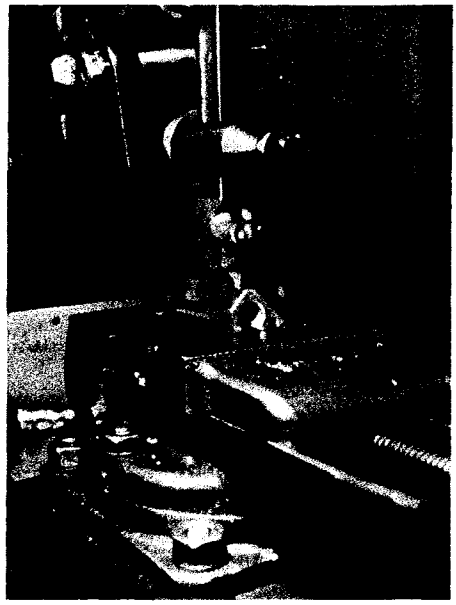




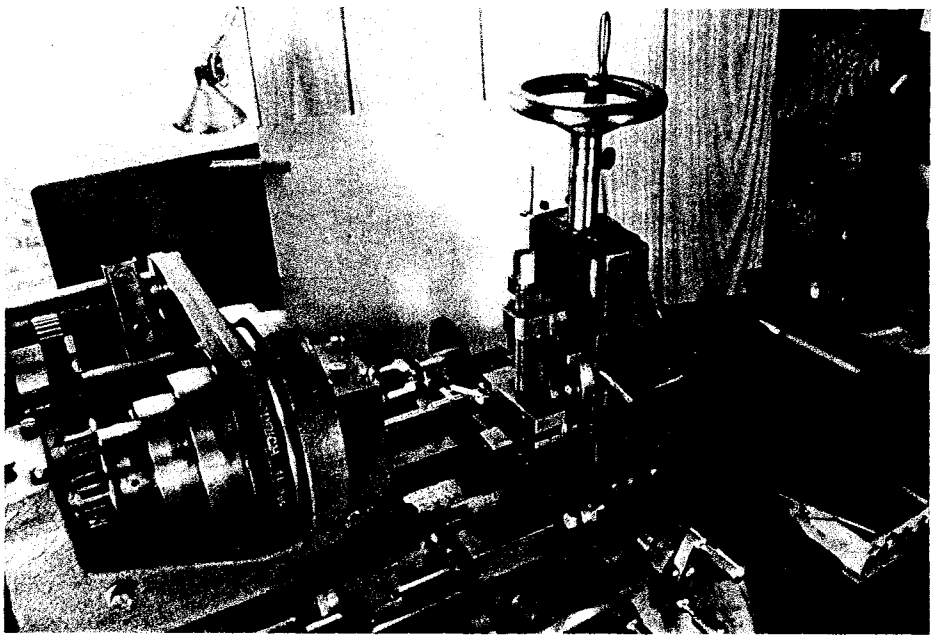


Upper left: Milling the ports in the Cylinder, using the Unimat spindle and cross slide milling attachment.

Upper right: Reaming the bores of the Cylinder Block.

Left: Shaping the bevels.

Below: Cutting away the Shaft material in the Crankshaft.



joint. This guarantees the Links will meet properly and match the center distance across the two Cylinder bores.

Use your favorite **PACKING** in the Stuffing Boxes. Thin strands of graphited asbestos were used in the model shown. Turn only finger-tight.

Make all the pieces for the **CRANKSHAFT**. Make two End Bars from 3/16" x 5/16" stock and the center piece from 5/16" x 11/16" stock. Lay out and prick punch the center hole in the center piece and one end hole in one EndBar. Lay out both holes in the otherEndBar. Drill #16 and ream 3/16" in the Center Piece and one end hole in each End Bar. Drill the second end hole in the one bar. With a close-fitting 3/16" guide pin, use this bar as a jig for drilling #16 for all the remaining holes. Ream 3/16" in all these drilled holes. Mill the Center Piece to shape. Assemble loosely on a flat surface. As you know, these joints must be clean for assembly with Loctite. Ease the pieces apart at **X** and apply Loctite at these two spots. Set the Crank Pins flush as shown and, with the rest of the joints still loosely assembled, set aside to cure with all the parts resting on a flat surface. Make two .194" **SPACERS**. Apply Loctite to the remaining joints and rest this assembly on the flat surface. Use the .194" Spacers, hold the 1/2" dimension and set aside to cure. Drill and insert 1/16" spring pins and cut away the Shaft as shown. The 1/16" pins are a bit large but very easy to use. The Crank shown used some 1" nails about .047"

CHAPTER

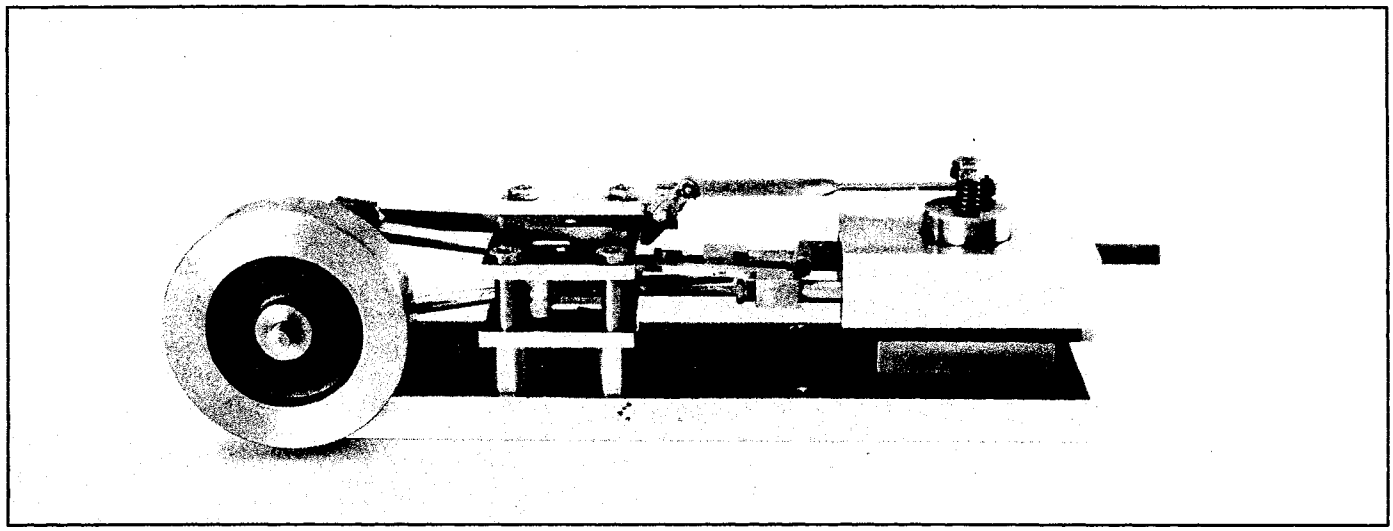
34 Cross Twin Engine

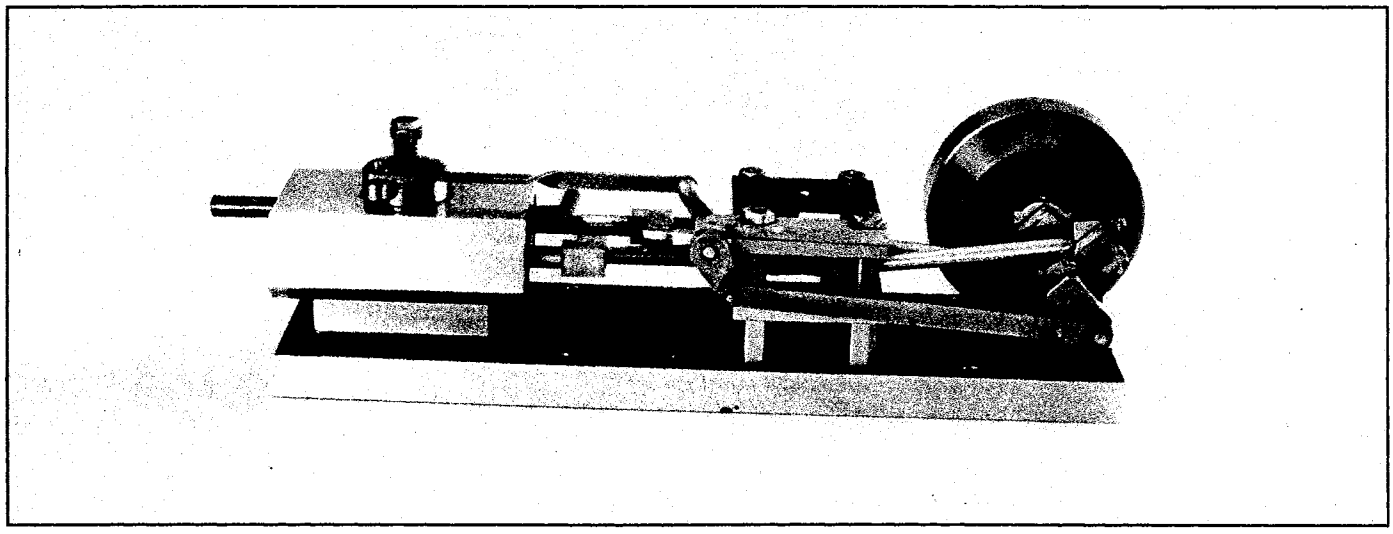
If you have made an assortment of the popular model engines, it may be interesting for a change to try this novel design. The idea came from a patent drawing for an engine made by D. H. Iseminger in 1901. There were no fine details or comments so everything had to be worked from scratch. About the only thing used was the general principle. The engine, as detailed here, is a fairly close likeness and not too difficult. It really is a conversation piece and a "show off" at club meetings, etc. Perhaps more durability should be built into it if it is to be run for long periods. For those who like to see a lot of action, it is a winner. The novelty is that it has two Cylinders, four Pistons and no Heads. The Valve and Linkage add to the action.

Study the assembly and note how the three components are related. The center-to-center distance across the Cylinders must be held across the Guides and at the throws of the Crankshaft. The height of the bore and Crosshead center are important for a free-running engine. This may call for a bit of filing and shimming at assembly. The Cross Links must be carefully assembled and soldered into the Stuffing Box. Some of the points that came up while building this engine are given here.

About the only thing to mention on the **BASE** is careful layout so the three sub-assemblies accurately straddle the centerline. It is a long and narrow engine. Mount the **BEARINGS** on the Base and line-ream for a close but free-running fit on the Crankshaft.

For the **CYLINDER BLOCK**, start with an accurate 3/4" x 1-5/8" x 2-1/8" piece and lay out all lines and hole centers. Note the pattern for the Valve holes and grooves are based on





six equally-spaced centers on a 1/2" circle. The same "six pattern" is used on the Valve so a 60° turn of the Valve matches the Cylinder pattern. Drill two shallow 3/32" holes on the 1/2" circle and mill the connecting groove with a 3/32" end mill. The 3/32" holes going down to the bores are centered in these grooves. Drill these holes before making the two 1/2" bored holes. The bores are made using the cross slide milling attachment. One hole is centered using a wiggler and bored and reamed. Feeding in .875" centers the other 1/2" bore. These bores could also be made in the 4-jaw, picking up the centers with a center test indicator. The remaining operations are straight machine work. Take care to have a clean flat surface to seal against the Valve. The **VALVE**, as mentioned above, has six evenly-spaced centers on a 1/2" circle. Drill shallow 3/32" holes and mill the grooves between them with a 3/32" end mill. Here, too, the face must be flat and smooth for a good seal on the Cylinder Block. The projection for the Link Pivot is a small block soldered into a milled groove parallel to the Valve grooves. Lay out the center for the Link Pivot 1/2" from the Valve center for a 1/16" pin. Set the pin with Loctite or solder.

The **VALVE LINKAGE** is mostly simple maching and soldering. The 1/16" pin entering the 1/16" thick link can be quite close fitting and still allow the movement through an arc at each end. In a large engine, these joints would require ball joints or self-aligning bearings of some sort.

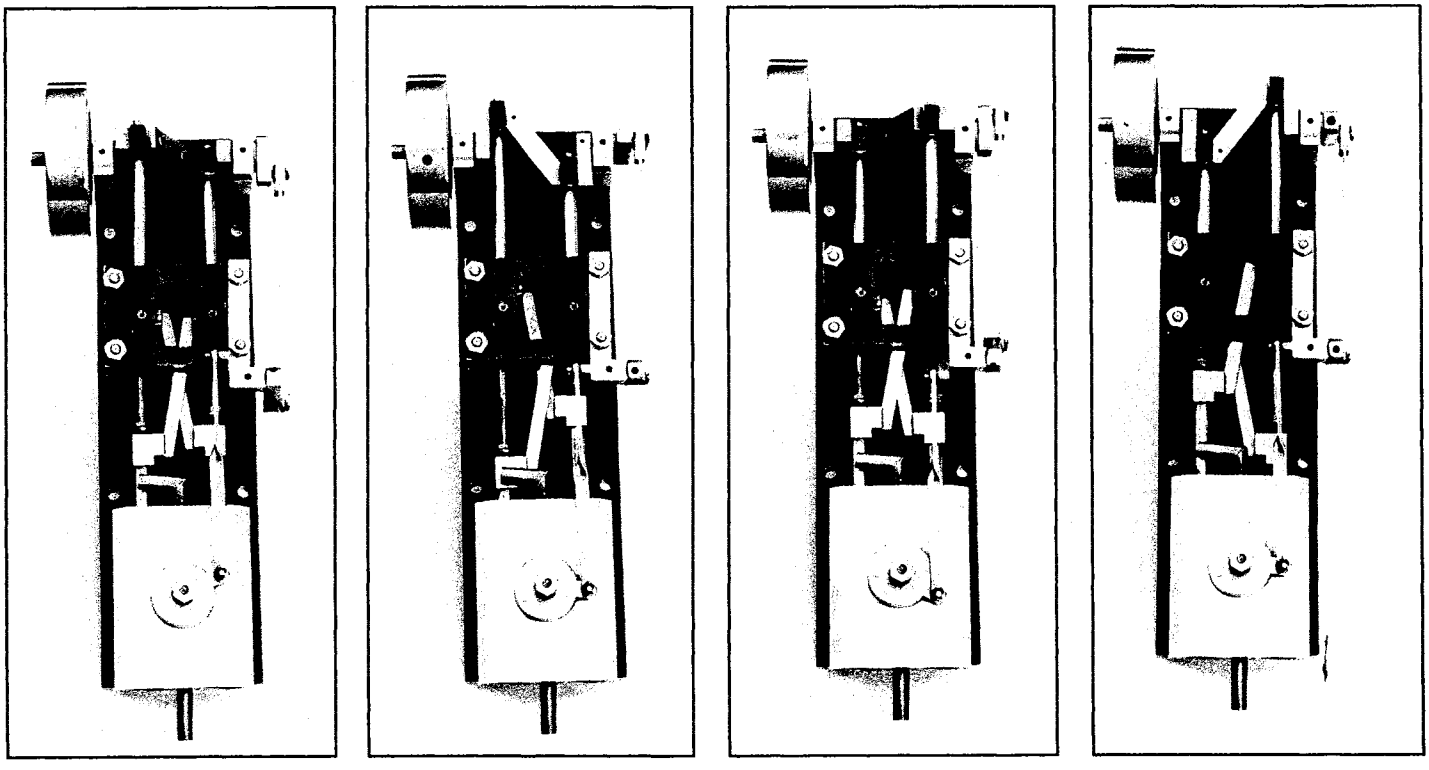
The **CROSS HEAD GUIDES** are made from a piece 1-3/4" x 2-9/16" x 1/8". Two parallel grooves that guide the Cross Heads, are made in this piece. While it is at this stage, lay out and make all the holes for the studs and cut out the 1/2" x 3/4" center hole. When all is to size and shape, cut the piece in two, forming the Upper and Lower Guides. It is important to have well-spaced and close-fitting, yet free-running, Guides. They have to take the forces from the Crank and angle thrust from the Cross Links. Perhaps some will prefer to cut the piece in two and lay out one piece and use it as a jig for the second piece. Take care that the upper and lower grooves are parallel at assembly. Be sure the holes match the tapped holes in the Base.

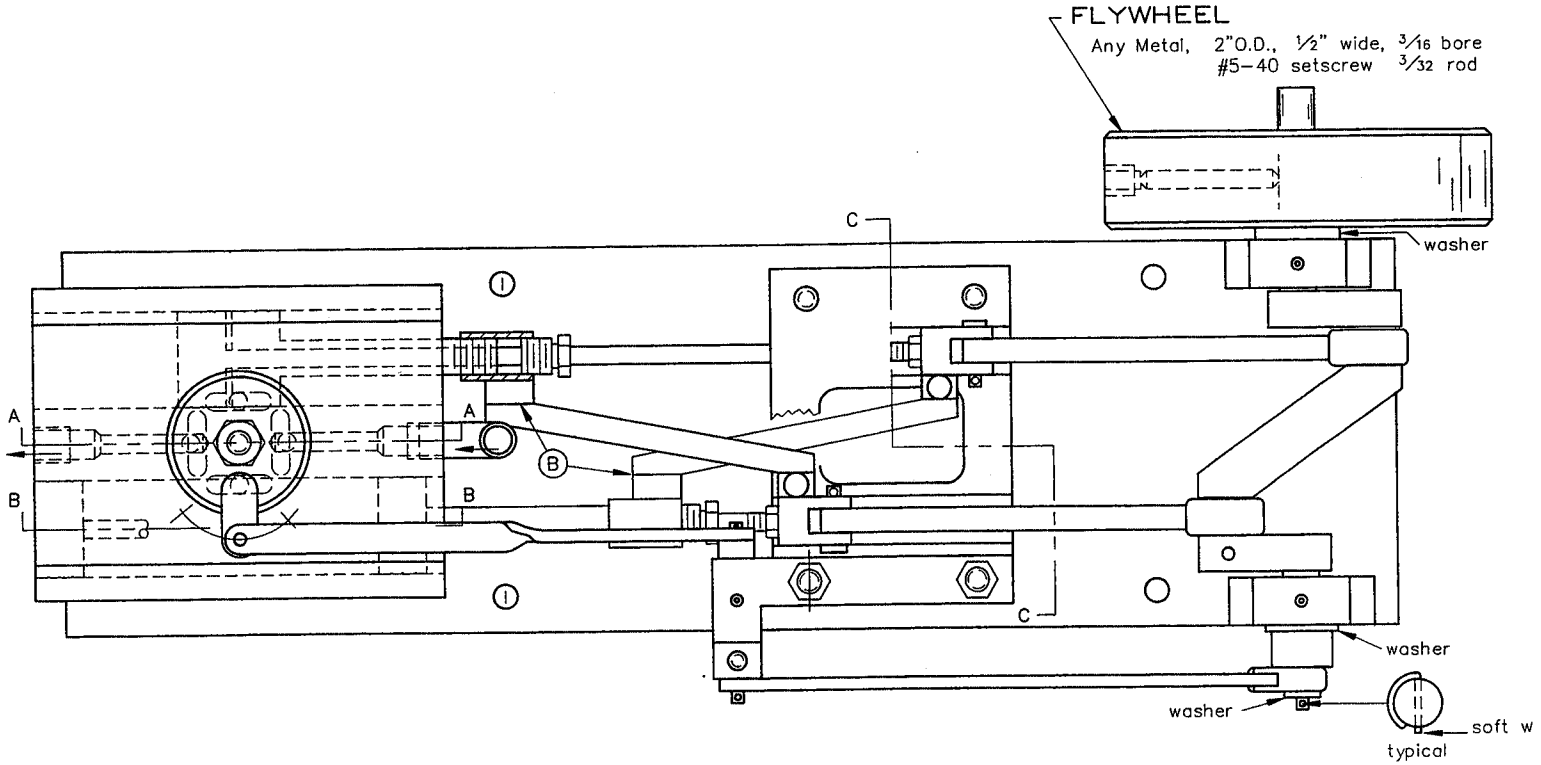
The **CROSS HEADS** are a bit more detailed and require the right fit in the Guide. A four-step plan is shown to help layout and machining. **Step 2** shows the 1/4" dimension that matches the groove width in the Guides. Make this dimension a few thousandths full so it can be carefully fitted to the Guide. Bolt the two Guides together using the studs and use as a gauge while fitting the Cross Heads. **Step 3** shows the cuts that make the Cross Link attachment. Here the cuts pick up the 1/4" dimension made in **Step 2**. Note: make both pieces alike. When they are assembled, one is turned over and provides for the two Cross Links to pass each other. **Step 4** shows the drilling and tapping. The 1/2" dimensions are important for a proper fit in the Guides. If you started out with a 1-1/32" piece and made a 1/32" milling cut, they should be close to size. Here, again, a few thousandths full will leave you a bit of "filin' and fittin'".

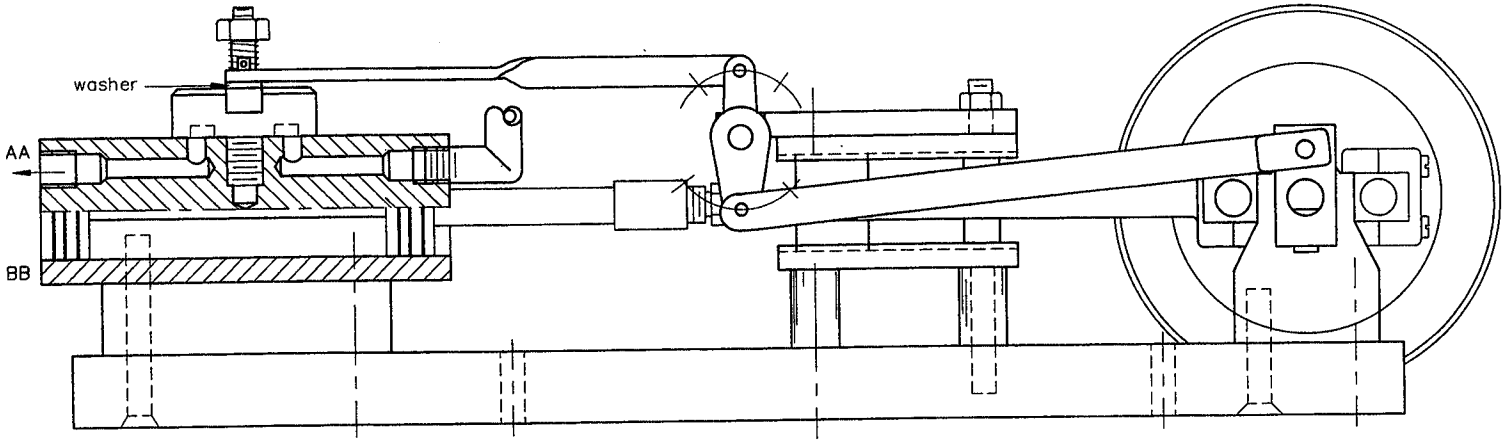
The **STUFFING BOXES** are less complicated than the Cross Heads. Again, make two alike.

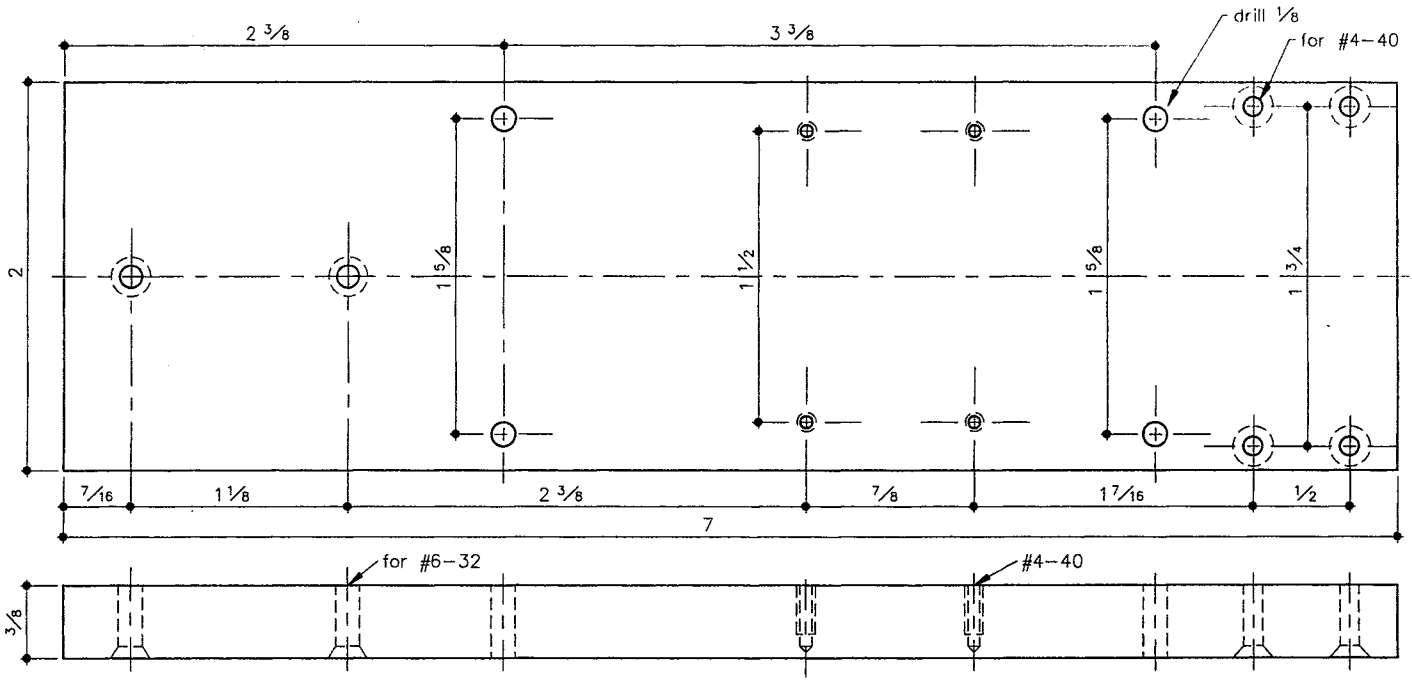
The **CROSS LINKS** are simple cutout jobs from 1/16" brass. At assembly, with Cylinders, Pistons, Base, Cross Heads, Glands and Cross Head guides in place, insert the Links in the slots and insert pins in the Cross Heads. Now, with the other end of the Cross Links in the Stuffing Box slots, add flux and a tiny pellet of solder. Carefully heat the Stuffing Box with a small propane flame until the solder melts and flows into the

The four photos below show the cross-action between the Piston Rods and the Cross Links. Note especially the relationship between the forward motion of the Cross-Links and the four dead-center positions of the Crankshaft.

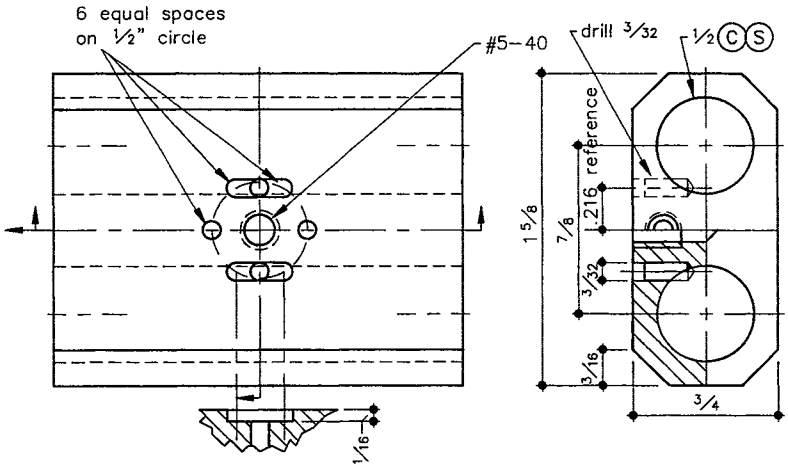


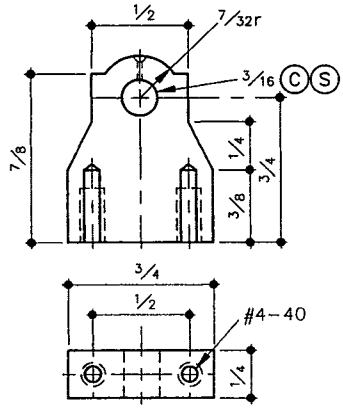

FLYWHEEL
Any Metal, 2"O.D., ½" wide, 3/16 bore
#5-40 setscrew 3/32 rod
washer
C
A
B
A
B
C
washer
washer
soft w
typical


washer
AA
BB

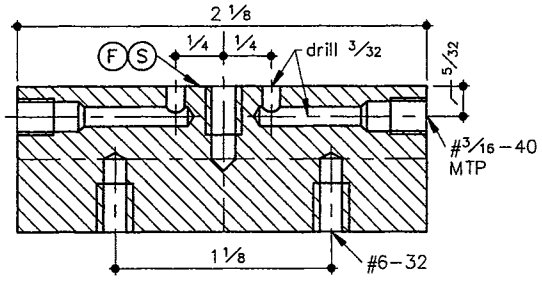


BASE
Any Metal

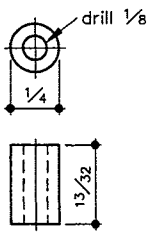




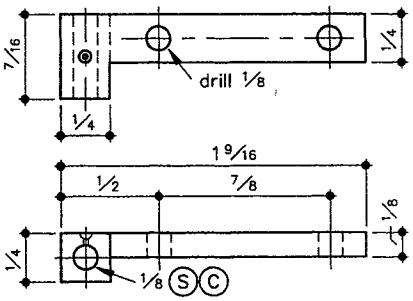
BEARING
Brass or Hard Aluminum
2 Required



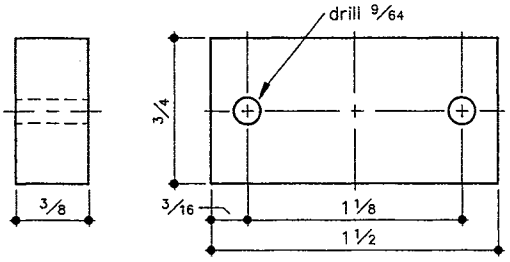
CYLINDER BLOCK
Fine Cast Iron, Brass or
Hard Aluminum



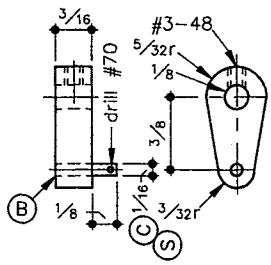
SPACER
Any metal
4 Required



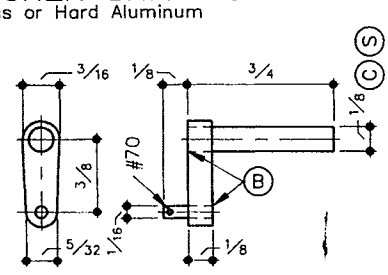
ROCKER SHAFT BEARING
Brass or Hard Aluminum



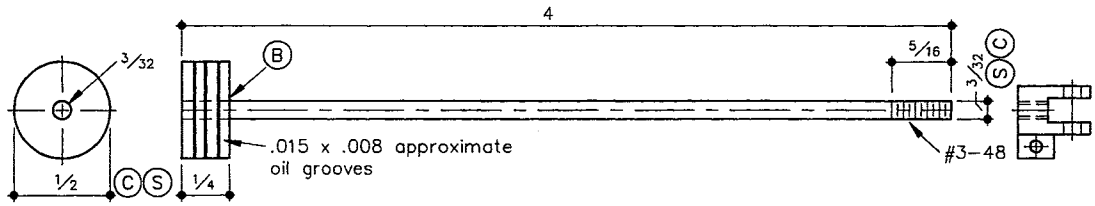
CYLINDER FOOT
Any metal



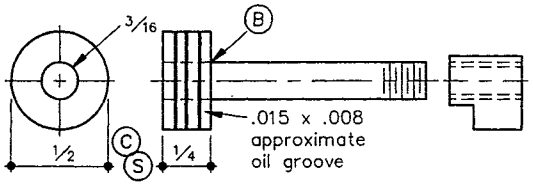
ROCKER CRANK ARM
Brass



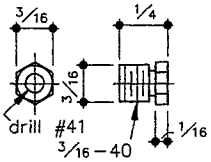
ROCKER SHAFT
Brass



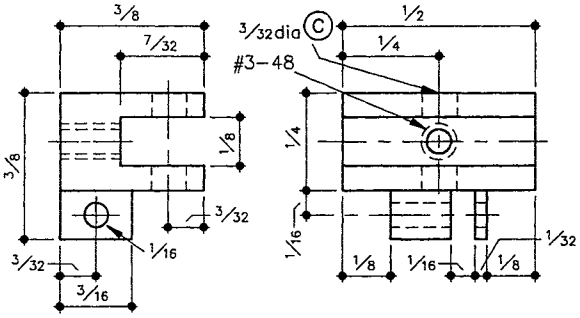
PISTON & ROD
Brass
2 Required



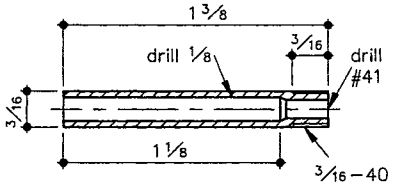
PISTON & TUBE
Brass
2 Required



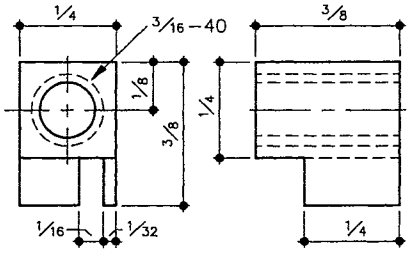
PACKNUT
Brass
2 Required



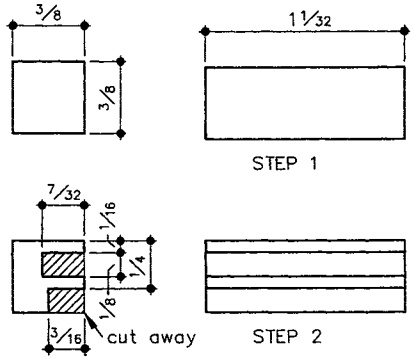
CROSSHEAD
Brass
2 Required

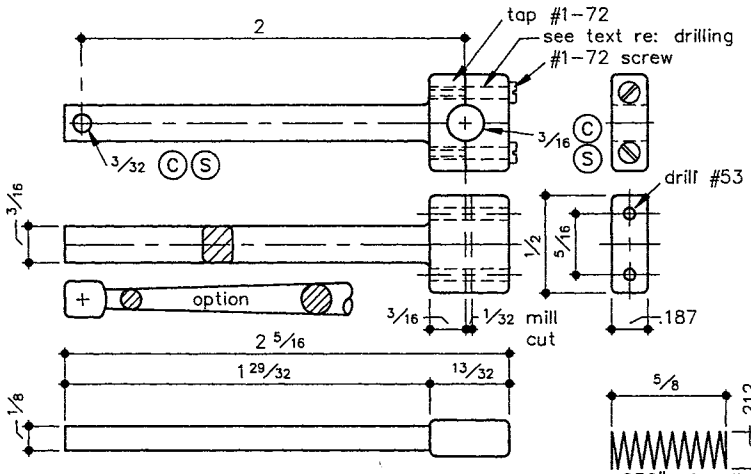


TUBE
Brass
2 Required



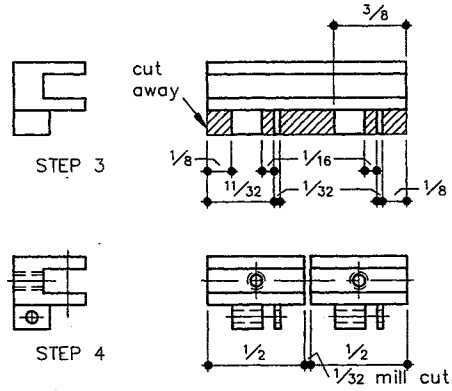
STUFFING BOX
Brass
2 Required

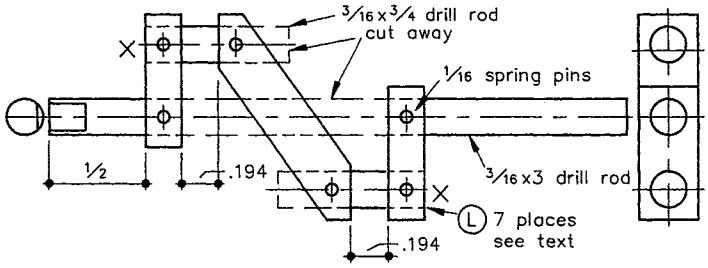




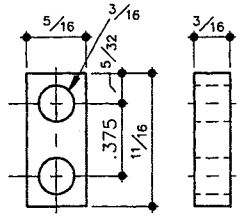
CONNECTING ROD
Brass or Hard Aluminum
2 Required

SPRING
Steel

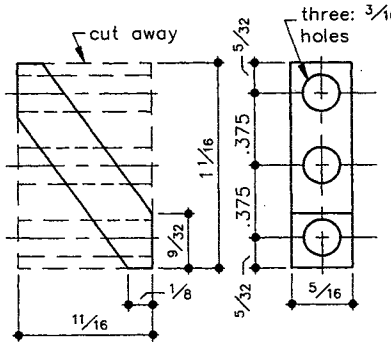




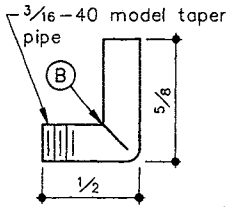
CRANKSHAFT
Steel



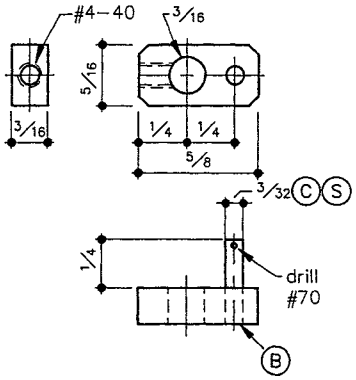
CRANK END BAR
Steel
2 Required



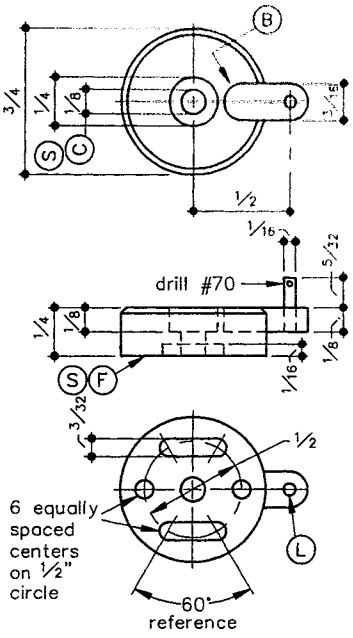
CRANK CENTER PIECE
Steel



STEAM CONNECTOR
Copper or Brass tubing (.035 wall)

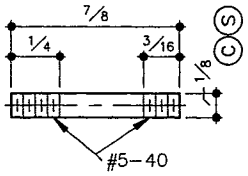


VALVE CRANK
Brass

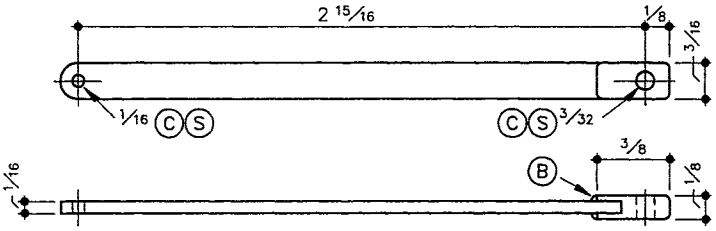


VALVE
Brass

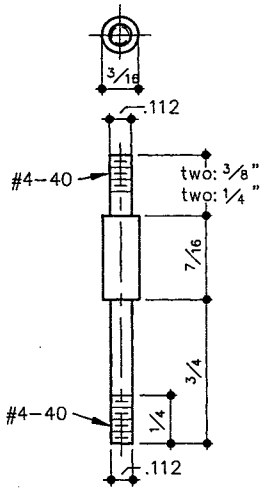
C close fit
S smooth
F flat
B braze or solder
L "loctite"



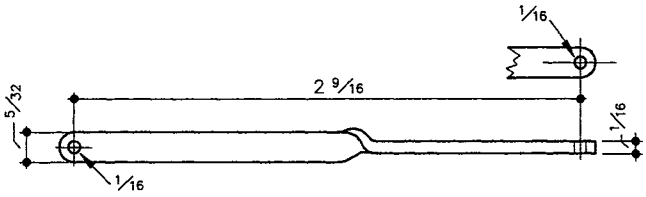
VALVE PIVOT
Steel



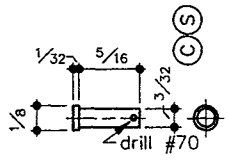
ECCENTRIC STRAP
Brass



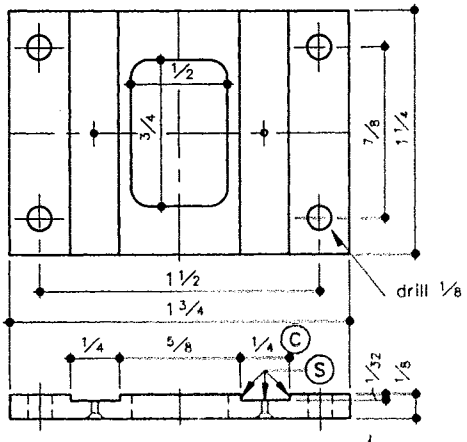
STUD
Steel
4 Required



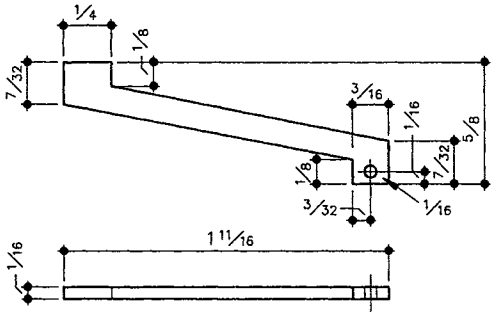
VALVE LINK
Brass



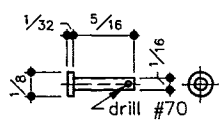
CROSSHEAD PIN
Brass
2 Required



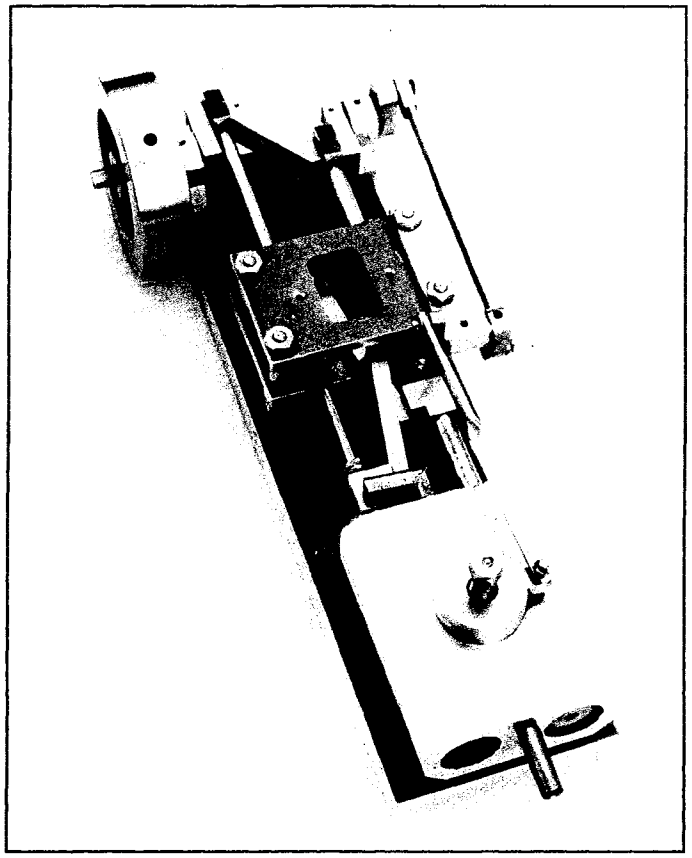
CROSSHEAD GUIDE
Hard Aluminum or Steel
2 Required

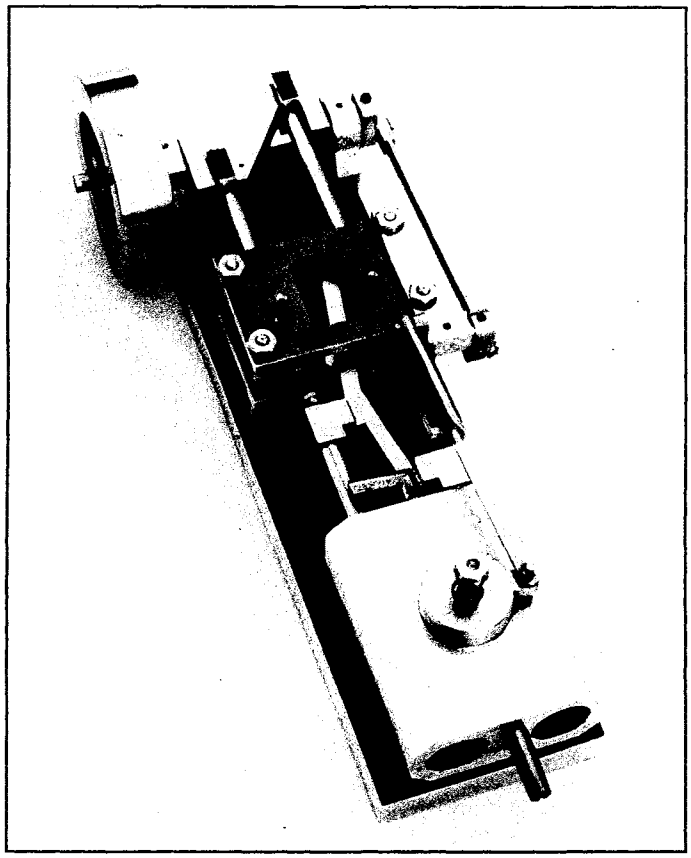


CROSS LINK
Brass
2 Required



CROSS LINK PIN
Brass
2 Required





Notice in the two views above that, as the left-hand Connecting Rod is at rear dead center, the left-hand piston is at the front end of the Cylinder Block. As the Crankshaft rotates, the opposite action takes place.

diameter set with Loctite.

The **CONNECTING RODS** start out as 3/16" x 1/2" stock. Lay out the outline of the Rod and tap-drill #53 for the 1-72 screws. Drill about 1/2" deep and make the 1/32" mill cut. Enlarge the holes in the small piece with a #48 drill. Tap the large piece #1-72. Assemble and lay out the 3/16" and 3/32" holes. Squarely drill and ream these holes to size. Cut 1/32" off each face to form the 1/8" thickness. Make similar cuts to form the 3/16" width. Dress up and polish to suit. An option is shown for a turned Shank. Using tail-stock support and the compound set at approximately 1-1/2° will produce a better looking Connecting Rod. While you still have square surfaces for holding and measuring, mill the 1/8" thickness about 1/4" wide at the Wristpin hole before turning this taper.

Make the 3/32" and 3/16" holes in the **PISTONS** a close, free fit on the Rods and Tube so solder will penetrate and make a good bond. 430° solder is the favorite in this shop, though common solder will do. The Piston **TUBE** is made from 3/16" solid rod. It threads into the Stuffing Box and has the same thread as the **PACK NUTS**, thus forming a cavity for packing.

The **VALVE SPRING** dimensions shown are for a spring found in the odds-and-ends department. Try one from your collection. At 8 to 12 pounds of air, this Spring doesn't have to be too strong. Less pressure on the Valve reduces the wear on a fairly light linkage system.

At final assembly, check the parts as they are brought together for a nice-running fit. Set the Valve Crank Arm 90° from the Crank Throw. Either port in the Cylinder can be used as intake. After about 1/2 hour running, this engine was running fine on about 10 pounds of air and really showing a lot of action.